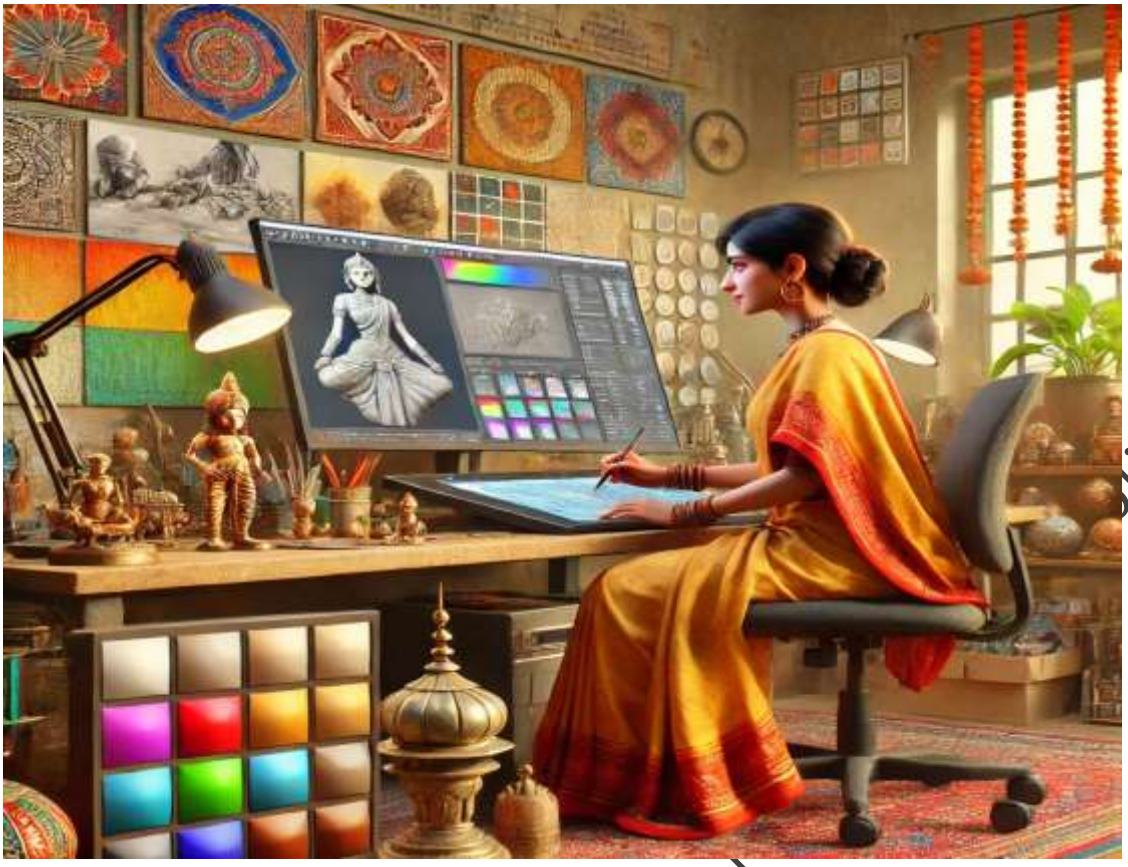
Draft Study Material



TEXTURING ARTIST

Qualification Pack: Ref. Id. MES/Q2503)

Sector: Media and Entertainment)

Grade XII

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Date: 7 November 2024

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Module 1	3D Animation

Module Overview

This module provides a comprehensive understanding of essential skills and techniques in Maya, covering the core principles of 3D modelling, texturing, materials, and lighting effects. It offers practical knowledge to create and enhance realistic 3D models using Maya's powerful tools.

The module begins with Session 1, "Essential Skills Movie Window in Maya," introducing Maya's interface and foundational tools through the Essential Skills Movie window. This interactive guide quickly familiarizes users with the software's key functions and navigation.

In Session 2, "Introduction to 3D Modelling," the focus shifts to core concepts of 3D modelling, teaching how to create both basic and complex objects using Maya's modelling tools.

Session 3, "Texturing Using Shaders," covers how to apply textures to models using different shader types, enhancing the visual appeal by manipulating UV Maps and material properties.

Session 4, "Maya Material," centres on mastering Maya's material editor, enabling the creation of realistic materials and applying them to 3D objects.

Session 5, "Real Life 3D Model," offers a hands-on experience where learners replicate real-world objects as 3D models, applying skills learned in previous class.

In Session 6, "Properties of Surface Materials," learners explore characteristics of various surface materials, such as reflectivity, roughness, and transparency, which are essential for achieving realistic textures in 3D models.

Session 7, "Effect of Lighting Conditions on Surfaces," demonstrates how different lighting setups affect surface materials. Natural and artificial sources create unique effects. This allows for experimenting with lighting to make models look more realistic.

Learning Outcomes

After completing this session, you will be able to:

- Describe the core principles and functions of 3D software, including modelling, rendering, and animation.
- Navigate and utilize the interface of popular 3D software applications.
- Apply textures using shaders to enhance the visual appearance of 3D models.
- Describe the key responsibilities of a texturing artist.
- Identify the textures and shaders for different texturing tasks.
- Differentiate between 2D, 3D, and environment textures.
- Develop a 3D model from concept to completion, applying skills in texturing and shading.
- Apply translucence settings to create realistic light transmission effects.
- Describe and demonstrate the use of ambient colour, incandescence, bump mapping, diffuse, and translucence in shaders.
- Demonstrate the impact of various lighting setups on the appearance of 3D models.

Module Structure

Session 1: Essential Skills Movie Window in Maya
Session 2: Introduction to 3D Modelling
Session 3: Texturing Using Shaders
Session 4: Maya Material
Session 5: Real Life 3D Model
Session 6: Properties of Surface Materials
Session 7: Effect of Lighting Conditions on Surfaces

Session 1: Mastering the Essential Skills Tutorial Window in Maya

3D animation is the art of using motion to bring characters and more to life within television shows, films, and games. Animators are responsible for giving objects weight and timing that results in the object feeling like it truly exists in the world we see them.

Gaining an initial understanding of basic concepts is essential to learning any software application, including how it functions and the core skills needed to work effectively with it. Those who are new to three-dimensional (3D) software, it may initially feel different compared to 2D applications. Before moving further, let us do a quick introduction with 3D software i.e., Autodesk® Maya®.

Maya is the premier application for creating compelling 3D digital content, including models, animation, visual effects, games, and simulations. It enables users to produce life like animations as seen in blockbuster films such as Avatar and Jurassic Park. Just as the driver of an automobile is familiar with the dashboard of their vehicle, it is important to become familiar with the Maya "dashboard". The Maya user interface refers to everything that the Maya user sees and operates within Maya. The menus, icons, scene views, windows, and panels comprise the user interface.

Through the Maya user interface, one will be allowed to access the features and operate the tools and editors and that will help to create, animate, and render your three-dimensional objects, scenes, and effects within Maya.

Textures are flat images that get applied to 3D objects. They are responsible for models being Colourful and interesting instead of blank and boring. The overall process for applying a texture onto a 3D mesh involves mapping the texture (image, logo, decal etc.) directly onto the mesh before printing. Now let us look at some of the terminologies that we will be using for texturing.

Image Textures

Image textures are a type of Texture Map used in 3D graphics to add visual detail to a model. When elements like logos, text, images, or barcodes are applied to the surface of a 3D model, they create the appearance of those graphics directly on the object. This technique helps make the model more realistic or branded without having to add complex geometry.

Image textures are mapped onto a model using UV Mapping, where the 2D image coordinates are wrapped around the 3D surface. This lets the texture align correctly

with the model's shape and contours, ensuring that the images or graphics display accurately in renders.

Basic Texturing

Starting with Bitmap-based textures is effective for learning the basics. A Bitmap is a type of digital image file that represents a picture as a grid of individual pixels, or dots. Each pixel in a Bitmap image is assigned a specific colour, and collectively, they form the complete image. Bitmap images are also known as raster images and are widely used in graphics because they offer detailed representations of photos and complex illustrations. Using Bitmap textures allows to create a specific look and feel for objects without needing complex shaders or procedural textures. Although Bitmap textures can be memory-intensive when used in large quantities or at high resolutions, they remain valuable because they are customizable. With Bitmap textures, one can paint directly on the image, tailoring it to the model's unique needs. This flexibility is ideal for adding realistic details like wear and tear, custom colours, or hand-drawn elements.

Bump and Displacement Mapping

Bump Mapping and Displacement Mapping are both techniques in 3D computer graphics used to simulate surface detail on 3D models, giving textures more depth and realism. Although they both serve the purpose of adding detail to surfaces, they work differently in how they affect the geometry.

Bump Mapping is a technique that simulates surface texture by altering the way light interacts with a model. It does this without actually changing the geometry of the surface. Instead, it uses a grayscale texture (called a Bump Map) to create the illusion of depth by adjusting the surface normal, which are used to calculate how light reflects off the surface.

Displacement Mapping, unlike Bump Mapping, actually modifies the geometry of the surface. It uses a texture (often a grayscale Displacement Map) to push or pull vertices on the model, creating real surface depth. This results in more realistic details, especially for highly uneven surfaces.

Mimicking real-world materials involves not just capturing colour but also emulating the material's physical properties to achieve realism. By using image textures beyond just colour, we can control various attributes to recreate how a material interacts with light and touch. For photorealistic effects, several types of image textures or maps are commonly layered together:

i. **Colour or Diffuse Map**: Provides the base colour of the material.
ii. **Normal or Bump Map**: Adds surface detail by simulating small height variations, giving the illusion of texture depth without increasing geometry.

iii. **Specular or Reflectivity Map**: Controls how shiny or reflective parts of the material are, allowing for surfaces like glossy plastic or brushed metal.

iv. **Roughness Map**: Dictates how smooth or rough a surface appears, affecting how light scatters.

v. **Displacement Map**: Actually modifies the geometry based on grayscale values, giving a true sense of height and depth.

These are the essential steps involved in texturing a 3D model, each with its own key purpose:

i. **Design a 3D Object**: Start with a simple 3D model in software like Maya, Blender, or other CAD programs. Basic shapes can be extruded or transformed to create a foundational geometry, which serves as a base for applying textures.

ii. **UV Mapping and Unwrapping**: UV refers to the 2D texture coordinates used in 3D modelling to map a 2D image (texture) onto a 3D surface. The letters "U" and "V" represent the axes of the 2D texture plane, similar to "X," "Y," and "Z" in 3D space. UV Mapping involves creating a 2D representation of a 3D model's surface, which allows textures to be accurately placed on the model. Unwrapping is the process of flattening a 3D model's surface onto the UV plane so textures can be applied without distortion.

Once the model is ready, UV Mapping is used to flatten the 3D surface onto a 2D plane. This process, known as UV unwrapping, enables textures to be applied accurately. A UV Map can be automatically generated or manually optimized to minimize seams and overlaps, making it easier to paint or project textures onto the model's surface.

iii. **Import the 2D Image Texture**: Textures are typically Bitmapimages (such as JPG, PNG, or TIFF) created in digital art tools like Photoshop. These textures are imported into 3D environments (e.g., Unity for real-time projects or Maya for 3D rendering) where they will be mapped onto the model.

iv. **Align the Geometry Map and Apply the Texture**: The imported texture is aligned with the UV Map to ensure it wraps properly around the 3D object. This step ensures that images and custom textures appear precisely where intended.

v. **UV Mapping a Polygon Object**: The UV coordinates are mapped to the model's polygons to wrap the texture onto its geometry. Proper alignment is crucial for accurate texture display on complex shapes.

i. **Layered Texturing and Baking Lights**: Layered textures allow multiple textures to blend, adding depth and complexity. Baking lights captures detailed light and shadow information directly into textures, reducing the need for real-time calculations. This technique is especially useful for game assets, as it significantly lowers processing demands and enhances performance during gameplay.

ii. **The Ramp Shader**: The Ramp Shader is an advanced tool that allows for creative shading effects by blending multiple colours or textures along a gradient. It is ideal for creating nuanced shading, from metallic to translucent effects, providing flexibility in designing sophisticated materials.

Essential Techniques for Maya Artists

The essential skills movies window in Autodesk Maya is designed to help new users get up to speed quickly. This introductory series covers foundational skills necessary for navigating and working within Maya's interface, including basics like creating and modifying 3D objects, manipulating the viewport, and understanding Maya's tools and settings. The videos are an excellent starting point as they provide step-by-step instructions, allowing users to follow along while learning essential techniques.

The tutorials are available with audio in multiple languages like English, French, German, Italian, Japanese, Korean, and Mandarin making them accessible to a diverse range of users worldwide. These initial lessons help lay a strong foundation for more complex tasks, from basic modelling and texturing to animation and rendering.

Accessing the Essential Skills Movies Window in Maya

To open the Essential Skills Movies window in Maya, follow these steps:

i. **Launch Maya**: Open the Maya application.
ii. **Access the Help Menu**: Navigate to the top menu bar and click on Help.
iii. **Open Essential Skills Movies**: From the drop-down menu, select Essential Skills Movies.
iv. **View Tutorials**: The Essential Skills Movies window will open, providing access to various video tutorials that cover fundamental skills and workflows in Maya.

Closing the Essential Skills Movies Window

Closing the Essential Skills Movies window is a straightforward process. When you close this window, it's essential to take a moment to reflect on the insights and techniques you have gained and think about how you will apply them in real-life scenarios. The steps to be followed are:

i. To close the window, click the close box in the upper right corner.

ii. To prevent this dialog box from appearing at start up, select the "Do not show this at start up" checkbox **(Figure 1.1)**.

iii. To close the multimedia player, select File > Exit or click the close box in the upper right corner of the window (this instruction may vary depending on the multimedia player used).

iv. To watch the movies again later, go to Help > Learning Movies in Maya. This will open the Essential Skills Movie window.

Figure 1.1: Maya Essential Skills Movies

When Maya starts for the first time, the workspace opens by default in a perspective window, or panel, with several components. The panel is labelled "Persp" at the bottom, indicating a perspective camera view of the Maya scene. A menu bar at the top left corner of the panel provides access to tools and functions specific to this view. The grid includes two heavy lines intersecting at the centre of the Maya scene, known as the origin. The origin represents the centre of Maya's 3D world, with all object positions measured relative to this point.In Maya, as in many other 3D applications, the three dimensions are labelled as the X, Y, and Z axes, with the origin located at X, Y, Z coordinates (0, 0, 0). The grid lies along the X, Z plane, visualized as a flat, imaginary square in 3D space **(Figure 1.2)**.

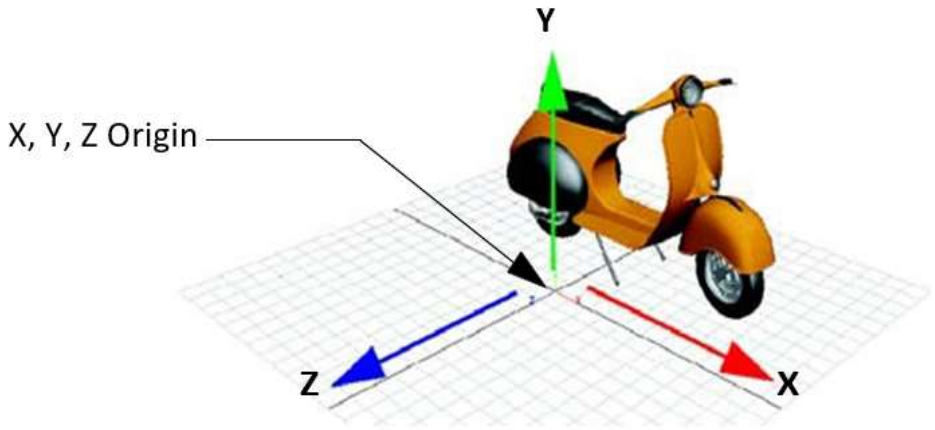


Figure 1.2: Object and it is 3-dimensional representation

Maya labels the X, Y, and Z axes with a Colour scheme: red for X, green for Y, and blue for Z. Many tools that are used in Maya use this Colour scheme to indicate that are accessing a particular item that relates to X, Y, and Z in some way. The controls regarding axis is being described in **(Figure.1.3)**.

Menu Bar

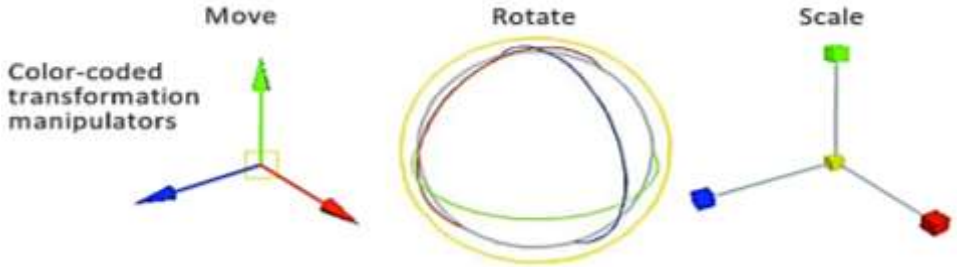


Figure 1.3: Colour codes to understand transformation manipulators

Tools and items are accessible from pull down menus located at the top of the user interface. In Maya, menus are grouped into menu sets. These menu sets are accessible from the Main Menu bar.

The Main Menu bar appears at the top of the Maya interface directly below the Maya title bar and displays the chosen menu set. Each menu set corresponds to a module within Maya: Animation, Polygons, Surfaces, Rendering, and Dynamics. Modules are a method for grouping related features and tools. Maya® Unlimited has additional menu sets (For example, Maya®nClothTM). Figure 1.4 will help you to understand the place as well as the sub menus of main menu bar.

Figure 1.4: Maya Main Menu Bar

It is easy to switch between menu sets of software by choosing the appropriate module from the menu selector on the Status Line (located directly below the File and Edit menus). When switching between menu sets, the right-hand portion of the menus changes, while the left-hand portion remains consistent. The left-hand menus, which are common across all menu sets, include File, Edit, Modify, Create, Display, and Window. This is further illustrated in the figure, which clearly explains the process of switching between different types of menus within the software.

Activities

Activity 1: Using help to understand basics of 3D software, like 3DS Autodesk®Maya®

Materials Required: Computer, and 3DS Autodesk®Maya® software

Procedure

- **Open Autodesk Maya**: Launch the Maya application on your computer.
- **Navigate to the Help Section**: Go to the Menu Bar at the top of the Maya interface. Click on Help.
- **Access Essential Training**: In the Help drop-down menu, look for and select
- **Essential Skills Movies** or **Learning Resources**: This will open a window or direct you to a section containing video tutorials.

- **Explore the Videos**: Browse through the list of videos to find those that cover the basics of Maya, such as navigating the interface, understanding the workspace, and learning about key features like modeling, texturing, and animation.

Activity 2: Hands on UV Mapping and Texture Application

Materials Required: Computer, and 3DS Autodesk®Maya® software

Procedure

1. **Create a Simple 3D Object**: Start with a basic shape like a cube or sphere. Modify the shape to get familiar with Maya's object transformation tools (move, scale, rotate).
2. **Apply a Basic Texture**: Import a 2D texture image, such as a PNG or JPG. Use UV Mapping to wrap the 2D texture around your 3D object. Practice unwrapping the UV Map to ensure the texture aligns correctly.
3. **Experiment with Bump and Displacement Mapping**: Apply a Bump Map to simulate surface detail without changing geometry. Try using a displacement map to see how it physically alters the shape by pushing and pulling the surface geometry.
4. **Practice Light Baking**: Add basic lighting to your scene. Use the Bake Lights feature to capture light and shadow details directly in your texture, optimizing your model for real-time applications.
5. **Explore the Ramp Shader**: Experiment with the Ramp Shader to create blended shading effects on your 3D model. Adjust colour gradients to understand how this shader impacts the appearance of materials.

Activity 3: Customizing the Main Menu Bar

Materials Required: Computer, and 3DS Autodesk®Maya® software

Procedure

1. Explore Menu Sets: Switch between different menu sets like Animation and Rendering to see how they modify the tool options available in the interface.
2. Customize Shortcuts: Use the menu selector on the Status Line to quickly switch between commonly used menu sets. Practice accessing frequently used commands like File, Edit, and Modify to streamline your workflow.

Check Your Progress

A. Multiple Choice Questions

1. What is the primary function of 3D animation in films, television, and games?

a) To create two-dimensional characters

b) To bring characters and objects to life through motion
c) To design still images for web design
d) To enhance sound effects in digital media

2. Which of the following software is used to create lifelike animations as seen in films like *Avatar* and *Jurassic Park*?
a) Blender
b) Adobe Illustrator
c) Autodesk Maya
d) SketchUp

3. What is the purpose of the Maya user interface?
a) To import 3D models
b) To access features and operate tools to create, animate, and render objects
c) To control lighting conditions in the scene
d) To manage hardware resources during rendering

4. What are textures in 3D animation primarily responsible for?
a) Providing colour and making models more visually appealing
b) Controlling the animation of objects
c) Determining the shape and size of the 3D objects
d) Handling the lighting and shadows in a scene

5. What is a UV Map in 3D modelling?
a) A 2D representation of a 3D model's geometry for texturing
b) A map used to determine the lighting in a scene
c) A diagram showing the camera angles in a scene
d) A visual representation of the object's physical properties

6. Which term describes using an image texture to control surface height and reflectiveness?
a) UV Mapping
b) Bitmap texturing
c) Bump and Displacement Mapping
d) Layered texturing

7. What feature in Maya allows you to generate shadows and lighting effects as a texture to reduce real-time rendering overhead?
a) UV unwrapping
b) Bump Mapping
c) Baking lights
d) Image textures

8. How can you reopen the Essential Skills Movie Window in Maya after closing it?
a) Click 'Window > Animation Movies'

b) Select 'Help > Learning Movies'
c) Reinstall the software
d) Restart the software with the default settings

Session 2: Introduction to 3D Modelling

In 3D computer graphics, 3D modelling involves creating a mathematical representation of any object's surface (animate or inanimate) in three dimensions using specialized software. In Maya, modelling refers to constructing virtual 3D surfaces for characters and objects within the scene, with surfaces playing a crucial role in achieving a convincing 3D image. Each surface type has distinct characteristics and advantages.

There are three surface types in Maya:

i. Polygon
ii. NURBS
iii. Subdivision surfaces

Polygon

Polygon surfaces consist of networks of three-or-more-sided flat surfaces called faces, which connect to form a polygonal mesh. Polygon meshes are made up of vertices, faces, and edges. Wireframe lines on the mesh represent the edges of each face, with the bounded regions being faces, and intersections of edges marking points called vertices.

Rendered polygon meshes can display hard or smooth edges, making polygons adaptable to both flat and curved 3D forms. These component types are used extensively when modelling with polygons. Polygonal surfaces are versatile and favoured in applications like interactive games and web development due to their data efficiency and fast rendering speeds, enhancing performance.

NURBS

NURBS (Non-Uniform Rational Basis Spline) surfaces are created by defining a shape's profile with one or more NURBS curves. A specific construction method is then used to generate the surface. NURBS surfaces are widely used in industrial and automotive design for creating smooth forms with minimal data. They are also ideal for defining motion paths in animations. Additionally, NURBS surfaces can be converted into polygonal meshes.

Subdivision Surfaces

Subdivision surfaces are hybrid surfaces that combine features of both NURBS and polygonal surfaces, along with additional attributes. Subdivision surfaces produce smooth, organic forms with a few control vertices, similar to NURBS, and allow for extruding specific areas and adding surface details like polygons. Working at multiple detail levels, a smooth, organic object can be constructed from a single primitive without needing to attach or stitch multiple surfaces, as required with NURBS.

Compositing After Output

The final composited and rendered scenes combine lighting, texturing, and animation outputs into a single video file (e.g., .MOV, .AVI, .MP4) or a sequence of still frames in TGA (Targa) or .TIF formats. These formats support alpha channels for background transparency. It is known for its ability to handle high-quality images and includes support for alpha channels, enabling transparency in graphics. These sequential files are later combined in video editing software like Adobe Premiere Pro, AVID Media Composer, or Final Cut Pro (FCP) to create a single animation sequence file.

Roles and Responsibilities of a Texturing Artist

A **Texturing Artist** plays a crucial role in the 3D content creation pipeline, focusing on adding detailed textures to 3D models to bring them to life. Below are the key roles and responsibilities of a Texturing Artist. Collaborate with the CG (Computer Graphics) Supervisor and Lead Texture Artist to achieve the required look for CG characters and objects. A Texturing Artist must understand the specifications based on the expectations of the compositor or art director, including knowledge of canvas sizes, shaders, textures, and mapping requirements across different environments, such as TV series, video games, or movies.

Roles and Responsibilities:

1. Texture Creation:

- Develop high-quality textures for characters, environments, props, and other 3D assets.
- Use tools like Photoshop, Substance Painter, or Mari to create detailed textures such as diffuse, specular, normal, and Bump Maps.

2. UV Mapping and Unwrapping:

- Create efficient and accurate UV Maps to ensure textures align properly with 3D models.
- Optimize UV layouts to minimize texture distortion and maximize texture resolution.

3. Shaders Development:

- Use shaders to define material surface properties, including reflection, transparency, and subsurface scattering.
- Collaborate with technical artists to ensure shaders function correctly within the rendering pipeline.

4. Material and Surface Detailing:

- Apply textures that simulate various material properties like metal, wood, fabric, or skin.
- Use procedural and hand-painted techniques to achieve realistic or stylized effects as required by the project.

5. Collaboration:

- Work closely with modelers, riggers, and lighting artists to ensure textures and materials complement the overall look of the scene.
- Coordinate with production and leads on scheduling and deadlines
- Coordinate with art directors and lead artists to align with the project's visual style and quality standards.

6. Quality Assurance and Optimization:

- Review and refine textures to ensure they meet visual and technical standards.
- Optimize textures and materials to balance visual fidelity with performance, especially in game development or real-time applications.
- Experiment with new workflows and technologies to enhance texturing efficiency and quality.
- Ensure quality control of Texture Maps before publishing to maintain consistency
- Meet deadlines and schedules while upholding the highest standards

7. Problem-Solving:

- Identify and resolve issues related to Texture Mapping, shader compatibility, and material performance.
- Troubleshoot visual discrepancies or artefacts that arise during rendering.

8. Research and Development:

- Stay updated on the latest texturing tools, techniques, and trends in the industry.
- Share techniques, reference materials, and ideas with the team
- Stay updated with new tools, software, data, and related technologies

Activities

Activity 1: Creating objects with the help of NURBS and Polygons on 3DS Autodesk®Maya®

Materials Required: Computer system, and 3DS Autodesk®Maya®

Procedure

1. **Open Maya**: Launch the Autodesk Maya application.
2. **Access NURBS Primitives**:
   - Go to the **Menu Bar**.
   - Click on **Create** > **NURBS Primitives**. You will see a list of available NURBS shapes, such as Circle, Square, Sphere, Cylinder, and more.
3. **Create a NURBS Object**:
   - Select a NURBS primitive from the list.
   - Click in the viewport to place the object or click and drag to define its size.
4. **Editing NURBS Objects**:
   - To modify the NURBS object, you can use the **Control Vertices (CVs)**:
   - Select the object and press the '**F8**' key to enter Component Mode.
   - Select the **CVs** (Control Vertices) and move them to reshape the NURBS object.
   - Use the **Edit NURBS** menu for additional options like smoothing, blending, and trimming.
5. **Converting NURBS to Polygons (Optional)**:
   - If you need to convert a NURBS object to polygons, select the NURBS object, then go to **Modify** > **Convert** > **NURBS to Polygons**.
   - **Creating Objects with Polygons in Maya:**
   - **Open Maya**:
   - Launch the Autodesk Maya application.
6. **Access Polygon Primitives**:
   - Go to the **Menu Bar**.
   - Click on **Create** > **Polygon Primitives**. This will show a list of polygon shapes like Cube, Sphere, Cylinder, Cone, and Plane.
7. **Create a Polygon Object**:
   - Select a polygon primitive from the list.
   - Click in the viewport to place the object or click and drag to define its dimensions.
8. **Editing Polygon Objects**:
   - Switch to **Component Mode** by pressing '**F8**'.
   - Select **Vertices**, **Edges**, or **Faces** to manipulate the geometry. You can move, scale, extrude, or merge components to refine the shape.

- Use the **Polygon menu** for additional editing options, such as smoothing, merging, or adding subdivisions.

9. Using the Modeling Toolkit:

- Access the **Modelling Toolkit** from the right side of the interface to utilize tools like **Extrude**, **Insert Edge Loop**, **Bevel**, and **Bridge** to create complex shapes and details.

Check Your Progress

A. Multiple Choice Questions

1. What is the primary benefit of using polygon surfaces in Maya?
a) Can produce smooth organic forms
b) Can be rendered quickly due to minimal data
c) Preferred for industrial design
d) Allows for easy stitching of surfaces

2. In which industry are NURBS surfaces most commonly used?
a) Video game development
b) Web development application
c) Industrial and automotive design
d) Animation for movies

3. What is the main advantage of subdivision surfaces over polygons and NURBS?
a) Minimal data for fast rendering
b) Capable of smooth organic forms with extrudable areas
c) Requires multiple NURBS curves for complex shapes
d) Best suited for creating flat surfaces

4. Why are polygonal surfaces preferred in video games?
a) They offer smooth organic forms
b) They require fewer vertex points
c) They can be rendered quickly and are lightweight
d) They offer high detail at different levels

5. Which file formats are typically used in compositing for background transparency?
a) .MOV, .AVI
b) .TGA, .TIF
c) .MP4, .AVI
d) .JPEG, .PNG

6. Which of the following is NOT a responsibility of a Texture Artist?

a) Collaborating with the CG Supervisor and Lead Texture Artist
b) Ensuring quality control of Texture Maps
c) Creating the animation rig for characters
d) Sharing techniques and ideas with the team

7. Which skill is most essential for a Texture Artist to succeed in their role?
a) Ability to design photo-real assets
b) Proficiency in video editing software like Adobe Premiere
c) Understanding of modelling and texturing software
d) Strong programming skills for asset creation

8. What is the final step in compositing after rendering scenes in 3D animation?
a) Creating a mesh using polygon surfaces
b) Joining sequential still frames in a video editing software
c) Converting NURBS surfaces into polygon meshes
d) Extruding subdivision surfaces for higher detail

Session 3: Texturing Using Shaders

Texturing using shaders in Autodesk Maya involves applying various materials and surface properties to 3D models to create realistic or stylized appearances. Shaders define how light interacts with surfaces, affecting attributes like colour, texture, glossiness, transparency, and more. Now let us first understand the various terms that will be used in this session.

Textures

Textures are 2D images applied to 3D objects to add colour and visual interest, defining the physical appearance and tactile qualities of a surface. They make models more engaging and realistic, reflecting the diverse textures found in the natural and manufactured world, such as water, wood, metal, or fabric.

Types of Textures:

Environment Textures: Simulate reflections and environmental effects, enhancing realism by mimicking the surroundings. They include Env Ball, Env Chrome, Env Cube, Env Sky, and Env Sphere, often used for reflective surfaces or creating realistic backgrounds in 3D scenes.

Layered Textures: Combine multiple textures on a single surface to create complex visual effects. This includes adding details like grime or wear, or using a Layered Shader to apply different materials, such as "phong1" and "blinn1," to geometry for varied surface appearances.

Shaders

Texturing using shaders involves applying textures with shaders, which are programmes designed to define how surfaces interact with light. This technique adds details like colours and textures to models, boosting realism without affecting performance.

Shading involves applying maps or nodes to shaders to create surface effects. For example, a brick wall image defines colour, while a contour image creates surface relief. This process is often called texturing, as textures are commonly applied to shaders.

Layer shader nodes aid in compositing intricate details, such as aging effects or multiple texture surfaces, enhancing realism through surface variety. This technique is often used to add lifelike detail to materials, such as human skin with pores, scars, and wrinkles, by controlling attributes like colour, surface bumps, transparency, reflection, and shine.

Shaders in Maya are node-based, with each node containing attributes that define the shader. Shader networks consist of interconnected nodes that create shading effects, ranging from simple to complex. A shader, or shading group, includes material nodes, which hold rendering details like colour, opacity, and shininess. Shading groups connect the surface with the defined material, and adjustments to the shader attributes in the Attribute Editor also update the material node.

3D Graphics

In 3D graphics, textures are categorized into three main types 2D Textures, 3D Textures, and Environment Textures each tailored to add unique visual qualities to a model's surface.

- **2D Textures**

Most 2D textures are procedural, meaning they are mathematically generated programs that remain resolution-independent. Unlike Bitmap-based textures, Procedural Maps maintain the same image quality whether viewed up close or from a distance, as the resolution is determined at the time of rendering rather than by the texture size. This approach allows for consistent detail and sharpness in rendered images. In the Create Render Node window, commonly available 2D textures include options such as Bulge, File, Grid, and others, each serving different purposes in texturing for visual effects and realism.

2D Textures are used to create flat, detailed imagery that wraps around 3D objects. Common 2D textures include Bulge, Checker, Cloth, File, Fluid Texture 2D, Fractal,

Grid, Mountain, Movie, Noise, Ocean, Ramp, and Water, which provide various patterns and visual effects.

- **3D Textures**

In 3D textures, objects gain the appearance of being carved from materials like rock or wood, adding realism and depth to the surface. These textures can be interactively scaled, rotated, and moved in the scene view to achieve precise effects. Most 3D textures, aside from snow, are random types, connected through a three-dimensional UVW coordinate manipulator that does not require existing UVW nodes. This flexibility allows 3D textures to be projected seamlessly, making them especially effective for volumetric effects, shading, and complex depth-based patterns such as marble, wood, and smoke.

3D Textures offer volumetric detail for more depth and realism, making them ideal for natural or organic materials. Examples include Brownian, Cloud, Crater, Fluid Texture 3D, Granite, Leather, Marble, Rock, Snow, Solid Fractal, Stucco, Volume Noise, and Wood.

- **Texturing Mapping**

Texture Mapping or simply mapping involves assigning textures to shader attributes, such as mapping a texture to the colour node of a shader that is applied to a Maya object. In real-world terms, an object's appearance is influenced by its material composition and interaction with light. Light absorption and reflection vary depending on surface smoothness, affecting whether the object appears shiny or matte. In Maya, a surface's appearance is determined by shading, a combination of the object's base material and any applied textures.

Hypeshade

Hypershade **(Figure 1.7)** is the working area for look development of scene elements. Here Shading networks are built and modified for rendering pixels for an image(s) or a movie. It offers access to shader properties, textures, lighting nodes, rendering utilities and custom advance sharing network setups. Steps to be followed are:

- Click on the Status line (toolbar)
- From the main menu bar: Windows > Rendering Editors >Hypershade
- In any panel menu: Panels > Panel >Hyper shade

The Hypershade is the central working area of Maya rendering, where one can build shading networks by creating, editing, and connecting rendering nodes, such as textures, materials, lights, rendering utilities, and special effects.

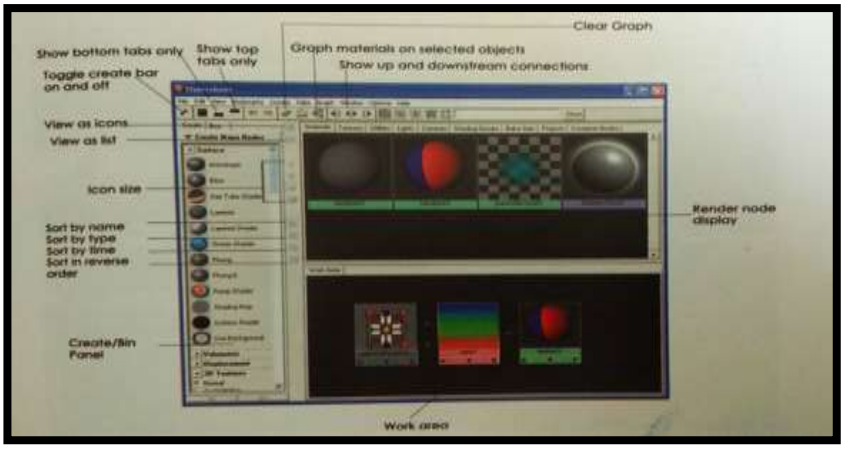


Figure 1.7: Hypershade work area

Steps to be followed are:

- While opening the Hyper shade, the Create panel appears at the bottom left. From this panel, one can choose among nodes that allows to create different types of rendering effects.
- Click on a node in the Create tab to add it to your scene
- Select one or more sections. Only the nodes in the selected sections are displayed in the right panel. To clear your selection, press Enter in the search area.
- Use the scroll bar to navigate through the Create tab and click to select the desired node.

The Hypershade has divided the following panels by default. Hypershade is a powerful visual interface in Autodesk Maya that allows users to create, manage, and edit shaders and materials for 3D models.

It serves as a comprehensive browser for organizing and visualizing all the shading networks in a scene, enabling artists to easily apply and manipulate textures, colours, and lighting effects. With its node-based system, Hypershade provides a clear representation of the relationships between materials, textures, and geometry. Users can create various types of materials, such as surface shaders, volume shaders, and displacement shaders, by connecting different nodes and adjusting their attributes. The intuitive drag-and-drop functionality simplifies the process of assigning materials to objects, making it easier to achieve complex visual effects **(Figure 1.8)**.

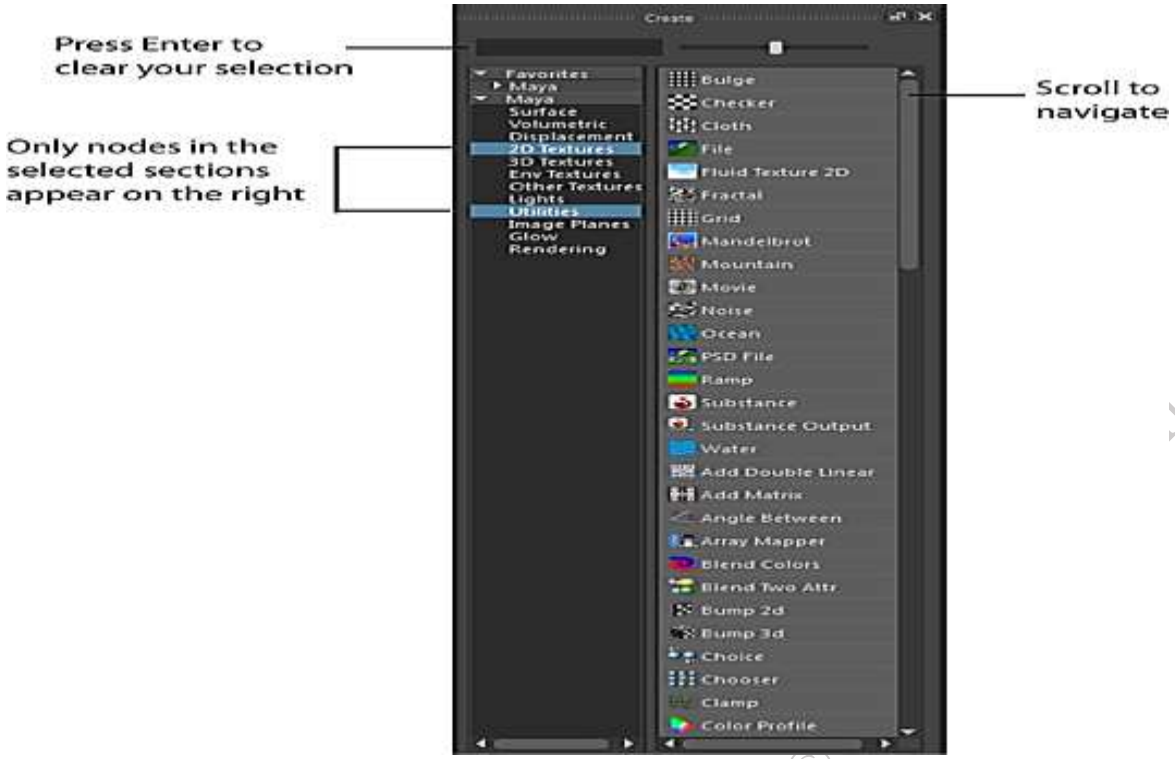


Figure 1.8: Hypershade browser

Hypershade Browser: This panel lists your materials, textures, and lights, sorted by tabs **(Figure. 1.9)**. Hypershade Browser are tabs containing the rendering components that contribute to the current scene; for example, your materials, textures, lights, and cameras.

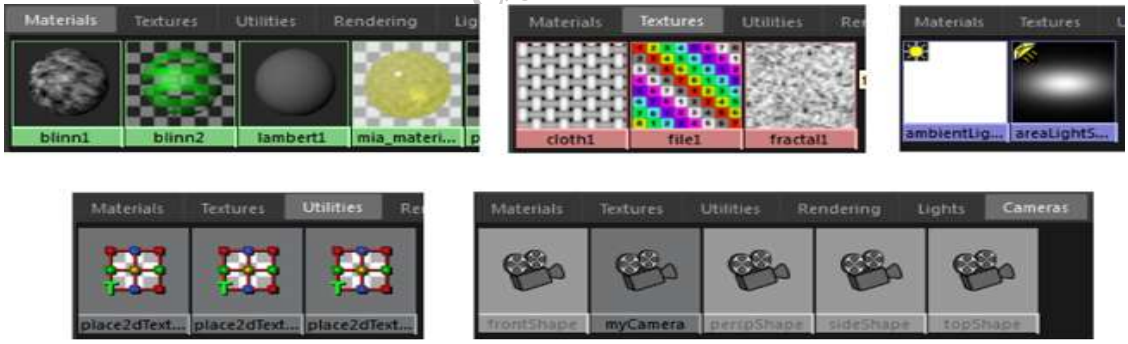


Figure 1.9: Node Workspace in Hypershade

In every Hypershade tab, each rendering node is displayed as a node icon (a swatch) that visually represents the characteristics of the node. When it is edited a nodes attributes or assign textures or special effects, the swatch updates in the Hypershade.

Unsupported nodes: In Hypershade, a node is marked as unsupported by the active renderer in the Render Settings window, indicated by a red swatch label. For example, if the renderer is set to Maya Software in a scene containing a mental ray for Maya node, like misss_fast_shader, the unsupported misss_fast_shader will display with a red swatch label **(Figure 1.10)**. Steps to be followed are:

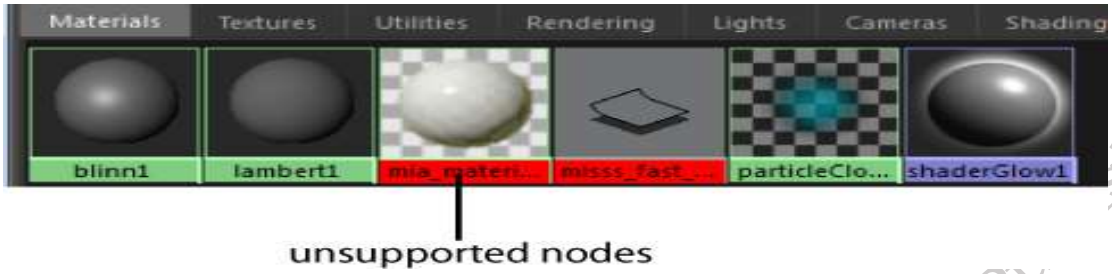


Figure 1.10: Hypershade browser showing unsupported node

- **Material Viewer:** This panel renders your shader or solid material.

- **Create tab:** Click a node in the Create tab to create and add nodes to your shader graph. Alternatively, one can also click Tab and enter the type of your node, or drag and drop a node from the Create tab to the work area.

- **Work area:** The Hypershade panel provides a node editing interface similar to the Node Editor, enabling the creation and management of a shader network. Within the Hypershade work area, located at the bottom of the Hypershade panel between the Create tab and the Property Editor, nodes can be created and connected to build a comprehensive shader network. This workspace offers the same flexibility as the Node Editor, allowing for advanced shader adjustments and customizations.

- In the Hypershade's work area, nodes can be added by selecting from the Create Tab, pressing the Tab key to type the node type, or dragging nodes directly from the Create Tab. Nodes are connected by dragging lines between them or middle-mouse dragging one node onto another. They can be displayed in various views simple, connected, full, or custom—defaulting to custom mode upon creation.

- The Hypershade allows attribute searches within nodes by using the search field in the toolbar, and node types can be filtered by right-clicking and selecting from the Show > Objects submenu. Default nodes displayed include cameras, shading groups, and shading nodes. Filtering nodes by name is supported, with "*" as a wildcard, and filters can be reset to show the entire graph by clicking the filter-clear icon.

- Tabs in Hypershade enable multiple shader networks to be managed at once. New tabs are created by clicking "+", and they can be renamed, duplicated, or reordered. Tabs remain accessible even after closing Hypershade or saving the file. Editing features, such as adding nodes to the graph or rearranging the

layout, are available on the toolbar and are shared with the Node Editor. Additionally, the grid background can be toggled, and nodes can be snapped to it for precise alignment.  .

- **Property Editor:** View your shading node attributes in a Lookdev template view that is optimized for Lookdev workflows. **(Figure 1.11)**

- **Bins:** Organize and track shading nodes in your scenes by separating them into sorting bins **(Figure 1.12)**. Use Sorting bins, which are containers for shading nodes (materials, textures, and so on), to help you organize and track shading nodes in your scenes.

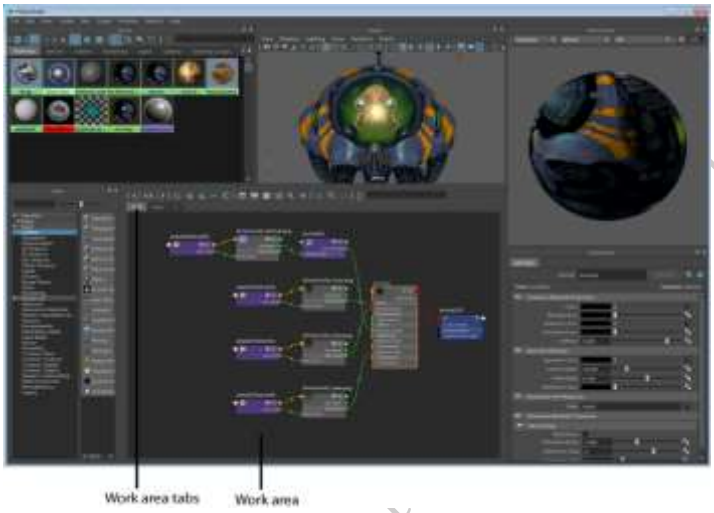


Figure 1.11: Property Editor Workspace with Node Connections

A default Master bin contains all shading nodes in your scene. One can add any number of additional bins to a scene and assign nodes to one or more of those bins. By strategically naming the bins, (for example, wood, metal, doors, foliage), It can quickly and more easily locate shading assets to work with them.

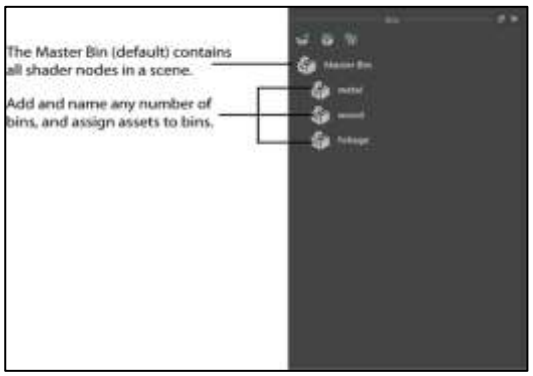


Figure 1.12: Hypershade bin space

Note:

- When a node is assigned to a bin, all the shading nodes upstream to this node are also assigned to this bin.
- The Hypershade asset tabs (Materials, Textures, and so on) exist for all sorting bins, allowing for further organization and filtering.
- While shading nodes can be assigned to more than one bin, they are not duplicated in the scene.
- One can rename an existing bin by double-clicking it.

Types of Shaders

Here is a brief information of the shader types in Maya:

1. Anisotropic Shader

- **Features**: Simulates directional reflections, with irregular specular highlights and sensitivity to surface texture.
- **Applications**: Best for materials like brushed metal, hair, satin, and foil.
- **Practical Uses**: Essential for simulating surfaces with directional reflection, such as hair, metal textures, and satin fabrics.

Figure 1.13: Sample of Anisotropic Shader

2. Surface Shader

- **Features**: Provides basic control over colour and transparency without simulating light interaction.
- **Applications**: Useful for special effects, backgrounds, or materials where light interaction is not needed.
- **Practical Uses**: Can be used for objects like labels, decals, or simple backgrounds.

3. Blinn Shader

- **Features**: Offers softer highlights compared to Phong, with a focus on specular reflections. It is computationally more intensive than Lambert and Phong.
- **Applications**: Ideal for shiny and metallic surfaces **(Figure 1.14)**.
-
- **Practical Uses**: Used for polished metals, glass, and glossy finishes where softer, more realistic specular highlights are desired.

Figure 1.14: Samples of Blinn Shader

4. Lambert Shader

- **Features**: A simple, non-reflective shader that simulates diffuse surfaces. It scatters light uniformly in all directions.
- **Applications**: Ideal for matte surfaces like paper, unpolished wood, and ceramics **(Figure 1.15)**.
- **Practical Uses**: Perfect for non-reflective materials like chalk, stone, or matte finishes.

Figure 1.15: Sample of Lambert shader

5. **Phong Shader**

- **Features**: A shader that combines diffuse and specular reflections, producing sharp specular highlights.**Applications**: Suitable for glossy materials like plastics, glass, and polished metals **(Figure 1.16)**.
- **Practical Uses**: Best for simulating shiny surfaces with distinct, hard reflections.

Figure 1.16: Samples of Phong Shader

6. Layered Shader

- **Features**: Combines multiple shaders to create complex materials with different properties.
- **Applications**: Ideal for materials with multiple layers, such as aged surfaces, labels, and decals.
- **Practical Uses**: Texturing vehicles, character skin, and environmental textures like moss or dirt.

7. Ocean Shader

- **Features**: Simulates realistic water surfaces with dynamic response to light and camera angle interaction.
- **Applications**: Designed for ocean, lake, and water simulations.
- **Practical Uses**: Useful for creating realistic water surfaces in outdoor scenes.

8. Ramp Shader

- **Features**: Creates smooth gradients in colour, transparency, incandescence, and specular highlights.
- **Applications**: Allows for the creation of varied properties across an object's surface.
- **Practical Uses**: Ideal for materials like skin, fabrics, or metallic surfaces and for creating smooth transitions in special effects like magical spells or animated trails.

9. Shading Map Shader

- **Features**: Creates cartoon-style "cell" shading, simulating a 2D painted effect.

- **Applications**: Originally used for traditional cartoon shading but now replaced by the Ramp shader for enhanced capabilities.
- **Practical Uses**: Used for cartoon-style 3D rendering or illustrations.

10. Surface Shader

- **Features**: Provides control over an object's basic colour, transparency, and glow.
- **Applications**: Useful for creating glowing objects or simple texturing needs.
- **Practical Uses**: For dynamic colour changes based on object movement, or creating basic objects with simple transparency.
- change colour based on their position or other environmental factors, adding a layer of interactivity to animations.
- Basic Object Texturing: It can be employed for basic object texturing where advanced material properties are not required, making it suitable for prototyping and testing.
- Visual Effects: The shader can be used in visual effects to create glowing elements or transparent surfaces, enhancing the overall aesthetic of the scene.

Activities

Activity 1: Applying a Shader in Autodesk®Maya®

Materials Required: Computer system, and Autodesk®Maya®

Procedure

1. Open Hypershade: Navigate to the top menu and select **Window** > **Rendering Editors** > **Hypershade**. This opens the Hypershade window where you can access various shading nodes.

2. Create a New Shader: In the Hypershade window, locate the **Create** section for Maya nodes. Click on the desired material type (e.g., **aiStandardSurface**, **Lambert**, **Blinn**, etc.) to create a new surface shader. This action will add the shader to the work area and generate its associated shading group.

3. Select Your Model: In the viewport, select the 3D model to which you want to apply the shader.

4. Assign the Shader: Right-click on the newly created surface material in the work area of the Hypershade.

Choose **Assign Material to Selected** from the context menu. This step assigns the material shading group to the model's shape node, effectively applying the material to the selected object.

5. Adjust Shader Properties (Optional):

After assigning the shader, you can adjust its properties in the **Attribute Editor** (usually on the right side of the interface) to fine-tune its appearance, such as colour, transparency, reflectivity, and Texture Mapping.

Activity 2: Exploring Shader Types in Texturing

Materials Required: 3D software (e.g., Maya) and 3D models (simple objects like spheres or cubes)

Procedure

1. **Introduction:**
   - Brief overview of shaders (Diffuse, Specular, and Special Effect shaders).
2. **Hands-On Application:**
   - **Diffuse Shader:** Apply a Lambert shader to a model and observe its matte effect.
   - **Specular Shader:** Apply a Blinn or Phong shader to simulate reflective surfaces (metal, glass).
   - **Effect Shader:** Apply Surface and Layered shaders for stylized or complex material effects (e.g., rust, water).
3. **Shader Comparison:**
   - Compare the visual results of each shader.
   - Discuss which shader suits specific materials (e.g., matte, shiny, complex surfaces).
4. **Reflection :**
   - Discuss shader choices and their applications in 3D projects.
   - Consider how different shaders behave with light and materials.

Check Your Progress

A. Multiple Choice Questions

1. What is the primary purpose of applying textures to 3D models in Maya?

a) To make the model lighter
b) To define the physical appearance and feel of a surface
c) To increase the rendering speed
d) To reduce the file size of the model

2. Which type of texture allows you to apply multiple layers of textures to a material in Maya?
a) 2D Texture
b) 3D Texture
c) Layered Texture
d) Environment Texture

3. In Maya, which of the following textures can be used to create realistic water effects?
a) Noise Texture
b) Ocean Texture
c) Cloud Texture
d) Ramp Texture

4. What is the main characteristic of procedural textures in Maya?
a) They are resolution-dependent
b) They require external image files
c) They are mathematically based and resolution-independent
d) They can only be used at a distance

5. Which shader would you use to create a glossy, reflective surface like water or polished metal?
a) Diffuse Shader
b) Specular Shader
c) Glossy Shader
d) Transparent Shader

6. You need to apply a shader that results in a matte, non-reflective surface, such as concrete or wood. Which shader should you use?
a) Phong Shader
b) Diffuse Shader
c) Glossy Shader
d) Reflective Shader

7. Which shader type is best suited for simulating materials like glass, which need to reflect and refract light?
a) Emissive Shader
b) Refractive Shader
c) Transparent Shader
d) Diffuse Shader

8. What effect does applying a Specular Shader to a surface have?
a) Adds a glowing effect
b) Makes the surface highly reflective
c) Applies a transparent effect
d) Gives a matte finish

9. Which shader would be appropriate to simulate a surface with both rough and smooth areas, such as rust on metal?
a) Subsurface Scattering Shader
b) Bump Map Shader
c) Roughness Shader
d) Procedural Shader

10. If you want a material to have a high level of reflectivity but low diffuse properties, which shader would you choose?
a) Lambert Shader
b) Glossy Shader
c) Phong Shader
d) Emissive Shader

Session 4: Maya Material Nodes

In Autodesk® Maya®, material nodes are essential components that determine how surfaces interact with light, enabling artists to replicate the properties of real-world materials within a 3D environment. These nodes provide the tools necessary for manipulating the visual attributes of surfaces, leading to realistic rendering effects. Here is an overview of the significance and functionality of material nodes in Maya:

Importance of Material Nodes

i. **Light Interaction:** Material nodes control how light reflects, refracts, and absorbs when it hits a surface. This interaction is vital for creating realistic-looking materials, as different materials behave differently under light.
ii. **Realism in 3D Rendering:** By using various material nodes, artists can simulate a wide range of surface properties such as glossiness, transparency, texture, and colour, enhancing the overall realism of 3D models.
iii. **Customizability:** Maya provides a variety of material nodes, each with unique attributes that can be customized. This flexibility allows artists to create specific visual effects tailored to the needs of their project.

Types of Material Nodes

In Autodesk® Maya®, material nodes are essential components of the shading and texturing process. These nodes define the appearance of the surfaces of 3D objects, controlling their properties such as colour, reflectivity, transparency, and how they interact with light. Understanding how material nodes work is crucial for creating realistic or stylized 3D models. Below are some key material nodes in Maya:

1. **Lambert**

- **Type**: Diffuse material
- **Properties**: This material is non-reflective and ideal for matte surfaces. It's commonly used for surfaces that don't reflect light, like chalk or fabric.

2. **Phong**

- **Type**: Specular material
- **Properties**: This material has a reflective surface and is commonly used for shiny surfaces like plastic or metal.

3. **Blinn**

- **Type**: Specular material (like Phong, but with a different reflection model)
- **Properties**: Often used for materials with softer reflections, such as skin, rubber, or satin.

4. **PhongE**

- **Type**: Specular material
- **Properties**: Similar to Phong, but provides a more energy-efficient reflection model, making it suitable for rendering high-quality results.

5. **Anisotropic**

- **Type**: Reflective material
- **Properties**: This material is used to simulate materials like brushed metal, hair, or satin that have directional specular highlights.

6. **Lambert 2**

- **Type**: Enhanced Lambert shader
- **Properties**: This shader offers more control and is used in cases where basic Lambert doesn't suffice, offering enhanced control over diffuse reflections and other properties.

7. **Standard Surface (Arnold)**

- **Type**: Physically-based rendering material (PBR)
- **Properties**: This is the standard material in Arnold for Maya and is used to create realistic materials. It combines diffuse, specular, and other complex properties into one shader.

8. **Use Background**

- **Type**: Special-purpose material

- **Properties**: Used in compositing and matte painting setups. This material is often used for creating invisible background objects that receive shadows but don't show up in reflections or other visual elements.

9. **Surface Shader**

- **Type**: Custom material
- **Properties**: This shader is used to create a completely flat or unique material that can be customized by combining other shaders, providing flexibility for complex shading setups.

10. **Car Paint**

- **Type**: Advanced reflection material
- **Properties**: This material simulates the complex layers in automotive paint, including clear coat and metallic flakes for more realistic results in automotive design.

11. **Subsurface Scattering (SSS)**

- **Type**: Translucent material
- **Properties**: Used to simulate materials like skin, wax, or marble where light penetrates the surface before being scattered inside.

12. **Ocean Shader**

- **Type**: Specialized material for water
- **Properties**: Used for simulating oceans, lakes, or other large bodies of water with detailed surface waves and reflections.

13. **Wireframe Shader**

- **Type**: Visualization material
- **Properties**: Used for creating a wireframe effect on 3D models, which helps with debugging and visualizing geometry.

14. **aiStandardSurface (Arnold)**

- **Type:** A versatile shader in Arnold that supports a wide range of material types, including metals, plastics, and skin.
- **Properties**: It combines multiple shading properties into a single node. It is excellent for realistic rendering of complex materials, such as character skin, car paint, and reflective surfaces.

15. **Arnold's aiStandard Hair**

- **Type:**It is specifically designed for hair and fur, this shader allows for realistic rendering of hair strands, providing control over attributes like colour, glossiness, and transparency.
- **Property:** It is used in character creation and animation for realistic hair rendering.

16. **aiStandardVolume**

- **Type:** This shader is used for creating volumetric effects like fog, smoke, or translucent materials. It allows for scattering and absorption of light within the volume.
- **Property:** It is useful for creating atmospheric effects in scenes or rendering materials like wax or jelly.

17. **ShaderFX**

- **Type**: A node-based shader creation tool that allows artists to create custom shaders visually.
- **Property**: ShaderFX can create various effects, from cartoonish styles to complex surface textures. It is ideal for game assets and stylized renders where unique visual effects are required.

18. **Texture Shader (File Texture)**

- **Type**: Although not a surface shader per se, file textures can be applied to any surface shader to give it a specific look by using image files (e.g., JPG, PNG).
- **Property**: It is used in combination with other shaders to create detailed surfaces, like wood grain, brick patterns, or skin textures.

19. **Use Background Shaders**

- **Type:** This shader is applied to objects to ensure their interactions with the background are visually coherent.
- **Property**: It is particularly useful for integrating 3D models into a scene with background images. Allows objects to cast shadows onto the background and creates "holes" in the alpha channel where the material appears, enhancing realism.

20. **Ocean Shaders**

- **Type:** Specifically designed for simulating water surfaces, allowing users to define colour schemes and depth.

- **Property:** It creates visually appealing water effects that respond dynamically to lighting and camera angles.

21. **Hardware Textures**

- **Type:** These are optimized for rendering performance, particularly in real-time applications or game engines. Examples: Lambert Shader.
- **Property:** Provides a matte finish and is commonly used for non-reflective surfaces.

22. **ShaderFX**

- **Type:** A node-based shader creation tool for advanced material effects and real-time rendering.
- **Property:** It helps to create complex effects like **subsurface scattering**, **reflections**, and **PBR**.

23. **Volume Shaders**

- **Type:** Designed for rendering volumetric effects, such as smoke, fog, and fire.
- **Property:** These shaders simulate how light interacts with particles or fields within a volume rather than on a surface.

Activities

Activity 1: Create double-sided shading texture

Materials Required: Computer system, and Autodesk®Maya®

Procedure

- Begin by applying a Phong material to the surface you want to use for double-sided shading.
- Open the Hypershade and find the textures you'll be using. For this activity, use a checker texture and a crater texture.
- In the Hypershade, create a Condition node. This node will control the colour output based on the side of the surface.
- Connect the Checker's out Colour attribute to the Condition node's colour. This will set the checker texture to display on one side of the surface.
- Connect the Crater's out Colour attribute to the Condition node's colour, If False attributed. This assigns the crater texture to the opposite side.
- Create a Sampler Info node, which will determine which side of the surface is facing outward.
- Connect the Sampler Info's flipped. Normal attribute to the Condition node's first Term or second Term attribute. This setup controls when each texture will

appear based on the surface orientation.

- Connect the Condition node's out Colour attribute to the Phong material's colour attribute. This link allows the Phong material to alternate textures based on the Condition settings.
- Perform a test render. Each side of the surface should display a different texture (checker on one side and crater on the other), creating a double-sided shading effect.

Activity 2: To apply material nodes for realistic 3D rendering in Maya.

Materials Required: Computer system, and Autodesk®Maya®

Procedure

1. Prepare the Scene

- Open Maya and load a model (e.g., sphere, cube).
- Set **Arnold** as the renderer.

2. Apply Material Nodes

- **Lambert:** Create a Lambert node for matte surfaces (e.g., fabric). Adjust the **colour**.
- **Phong:** Create a Phong shader for shiny surfaces (e.g., metal). Adjust **specular** and **reflectivity**.
- **aiStandardSurface:** Apply this Arnold shader for complex materials like skin or metal. Adjust **roughness** and **specular**.

3. Use Specialized Shaders

- **Subsurface Scattering:** Apply for materials like **skin** or **wax**. Adjust **scattering radius**.
- **Ocean Shader:** Apply to simulate water surfaces and adjust **wave height** and **reflection**.

4. Customize with ShaderFX

- Use **ShaderFX** to create custom shaders with a node-based interface for unique effects.

5. Test Light Interaction

- Set up **lighting** and observe how materials reflect light:
  - **Lambert**: Soft, no reflections.
  - **Phong**: Reflective highlights.
  - **aiStandardSurface**: Realistic rendering with reflections and subsurface effects.

6. Render the Scene

- Adjust camera angles and render settings.
- Review the final render to see the material effects.

Check Your Progress

A. Multiple Choice Questions

1. Which material node is most suitable for creating a non-reflective, matte surface like fabric or chalk in Maya?
a) Phong
b) Lambert
c) aiStandardSurface
d) Ocean Shader

2. For simulating a glossy, reflective surface like plastic or metal, which material node should be used?
a) Phong
b) Lambert
c) aiStandardSurface
d) Subsurface Scattering

3. When rendering a character's skin with realistic translucency and light scattering, which shader is the best choice in Maya?
a) aiStandardSurface
b) Subsurface Scattering (SSS)
c) Blinn
d) aiStandard Hair

4. To simulate an ocean's surface with dynamic wave behavior and reflective properties, which shader should be applied?
a) PhongE
b) Ocean Shader
c) aiStandardSurface
d) ShaderFX

5. Which material node would you use for creating realistic car paint with complex layers like clear coat and metallic flakes?
a) aiStandardHair
b) Car Paint
c) Phong
d) Surface Shader

6. For applying complex, custom shader effects in a real-time game engine, which node-based tool in Maya would be most useful?
a) aiStandardVolume
b) ShaderFX
c) Lambert 2
d) Use Background

7. To render materials that scatter light through a surface, such as skin, wax, or marble, which material node should be used?
a) aiStandardSurface
b) Subsurface Scattering (SSS)
c) Blinn
d) Phong

8. Which material node is best for creating a highly reflective surface that can simulate brushed metal or satin?
a) Lambert
b) Anisotropic
c) Surface Shader
d) PhongE

9. When creating a simple, flat surface without any shading complexity, which shader would be most suitable?
a) aiStandardSurface
b) Surface Shader
c) aiStandardVolume
d) Lambert

10. For creating volumetric effects like smoke or fog that scatter light, which material node should be used?
a) aiStandardVolume
b) aiStandardSurface
c) Subsurface Scattering
d) Ocean Shader

Session 5: Real Life 3D Model

Creating a 3D Realistic Shark in Autodesk® Maya® Using Subdivision Surfaces

3D models are digital representations of physical objects, constructed with points in 3D space connected through geometric elements like triangles, lines, or curved surfaces. In this activity, we will create a lifelike 3D shark in Maya using Subdivision Surfaces a unique modelling approach that combines the smooth, organic qualities of NURBS with the flexibility and detail control of polygons.

Workflow Overview: Creating a realistic shark model involves several stages:

i. Modelling
ii. UV Mapping
iii. Texturing

iv. Rigging
v. Rendering.

Each step is integral to achieving a believable, lifelike 3D model.

Step 1: In Maya, Subdivision Surfaces are designed to bridge the characteristics of Polygon and NURBS surfaces:

NURBS-Like Smoothness: Subdivision surfaces enable smooth, flowing shapes with minimal control vertices, ideal for organic forms like animals. They offer polygon-like detail control, allowing intricate refinements by extruding specific areas and adjusting detail levels as needed. This multi-level control makes it easy to switch between different detail levels on the same surface. Additionally, Maya allows seamless conversion between NURBS, polygons, and subdivision surfaces, enhancing modelling flexibility.

Step 2: Setting Up the Scene with Reference Images

To accurately shape the shark, start with polygon modelling and later convert to a Subdivision Surface to leverage its controls. Use reference images for guidance in achieving realistic proportions.

Steps for Setting Up Reference Images:

i. Open the View menu in the panel menu bar.
ii. Select Import Image under the Image Plane submenu to load the side, top, and front views of the shark as background images **(Figure 1.18)**.
iii. By positioning these references in your viewport, one can begin shaping the shark using polygonal geometry, which will later be refined with Subdivision Surface controls for smoothness and detail.

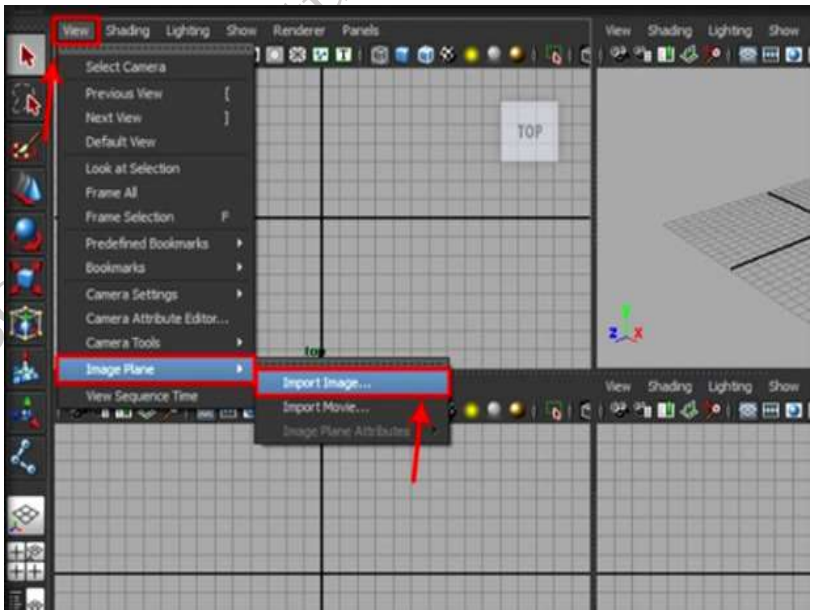


Figure 1.18: View menu on the panel menu bar

Using this method, one has to imported all three reference images into the background **(Figure 1.19)**. One can adjust the attributes of each image by going to View > Image Plane **>** Image Plane Attribute **(Figure 1.20).**

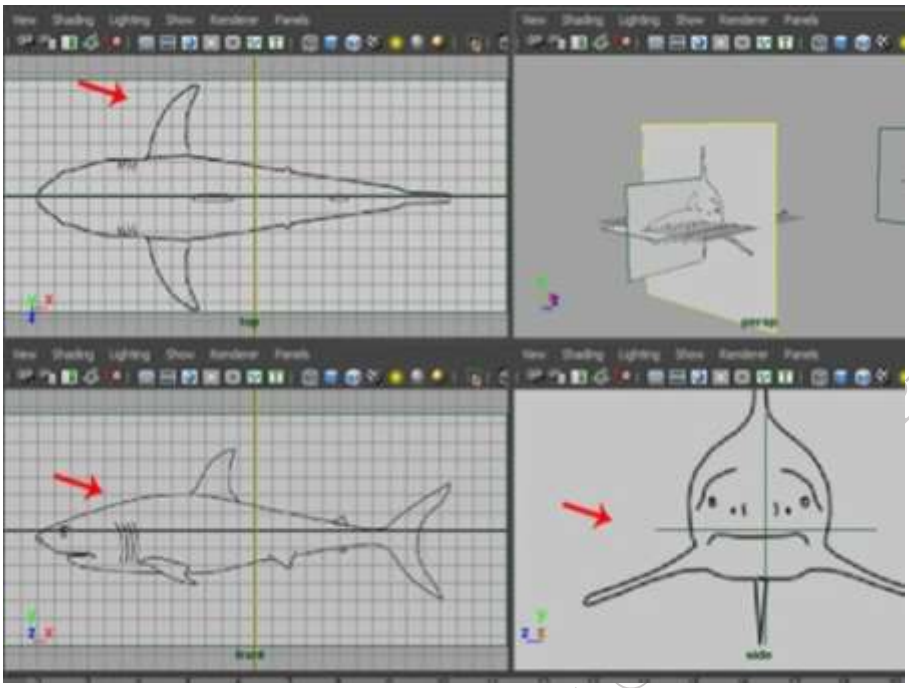


Figure 1.19: Showing Perspective and other angles (Front, Top and Side)

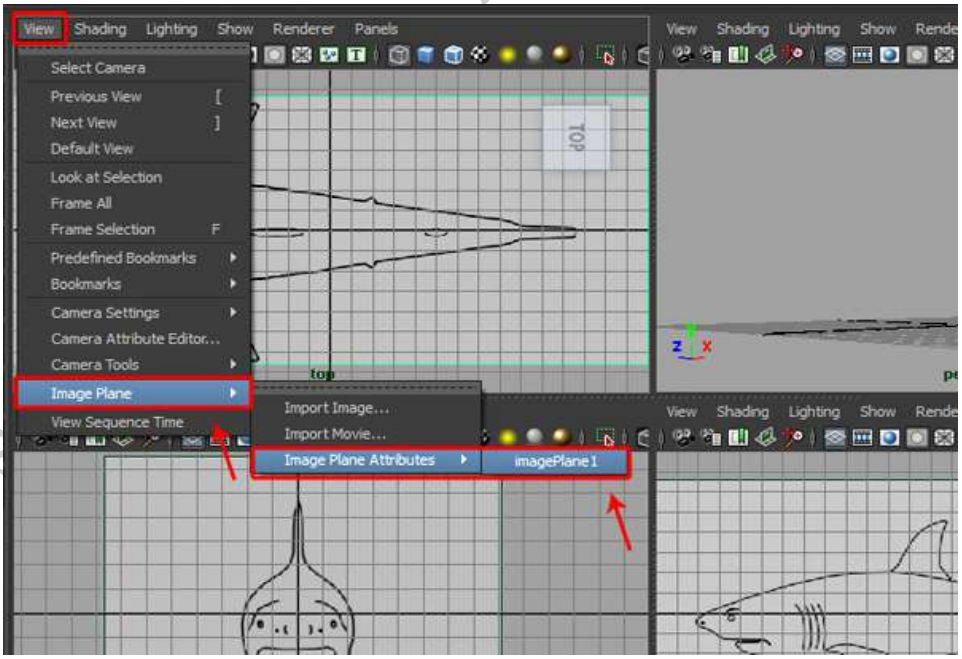


Figure 1.20: Adjusting attribute of images

In the Image Plane Attribute settings, use the Centre X, Y, Z and Width values as needed to match the images **(Figure 1.21)**.

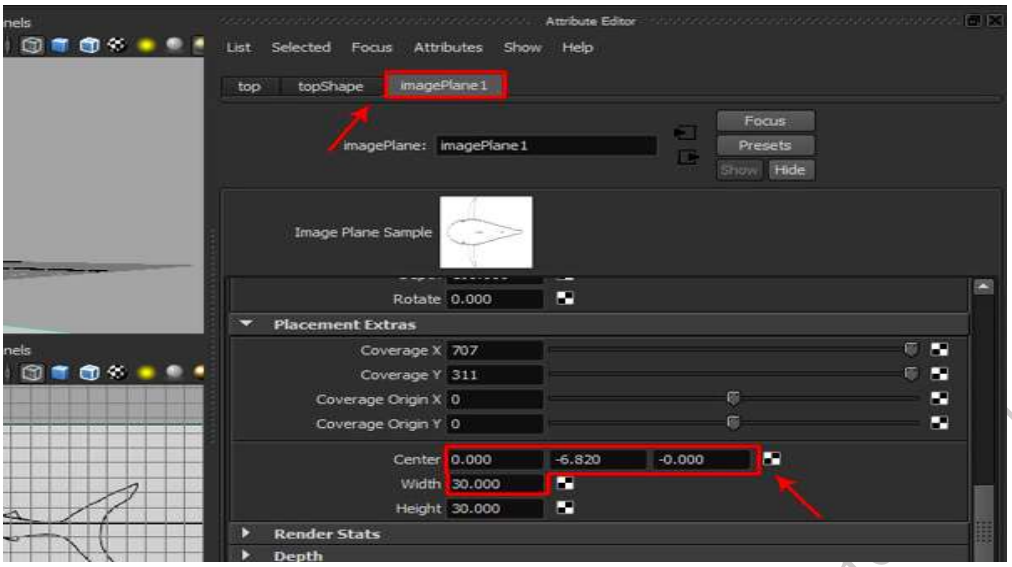


Figure 1.21: Adjusting Properties

The interface should look like this after matching the reference images **(Figure 2.22)**.

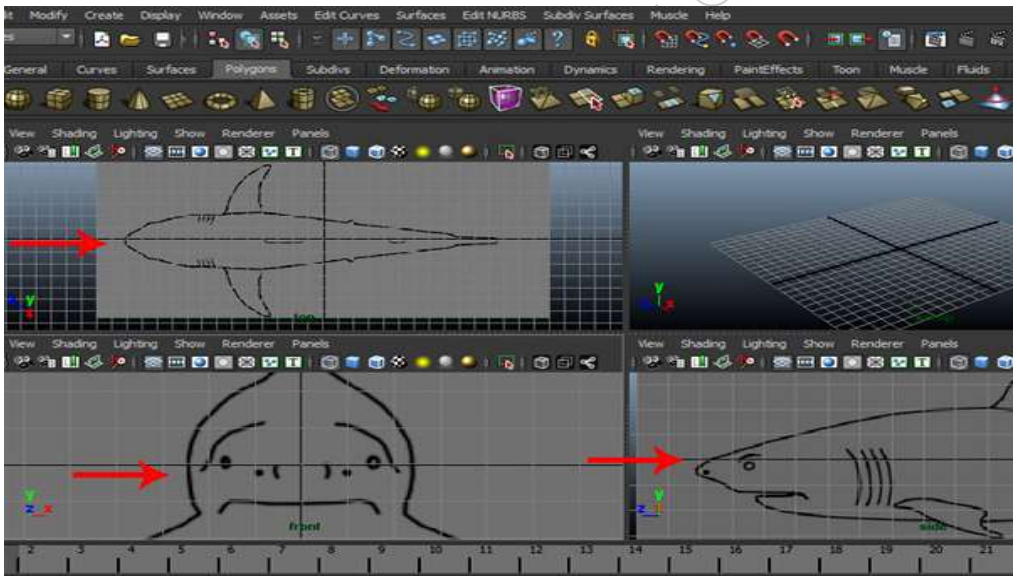


Figure 1.22: Interface after matching the reference image

Modelling the Body

Step 1

Now to begin the modelling process, create a Cylinder poly primitive in the Front view. **(Figure. 1.23)**

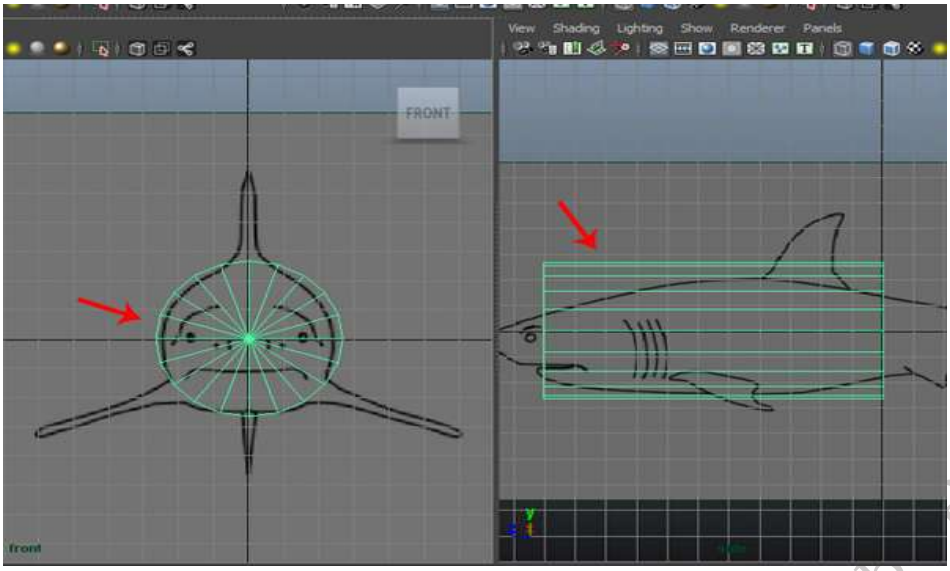


Figure 1.23: Create Cylinder for Modelling process

Step 2

Now with the polyCylinder selected, press Control-A to open its Channels Settings attributes. Go to the INPUTS tab and keep the Sub Divisions Axis value at8, and the Subdivisions Height value at 4 **(Figure 1.24)**.

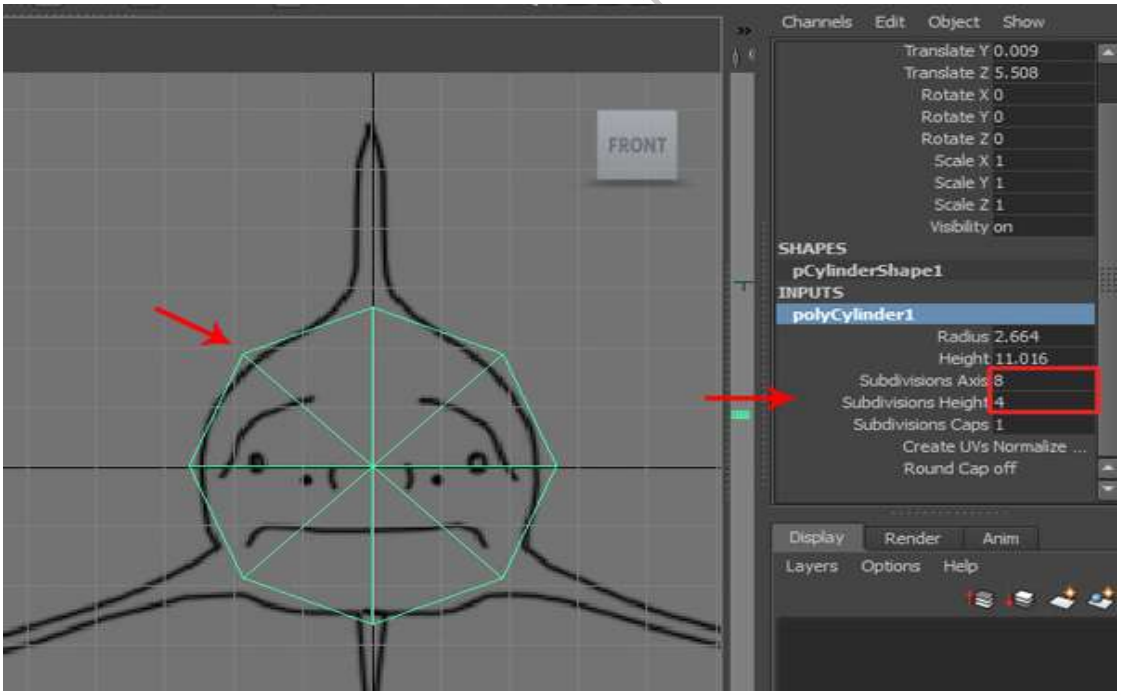


Figure 1.24: Setting value of subdivision axis and subdivision height

Step 3

Then press the F9 key to jump into Vertex selection mode, and arrange the vertex according to the Front and Side reference images **(Figure. 1.25)**.

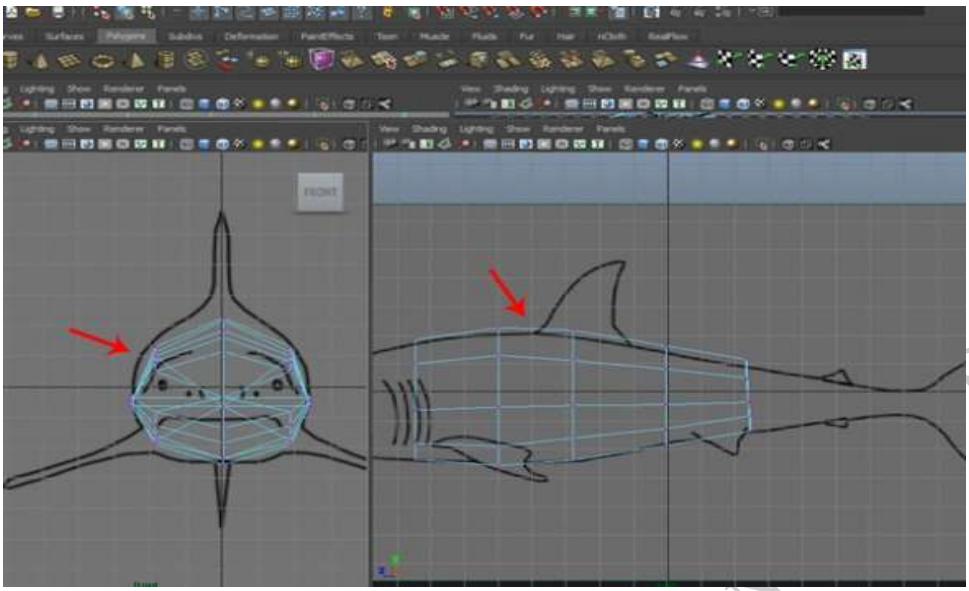


Figure 1.25: Vertex arrangement according to front and Side reference

Arrange the vertex according to the Top reference image also **(Figure. 1.26)**.

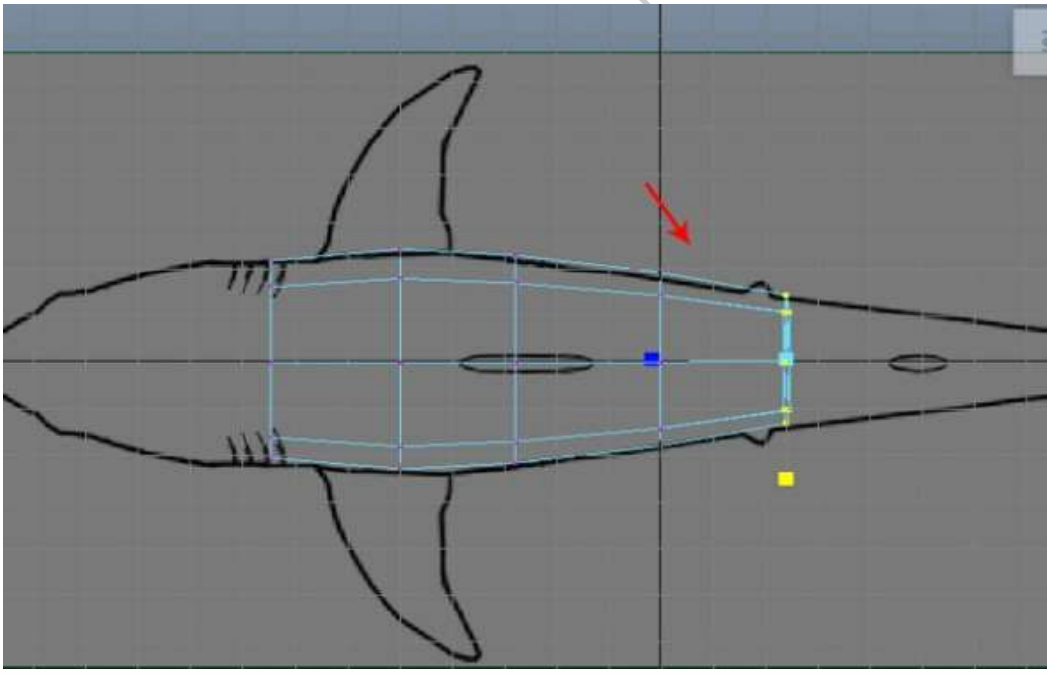


Figure 1.26: Arrangement of vertex according to top reference image

Step 4

Now in the **Perspective** view and with the **polyCylinder** mesh still selected, press**F11** to jump into **Face** selection mode, and select the front and the back cap faces. Then press the **Delete** key to delete the selected faces **(Figure. 1.27).**

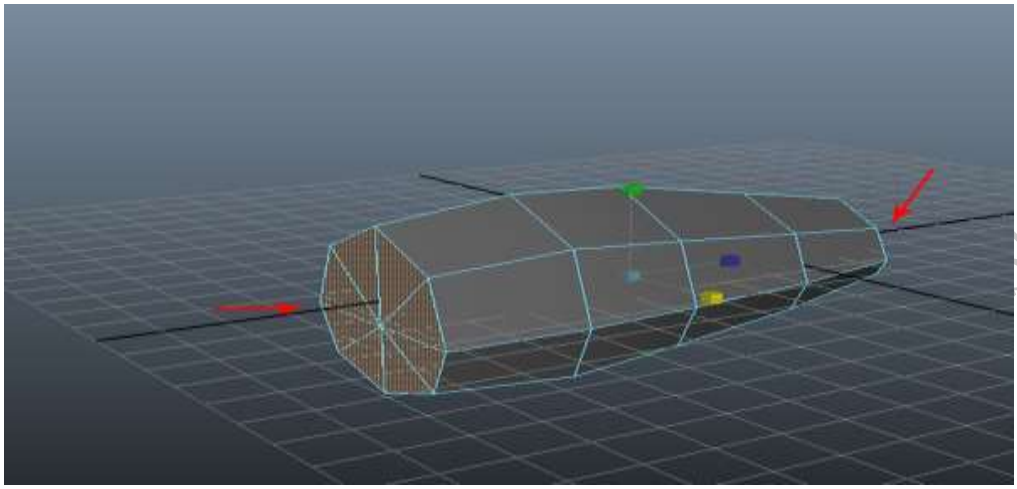


Figure 1.27: Perspective view of the poly

Next, jump into the **Front** view and select half of **polyCylinder** mesh. And press the **Delete** key to delete the selected faces **(Figure. 1.28).**

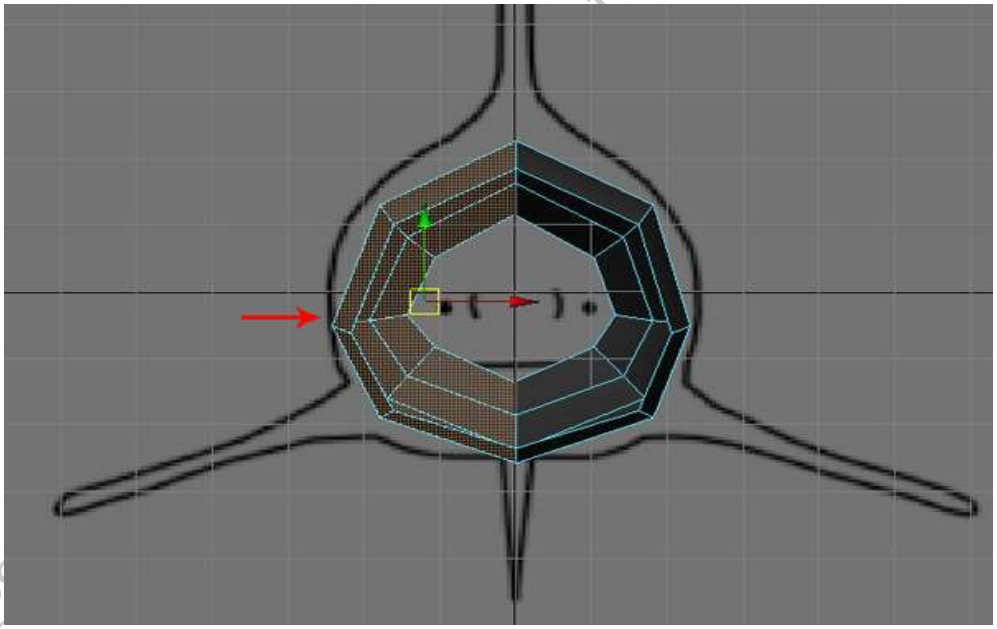


Figure 1.28: Front view of poly cylinder mesh

Step 5

After deleting half of the side faces, select the remaining half and press **F8** key to jump into **Object** selection mode. Then go to the **Edit** menu and click on the **Duplicate Special** options box **(Figure. 1.29)**

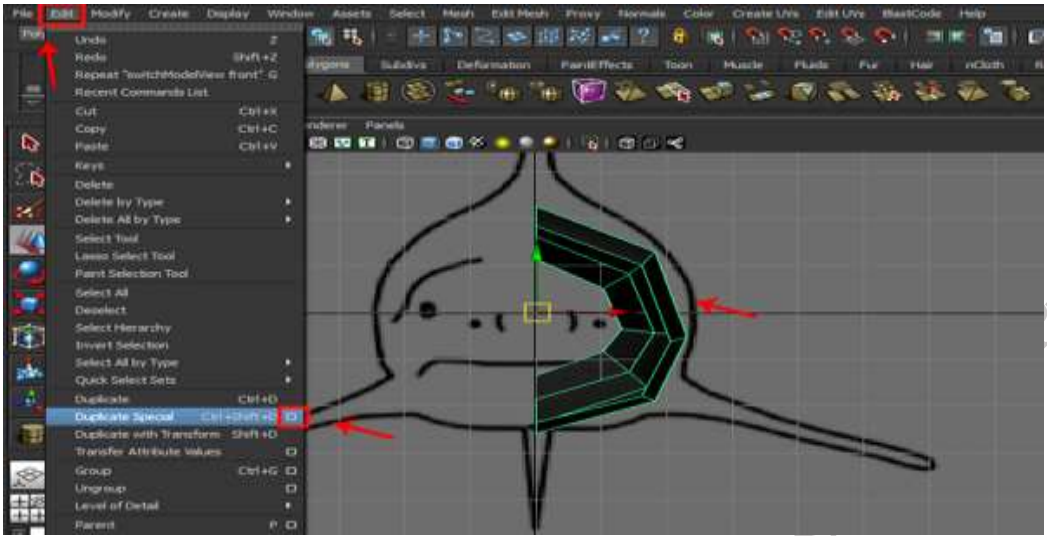


Figure 1.29: Click Edit menu and also click on the duplicate special options box.

Step 6

In the **Duplicate Special** Options, turn on the **Instance** radio button and keep the **Scale** value for the **X Axis** at **-1.00**, and then click on the **Duplicate Special** button. (Fig. 1.31)

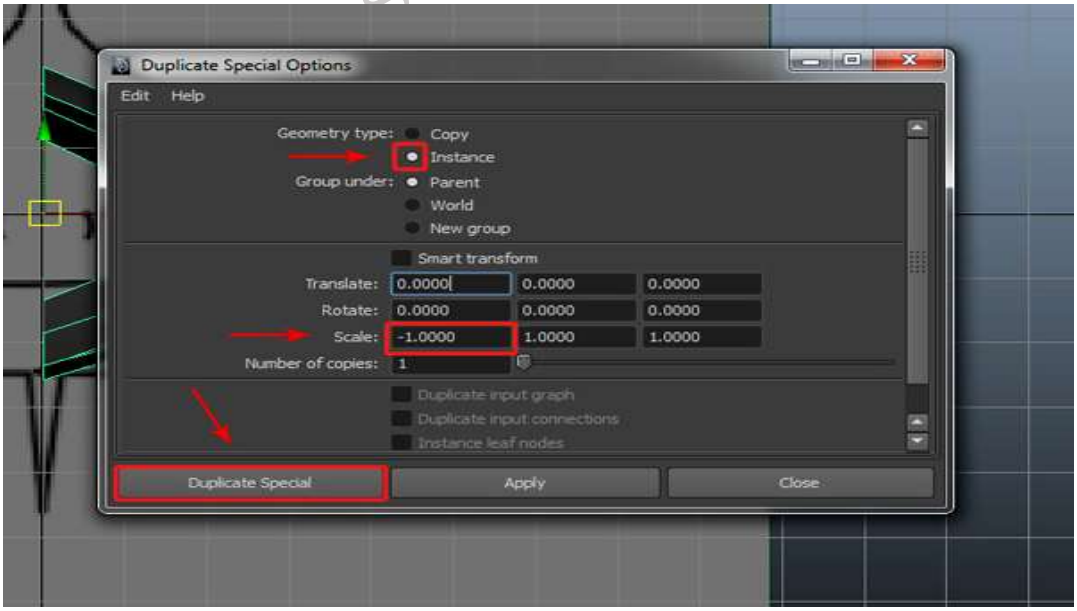


Figure 1.30: Set scale value for the X Axis at -1.00

Step 7

In this step, an instanced copy of the mesh has been created along the -X axis. This means that any adjustments made to the original mesh will be mirrored on the instanced copy in real time **(Figure. 1.31).**

Instancing is particularly useful for symmetrical modelling tasks, like creating characters or objects with bilateral symmetry, as it allows you to focus on modelling one half while the mirrored side updates automatically. This approach is both efficient and ensures that any modifications maintain symmetry across the -X axis.

Step 8

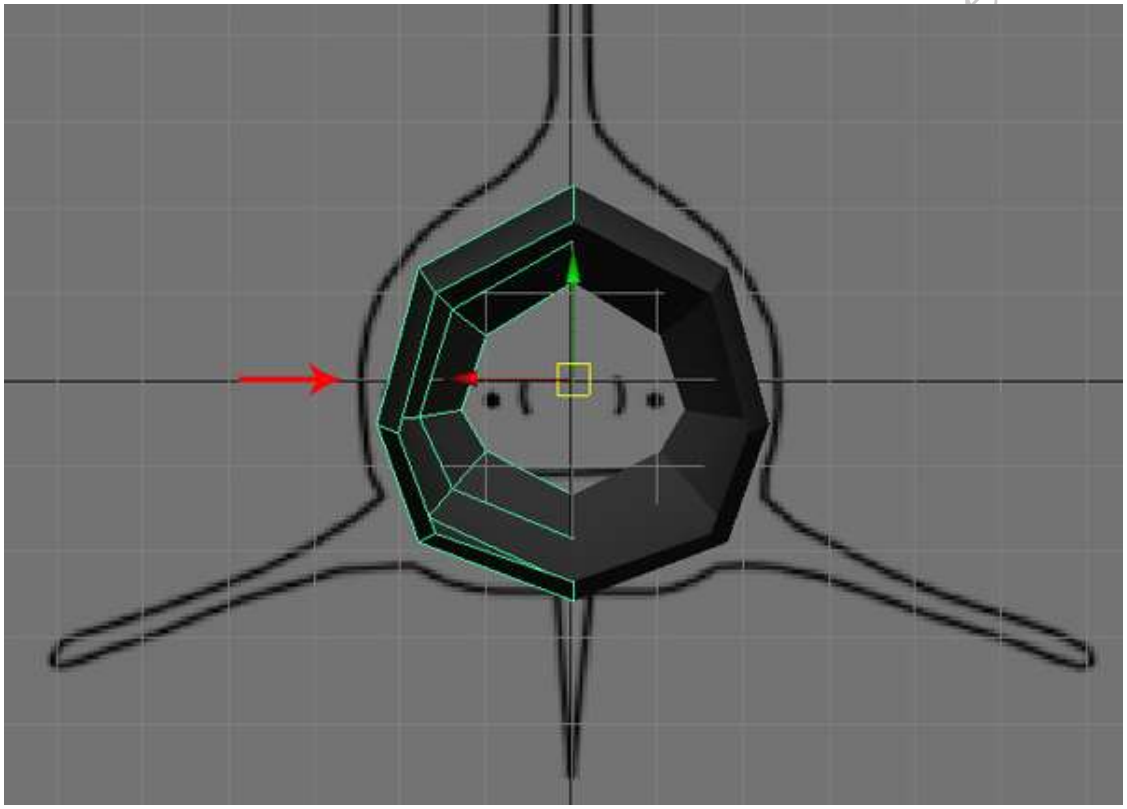


Figure 1.31: Instanced duplicate of the mesh

Now press **F10** to enter **Edge** selection mode, and select one half of the border edge on the *front left* side **(Figure 1.32)**.

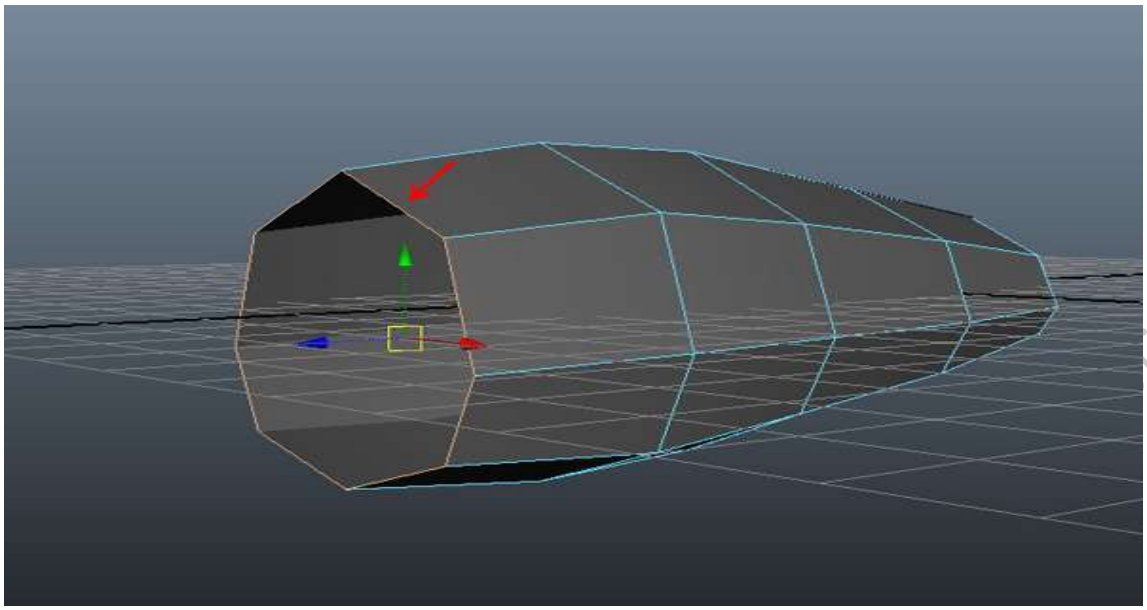


Figure 1.32: Selection of one half of the border edge

Step 9

Jump into the **Side** view, go to the **Edit Mesh** menu and click on the **Extrude** command **(Figure 1.33)**.

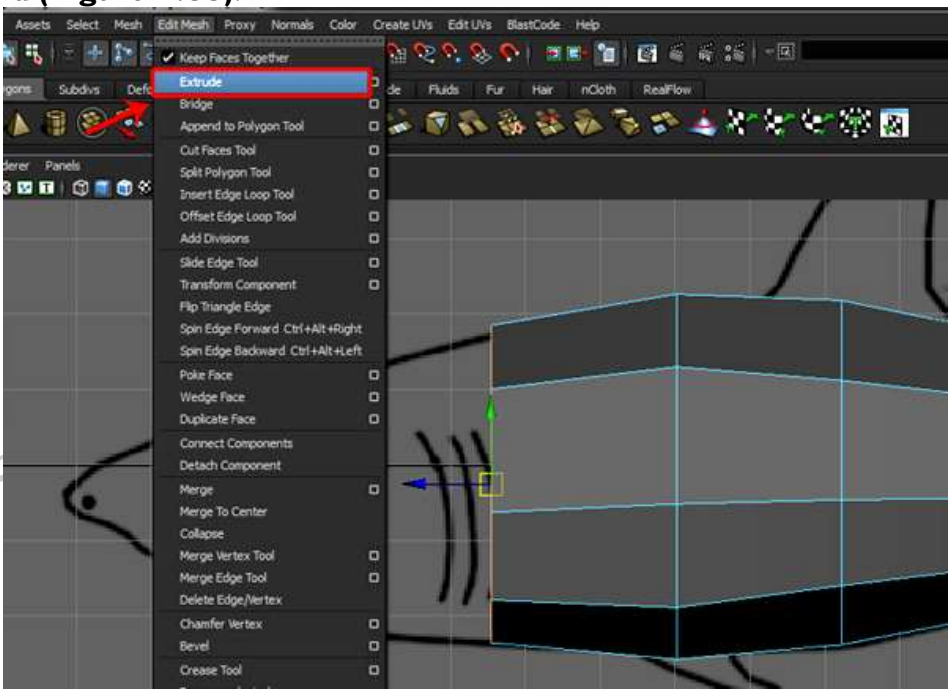


Figure 1.33: Extrude command

Step 10

Following the same approach, the border edge has been extruded five times moving gradually toward the shark's head. Each extrusion step brings additional geometry to shape the body, allowing finer control over the form and contours of the shark's structure. This method ensures a smooth transition along the body, helping to capture the natural, organic shape of the shark as it narrows towards the head **(Figure 1.34)**.

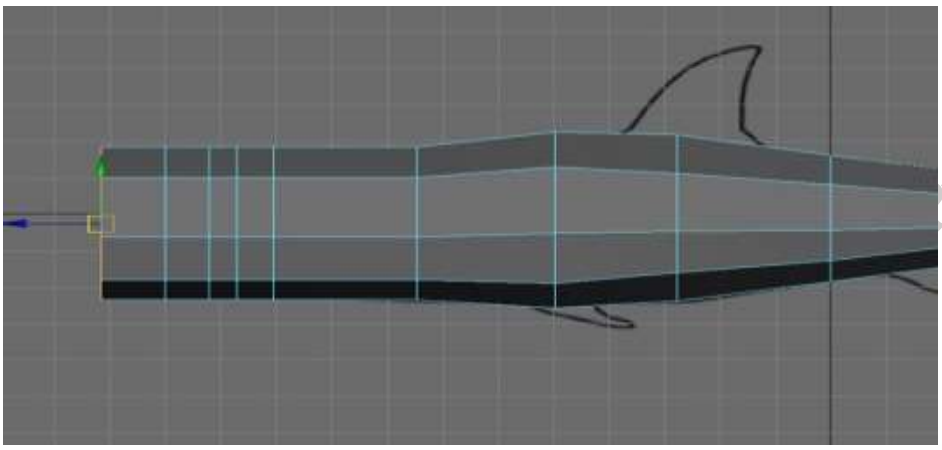


Figure 1.34: Extruding of border edge towards shark's head

Step 11

While still in the same **Side** view, press the **4** key to convert the selected mesh into **Wireframe** mode, and also press **F9** to jump into **Vertex** selection mode. Then try to arrange the vertex according to the reference image, as shown **(Figure. 1.35).**

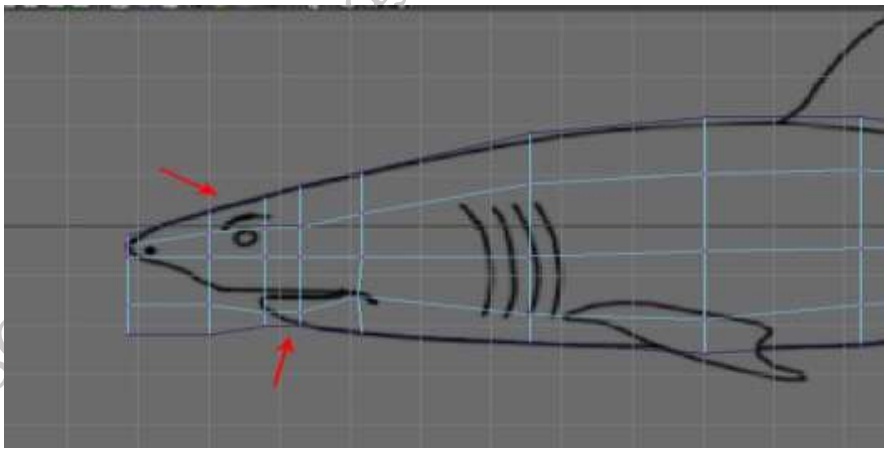


Figure 1.35: Arrangement of vertex according to the reference image

Step 12

Once done, go to the **Edit Mesh** menu and select the **Split Polygon Tool (Figure 1.36).**

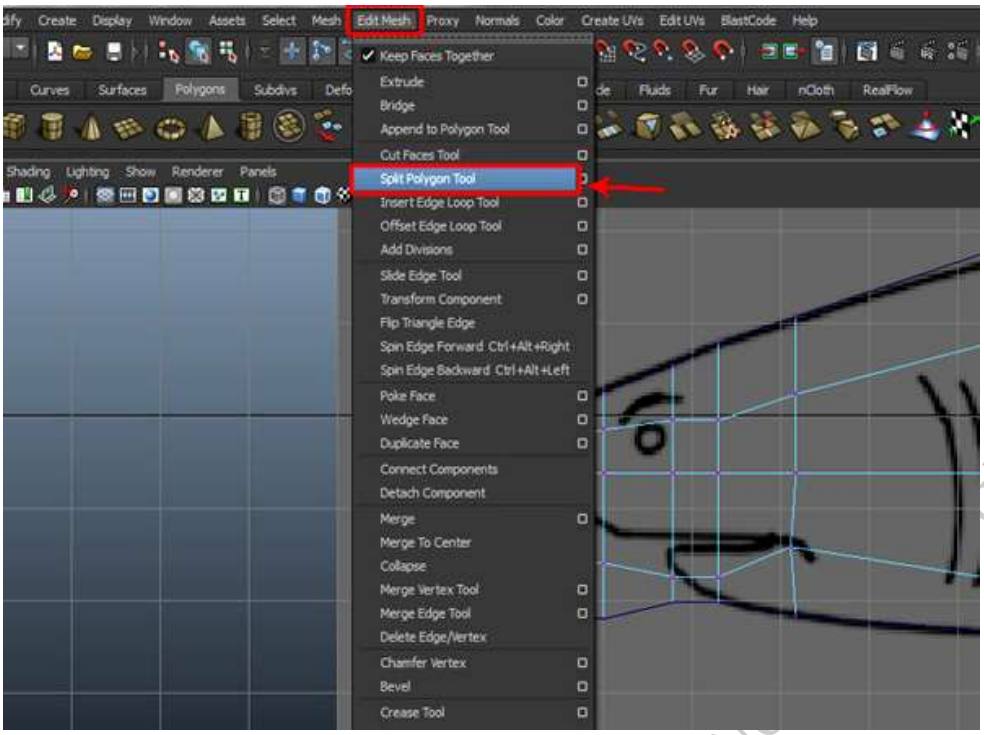


Figure 1.36: Clicked edit mesh menu and selected the split polygon tool

Step 13

With the **Split Polygon Tool** selected, split and divide the faces indicated below for the upper and lower parts of the shark's mouth **(Figure 1.37)**.

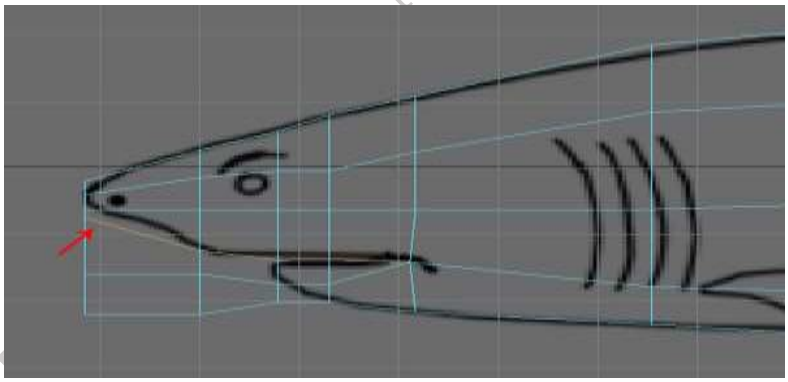


Figure 1.37: Upper and lower parts of the shark's mouth.

Step 14

Press **F11** to jump back into **Face** selection mode, and then with the **four** lower unnecessary faces selected (marked below), press the **Delete** key to delete them **(Figure 1.38).**

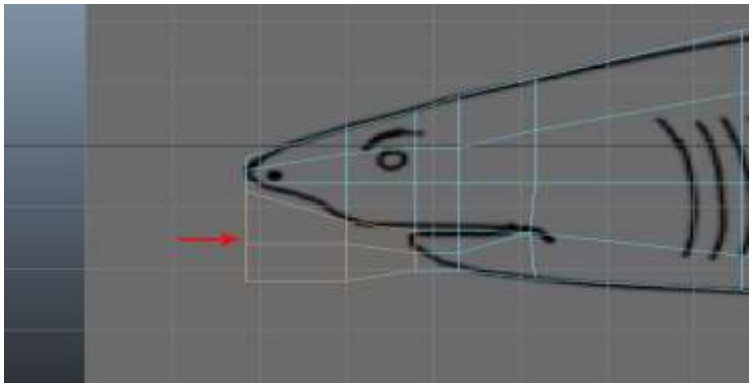


Figure 1.38: Face selection mode

After deleting the faces, it should look something like this **(Figure 1.39)**.

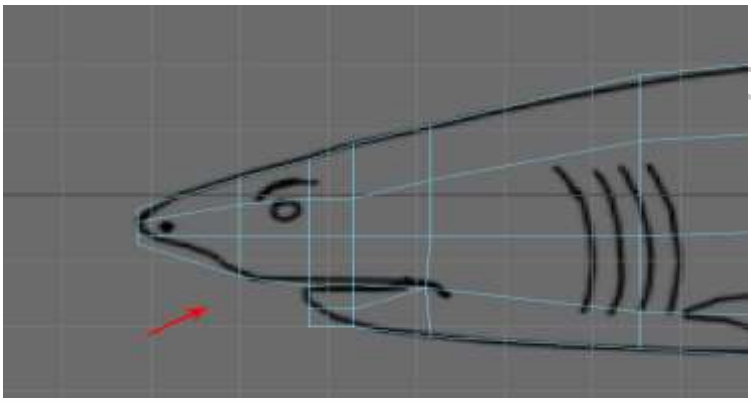


Figure 1.39: Image after deletion of selected faces

Step 15

Also jump into the **Top** view and arrange the vertex by pressing **F9 (Figure 1.40)**.

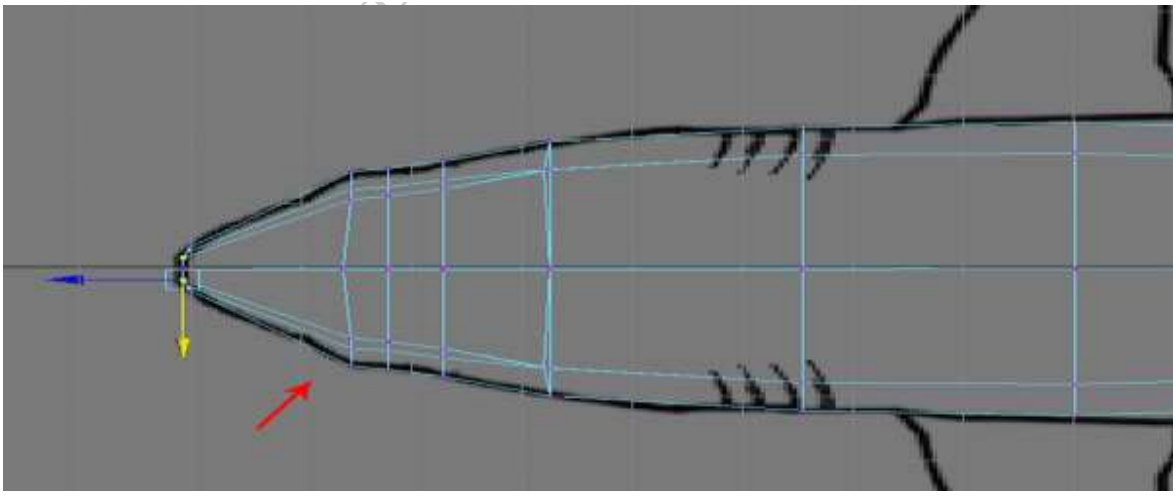


Figure 1.40: Arrangement of the vertex at top views

Step 16

Once again press the **F11** to enter **Face** selection mode, and then select the faces inside the mouth (indicated below), and **Delete** them **(Figure 1.41)**.

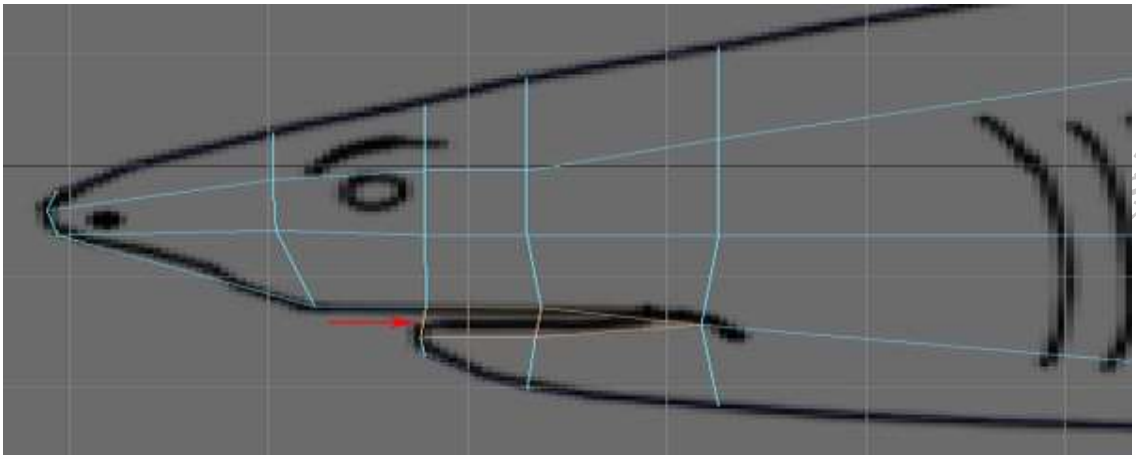


Figure 1.41: Selection of the faces inside the mouth

Step 17

Now we need to insert several edge loops to add more detail. Go to the **Edit Mesh** menu and select the **Insert Edge Loop Tool (Figure 1.42)**.

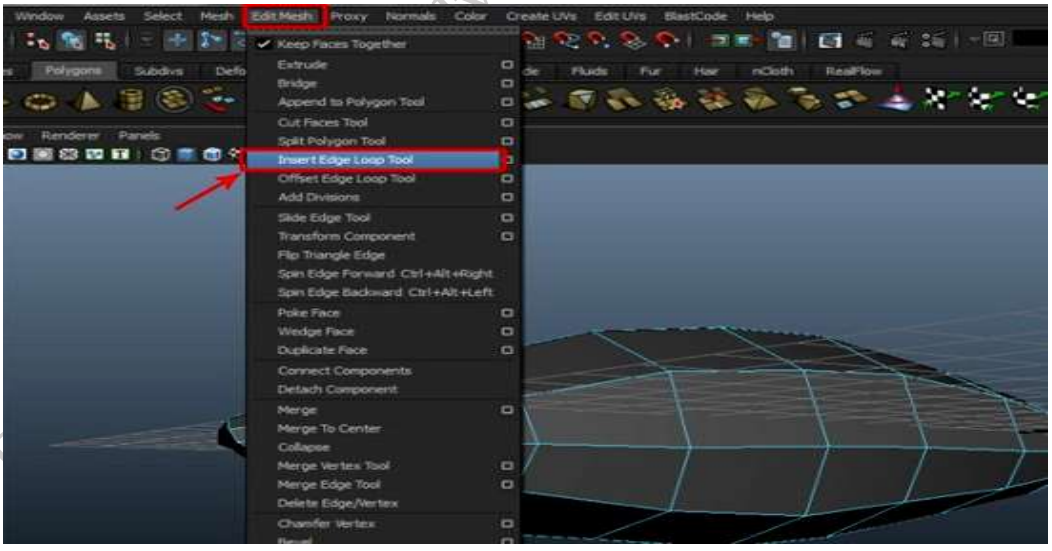


Figure 1.42: Insertion of several edge loops

With the Insert **Edge Loop Tool** selected, insert **two** edge loops along the upper and lower body as shown in the image below **(Figure 1.43)**.

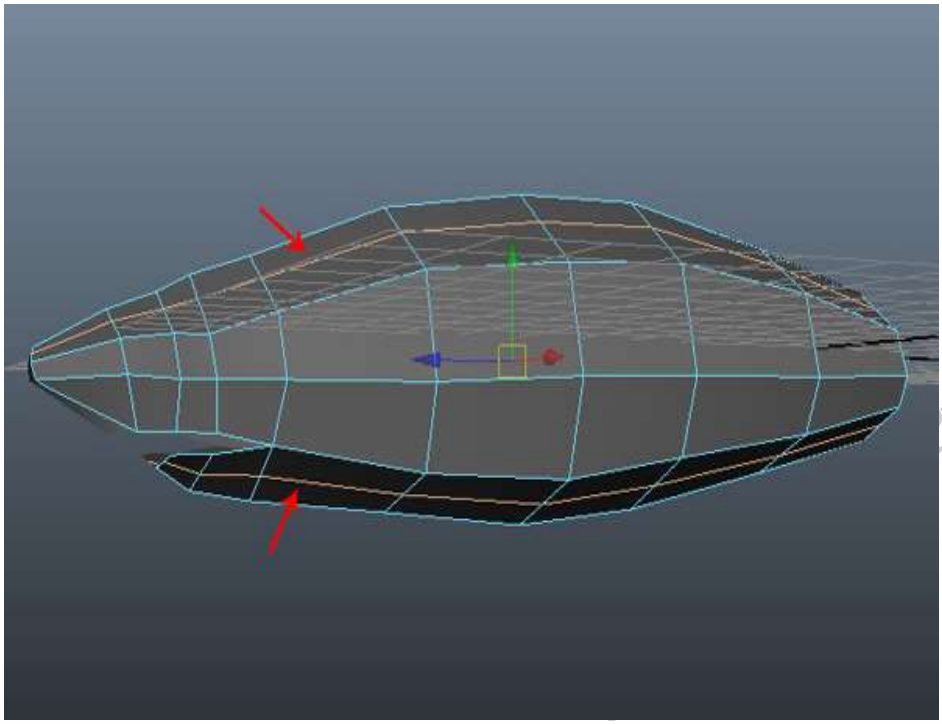


Figure 1.43: Two edge loops along with the upper and lower body

Step 18

Jump into the **Side** view and insert **four** more edge loops around the mouth area, as shown **(Figure 1.44)**.

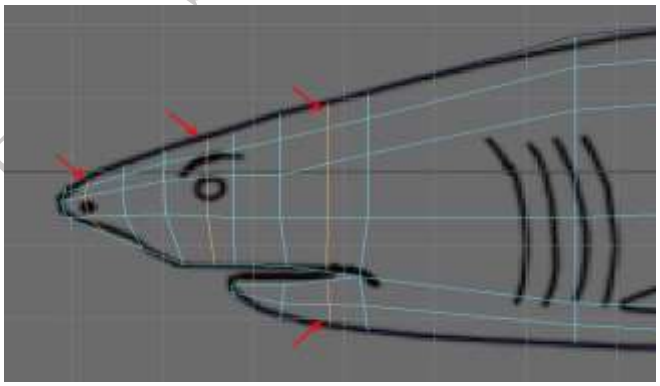


Figure 1.44: Four more edge loops around the mouth area

Modelling the Tail

Step 1 Now **Extrude** the back border edge **three** times for the shark's tail **(Figure 1.45)**

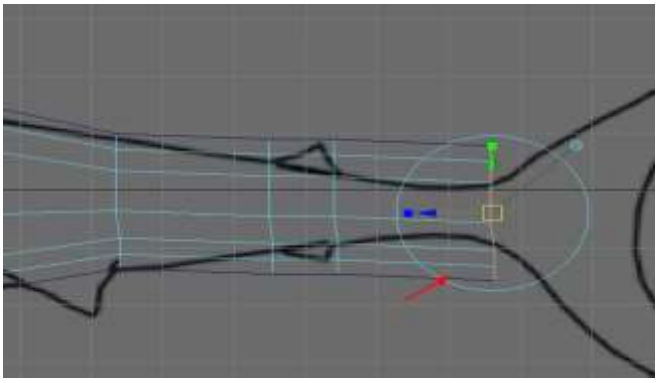


Figure 1.45: Extruded back border edge of the shark's tail.

Step 2

Press **F9** for **Vertex** selection mode, and then arrange the tail vertex according to the reference image **(Figure 1.46).**

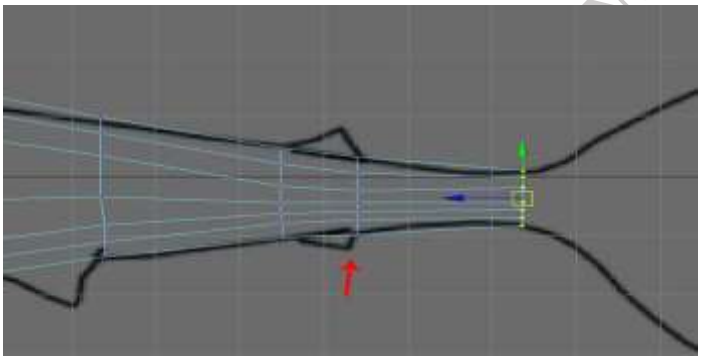


Figure 1.46: Vertex selection mode

Also jump into the **Top** view, and arrange the vertex here too according to the reference image **(Figure 1.47).**

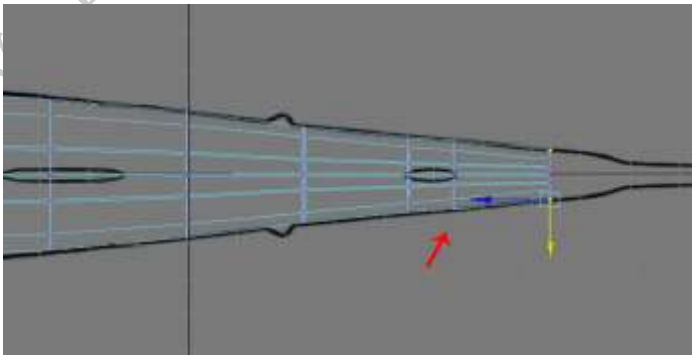


Figure 1.47: Top view and arranged vertex according to the reference image

Step 3

Now **Extrude** the tail edges **three** more times to the end corner, as shown in the following image **(Figure 1.48)**

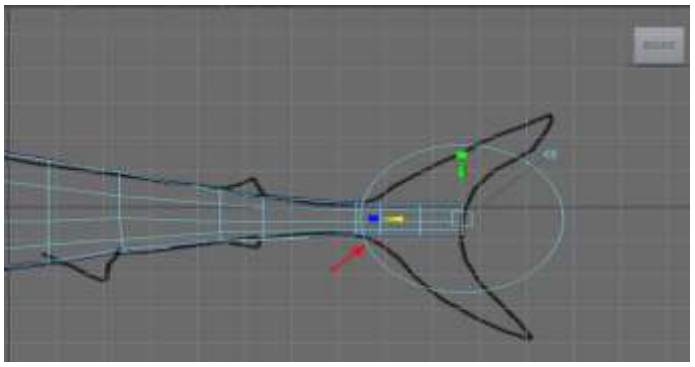


Figure 1.48: Extruded tail edges three more times to the end corner

Step 4

Press **F9** to enter **Vertex** selection mode, and then expand and arrange the vertex according to the reference image **(Figure 1.49)**.

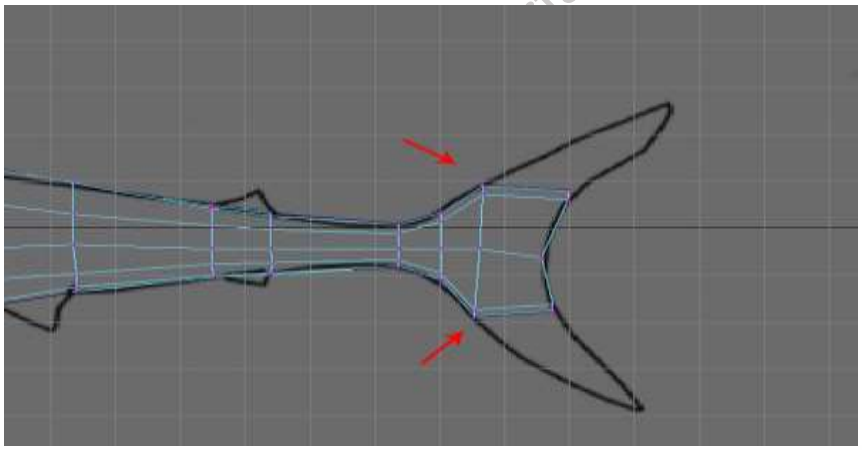


Figure 1.49: Expansion and arrangement of the vertex

Step 5

Jump into the **Perspective** view now and press **F11** to enter **Face** selection mode. And then select the *both* top faces **(Figure 1.50)**.

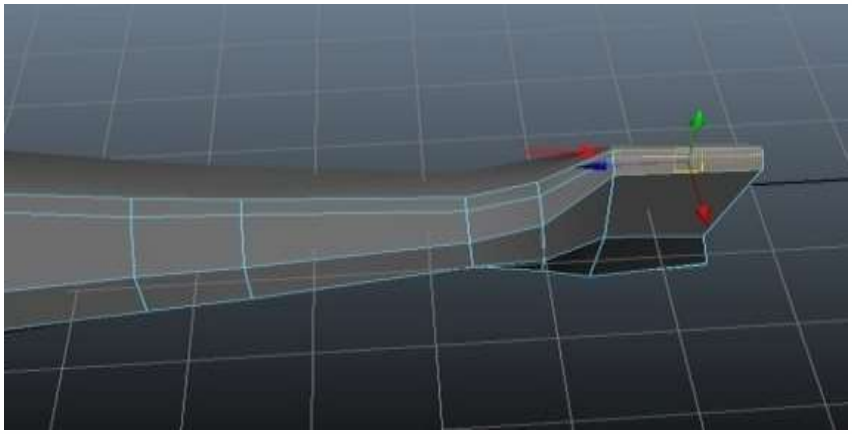


Figure 1.50: Perspective view of both top faces

Step 6

With the top faces selected, jump into the **Side** view and then using the **Extrude** command, **Extrude** them **two** times towards the end of the tail fin **(Figure 1.51)**.

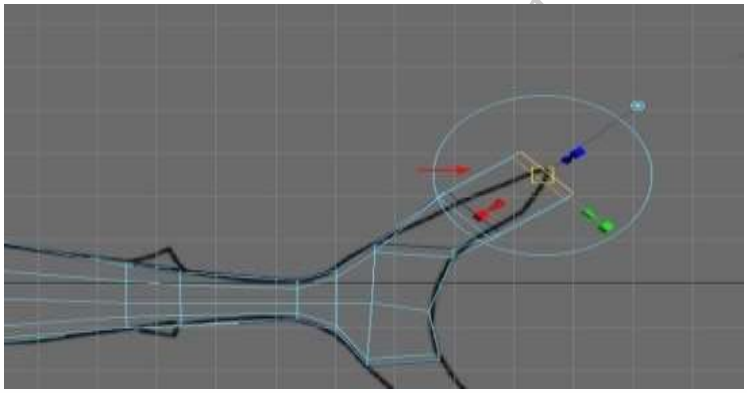


Figure 1.51: Extrude two times towards the end of the upper tail fin

Do the same with the lower tail faces also **(Figure 1.52)**.

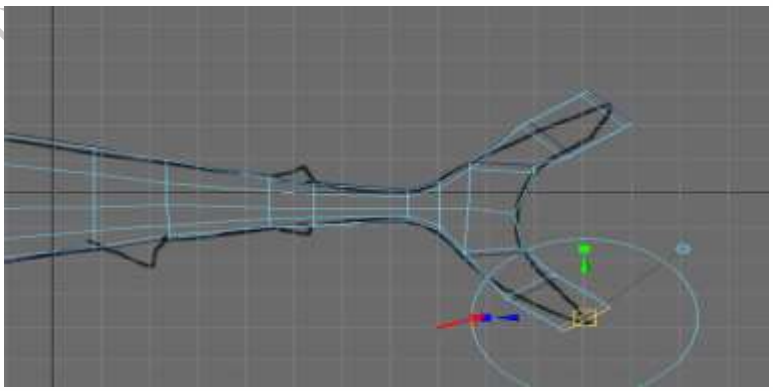


Figure 1.52: Extrude two times towards the end of the lower tail fin

Step 7

After extruding, press the **F9** key to enter front left side **Vertex** selection mode and arrange the tail fins according to the shape shown on the reference image **(Figure 1.53)**.

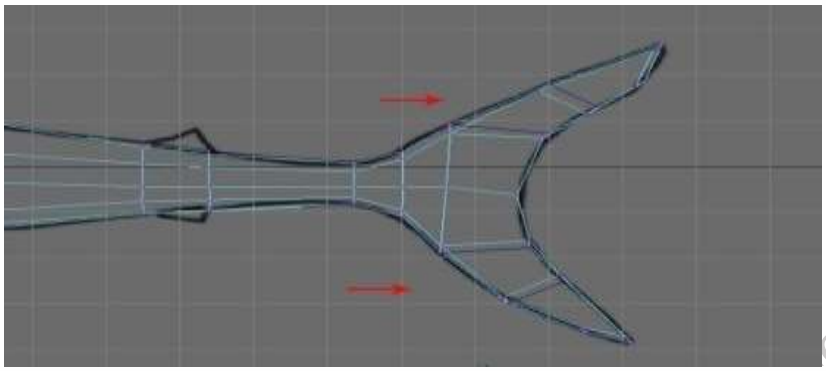


Figure 1.53: Click Front left side Vertex selection mode and arrangement of the tail fins

Step 8

Now go back to the Perspective view and focus on the back of the tail mesh. Here we need to fill the gap between the polygons, so first press **F10** for **Edge** selection mode and then select the **two** border edges, as shown in the image below **(Figure 1.54)**.

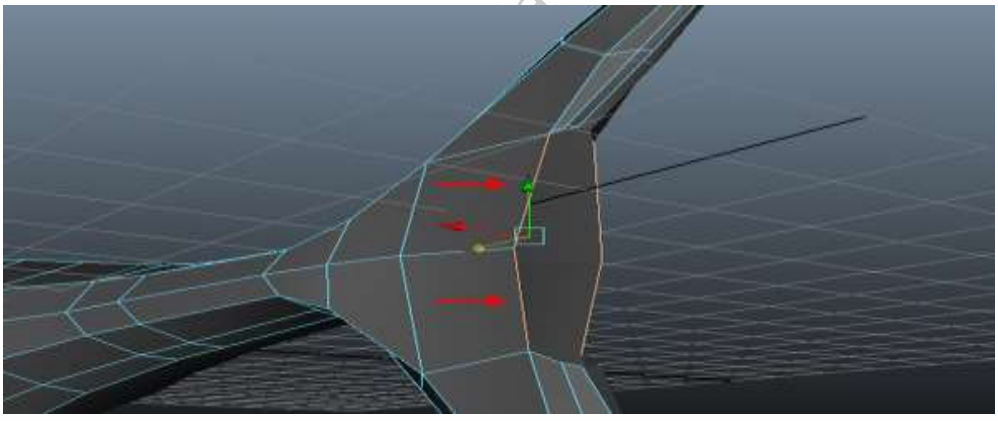


Figure 1.54: Focus on the back of the tail mesh

Step 9

With the edges selected, **Extrude** them **two** times while maintaining the edge loops. **(Figure 1.55)**.

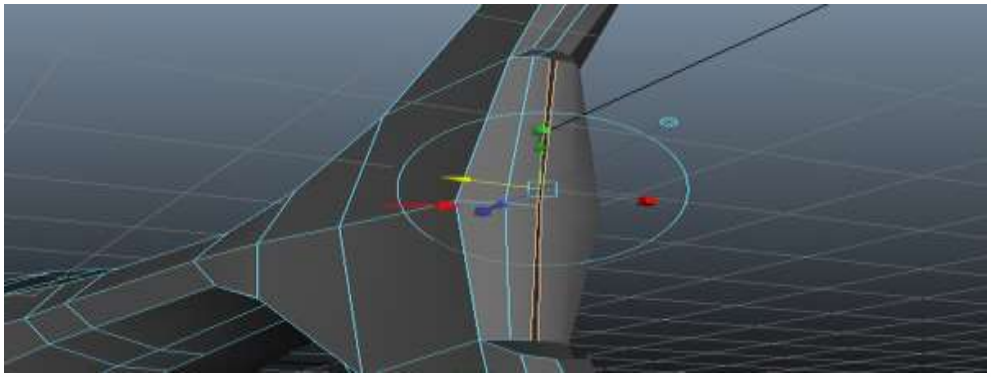


Figure 1.55: Extruded two times while maintaining the edge loops

Step 10

Now we need to weld the vertex. With *both* of the vertex selected, go to the **Edit Mesh** menu and choose the **Merge** command to weld the selected vertex together **(Figure 1.56)**.

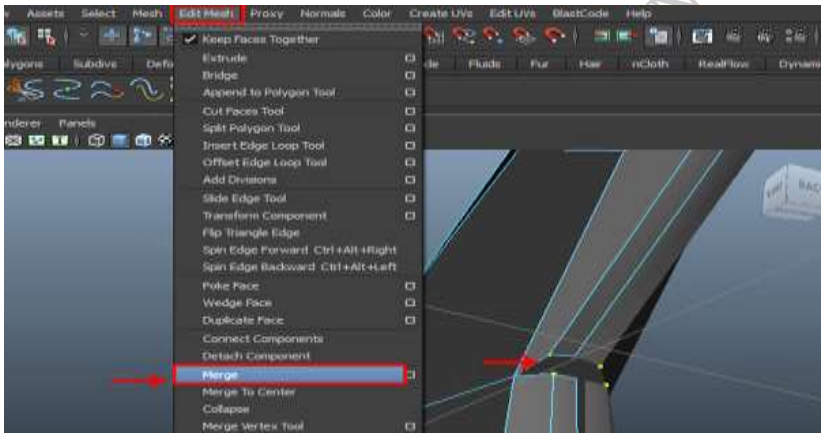


Figure 1.56: Use merge command to weld the selected vertex together

Step 11

Following the same process, weld the vertex of the lower tail also **(Figure 1.57)**.

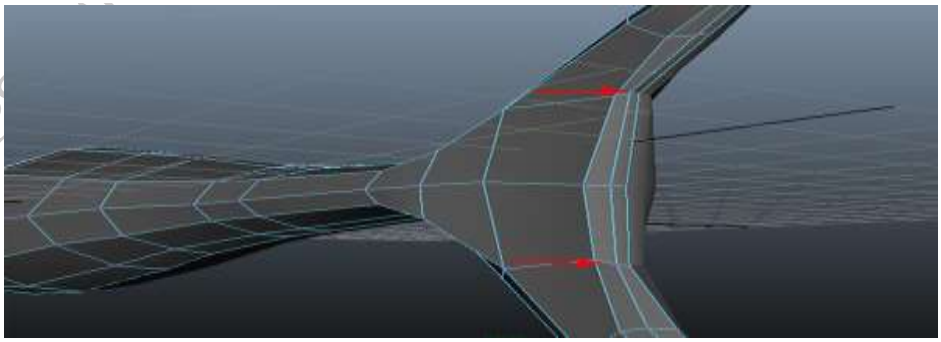


Figure 1.57: Use merge command to weld the vertex of lower tail

Creating the Fins

Step 1

We need some more faces to create the dorsal fins. With the **Insert Edge Loop Tool** selected, insert **three** edge loops around the fin areas as shown in the image below **(Figure 1.58)**.

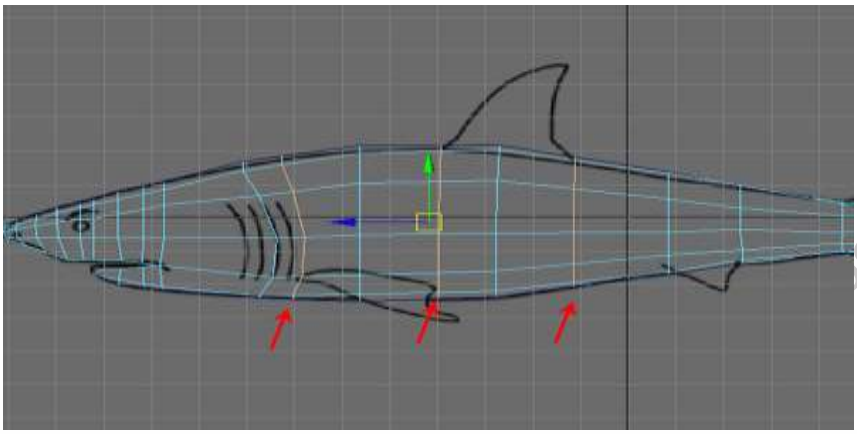


Figure 1.58: Inserting of three edge loops around the fin

Step 2

Now in the **Side** view, press **F11** to enter **Face** selection mode and select the top faces around the area of the dorsal fin **(Figure 1.59)**.

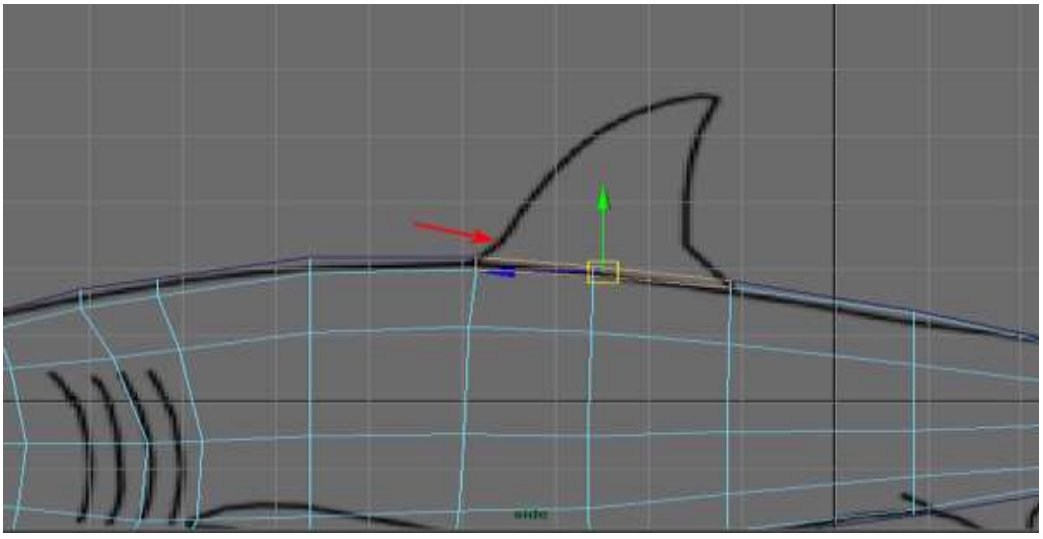


Figure 1.59: Select the top faces around the area of the dorsal fin.

Step 3

With the faces selected, **Extrude** them upward **two** times as shown **(Figure 1.60)**.

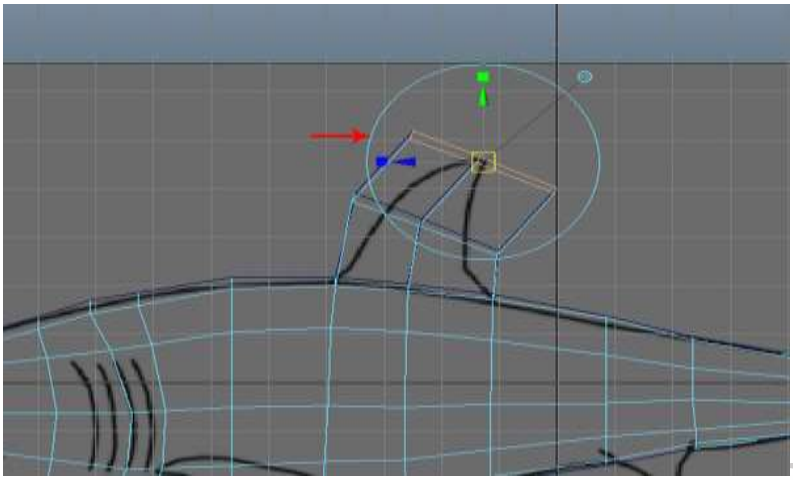


Figure 1.60: Extruded selected faces upward two times

Step 4

Again press **F9** to access **Vertex** selection mode, and then arrange the vertex according to the background image **(Figure 1.61)**.

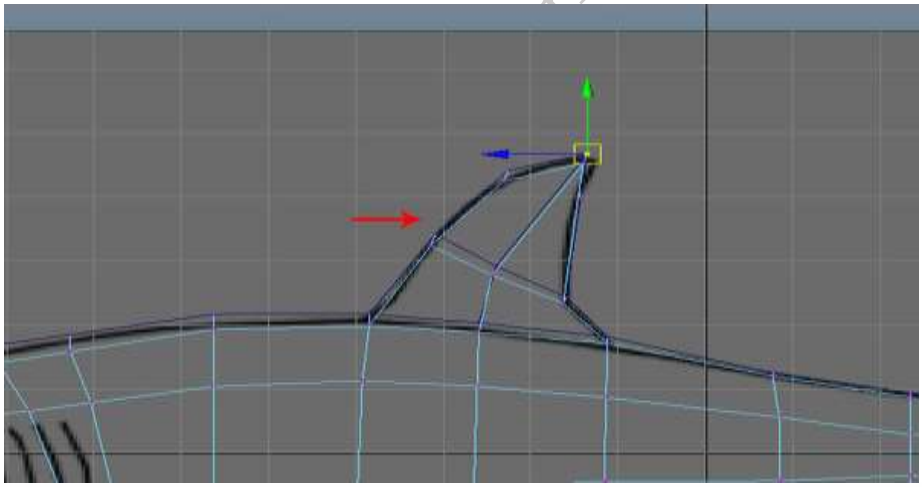


Figure 1.61: Vertex arrangement

Step 5

While in the **Perspective** view, select *half* of the shark model. Then go to the **Show** menu, and check on the **View Selected** check box inside the **Isolate Select** sub menu. This will isolate the selected half of the shark body **(Figure 1.62)**.

Step 6

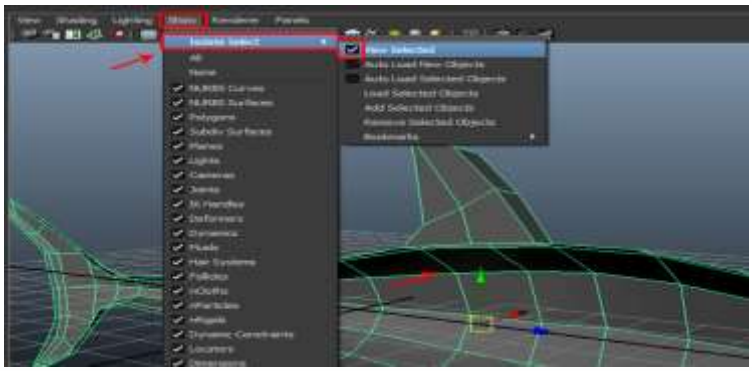


Figure 1.62: View selected check box inside the Isolate sub menu

This step is essential to remove unwanted faces hidden within the body structure. The dorsal fin faces are still present internally, which could lead to issues later on. To address this, press the **F11** key to enter Face selection mode, select the dorsal fin faces from the interior, and press the **Delete key** to remove them **(Figure 1.63)**.

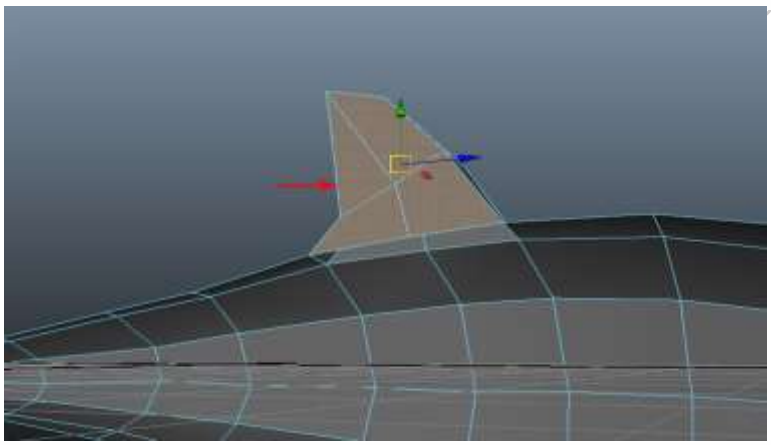


Figure 1.63: Process of deleting of unwanted faces hidden inside the body

Step 7

Now we will make the anal fins of the shark. Select the top and bottom faces around these fins according to the reference image **(Figure. 1.64)**.

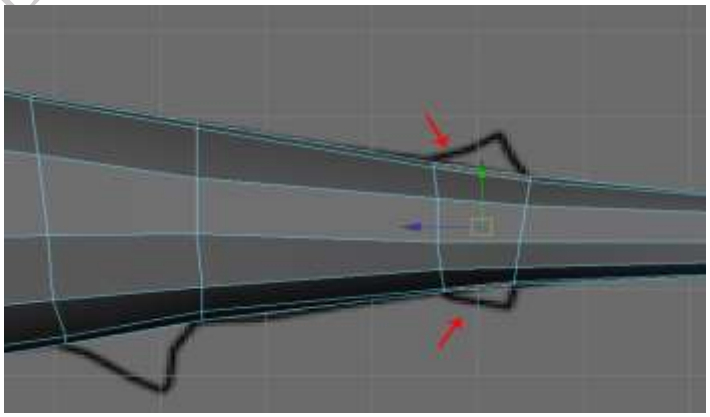


Figure 1.64: Making of anal fin of the shark

Step 8

With the faces selected, apply the **Extrude** command and then **Extrude** them once **(Figure. 1.65)**.

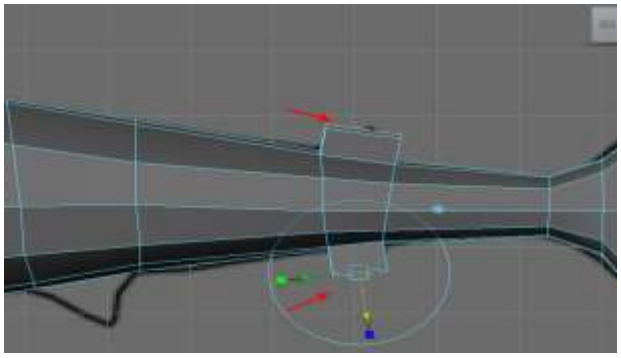


Figure 1.65: Extrude command applied on the selected faces

Step 9

Back in **Vertex** selection mode, arrange the vertex properly **(Figure 1.66)**.

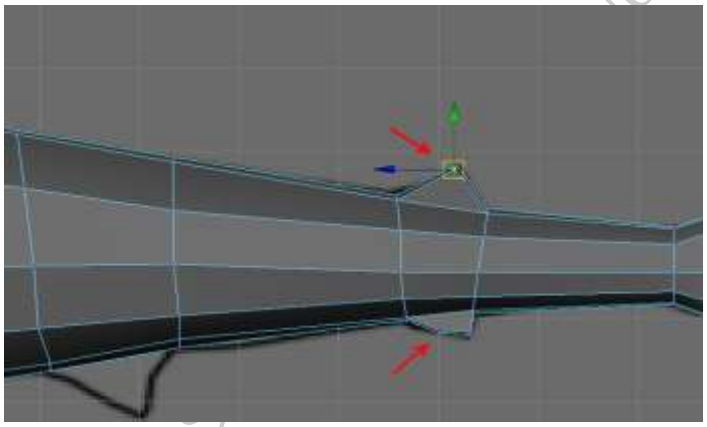


Figure 1.66: Arrangement of vertex in the vertex selection mode

Step 10

Back in the **Perspective** view. Select the *inside* faces of the anal fins and then **Delete** them, as we did previously with the dorsal fin **(Figure. 1.67)**.

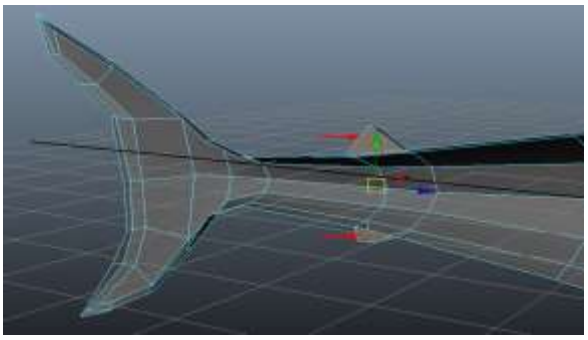


Figure 1.67: Selection of inside faces of the anal fins

Step 11

After that, bring the vertex closer to each other and make the required adjustments **(Figure 1.68)**.

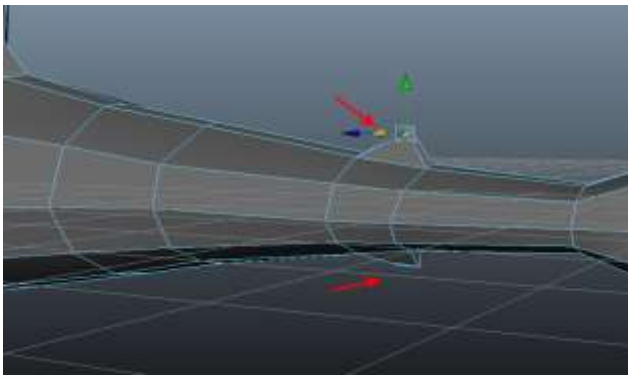


Figure 1.68: Adjustments of vertex closer to each other

Step 12

Now we will make the pelvic fin of the shark. Select the bottom face around the pelvic fin area according to the reference image **(Figure 1.69)**.

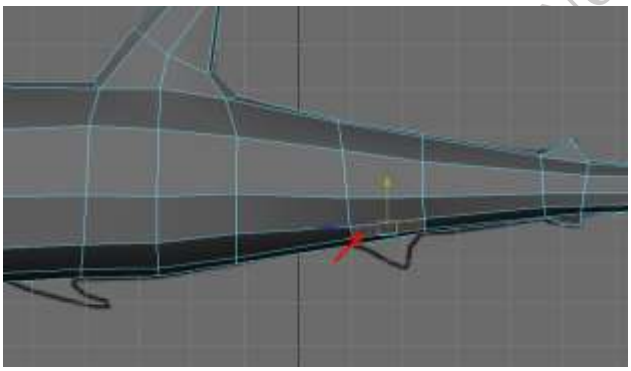


Figure 1.69: Pelvic fin of the shark

Step 13

And **Extrude** the selected face **once (Figure 1.70)**.

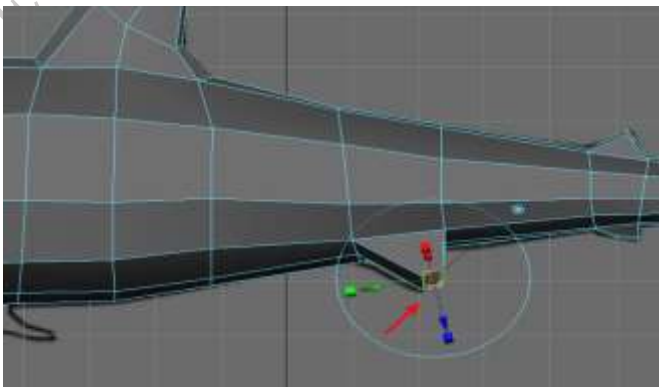


Figure 1.70: Extrude the selected face

Head back to the **Perspective** view, and properly arrange the vertex of the pelvic fin **(Figure 1.71)**.

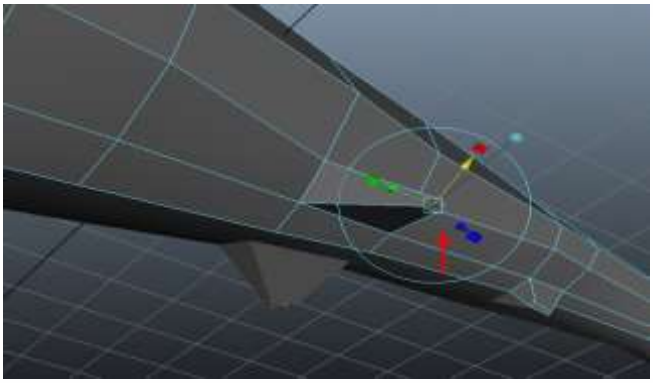


Figure 1.71: Process of arrangement of vertex of the pelvic fin.

Also, jump into the **Top** view, and then try to maintain the shape according to the *top* reference image **(Figure 1.72)**.

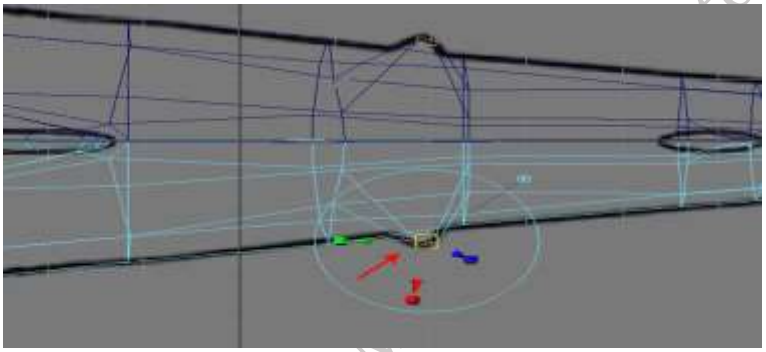


Figure 1.72: Adjustment of the shape according to top reference image.

Step 14

Now we will make the pectoral fins of the shark. Select the two bottom faces around the pectoral fin area following their placement on the reference image **(Figure 1.73)**.

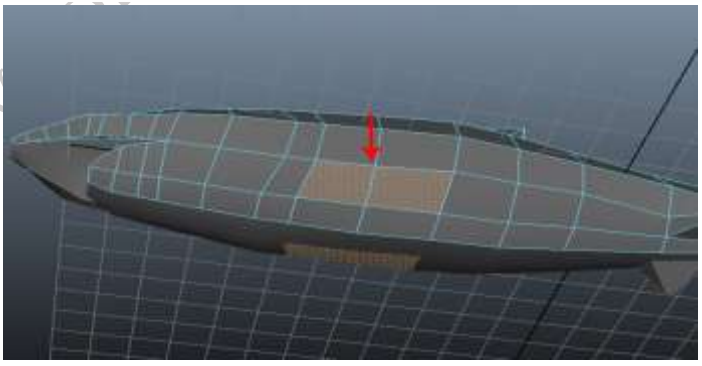


Figure 1.73: Making of Pectoral fin of the shark

Step 15

With the faces selected, go to **Edit Mesh** and select the **Extrude** tool **(Figure 1.74)**.

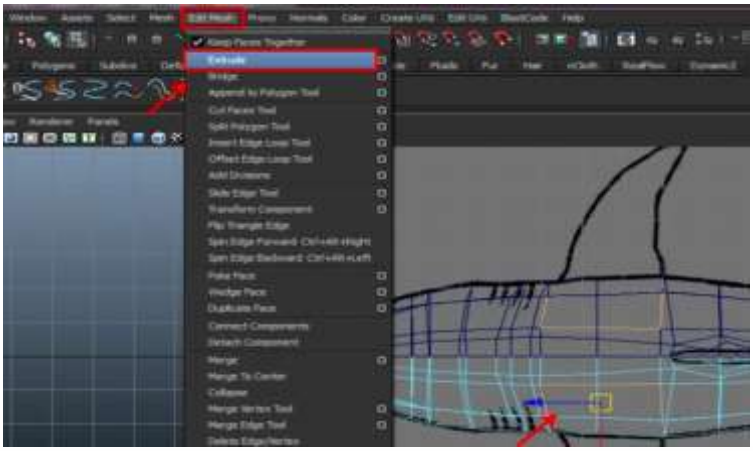


Figure 1.74: Selection of the Extrude tool

Step 16

In the **Top** view, **Extrude** the faces **two** times as shown **(Figure 1.75)**.

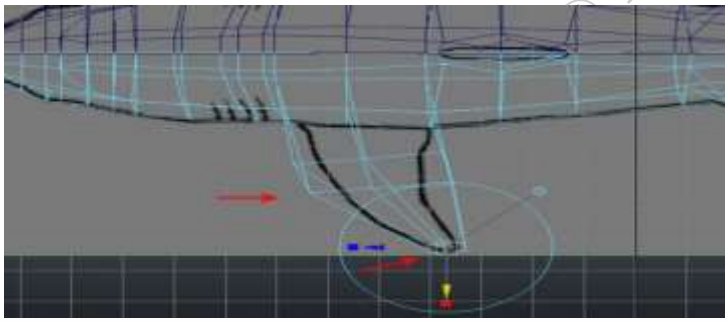


Figure 1.75: Extrude the faces two times in the top view

Step 17

Also try to arrange the vertex according to the reference image **(Figure 1.76)**.

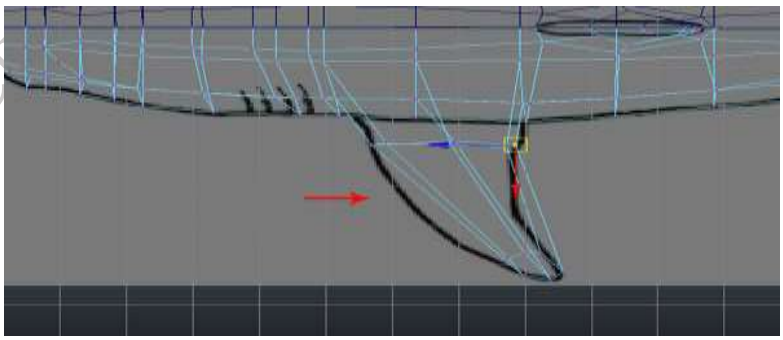


Figure 1.76: Arrangement of the vertex according to the reference image

Step 18

To make the fin curved, we need to add several edge loops. Again go to the Edit Mesh menu, and then select the Insert Edge Loop Tool **(Figure 1.77)**.

Step 18

To make the fin curved, we need to add several edge loops. Again go to the **Edit Mesh** menu, and then select the **Insert Edge Loop Tool (Figure 1.77)**.

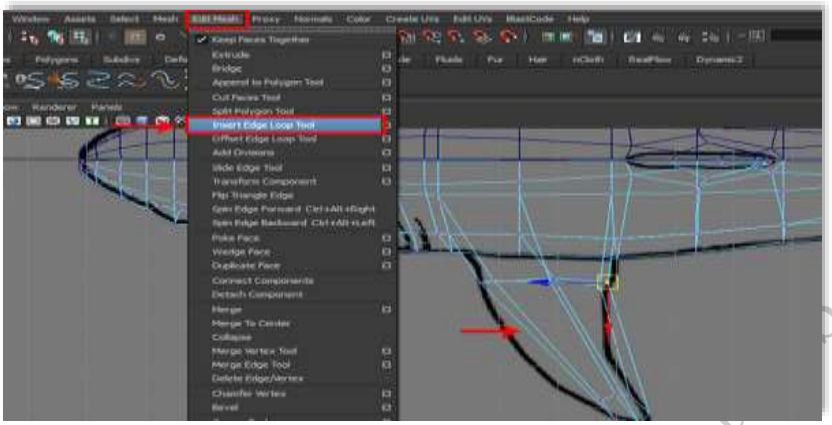


Figure 1.77: Making of fin curved

Step 19

Here we have inserted **one** edge loop, and then arranged the vertex according to reference image **(Figure 1.78)**.

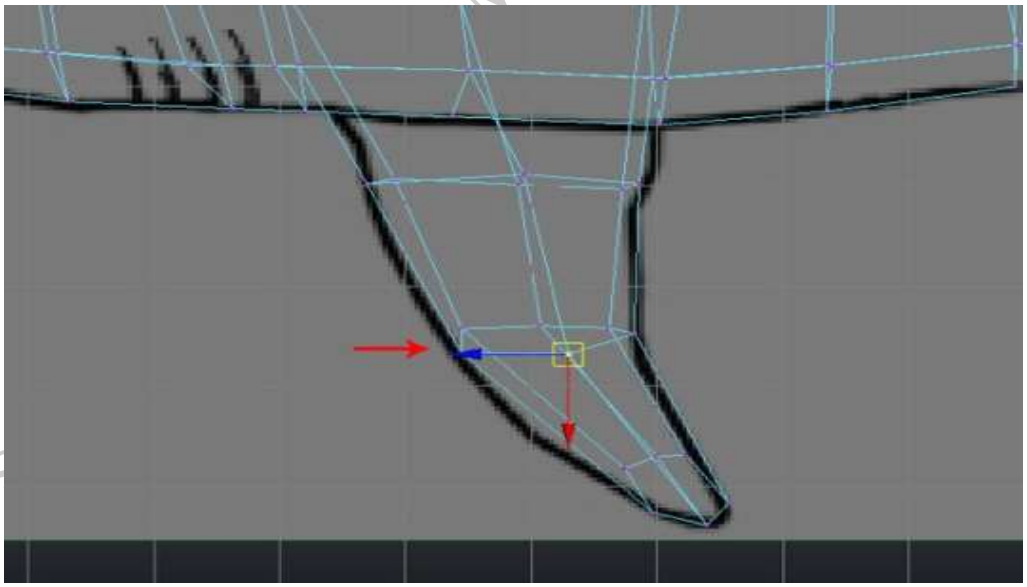


Figure 1.78: Arrangement of the vertex according to reference image

Step 20

Next, jump in the **Front** view and then try to match the fin's outline to the reference image **(Figure 1.79)**.

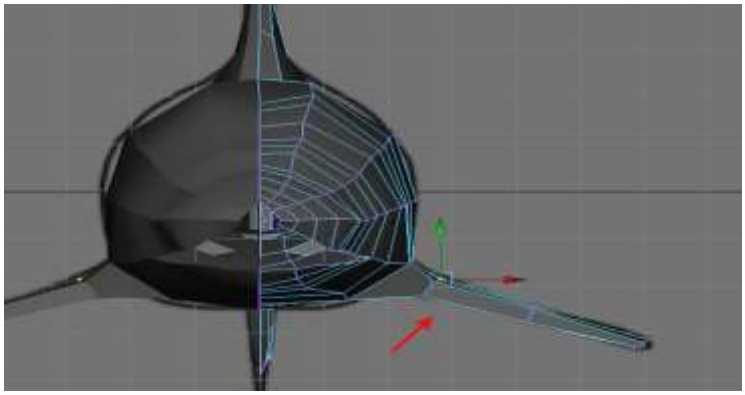


Figure 1.79: Matching the fin's outline

Creating the Nose and Mouth
Step 1

Now we'll work on the tip of the nose. Select the edge of the nostril and then **Extrude** it once, as shown in the image **(Figure 1.80)**.

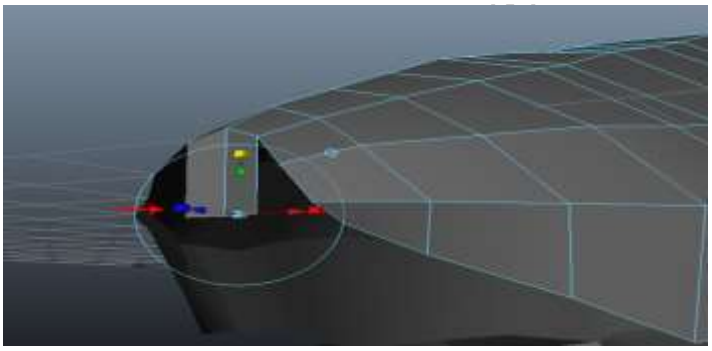


Figure 1.80: Extrude the edge of the nostril

Step 2

With the help of the **Insert Edge Loop Tool**, insert **one** edge between the extruded faces as shown **(Figure 1.81)**.

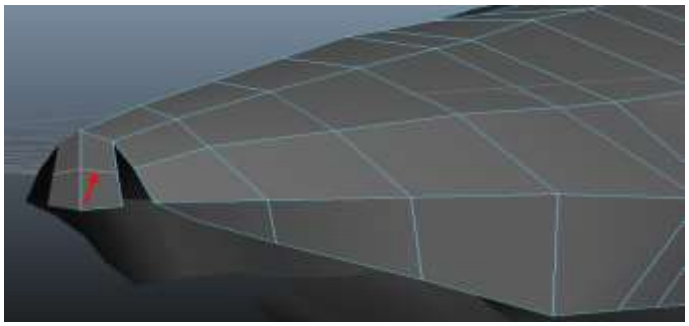


Figure 1.81: Inserting one edge between the extruded

Step 3

Now select the two corresponding vertex and go to the **Edit Mesh** menu, and choose **Merge (Figure 1.82)**.

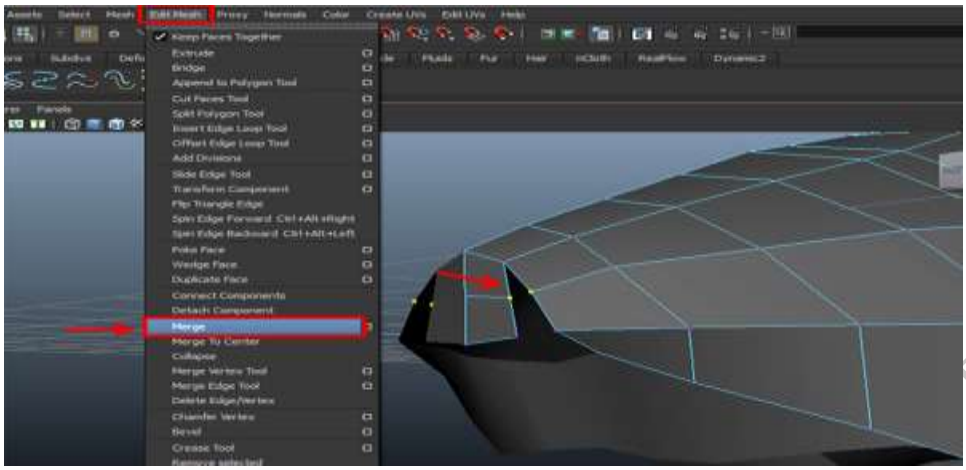


Figure 1.82: Merging of two corresponding vertex

Step 4

Using this method, complete the merging operation on the remaining pair of vertex. Now select the **eight** boarder edges **(Figure 1.83)**.

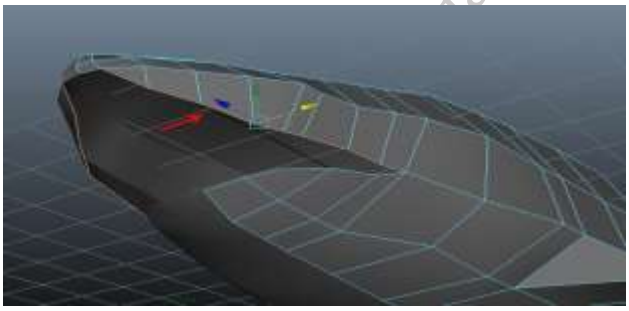


Figure 1.83: Merging operation of the remaining pair of vertex

Step 5

With the edges selected, **Extrude** them once towards the inside to fill the gap **(Figure 1.84)**.

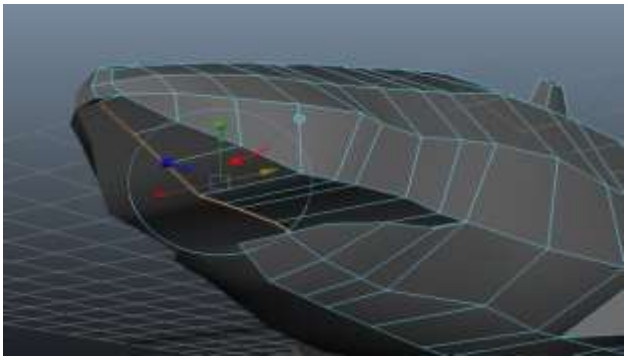


Figure 1.84: Filling gap between eight border edges

Step 6

We'll do the same thing for the lower jaw. Select the **three** edges of the lower jaw, as shown in the image **(Figure 1.85)**.

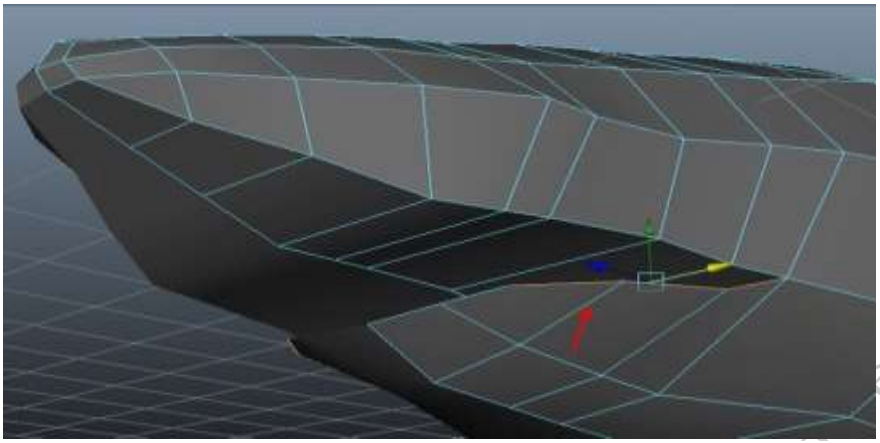


Figure 1.85: Filling gap between three edges of the lower jaw

Step 7

With the lower jaw edges selected, **Extrude** these inside the same as we did with the upper jaw's edges **(Figure 1.86)**.

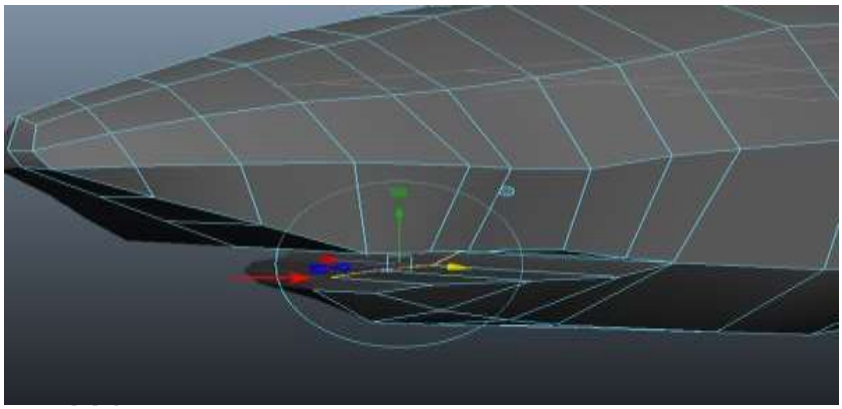


Figure 1.86: Filling gap between eight border edges

Step 8

Now let us isolate half of the shark's body. So with exactly half of the shark's body selected, go to the **Show** menu (in the menu bar), and then check on the **View Selected** check box, from inside the **Isolate Select** submenu **(Figure 1.87)**.

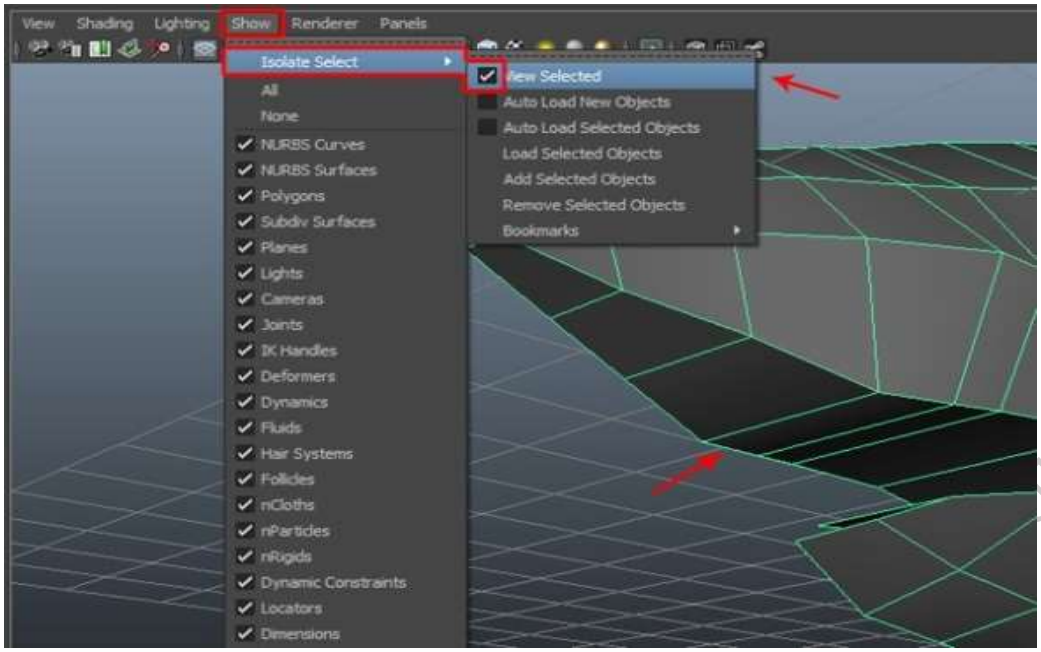


Figure 1.87: Isolating half of the shark's body

Step 9

Now go to the **Edit Mesh** menu and select the **Append to Polygon Tool (Figure 1.88)**.

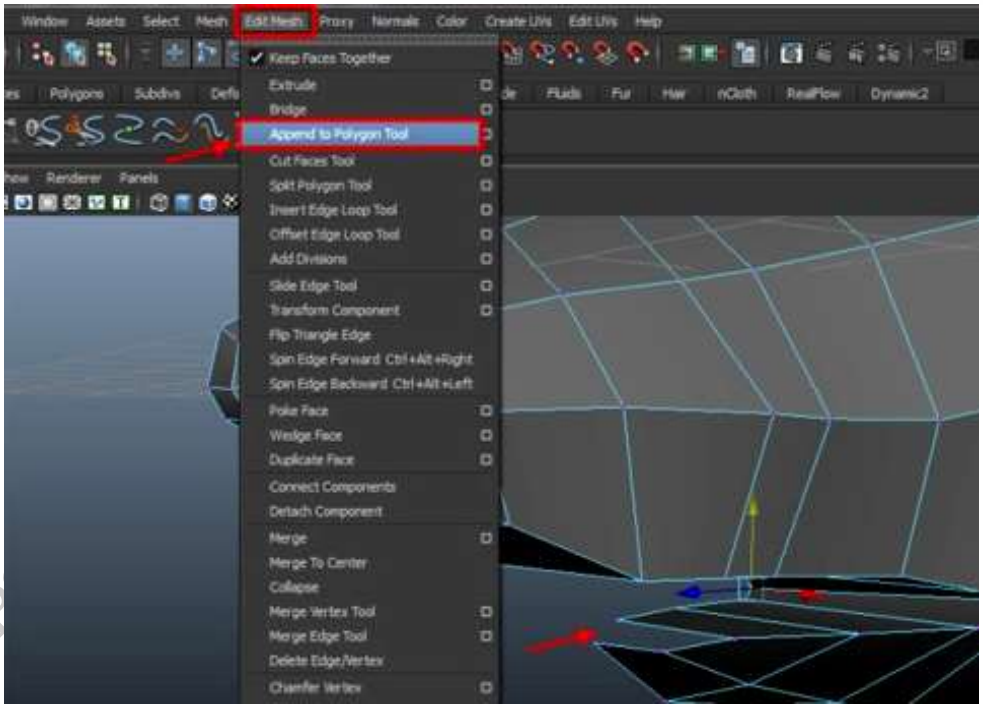


Figure 1.88: Append to polygon tool selected

With the **Append to Polygon Tool** selected, click on the parallel border edges to create a face to fill the gap. Then press **Enter** to apply and finish with the **Append to Polygon Tool (Figure 1.89)**.

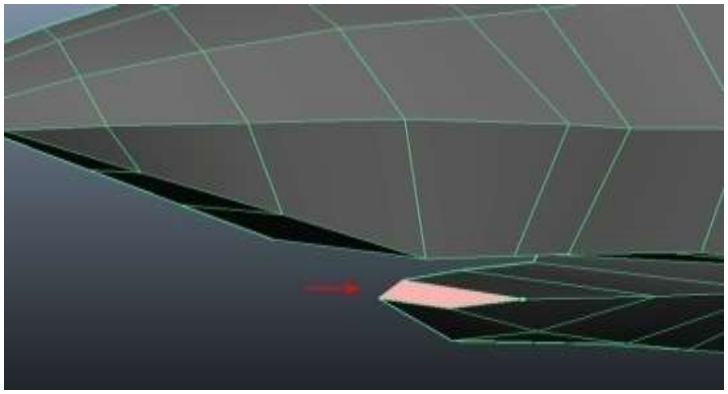


Figure 1.89: Creating face to fill the gap

Step 10

Now we need to split some faces to add more detail. Go to the **Edit Mesh** menu and select the **Split Polygon Tool (Figure 1.90)**.

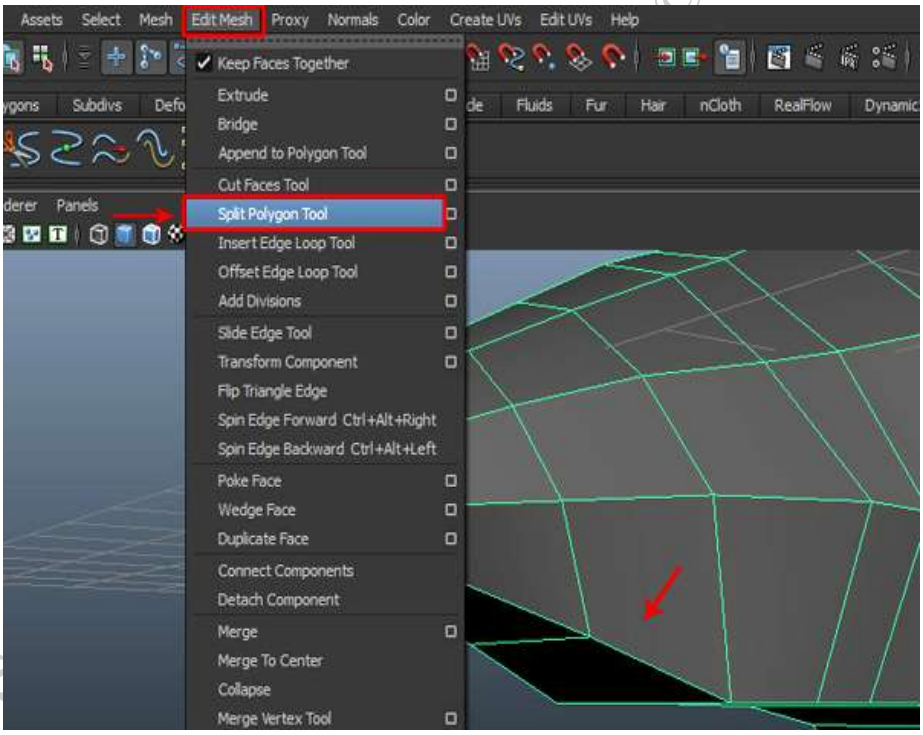


Figure 1.90: Splitting the faces of image

Step 11

With the **Split Polygon Tool** selected, split the mouth border faces as shown in the image below **(Figure 1.91)**.

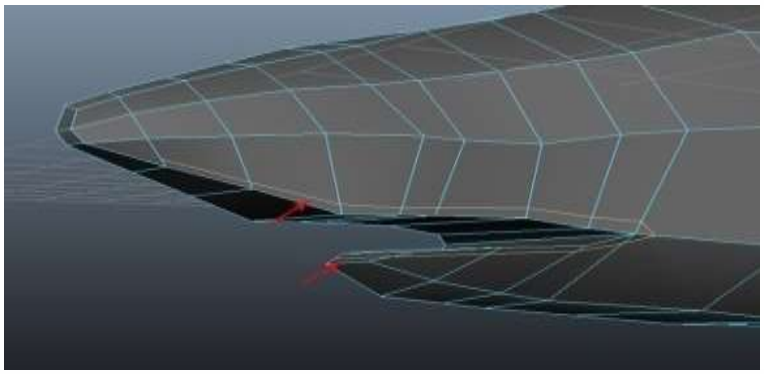


Figure 1.91: SplitIing the mouth border faces

Also split the corner faces, to eliminate the triangulated faces **(Figure 1.92)**.

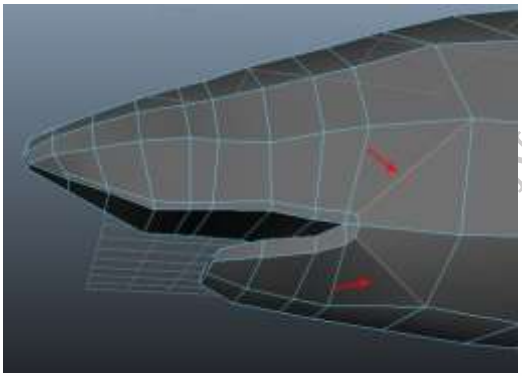


Figure 1.92: SplitIing the corner faces

Step 12

Now, select the faces inside the mouth **(Figure 1.93)**.

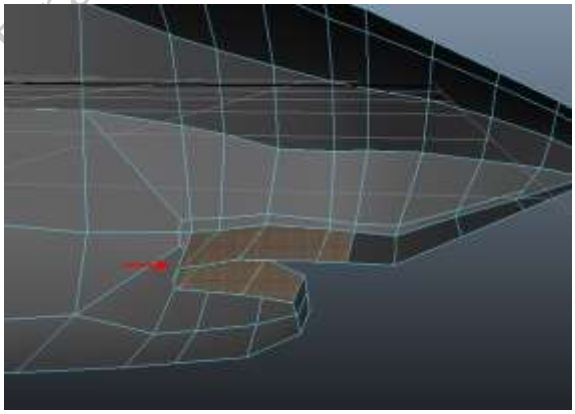


Figure 1.93: Face inside mouth selected

Step 13

With the inner mouth polygons selected, **Extrude** them once, as shown in the image **(Figure 1.94)**.

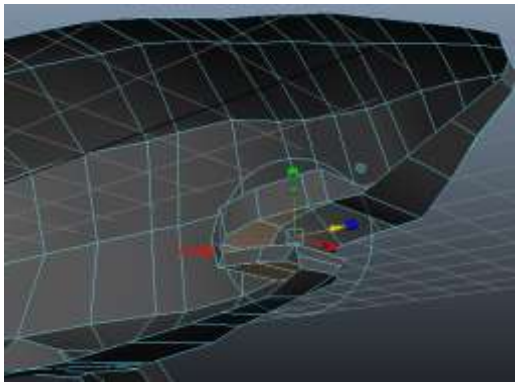


Figure 1.94: Polygons extruded

Step 14

After extruding the faces, select the unneeded border faces (as shown in the image.) and **Delete** them **(Figure 1.95)**.

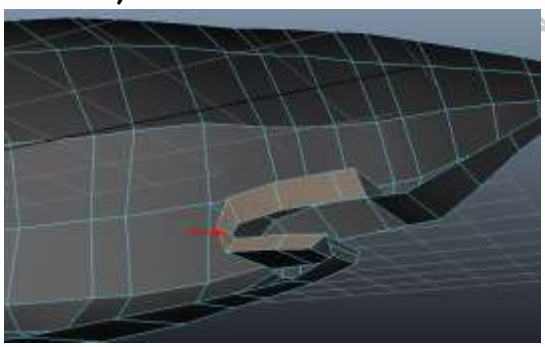
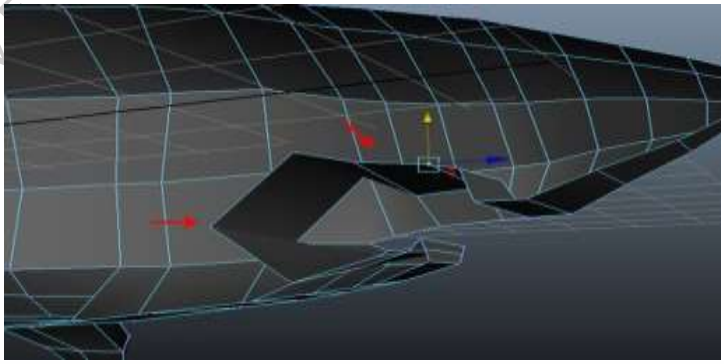


Figure 1.95: Unneeded borders

Step 15

After deleting the faces, press **F9** for **Vertex** selection mode and then arrange the vertex to form a gap inside the mouth **(Figure 1.96)**.



Step 16

Also insert an extra edge loop with the **Insert Edge Loop Tool**, as shown in the image **(Figure 1.97)**.

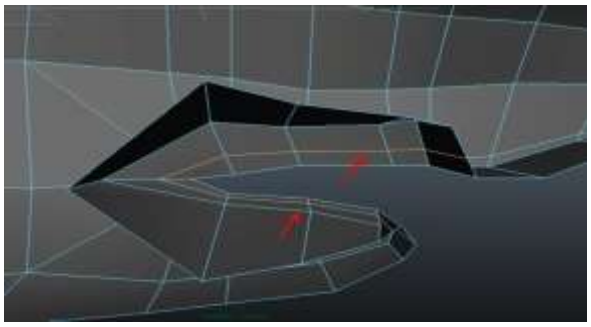


Figure 1.97: An extra edge loop inserted

Step 17

We have now completed the blocking of the shark mesh. Now we can convert it into **Sub div** mode to add more details, or we can convert it later after completing the modelling of the eyes and nostrils **(Figure 1.98)**.

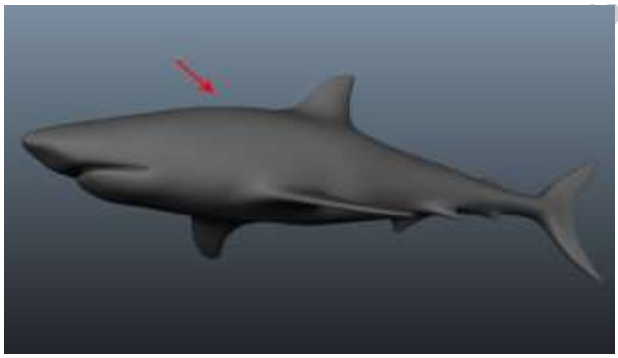


Figure 1.98: Blocking of the shark mesh

Refining the Head

Step 1

In this case, we will complete the eye and nose parts first, and then convert it to subdivision later, to add extra detail with sculpting. Select the **two** faces around the eye area, and then **Extrude** them inwards to make the eye socket **(Figure 1.99)**.

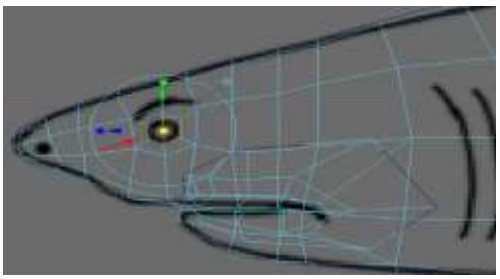


Figure 1.99: Completing the eye and nose parts

Step 2

Also add an edge loop to make the nose hole, as shown in the image **(Figure 1.100**) below.

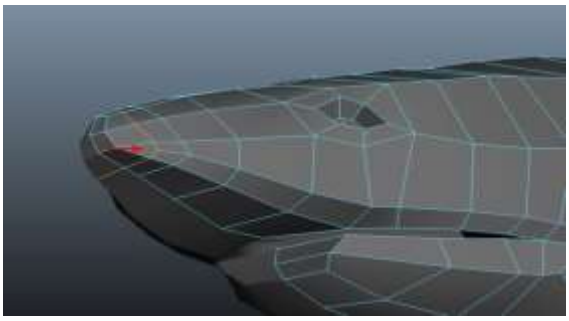


Figure 1.100: Making of nose hole while adding an edge loop

Step 3

Will do the same thing for the nostrils as well.

Step 4

Select the **two** faces around the nostril area, and **Extrude** them inwards to make a hole **(Figure 1.101)**.

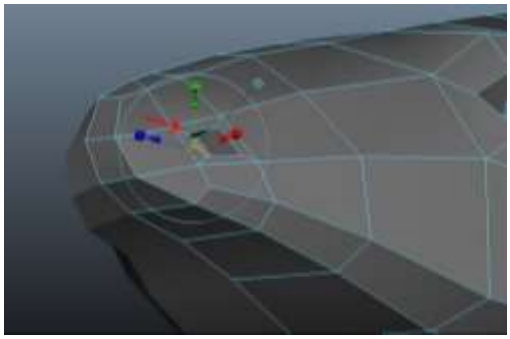


Figure 1.101: Making of hole

Adding the Gills

Step 1 Now will make the gill slits for the shark. With the help of the **Insert Edge Loop Tool**, insert **three** edge loops around the gill area, according to the reference image **(Figure 1.102)**.

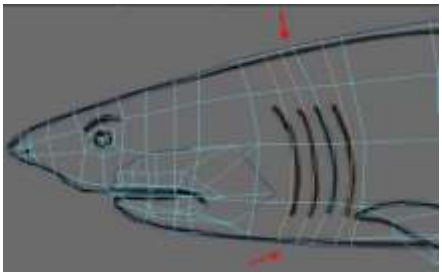


Figure 1.102: Making the gill slits for the shark

Step 2

Using the **Split Polygon Tool**, split each gill slit edge to add more detail **(Figure 1.103)**.

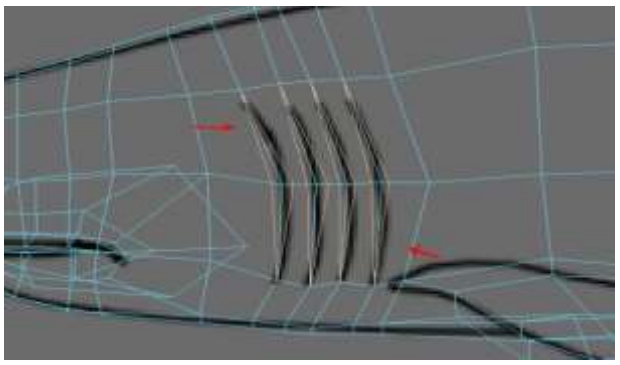


Figure 1.103: Spliting each gill slit edge

Step 3

Now press **F11** for **Face** selection mode, and with *all* the split faces selected, **Extrude** them inside to create a cavity **(Figure 1.104)**.

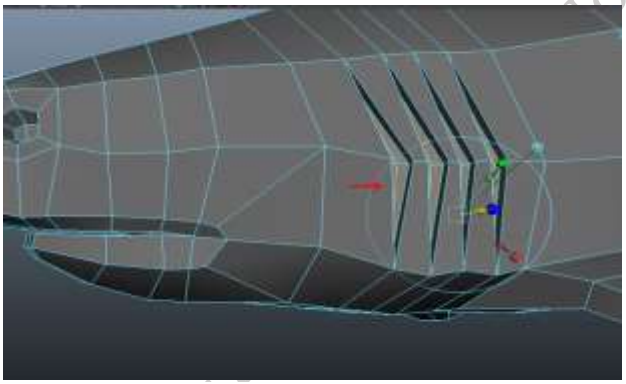


Figure 1.104: Creating cavity

Step 4

We have now completed the base model of the shark. But we still need to add more detail to it **(Figure 1.105)**.

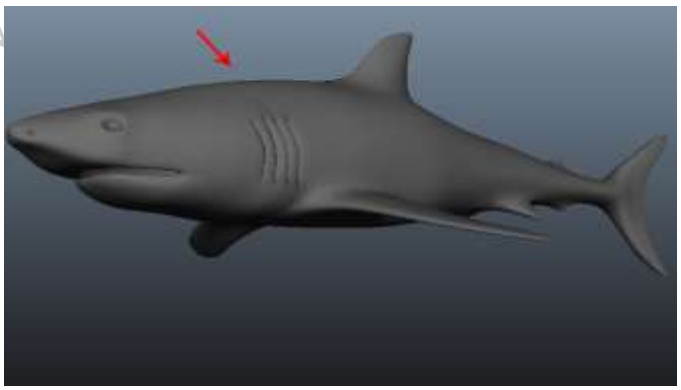


Figure 1.105: Base model of the shark

Combining Meshes

Step 1

Now will use subdivision conversion to do sculpting and detailed modelling. First select both side meshes, and then go to the **Mesh** menu and choose **Combine**, to attach the selected polygon meshes together **(Figure 1.106)**.

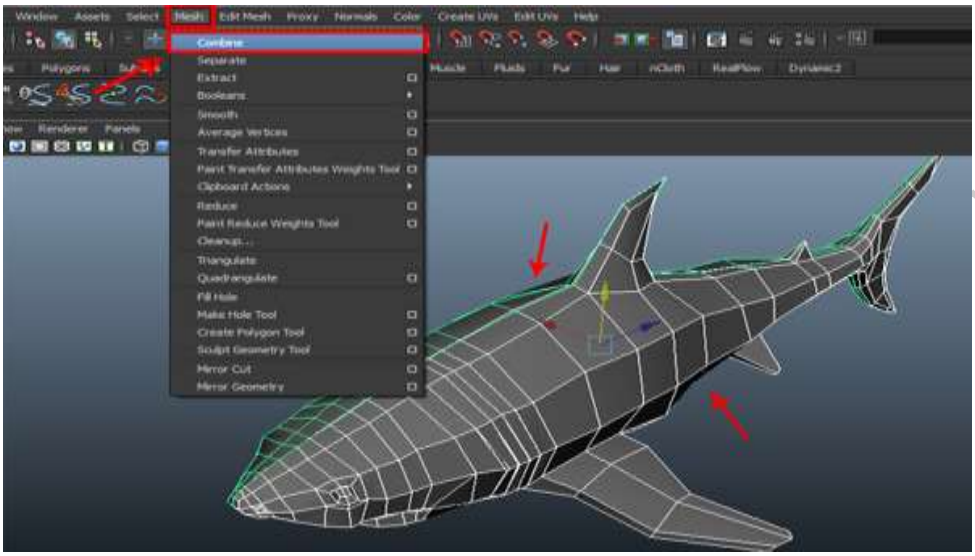


Figure 1.106: Subdivision conversion

Step 2

Now select a pair of border vertex along the centre, and then go to the **Edit Mesh** menu and select **Merge,** to weld the selected vertex **(Figure 1.107)**.

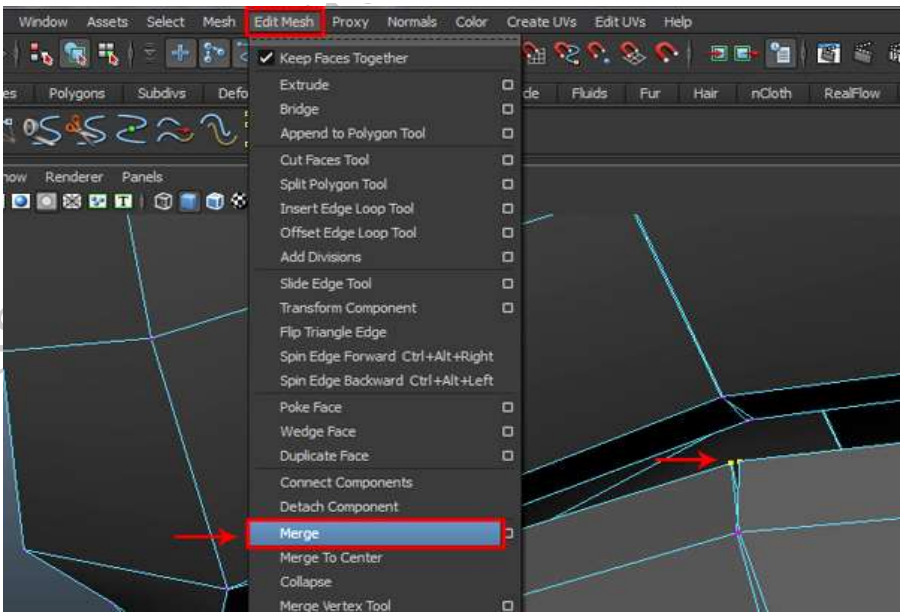


Figure 1.107 Welding the selected vertex

Step 3

In this way, select and **Merge** all the centre border vertex one by one **(Figure 1.108)**.

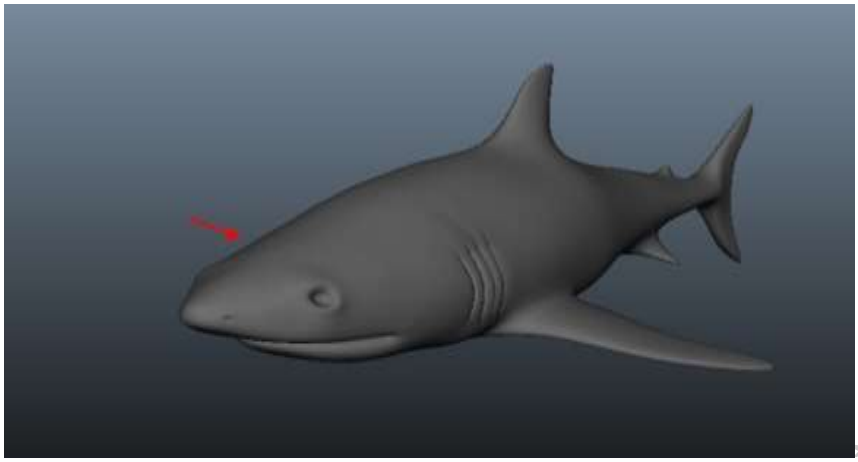


Figure 1.108: Merging all the centre border

Initial UVs

Step 1

Before converting from polygon to a subdivision surface, we need to apply UV Mapping for texturing. With half of the shark body mesh selected, go to the **Create UVs** menu, and click on the Planar Mapping options box **(Figure 1.109)**.

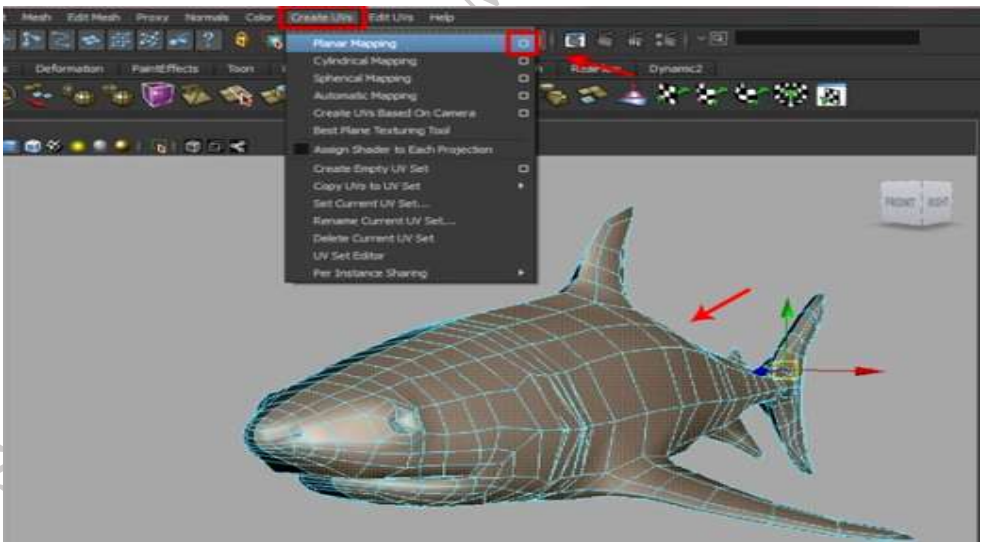


Figure 1.109: Applying UV Mapping for texturing

In the **Planar Mapping Options** box, turn on the **Fit projection: Best Plane** radio button, as shown in the image below **(Figure 1.110)**.

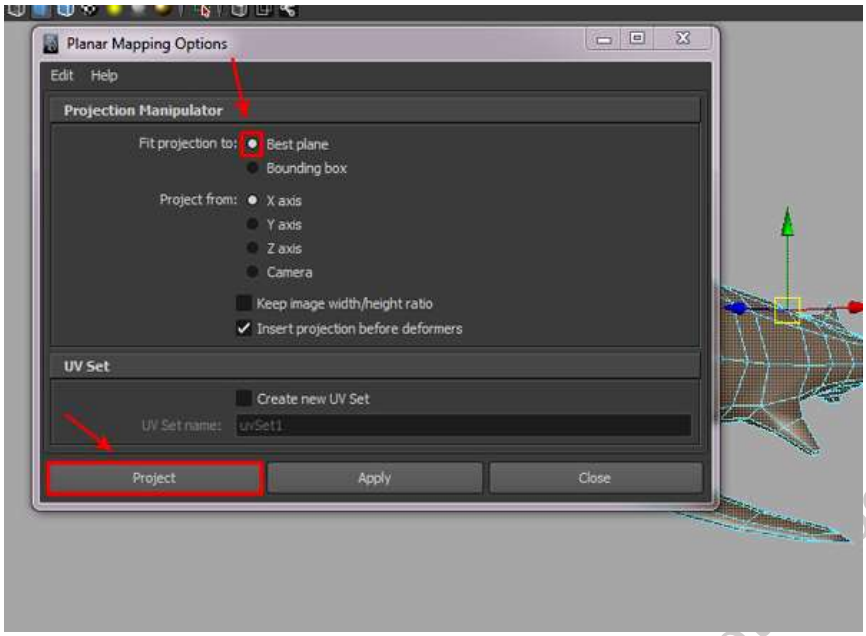


Figure 1.110: Turning on the fit projection

Step 2

After applying a Planar Map, go to the **Edit UVs** menu and select **UV Texture Editor** to see the UV Map **(Figure 1.111)**.

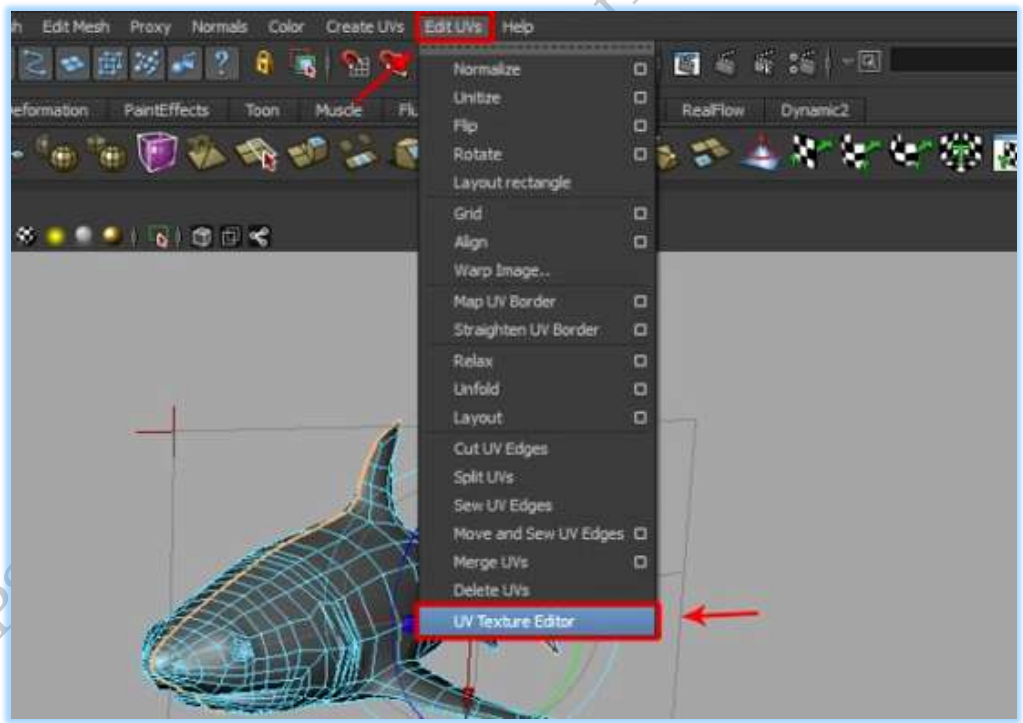


Figure 1.111: Applying a planar Map

You can see the result of the applied Planar Map from a side view of the shark body mesh **(Figure 1.112)**.

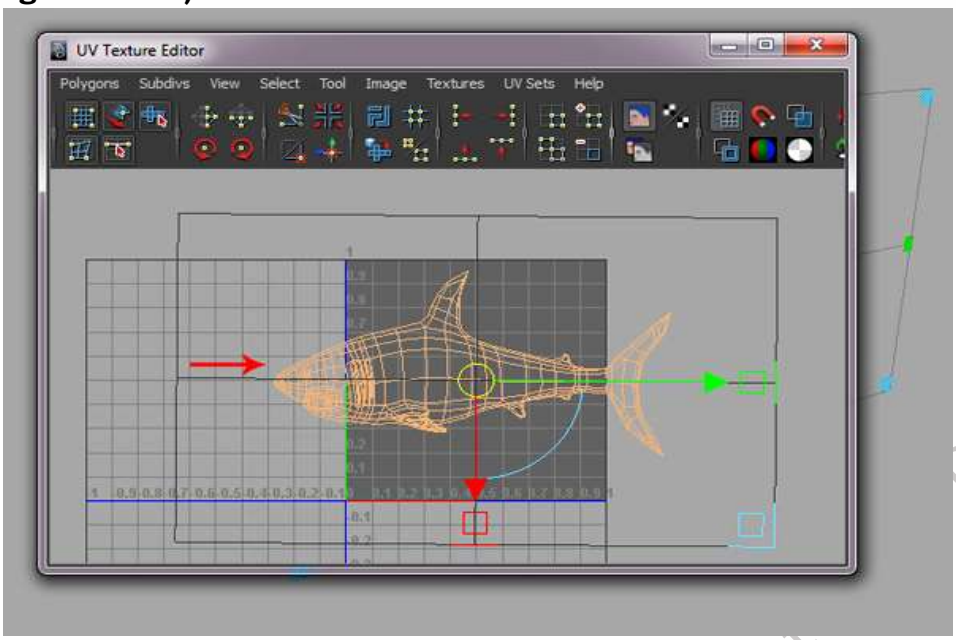


Figure 1.112: Result of the applied Planar Map

Step 3

To apply the Planar Map to the other side, first select the half with the applied Planar Map, and then go to the **Edit** menu and select **Invert Selection (Figure 1.113)**.

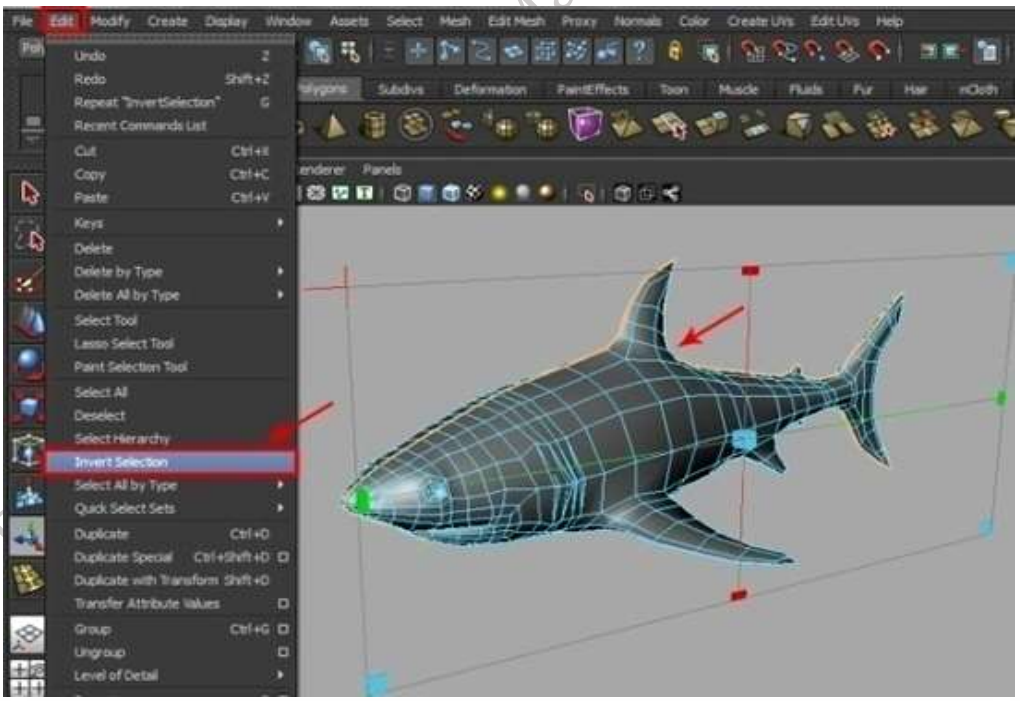


Figure 1.113: Applying the Planar Map to the other side

With the other side's faces selected, go to **Create UVs** and select **Planar Mapping (Figure 1.114)**.

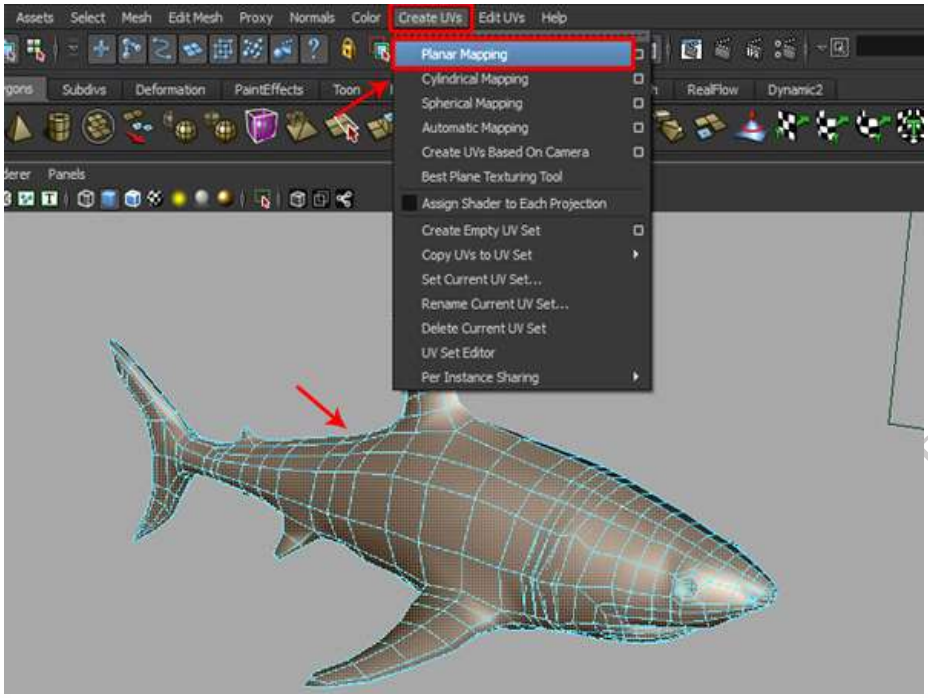


Figure 1.114: Selecting Planar Mapping

You can see the result in the **UVs Texture Editor** window **(Figure 1.115)**. We will edit it later.

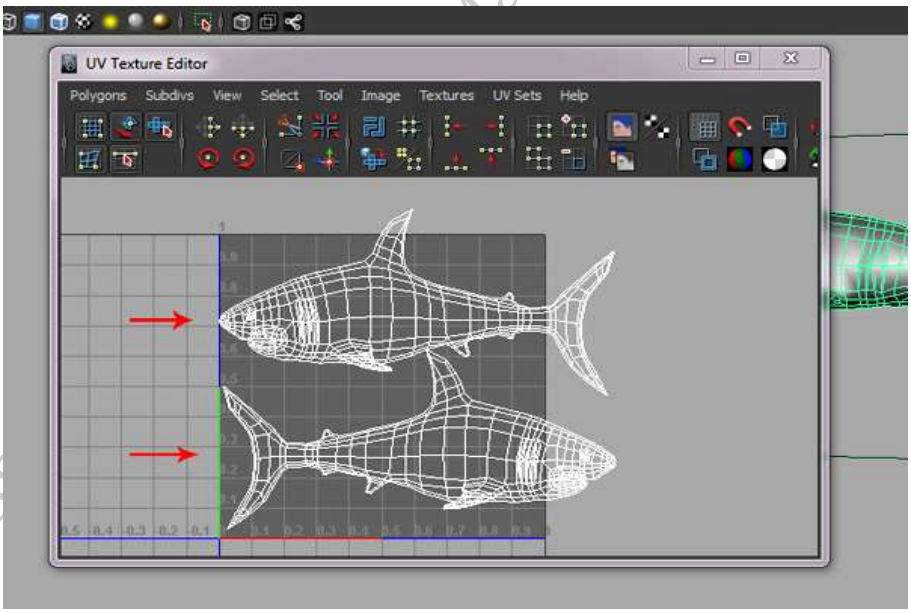


Figure 1.115: Result in the UVs Texture editor window

Mesh Clean-up

Step 1

Now with the shark body mesh selected, go to the **Edit** menu and select **History**, from inside the **Delete by Type** submenu to delete the history **(Figure 1.116)**.

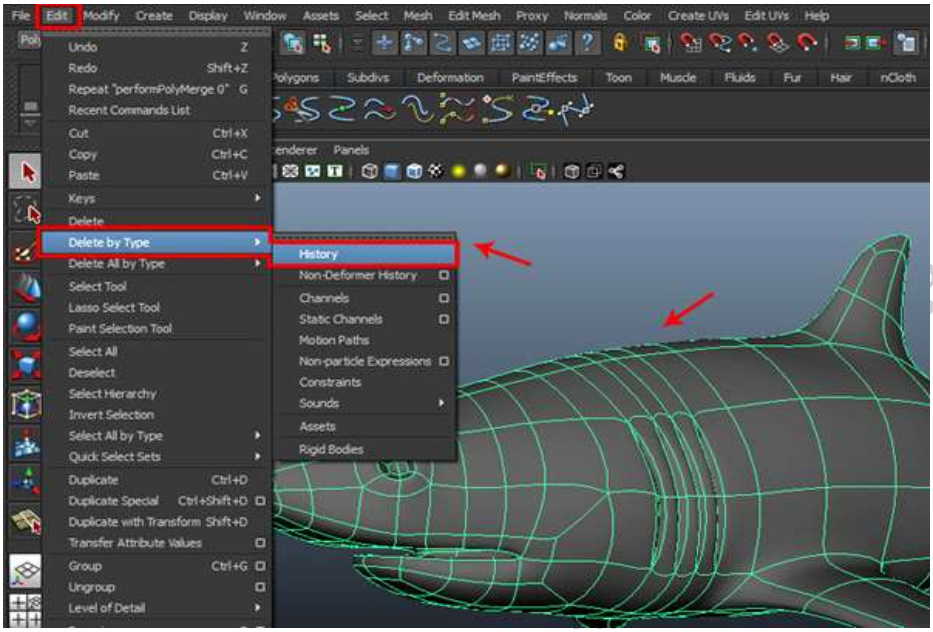


Figure 1.116: Selecting shark body mesh and Deleting history

Step 2

Now go to the **Mesh** menu and select **Clean-up (Figure 1.117)**.

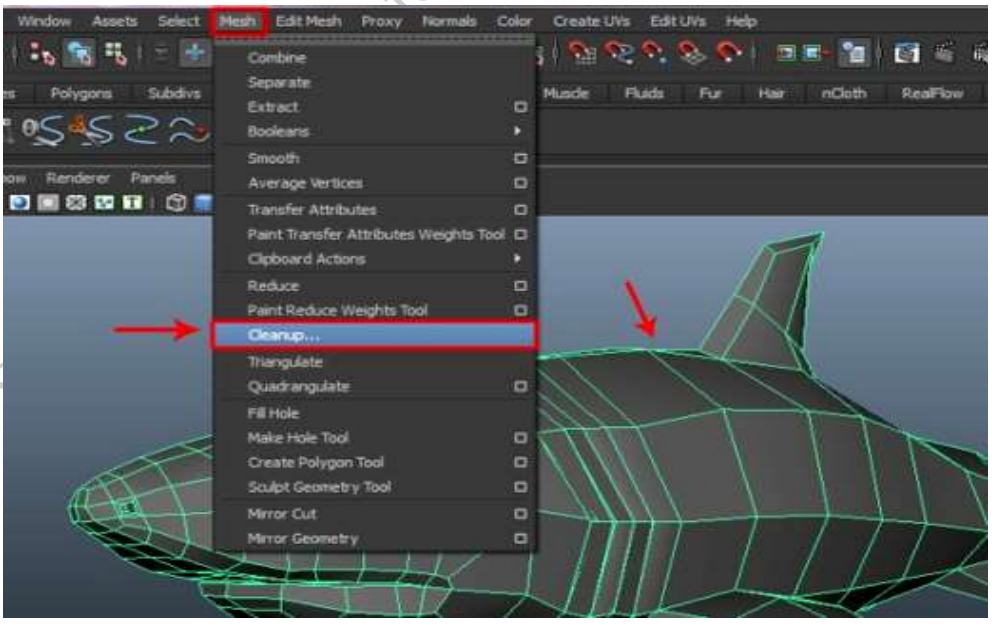


Figure 1.117: Selecting clean-up option

Step 3

In the **Clean-up Options** window, check on the **No manifold geometry** option and then click on the **Clean-up** button, to clean up the selected polygon mesh **(Figure 1.118)**.

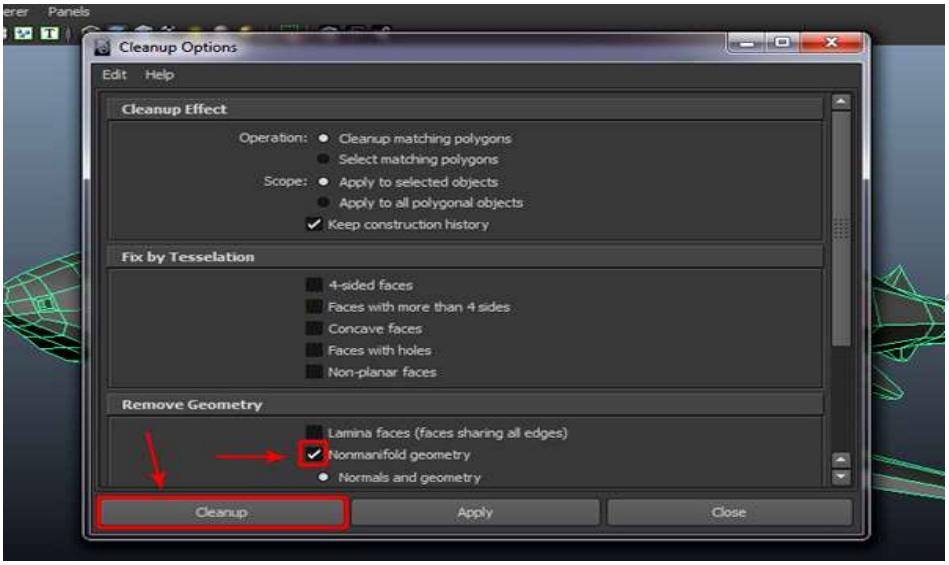


Figure 1.118: Clean up the selected polygon mesh

Converting to Subdivision

Step 1

After this, select the shark mesh and go to the **Modify** menu and click on the **Polygon to Subdiv** option box, from inside the **Convert** submenu **(Figure 1.119)**.

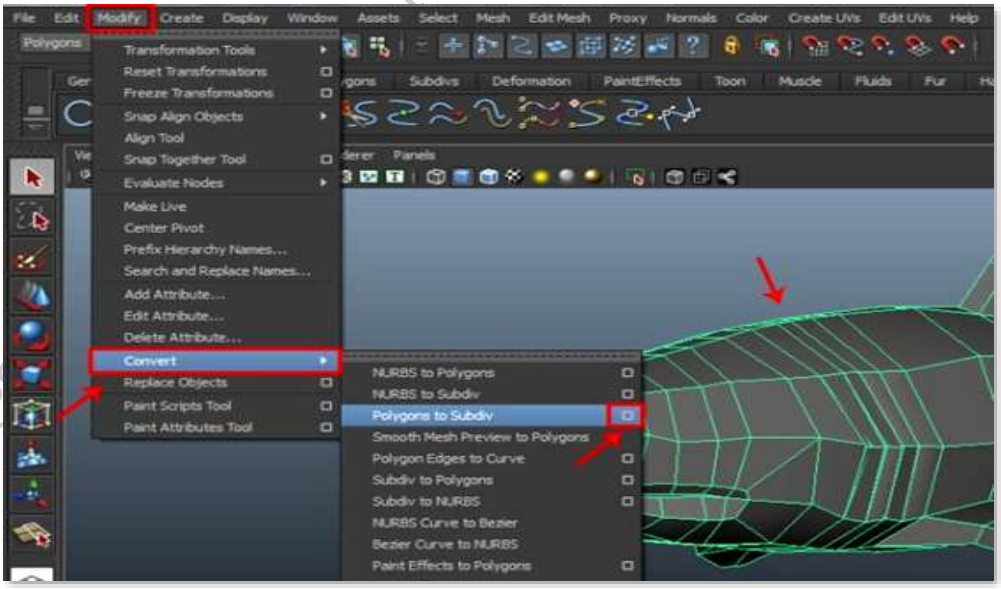


Figure 1.119: Selecting the Polygon to Subdiv option

Step 2

In the **Convert NURBS/Polygon to Subdiv Options** window, keep the **Maximum base mesh faces** value at **10000**, and then click on the **Create** button **(Figure 1.120)**.

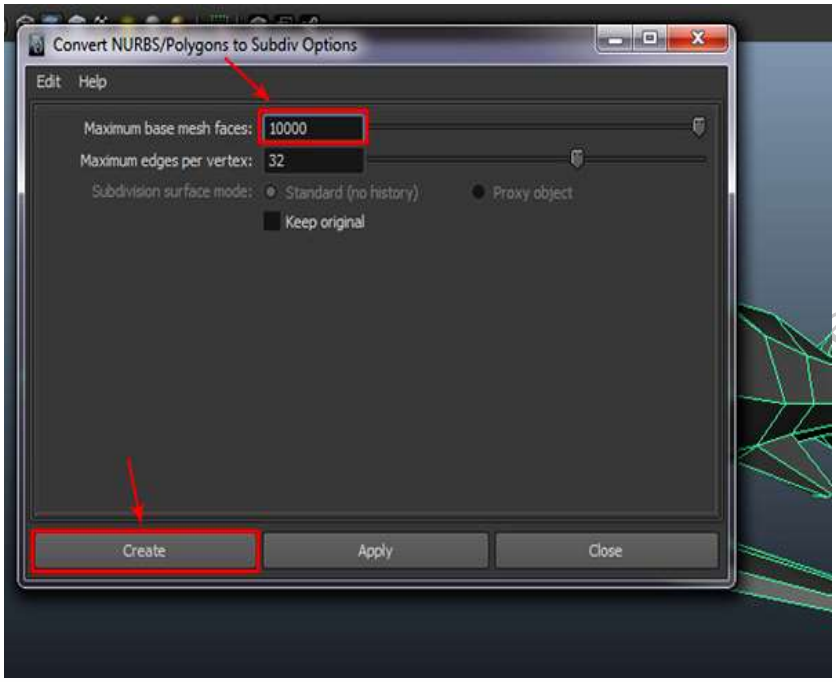


Figure 1.120: Selecting Maximum base mesh faces value at 10000

When we convert a polygon mesh to a subdivision surface, it may delete its shader node. In this case, we may need to apply the shader node again **(Figure 1.121)**.

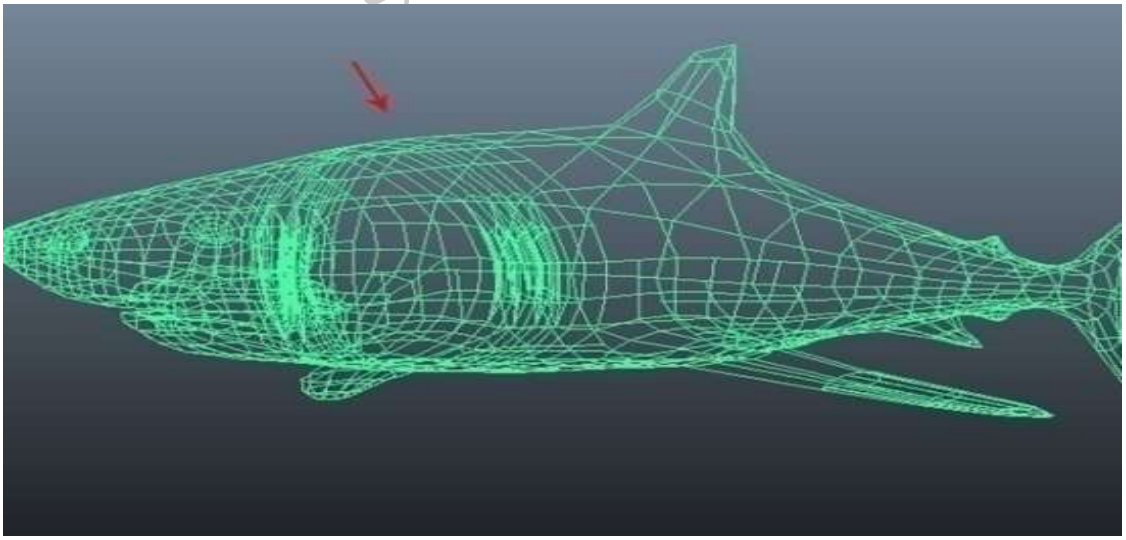


Figure 1.121: Applying shader notes

Step 3

With the shark polygon mesh selected, **Right Click** in the viewport and select **Blinn**from inside the **Assign Favorite Material** fly-out menu **(Figure 1.122)**.

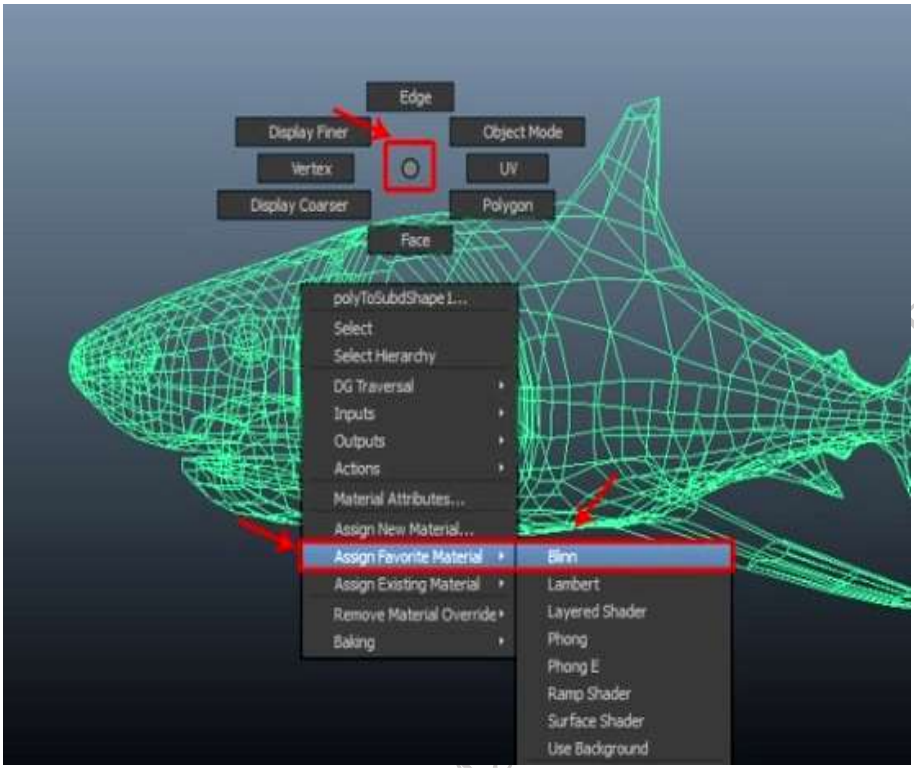


Figure 1.122: Blinn selected

Step 4

Once again, you can see the surface shader has been applied to the selected shark mesh **(Figure 1.123)**.

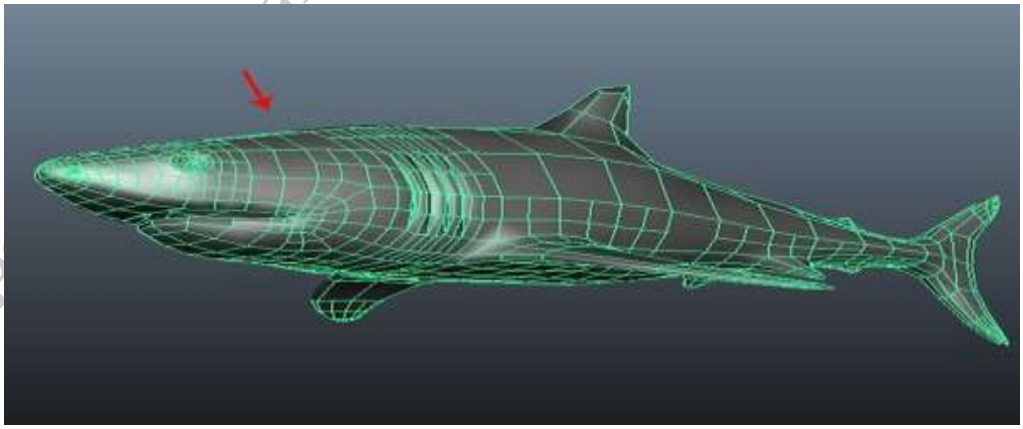


Figure 1.123: Surface shader applied

Step 5

With the shark body selected, **Right Click** and hold, and then chooses the **Polygon** option **(Figure 1.124)**.

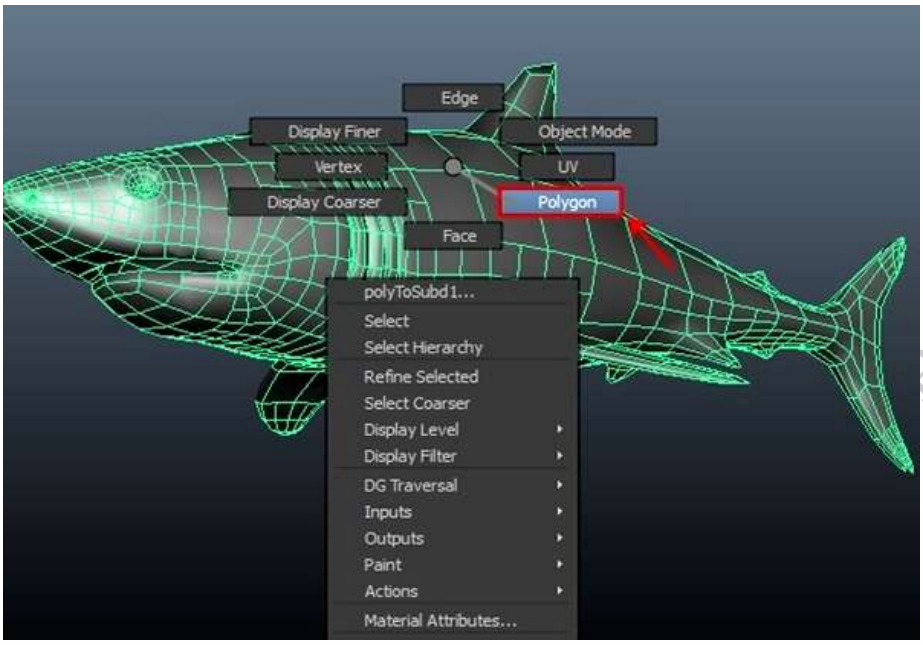


Figure 1.124: Polygon selected

Step 6

Again, **Right Click** on the shark body and choose **Standard** mode. You will see some changes in the Standard mode; the refore we can always interchange between both **Standard** and **Polygon** mode to use their tools as needed. So, here we have selected **Standard** mode to use subdivision tools **(Figure 1.125)**.

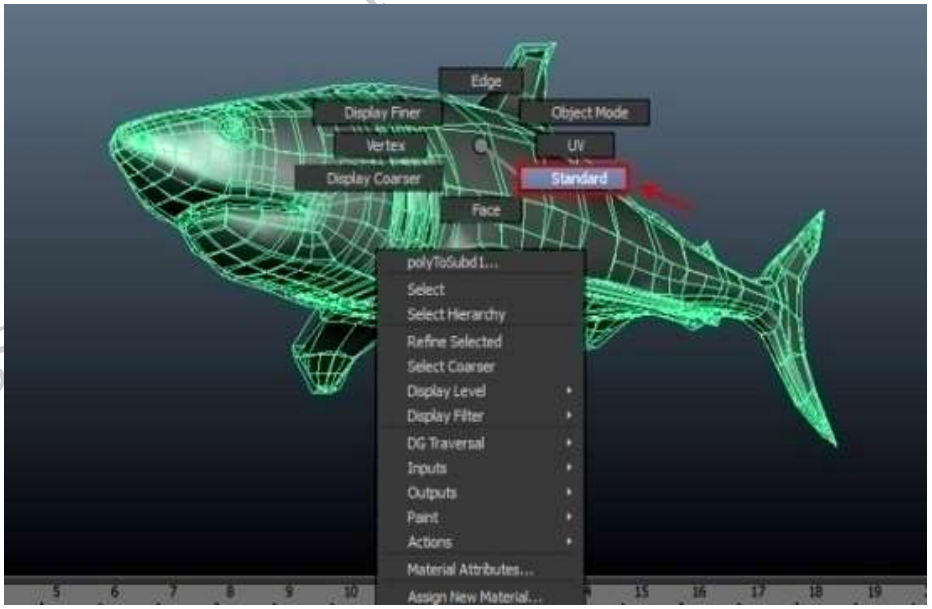


Figure 1.125: Using subdivision tools

Step 7

Again **Right Click** and select **Vertex** mode, to select the vertex **(Figure 1.126)**.

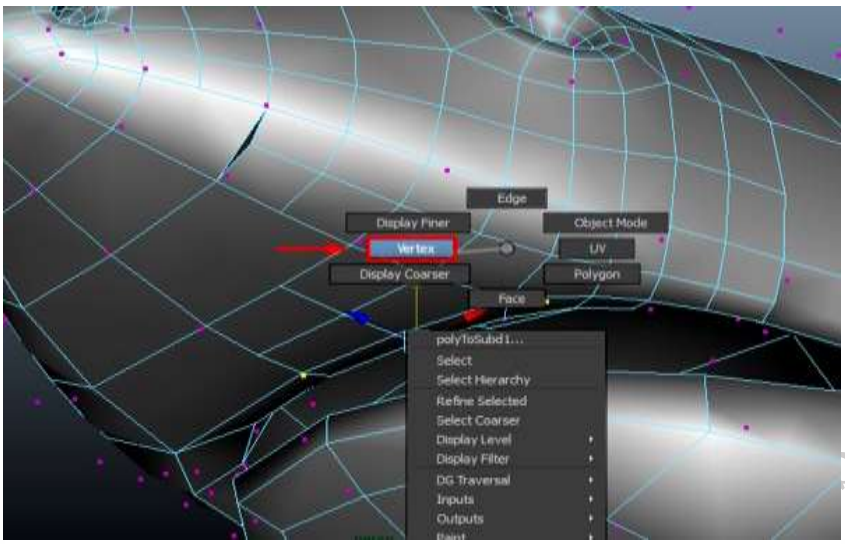


Figure 1.126: Vertex selected

Again do a **Right Click** and select **Display Finer**, to display the finer components, as shown in the image below.

Step 8

After this, you'll see the finer vertex close to the subdivision surface as control vertex. Now select some vertex around the lip outline and then change the mode to **Surface**, as shown in the image below **(Figure 1.127)**.

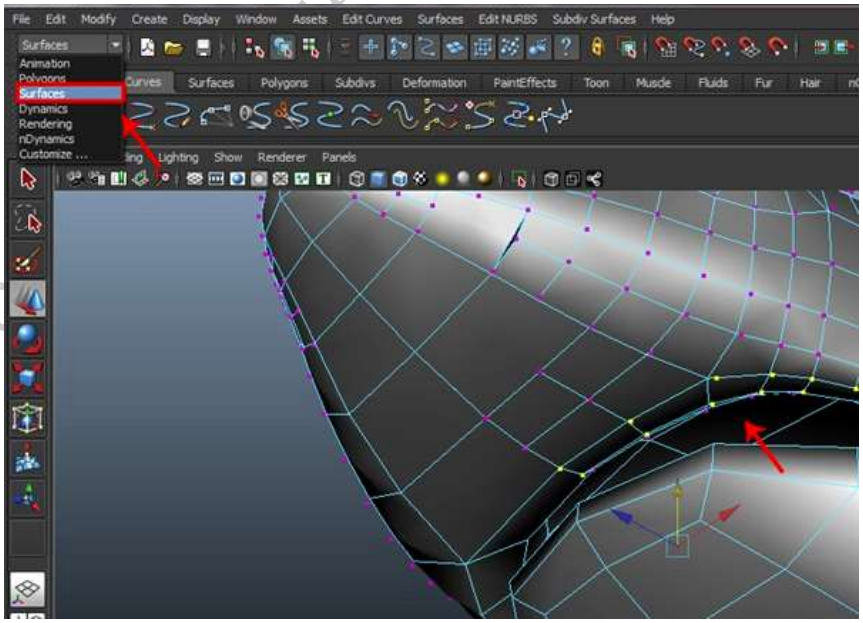


Figure 1.127: Changing mode to surface

Step 9

With the same vertex selected, go to the **Subdiv Surfaces** menu and select **Refine Selected Components (Figure 1.128)**.

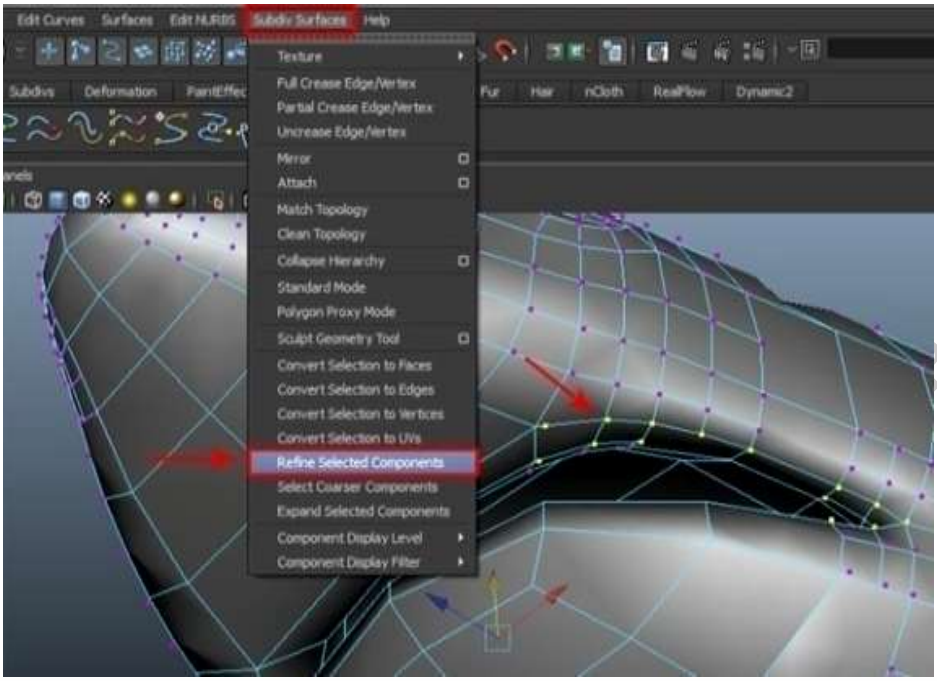


Figure 1.128: Select Refine Selected Components

You can see some changes after using the **Refine Selected Components** command. Now you can arrange the vertex or sculpt the area as you need **(Figure 1.129)**.

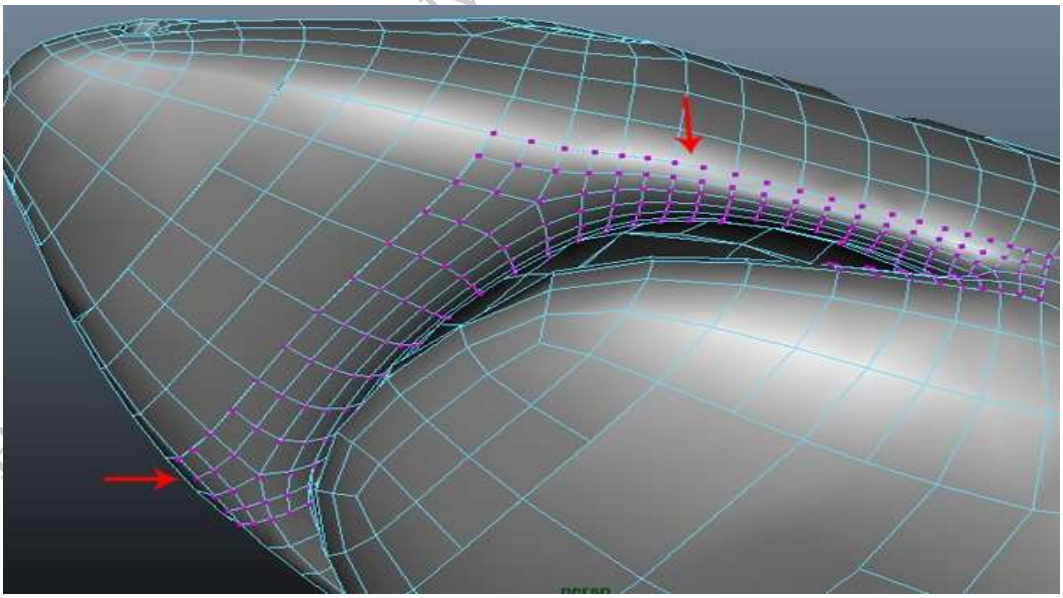


Figure 1.129: Changes occurred

Step 10

Now you may notice that several vertexes are not displayed properly. After selecting those vertexes, try to adjust them a bit so you can see the finer vertex, as shown in the image below **(Figure 1.130)**.

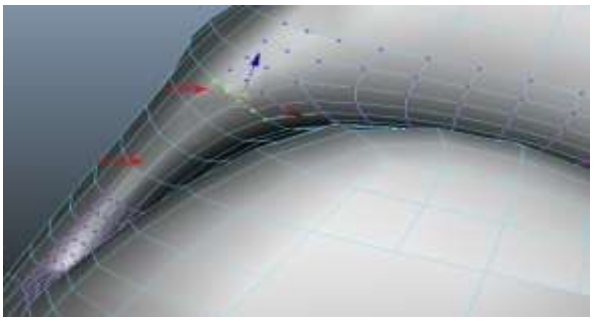


Figure 1.130: Adjusting vertex

Adding Detail to the Mouth

Step 1

Now select a row of vertex around the lip outline and move them up a bit **(Figure 1.131)**.

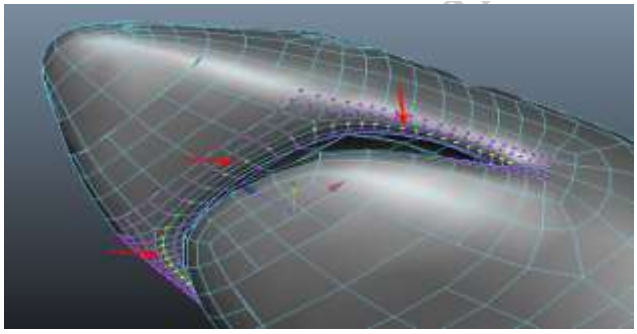


Figure 1.131: Moving vertex towards lip outline

If you want to check to see how it look, just click on the **Current Render Frame** button on the main tool bar **(Figure 1.132)**.

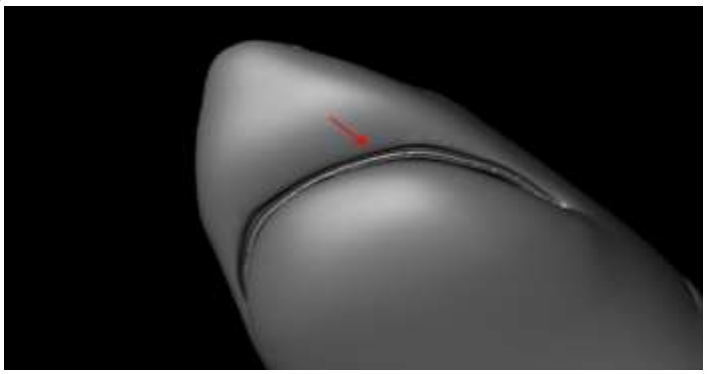


Figure 1.132: Observing view

You can then see the result in a rendered frame. Moving the row of the vertex has made a space for the teeth and gums **(Figure 1.133)**.

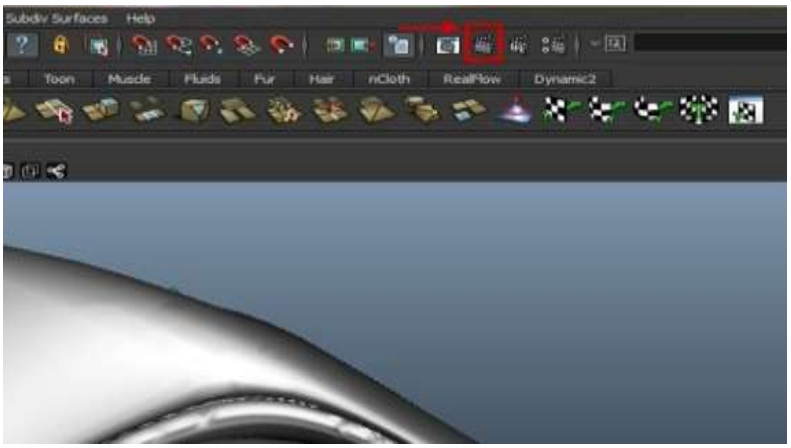


Figure 1.133: Result in a rendered frame

Step 2

Just like this, keep arranging the vertex to sculpt the mesh as you need, and to add more detail **(Figure 1.134)**.

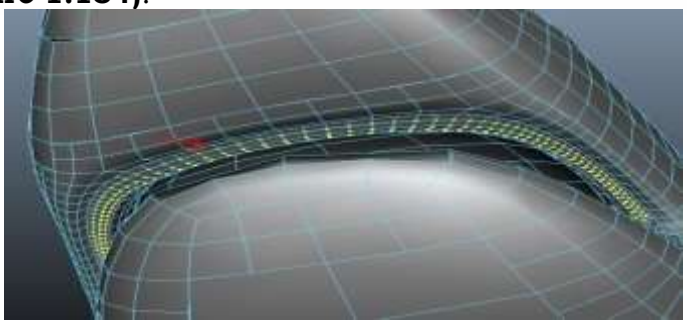


Figure 1.134: Arranging vertex

It will take a bit of time and your own creativity for you to come up with the teeth and gums space **(Figure 1.135)**.

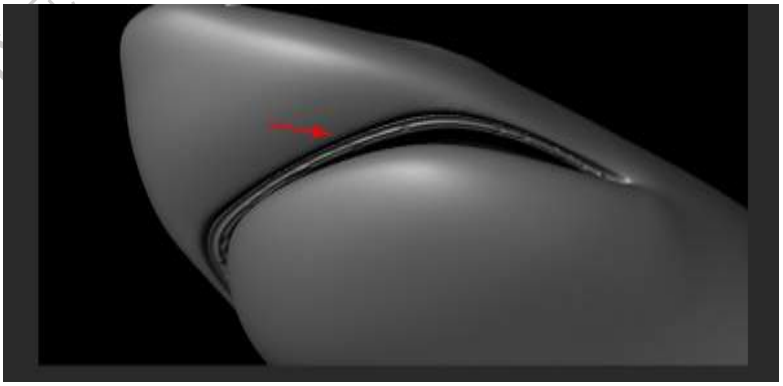


Figure 1.135: Space between teeth and gums

Creating and Positioning the Teeth

Step 1

Now it's time to create the teeth for the shark. Go to the **Create** menu and select the **Cone** tool, from inside the **NURBS Primitives** submenu **(Figure 1.136)**.

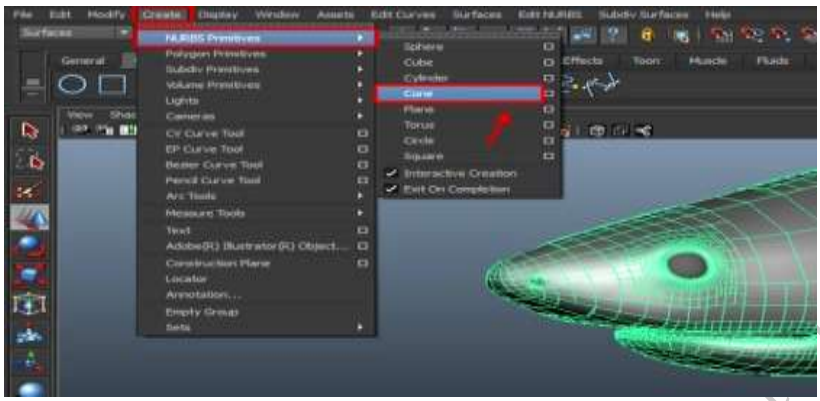


Figure 1.136: Creating shark's teeth

Step 2

Now draw a cone shape in the viewport with the following values: Sections: 4, Span: 3. And also don't forget to delete the bottom cap face **(Figure 1.137)**.

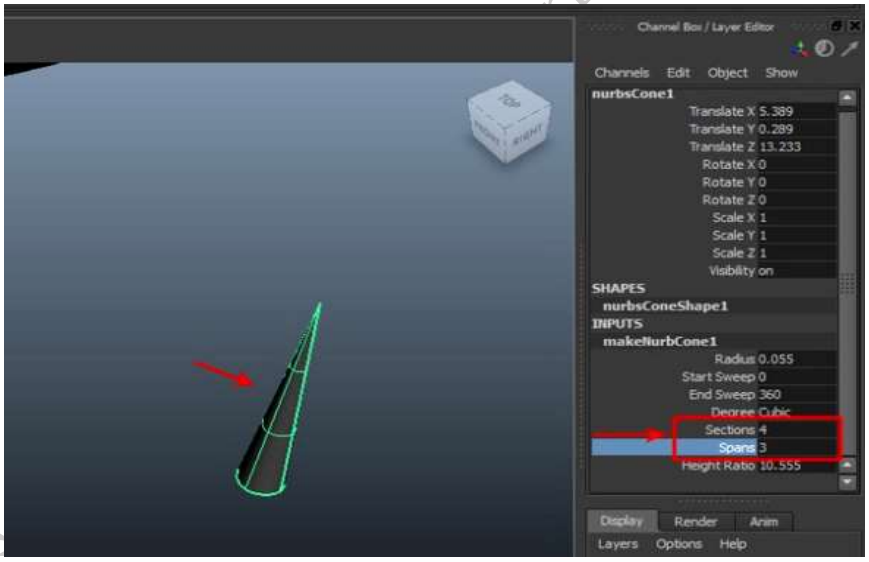


Figure 1.137: Drawing a cone shape

Step 3

With the cone mesh selected, press **F9** to enter **Vertex** selection mode and then arrange the vertex to form a shark's tooth **(Figure 1.138)**.

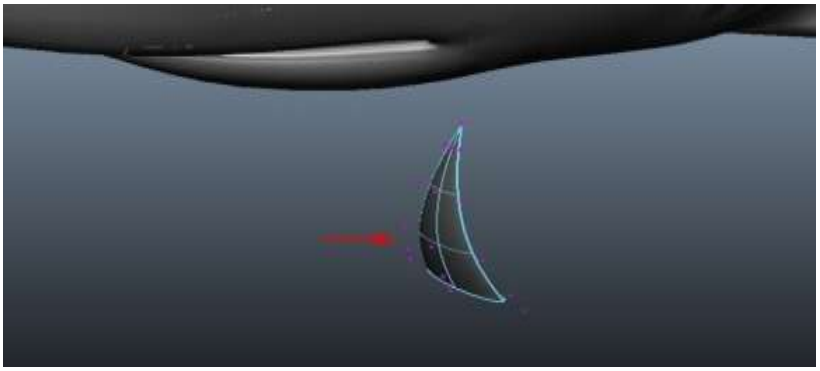


Figure 1.138: Formation of a shark's tooth

Step 4

Make several copies of the tooth mesh and distribute them with random scale values onto the lower and upper gum areas **(Figure 1.139)**.

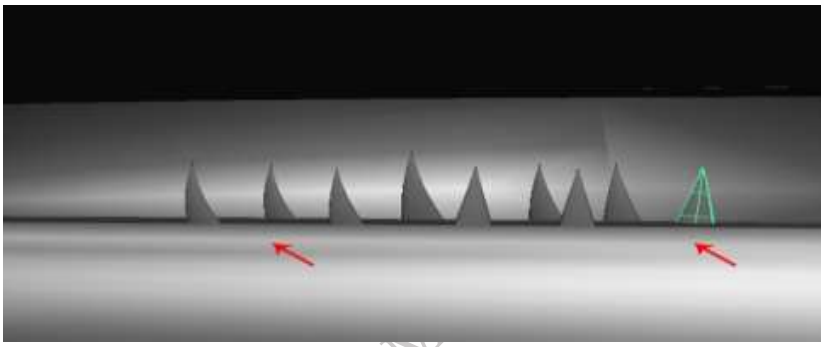


Figure 1.139: Several copies of shark's tooth

Step 5

We are now done with the teeth arrangement **(Figure 1.140)**.

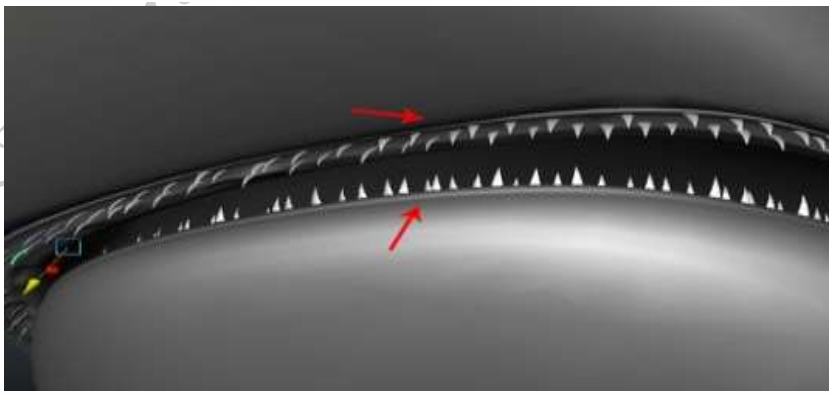


Figure 1.140: Teeth job done

Creating the Eyes

Step 1

Everything is almost complete, except for the eyes. Go to the **Create** menu and select **Sphere**, from inside the **NURBS Primitives** menu **(Figure 1.141)**.

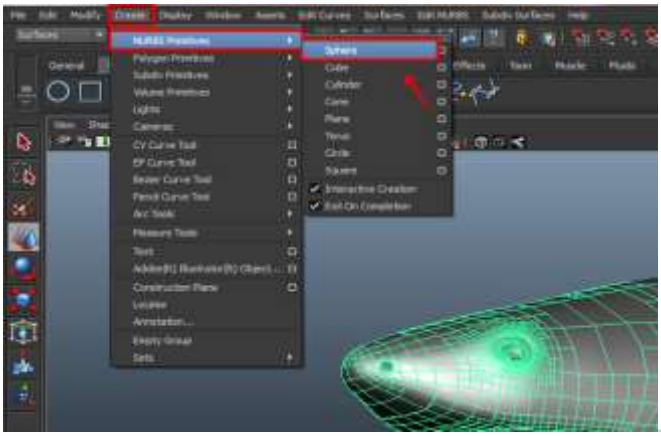


Figure 1.141: Eyes making process started

Jump into the **Side** view and draw a **Sphere** around the eye area, as shown in the background image **(Figure 1.142)**.

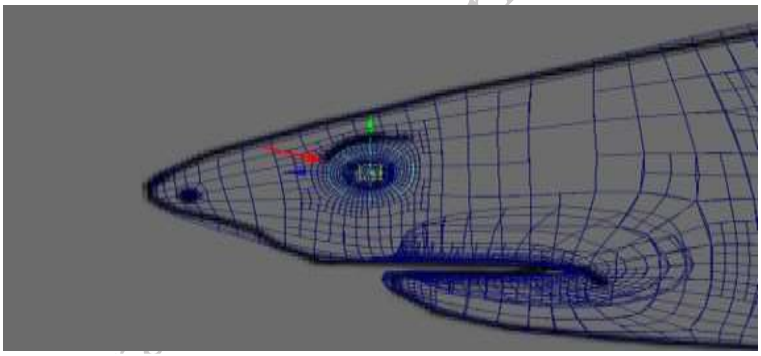


Figure 1.142: drawing a Sphere

Step 2

Finally position the sphere properly, so it looks like an eyeball **(Figure 1.143)**.

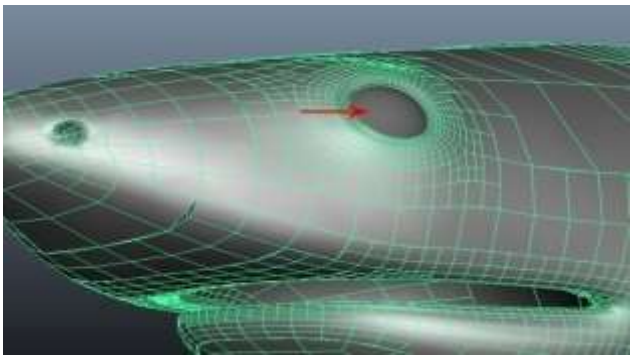


Figure 1.143: Sphere position adjusted accordingly

Conclusion

Finally, we have completed the modelling of the shark **(Figure 1.144)**. In the next part of the tutorial, we will learn about proper unwrapping and texturing. I hope you enjoyed this part.

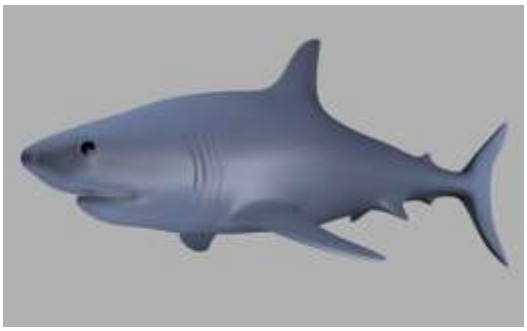


Figure 1.144: The final result of modelling of the shark

Activities

Activity 1: Creating a Realistic 3D Model in Autodesk® Maya®

Objective: - Create a real live 3D model using Autodesk®Maya® and try to texture the same model as the real live version looks like. Examples of real live models are Table, Chair, Scooter, Motorcycle etc.

Materials required: Computer system, and Autodesk®Maya®

Procedure

- Import the reference images for the chosen model (e.g., table, chair, scooter, or motorcycle) from various angles: front, side, top, and any other relevant perspectives.
- Go to the Create menu and select Polygon Primitives > Cylinder.
- Switch to Front View and position the cylinder as the main base of your model.
- Press F9 to enter Vertex Selection Mode.
- Using the Move Tool (W), adjust vertices to match the shape of the reference images in both the Front View and Side View.
- Continue adjusting the vertices in the Top, Left, Right, and Front Views until the shape aligns with the references.
- For more complex models, add additional geometry as needed, such as additional cylinders, cubes, or other primitives.
- Extrude faces or add edge loops to create finer details, making sure to check from multiple angles for accuracy.

- Open Hyper shade to access material nodes and create new materials such as Phong, Blinn, or Lambert, depending on the surface characteristics.
- Use real-life textures (e.g., wood grain for a table, metal for a motorcycle frame) and apply them to the model.
- Adjust attributes like Colour, Specularity, and Reflectivity to enhance realism.
- Review the model from various angles and make final adjustments to textures and lighting.
- Perform a Test Render to evaluate the appearance and make further refinements if needed.

Check Your Progress

A. Multiple Choice Questions

1. Which of the following attributes would you adjust to control how a 3D object reflects ambient light in Maya?

a) Incandescence
b) Diffuse
c) Ambient Colour
d) Bump Mapping

2. What is the primary purpose of Bump Mapping in Maya's surface material settings?

a) To adjust the transparency
b) To give the appearance of a bumpy or rough surface
c) To change the colour of the object
d) To control ambient lighting

3. In Maya, what happens to the background of the material's Hypershade swatch when Transparency is increased from its default setting?

a) It turns red
b) It becomes a checkered pattern
c) It becomes fully opaque
d) It shows a gradient pattern

4. If you want to make a 3D object appear to emit light without actually illuminating other objects, which attribute should be used?

a) Translucence
b) Transparency
c) Incandescence
d) Diffuse

5. To create a glowing effect on a backlit leaf without it appearing washed out when front-lit, which translucence property should be adjusted?

a) Translucence Focus
b) Diffuse
c) Bump Mapping
d) Incandescence

6. What effect does increasing the translucence depth attribute have on a translucent object?

a) Allows light to penetrate deeper
b) Increases object's opacity
c) Controls the object's reflection
d) Changes the object's colour

7. Which material attribute would you adjust to simulate a frosted glass effect by diffusing light across a surface?

a) Translucence
b) Ambient Colour
c) Incandescence
d) Transparency

8. If you want a 3D object to look like wax with light shining through it, what combination of settings is recommended?

a) Low transparency and high incandescence
b) High translucence depth and low focus
c) High specular and low Bump Mapping
d) Low translucence focus and high diffuse

B. Subjective Questions

1. Explain the advantages of using Subdivision Surfaces in Maya for modelling organic forms like a shark. How do they differ from traditional polygon and NURBS surfaces?

2. Describe the process of setting up reference images in Maya for modelling. Why is it important to align these images accurately during the modelling process?

3. Detail the steps involved in creating the initial shape of the shark's body using a cylinder poly primitive. What are the key modifications you must make to the cylinder to match the reference images?

4. Discuss the significance of using vertex and face selection modes in Maya while modelling. How does switching between these modes facilitate the shaping of complex forms like a shark?

5. After modelling half of the shark's body, you use the Duplicate Special function. Explain the process and reasoning behind using the Instance option and setting the Scale value for the X Axis to -1.00. What is the outcome of this operation?

Session 6: Properties of Surface Materials

The colour, shininess and reflectivity attributes of a 3D object are controlled by its surface material (also called as a shader, or shading material). Material Attributes refer to how the object is created by simulating light that naturally exists using Maya Software's 3D Digital Environment.

Maya assigns a default shading material called "Lambert" to all objects when they are first created. This section, is focused on how to assign a new material to objects. The following properties are common to most of the surface materials:

i. **Type:** The material's basic type (such as Phong). When you change a material's type, only those attributes common to both types retain their previous values or settings.

ii. **Colour:** The default material colour.

iii. **Transparency:** A material's colour and level of transparency are defined in the following ways:
- If the Transparency Value is 0 (black), the surface is totally opaque and if the Transparency value is 1 (white), the surface is totally transparent.
- To make an object semi-transparent, one can set the Transparency Colour to a shade of grey or to the same Colour as the material Colour. The default value is 0 (black).
- If you change Transparency from the default black (0), the background of the material's Hyper shade swatch becomes a checkered pattern. This is a visual aid and is not rendered.

Note:

If the material has specular highlights the transparency setting does not affect the highlights. Therefore, animating the transparency attribute to make an object disappear can be achieved by animating the specular highlight attributes instead.

Ambient Colour

The ambient colour of a material determines how it will reflect various wavelengths of ambient light. Ambient colour is generally set to be the same as the diffuse colour.

Set to black by default, which means it does not affect the materials colour. As the ambient colour becomes lighter, it affects the material's colour by lightening it and blending the two colours. If there are ambient lights in the scene, the colour and

brightness of those lights are used to control how much the ambient colour contributes to the final colour of the material.

Incandescence

- The Colour and brightness of light that material appears to be emitting.
- The Incandescent objects do not illuminate other objects.
- To create a lava, use a bright red Incandescence. The default Colour value is 0 (black).
- Although incandescence opinion makers a surface appear to glow, it does not actually act as a source of light in the scene.
- One can use a little Incandescence for vegetation to make it look organic.

Bump Mapping

Bump Mapping is a Texture Mapping technique in computer graphics for simulating bumps and wrinkles on the surface of an object. This makes the surface appear rough or bumpy by changing the surface normal, during rendering, according to the intensity of the pixels in the Bump Maptexture. A Bump Map does not alter the surface in reality but just gives it a look (texture). A silhouette of the surface appears smooth.

Diffuse

This Option gives the material the ability to reflect light in all directions. The Diffuse value acts like a scaling factor applied to the Colour setting—the higher the Diffuse value, the closer the actual surface Colour is to the Colour setting. The valid range is 0 to infinity. The slider range is 0 (no light is reflected in all directions) to 1, but you can type in a higher value. The default Colour value is 0.8.

Translucence

Gives the material the ability to transmit and diffuse light. Light falling on a translucent surface is first absorbed beneath the surface, and then diffused in all directions. If set to 0, the default, no light shows through the object. If set to 1, all the light shows through. The default value is 0. Use translucence to simulate clouds, fur, hair, marble, jade, wax, paper, leaves, flower petals, or frosted light bulbs.

Note

- The Translucence value of a surface lit by a non-shadow-casting light is zero or infinite (all non-zero values).
- If the scene combines a translucent surface with a shadow casting spotlight, faint grid-like artefacts may become visible. If this happens, increase the spotlight Filter Size or lower the Resolution.
- For high values of translucence, lower diffuse accordingly to avoid washout.

- A surface's actual translucence is based on the illumination it receives from lights, and is not related to its transparency. However, as an object becomes more transparent, its translucent (and diffuse) illumination gets dimmer.

Translucence Depth

Simulates the way light diffusely penetrates through translucent objects. For example, when light shines on one side of the object, the other side is partially illuminated. This can be used for effects such as clouds, fur, hair, marble, jade, wax, paper, leaves, and so on **(Figure 1.145)**. (To see this effect, turn on raytraced shadows for the light shining on the object.)

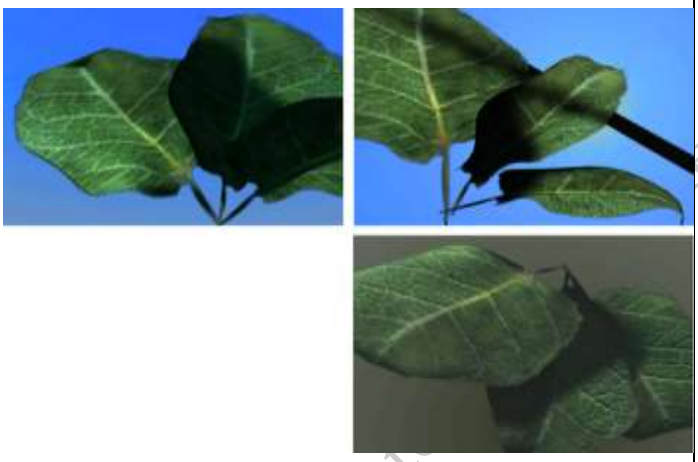


Figure 1.145: Sample showing Translucence Depth

Translucence depth is based on world space. If it is set to 0 (the default), no light shows through the object. If set to 10, light penetrates through the surface, 10 units past the point where the object is in shadow.

To see the effects of translucence depth, set the transparency to a non-zero value. If the surface is supposed to be opaque, set the transparency to a very small value, such as 0.0001.

Translucence Focus

The Translucence Focus value controls how much translucent light is scattered depending on the direction of the light **(Figure 1.146)**.

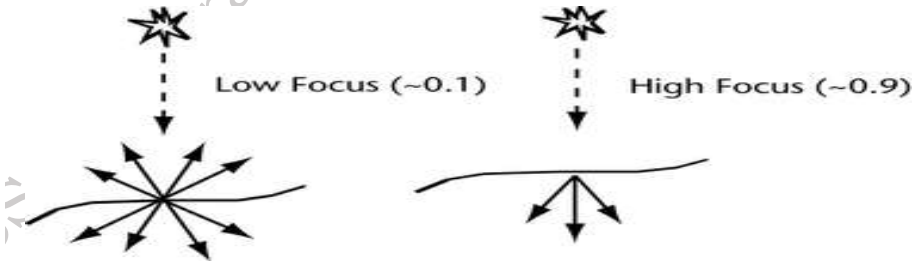


Figure 1.146: Working of Translucence light scatter

For example, use a high value for very thin materials, such as wax paper or steam, where most of the light is scattered over a small angle relative to the light's direction **(Figure 1.147)**. The object looks brightest with the light source directly behind it.

Figure 1.147: Sample showing Translucence light

Note:

When a spotlight is used to light an object with a translucent material, the light does not scatter past the light's cone of influence, even if Translucence Focus is lowered **(Figure 1.148)**.

Use a mid-range focus value for items such as leaves. The leaves glow when backlit, but do not wash out when lit from the front.
Use a low focus value for thicker objects, such as wax. To compensate for the added light and avoid a washed out result, lower the diffuse value, or lower the overall Colour (which also affects ambient lighting).

Figure 1.148: Another Sample showing Translucence light

Note:

Lower the Colour value for very shiny objects that have a bright specular component.

Activities

Activity 1: Texture the same model as developed in earlier session to the real live version looks like. Examples for a real live models are Table, Chair, Scooter, Motorcycle etc.

Material required: Computer system, and Autodesk®Maya®

Procedure

- In the perspective view, click the torso and select assign new material from the pop-up menu.
- Select lambert, attribute editor and select the lambert tab.
- In the attribute editor, click the folder icon next to the image name field.
- In the attribute editor, navigate to the mat torso tab, click the box next to Bump Mapping.
- Normal Maps appear on the soldier's chest. Normal Maps give the flat portions of the texture the illusion of 3D bumps.

Check Your Progress

A. Multiple Choice Questions

1. What does the Transparency attribute of a material control in Maya?
a) The material's ability to reflect light
b) The opacity level of the material
c) The colour of the material
d) The shininess of the material

2. Which material type is the default in Maya when an object is created?
a) Phong
b) Lambert
c) Blinn
d) Plastic

3. What does the Incandescence property of a material represent?
a) The material's reflectivity
b) The colour and brightness of light that the material appears to emit
c) The smoothness of the surface
d) The material's transparency

4. Which attribute is responsible for how light reflects in all directions from a material's surface?
a) Diffuse
b) Transparency
c) Specularity
d) Bump Mapping

5. What is the function of Bump Mapping in Maya?
a) It changes the surface material's reflectivity.
b) It simulates bumps and wrinkles on the surface without altering the actual surface.

c) It alters the shape of the object.
d) It affects the transparency of the material.

6. How does the Ambient Colour of a material affect its appearance?
a) It determines how much the material absorbs light.
b) It changes the material's reflectivity in response to ambient light.
c) It creates the illusion of glowing light.
d) It makes the material appear transparent.

7. What does the Translucence Depth attribute simulate?
a) The way light scatters on a material's surface.
b) The way light penetrates and diffuses through translucent objects.
c) The brightness of the material's reflection.
d) The transparency of the material at a distance.

8. What effect does setting the Translucence Focus value to a high number have?
a) It increases the amount of light that passes through the material.
b) It causes light to scatter over a small angle, making thin materials appear brighter when backlit.
c) It makes thick materials like wax more opaque.
d) It reduces the brightness of the material when backlit.

9. Which of the following materials would benefit from using a high value for Translucence Focus?
a) Wax paper
b) Steel
c) Marble
d) Water

10. In Maya, how does changing the Transparency value from 0 (black) to 1 (white) affect the object?
a) The object becomes more reflective.
b) The object becomes completely transparent.
c) The object appears more opaque.
d) The object will have a shinier surface.

B. Subjective Type Questions

1. What is Translucence Depth and translucence focus?
2. What are common properties of the surface materials?
3. Explain Ambient Colour, Incandescence, Bump Mapping, Diffuse and Translucence.

Session 7: Effect of Lighting Conditions on Surfaces

It depends upon the types of surfaces that react to varying lighting conditions to control the appearance of glows produced from light reflecting off surfaces, or from surface incandescence.

Special Effects attributes are available for Anisotropic, Blinn, Lambert, Phong, and PhongE material types.

Hide Source

Makes the surface invisible when rendered (if the glow intensity value is non-zero) showing only the glow effect. Hide Source is off by default.

Glow Intensity

The brightness of the surface glow effect. The slider range is 0 to 1, but one can type in higher values to create a 'blown out' or 'burn in' effect. The default value is 0. Mapping a texture to the Glow Intensity can create very interesting effects. Turn on Hide Source to view the results **(Figure 1.149)**.

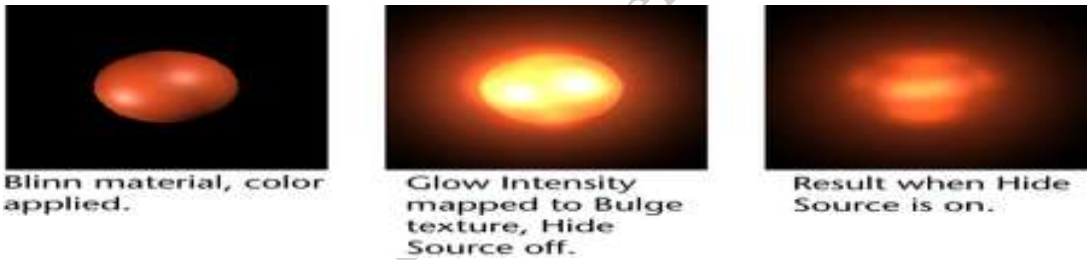


Figure 1.149: Sample showing glow intensity with various materials

Matte Opacity

The mask value for individual objects can be controlled. Matte Opacity attributes are available for material types such as Anisotropic, Blinn, Lambert, Layered Shader, Phong, PhongE, Shading Map, and use background.

Matte Opacity Mode

It is a rendering technique used in 3D graphics to control the transparency or opacity of an object's surface. It allows the background or other objects behind the surface to be visible through it, while the surface itself remains partially or fully transparent. Now select from the list of modes in the drop-down list. For best results when adjusting these attributes, select the Display Alpha Channel icon in the Render View to view the mask channels when re-rendering the scene.

Opacity Gain

This is the default Matte Opacity Mode. This mode produces both reflections and shadows **(Figure 1.150)**.

The matte channel is first calculated, and then multiplied by the specified Matte Opacity value. The Opacity Gain value is used as a multiplier on the matte value produced by this material.

The Matte Opacity Mode value is also keyable. The Opacity Gain range is from completely invisible to no effect (rendered as usual).

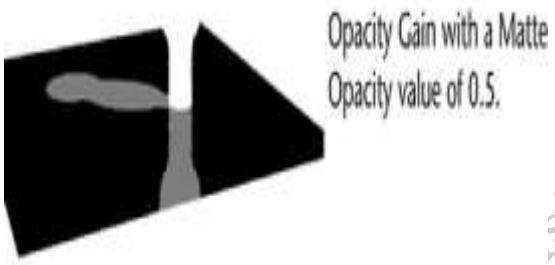


Figure 1.150: Sample showing Opacity Gain

Solid Matte

Solid Matte makes the value of the matte channel constant for the material. The value you specify in the Matte Opacity slider is used, instead of the default value.
Use Solid Matte to adjust the overall density or visibility of the use background material **(Figure 1.151)**.

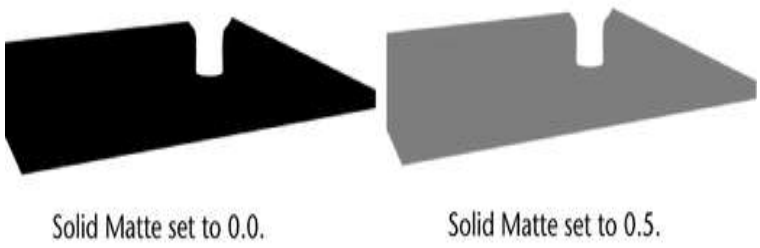


Figure 1.151: Sample showing Rendered Solid Matter

Black Hole

When the Black Hole mode is selected, the matte channel for the material is set to 0 (fully transparent). This creates a black hole in the alpha output where the object assigned shader renders the matte 'knocked out' **(Figure 1.152)**. In this mode, the Matte Opacity slider is disabled and its value ignored.

Figure 1.152: Rendered result with Matte Opacity Mode set to Black

Note:

For the Opacity Gain and Solid Matte modes, if an object has non-zero Transparency, objects behind it make their usual contribution to the matte channel's values. This is

the difference between setting Matte Opacity to 0.0 in these modes, and choosing the Black Hole mode.

Matte Opacity

This value depends on Matte Opacity Mode is selected (Opacity Gain or Solid Matte). For example, for Opacity Gain, the Matte Opacity value indicates the multiplier amount for the alpha channel. The default is 1, which means that any opaque material registers an unaffected alpha value.

Any values between 0 and 1 act as a multiplier to the alpha channel value to arrive at modified value. Use the slider or enter a value to adjust the density or visibility of the mask channels **(Figure 1.153)**.

Opacity Gain with a Matte Opacity value of 1.0.

Opacity Gain with a Matte Opacity value of 0.5.

Figure 1.153: Rendered result with Matte Opacity Gain at value 1.0

Raytrace Options

The Raytrace Options attributes to control the appearance of a surface during raytracing only. Raytrace options attributes are available for Anisotropic, Blinn, Lambert, Phong, and Phong E material types.

Refractions

Refraction is the change in direction of a wave passing from one medium to another medium. Refraction of light is the most commonly observed phenomenon, but other waves such as sound waves and water waves also experience refraction. When enabled, rays that are traced through transparent or semi-transparent objects are refracted, or bent according to the material's refraction index.

Refractive Index

Refractive index, also called index of refraction, measure the bending of a ray of light, when passing from one medium into another. Refractive index is also equal to the velocity of light c of a given wavelength in empty space divided by its velocity v in a substance, or n = c/v.

The amount that light rays bend when passing through a transparent object. A refractive index value of 1 does not bend light rays at all, so it is required to set the

index value higher than 1. Refractive Index values for common materials are: glass (1.6), air (1), water (1.333), crystal (2), diamond (2.417).

The valid range is 0.01 to infinity. The slider range is 0.01 to 3, but you can type in a higher value. The default setting is 1.6.

Notes:

- The material's Hyper shade swatch only approximates the effect of the refractive index attribute.
- Surfaces must have a thickness for refractive index to have any effect. If a surface does not have thickness (for example, a plane or face element), set the Refractive Index value to 1.
- For best results, make sure there are suitable objects in the background to be refracted.

Refraction Limit

The Refraction Limit determines the maximum number of times a surface allows a light ray to be refracted. For instance, if the Refraction Limit is set to 10, the surface will refract light rays that have been refracted or reflected up to 9 times. However, it will not refract rays that have been refracted or reflected 10 or more times. The valid range for this value is from 0 to infinity, with the slider range between 0 and 10. The default setting is 6. Increasing this value can greatly extend render times.

You must also consider the Render Settings Window Raytracing refractions attribute too **(Figure 1.154)**. Maya uses the lower value of the 2. For instance, if your limit is set to 9 on the material and 6 in the Render Settings window, a value of 6 is being used.

In the following example, a glass sits in front of a mirror.

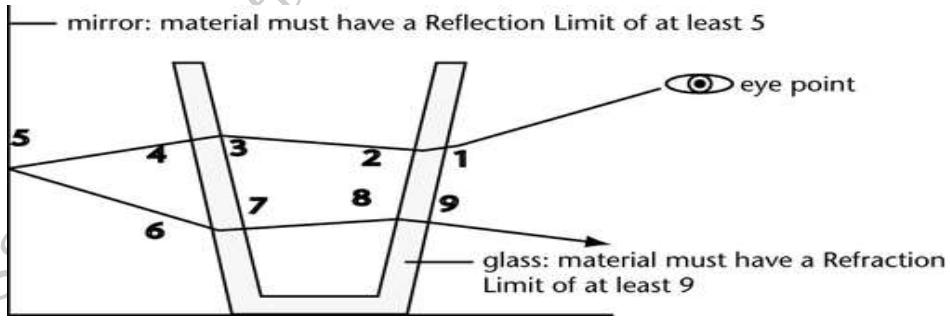


Figure 1.154: Showing Refraction Limit

The number of refractions includes both the entry and exit of a light ray from a surface having a thickness.

The physical property of Total Internal Reflection (TIR) can make some transparent objects appear not to refract light. This is caused by light rays reflecting inside the thickness of the object. If this occurs, increasing refraction limit has no effect because

the reflection limit is stopping light rays before they can exit the surface. However, because TIR is a real-world property, one may want to keep this effect.

Note: To simulate realistic looking glass, set the Refraction Limit value to 9 or 10.

Reflection Limit

The maximum number of times the surface allows a light ray to be reflected. For example, if the reflection limit value is 4, the surface reflects light rays previously reflected (off itself or off other surfaces) 3 times or less; the surface does not reflect light rays previously reflected 4 or more times. The valid range is 0 to infinity. The slider range is 0 to 10. The default value is 1.

Set the reflection limit value according to the material's reflectivity value. For example, if the reflectivity value is between 0 and 0.5, set the reflection limit value between 1 and 2. If the reflectivity value is between 0.5 and 1, set the reflection limit value between 2 and 5.

High values for reflection limit greatly increase rendering time. Test render the scene using various settings, and use the lowest values that give acceptable results. Even highly reflective surfaces rarely need a Reflection Limit value as high as 10 or more.

Reflection Specularity

This attribute is available for Blinn, Anisotropic, Phong, *and* PhongE materials. Reduce this value to avoid highlight aliasing artifacts produced in reflections during raytracing because of very thin or small highlights. Maya adds reflection specularity to each material to control the contribution of the specular highlights in reflections. The valid range is 0 to 1. The default is 1 (full contribution).

Light Absorbance

A material with an absorbance of 0.0 transmits completely. The higher the value, the less light passes through.

Transparent materials generally absorb an amount of the light which passes through them. The thicker the material, less light gets through the thinner the material, more light gets through.

Surface Thickness

The simulated thickness (in world space) of transparent objects created from single surfaces (for example, a NURBS plane, or polygon face).

Using surface thickness does not produce the same results as building a surface with actual thickness the effect works well when the edges of the surface are not visible (for example, closed surfaces, or bounded shapes, like a car windshield).

Shadow Attenuation

Shadows of transparent objects are brighter in the center, simulating a light's focus. A setting of 0 results in constant intensity shadows. The focusing increases as the parameter increases from 0 to 1. The default value is 0.5. The amount of attenuation for a given light ray depends on the angle between the light ray and the surface normal of the transparent object: the greater the angle, the greater the attenuation. To turn off the shadow attenuation completely, set shadow attenuation to 0.

Chromatic Aberration

Different wavelengths of light refract at different angles when passing through a transparent surface during raytracing. Chromatic Aberration only affects light rays as they pass through the second surface of a transparent object (the first exit ray).

Activities

Activity 1: Adjusting Glow Intensity and Surface Brightness Using Blinn Material

Materials required: Computer system, and Autodesk®Maya®

Procedure

- These attributes control the appearance of glows produced from light reflecting off surfaces, or from surface incandescence. Special Effects attributes are available for Anisotropic, Blinn, Lambert, Phong, and PhongE material types.
- For best results when adjusting these attributes, select the Display Alpha Channel icon in the Render View to view the mask channels when re-rendering the scene
- The matte channel is first calculated, and then multiplied by the specified Matte Opacity value. The Opacity Gain value is used as a multiplier on the matte value produced by this material.
- Solid Matte makes the value of the matte channel constant for the material. The value you specify in the Matte Opacity slider is used, instead of the default value.
- Matte Opacity Mode is selected (Opacity Gain or Solid Matte). For example, for Opacity Gain, the Matte Opacity value indicates the multiplier amount for the alpha channel.
- Matte Opacity Mode is selected (Opacity Gain or Solid Matte). For example, for Opacity Gain, the Matte Opacity value indicates the multiplier amount for the alpha channel.

Check Your Progress

A. Multiple Choice Questions

1. What is the effect of "Hide Source" in the Special Effects attributes?
a) Makes the surface visible in render
b) Makes the surface invisible when rendered, showing only the glow effect
c) Increases the glow intensity
d) Reduces the glow intensity

2. What does the "Glow Intensity" slider control?
a) The opacity of the surface
b) The brightness of the surface glow effect
c) The colour of the glow
d) The transparency of the glow

3. Which material types have available "Matte Opacity" attributes?
a) Only Blinn
b) Only Phong
c) Anisotropic, Blinn, Lambert, Phong, PhongE, Shading Map, and Use Background
d) Lambert and Phong only

4. What is the effect of the "Black Hole" Matte Opacity mode?
a) It increases the opacity of the material
b) It creates a fully transparent matte channel, resulting in a "knocked out" effect
c) It reduces the transparency of the material
d) It makes the material fully visible

5. What does the "Refraction Limit" control?
a) The maximum number of times light can be reflected
b) The maximum number of times light can be refracted through an object
c) The amount of light that passes through the material
d) The angle at which light is refracted

6. What happens when "Refraction Limit" is set to 10?
a) It will stop refracting light after 10 times
b) It will allow light to be refracted up to 9 times
c) It has no effect on light refraction
d) It will refract all light without any limit

7. What is the default value of the "Refraction Limit"?
a) 1
b) 6
c) 10
d) 0

8. What is the "Reflection Specularity" attribute used for?
a) To control the intensity of reflections in raytracing
b) To control the amount of absorption in transparent materials
c) To reduce light absorption in the material
d) To simulate thickness of transparent surfaces

B. Subjective Questions

1. Explain application of the various lighting conditions.
2. What is Matte Opacity?

Module 2:	Surface Shading and Maps

Module Overview

The module on Surface Shading and Texturing in 3D Modelling begins with Session 1, which introduces surface shading and its properties, emphasizing the interaction between light and surfaces and exploring various shading models such as Phong and Lambert.

Session 2 is about shading networks, learning to construct complex node-based workflows that enhance the realism of their models.

Session 3 focuses on the creation and assignment of materials, detailing different material types and how to edit their attributes for desired visual effects. Session 4 deals with Texture Maps are examined, highlighting their critical role in adding detail and realism to 3D objects.

Session 5 introduces UV Texture Mapping, teaching how to effectively unwrap UVs and apply textures accurately to their models.

Session 6, covers Bump Mapping, demonstrating how to simulate surface details without modifying geometry.

Session 7 focusses on the creation and application of Specular Maps, which control the shininess and highlights on surfaces, contributing to a model's overall realism.

Session 8 will equip you with the skills to create seamless textures in Adobe Photoshop, enabling them to design high-quality textures that can be easily integrated into their 3D projects.

Learning Outcomes

After completing this module, you will be able to:

- Demonstrate surface material shading.
- Explain and demonstrate the procedure to create and assign material using shader on different objects.

- Demonstrate the knowledge of networking between shaders
- Differentiate between various types of maps in texturing; and
- Explain the purpose of various types of maps in texturing.
- Explain and demonstrate the use of UV texture
- Explain and understand the process to create Bump Maps
- Demonstrate the process of creating Specular Maps
- Describe about the seam and how to create a seamless texture using Photoshop tools

Module Structure

Session 1: Surface Shading and its Properties

In Autodesk® Maya®, shading and texturing work together to control the visual characteristics of a 3D object by defining its colour, transparency, shininess, and other surface details. Here is a breakdown of the key concepts and how they are applied:

Shading and Texturing in Maya

i. **Shaders (Materials):** Each new object in Maya starts with a default shader called Lambert1, a neutral grey, non-reflective material that allows objects to render visibly. Shading applies colour, surface bumps, transparency, and shine

to an object, and is distinct from texturing, which adds details to these attributes.

ii. **Texture Mapping:** Texture Mapping adds detailed surface attributes by applying images or patterns to a shader's attributes. For instance:
- Adding a scanned photo of a brick wall to the colour attribute is considered a texture.
- Applying a Bump Map to simulate brick wall contours is another form of texturing.

iii. **Shader Networks:** These are interconnected nodes that define material attributes. Texturing is often informally referred to as part of shading since textures are applied to shaders.

iv. **Material Attributes:** Material attributes simulate how an object naturally reacts to light in a 3D environment. Common attributes include:
- **Colour**: The base colour of an object. Colours can be basic or controlled by advanced shaders (e.g., Ramp Shader).
- **Transparency**: Ranges from fully opaque (0) to fully transparent (1). Textures can also define varying transparency in regions of the material.
- **Specular Highlights (Shininess)**: Available in certain shaders (e.g., Phong, Blinn), this controls the shiny reflection on an object. One can adjust both the intensity and colour of these highlights.
- **Bump Mapping**: Creates the illusion of texture by altering the way light interacts with the surface.

v. **Surface Shading vs. Surface Texture**
- **Surface Shading**: Defines an object's basic appearance (e.g., colour, transparency, shine) based on its material and light interaction.
- **Surface Texture**: Adds detailed surface qualities like relief (bumps, grooves) or atmospheric reflections. Textures can be Colour Maps, Transparency Maps, or Bump Maps.

vi. **Colour and Transparency Manipulation**
- **Colour**: Adjust directly through the colour attribute or apply Colour Maps. Additional utilities like Blend Colours and Gamma Correct enable blending, contrast adjustment, and colour conversions.
- **Transparency**: Change transparency directly or use a Transparency Map to control specific transparent and opaque areas.

vii. **Specular Highlights**

- Specular attributes add glossy reflections that vary depending on the type of material (e.g., Blinn or Phong). Adjusting the Specular Shading attributes affects highlight size and colour, creating a shiny effect visible as a white glow on the material's surface.

Note: Only materials with specular attributes (Anisotropic, Blinn, Phong, and PhongE) have surface highlights. The specular highlight is the white shiny glow on the material **(Figure 2.1)**.

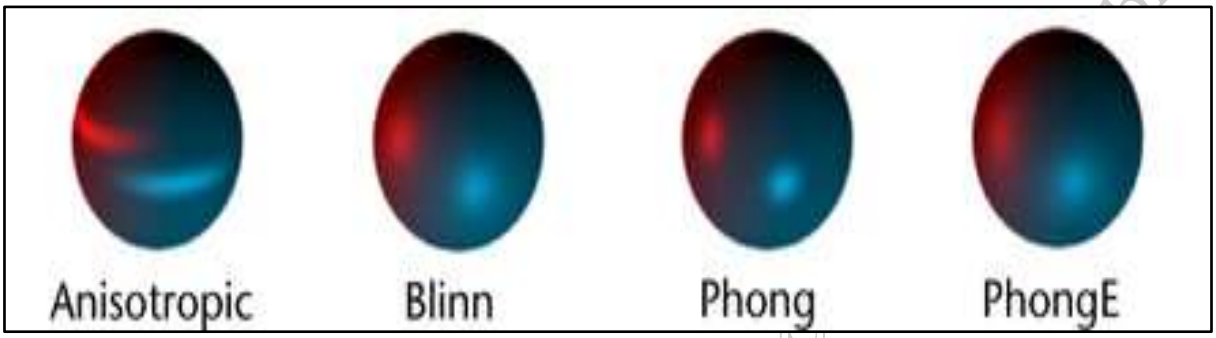


Figure 2.1: Preview of applied shaders on default object

Specular Highlight?

Some surfaces are shinier than others (for example a wet fish has a shinier surface than a dry leaf). Depending on how shiny a surface is, it reflects light in different ways.

Shiny objects reflect light directly; matte objects diffuse light. Specular highlights show the places on the object where the light sources are reflected at consistent angles; reflections on an object show, among other things, light bounced from surrounding objects **(Figure 2.2 and 2.3)**.

Specular highlights depend directly on the view (camera), not the position of the light, like diffuse shading does.

Note:
The Blinn material is recommended for shiny surfaces in animations. Highlights on other specular materials, like Phong and PhongE, may flicker when animated.

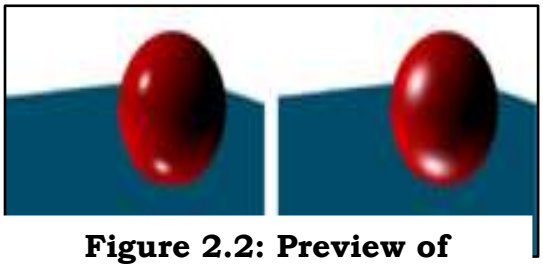


Figure 2.2: Preview of applied Highlights

Highlights

The size of a specular highlight on a surface makes the surface look either flat or shiny.

Highlight Colour

The colour of highlights on surfaces can be controlled and is an important aspect of realistic shading in 3D texturing.

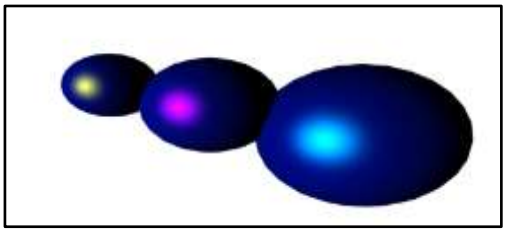


Figure 2.3: Preview of colour control on

Reflections

You can control the degree of reflectivity as well as other surface properties like refracted Colour.

Activities

Activity 1: Define Specular on object

Objective: The objective of this activity is to understand and apply the concept of specular highlights in 3D modelling using Autodesk® Maya®.

Materials Required: computer system, Autodesk®Maya®

Procedure

- Create Basic Shapes: Start by creating a few simple shapes (e.g., spheres, cubes, or cones) in the Maya workspace.
- Experiment with Shaders: Explore different shaders such as Phong, Blinn, and Lambert to observe how each shader affects the object's surface. Note how each shader type impacts the appearance of highlights and colours on the object.
- Apply Specular Mapping:
- Select one of the shapes and open the Material Attribute Editor.
- Locate the Specular Attribute section.
- Map a texture to the Specular attribute to create a Specular Map. This map will control where and how the highlights appear on the object's surface, allowing you to adjust the shine and intensity of reflections.
- Observe the Effects: Adjust the settings of the Specular Map to see how different textures affect the shininess and highlight size on the object. Experiment with different colours and intensities for the highlights to better understand how Specular Mapping affects the overall material appearance.

Check Your Progress

A. Multiple Choice Questions

1. What is the default shader applied to new objects in Autodesk® Maya®?
a) Phong
b) Blinn
c) Lambert1
d) Anisotropic

2. Which of the following attributes is not typically part of basic surface shading?
a) Colour
b) Specular Highlight
c) Texture Bump Map
d) Animation Keyframes

3. What does a Bump Map simulate on a surface?
a) Surface colour
b) Transparency changes
c) 3D contours and surface irregularities
d) Specular highlights

4. Which shader type is recommended for creating shiny surfaces in animations to avoid flickering?
a) PhongE
b) Blinn
c) Lambert
d) Anisotropic

5. How can you control the transparency of an object in Maya?
a) By adjusting only the colour attribute
b) By modifying the specular shading attribute
c) By using a Transparency Map or adjusting the transparency attribute
d) By changing the diffuse attribute

6. Which statement about specular highlights is true?
a) They depend on the position of the light only.
b) They are independent of the camera view.
c) They are controlled by the specular shading attributes and can be coloured.
d) They are only visible on Lambert materials.

7. What is a common use for the Blend Colours utility in Maya?
a) To adjust the transparency of a material
b) To simulate Bump Mapping
c) To blend two different colours or maps on a material
d) To change the surface reflectivity

8. Which shader types have specular highlights by default?
a) Lambert and Anisotropic
b) Phong, PhongE, Blinn, and Anisotropic
c) Lambert and Blinn only
d) Only Phong

9. What can affect the size and intensity of a specular highlight on a material?
a) The object's position only
b) The camera angle and material attributes
c) Only the light's distance from the object
d) The shader type and Diffuse Map

10. Why might highlights on Phong and PhongE materials flicker during animations?
a) They do not reflect light accurately.
b) The specular shading is unstable during camera movement.
c) The highlights are too diffused.
d) They lack reflective attributes.

Session 2: Shading Network

The colours and textures that define the look of the material, can be represented as a shading network. In this example, a rock texture defines the colouring for the Phong material, while the mountain texture defines the incandescence.

About Shading Networks

A shading network is a collection of connected rendering nodes that defines how colours and textures contribute (usually with lights) to the final look of surfaces (materials). A shading network typically consists of any number of connected rendering nodes plugged into a shading group node.

A good portion of your time building shading networks is spent connecting node attributes to each other and adjusting node attributes to describe what a surface should look like and how it should be positioned.

Importing Shading Networks

By default, when you import a file more than once into Maya, the geometry and shading networks are duplicated. These redundant shading networks and reassignment of geometry inflate the scene size and load time, and clutter your working scene. You can prevent the duplication of a shading network (unless, of course, you need it) when you import a scene, or you can delete any duplicated network from within your working scene **(Figure 2.4)**.

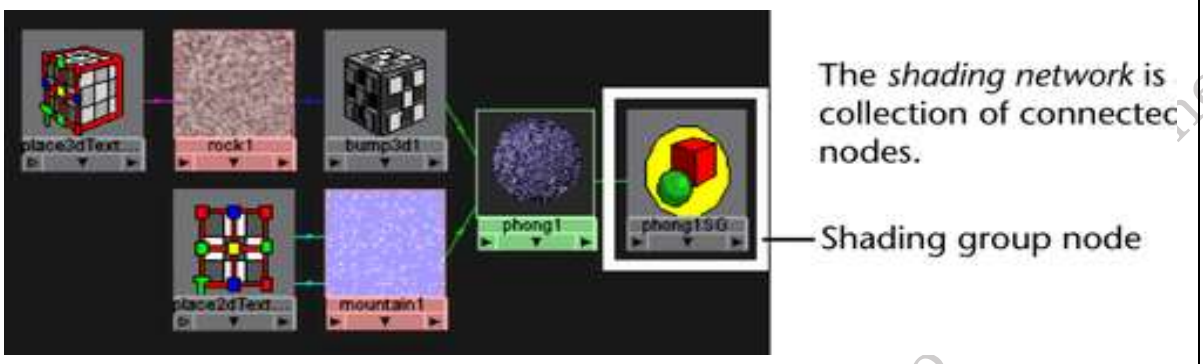


Figure 2.4: A view of Shading Network

To prevent redundant shading networks on import, when you import a scene (File > Import>), turn on Remove Duplicate Shading Networks.

To delete a redundant shading network, in Hypershade, select Edit > Delete Duplicate Shading Networks.

Shading Group Node

Shading networks are designed as a data flow network, where data streams from the left side of the network toward a final shaded result that emerges from the right node.

The rightmost nodes (which are not always visible by default; click the Input and Output Connections button in the Hypershade to see it) are the Shading Group for that particular network. The Shading Group is a collection of materials, textures, and lights that efficiently describe all the necessary attributes required to shade or render an image. All of the nodes connected upstream (that is, further to the left of the node) of the shading group contribute to the final look of surfaces in the scene. Adjusting any node's attributes or connections causes a downstream (that is, farther to the right) reaction that can be seen in the final rendered image. It is not recommended that you manually try and edit the shading group connections. Instead, always use the higher-level interfaces, like the Hypershade and shading group editors, to ensure the connections do not become inconsistent which will result in the surface not appearing when rendered.

Render Nodes

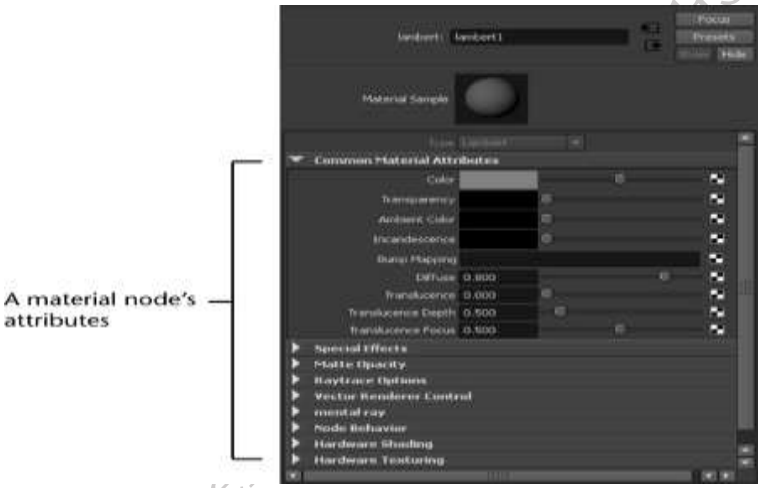
Render nodes are individual components that interconnect to serve as building blocks for producing all rendering effects. Like other nodes in Maya, render nodes can be

animated or mapped to the parameters of other nodes. Texture nodes, placement nodes, and material nodes, along with their input and output connections (attributes), define all aspects of the final rendered images, including surfaces, lights, and shadows.

Nodes can be connected to create the desired effects. Additionally, nodes can be shared to establish visual relationships and improve rendering efficiency. For instance, two objects can share a single texture, making them appear the same while reducing memory usage and processing requirements.

Render Node Attributes

A node attribute describes one aspect of the node. When an attribute of a node is adjusted, one aspect of its description is modified. For example, the Colour attribute can be changed from red to blue, or an opaque object can be made transparent by adjusting the transparency attribute **(Figure 2.5)**.



Although some attributes can be adjusted interactively, precise numerical values are typically verified and entered using the Attribute Editor. Node attributes can also be displayed and adjusted in the Attribute Spread Sheet or the Channel Box. Only some attributes are displayed in the Channel Box, while all attributes are visible in the Attribute Editor and Attribute Spread Sheet.

Render Node Connections

Connections between node attributes are shown by coloured arrowed lines in the Hypershade. The connection lines between nodes indicate what type of data flows through the connection. Depending on the types of nodes and connections used, different information is passed. That is, values may be of colour, distance, position, and angle or object ID.

Some information can come as a single value (for example, Out Alpha is a single value) or as a triple (for example, an RGB value or an XYZ value). Triple connections are represented by green connection lines.

Single, double, triple, data, and array data each have an assigned default colour **(Figure 2.6)**. The colours and their meanings can be customized to suit specific preferences or needs.

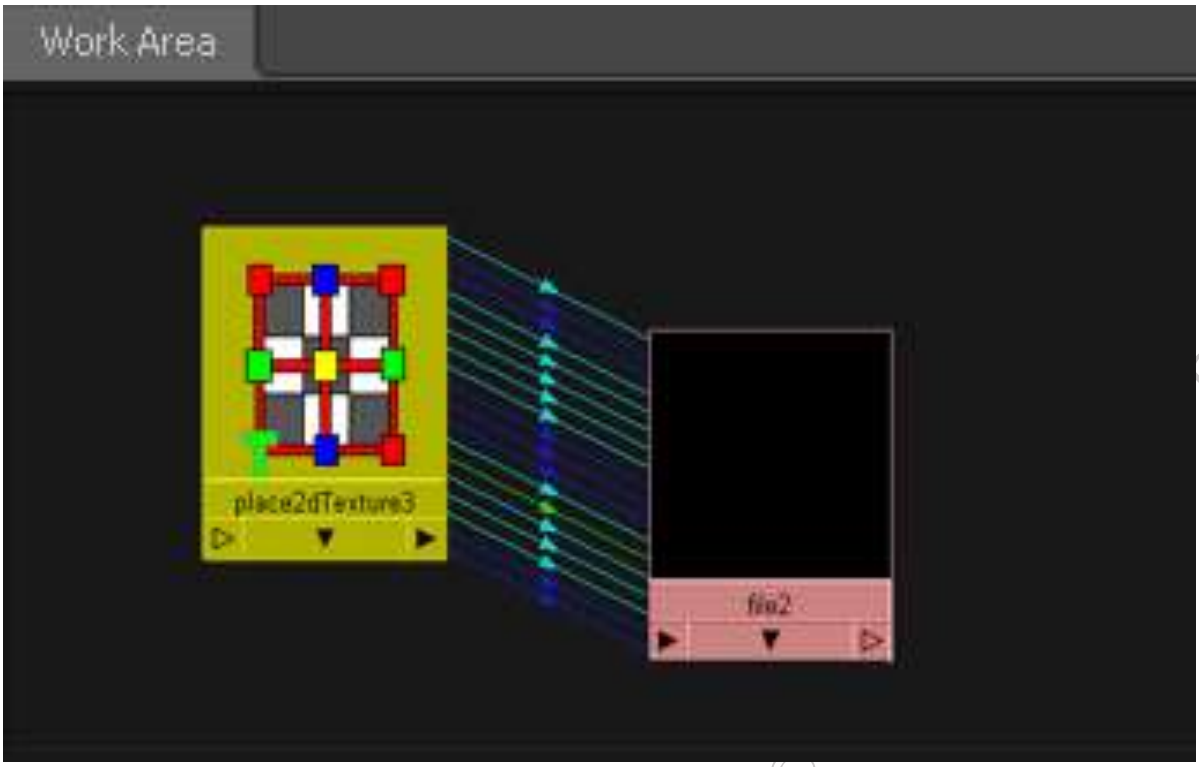


Figure 2.6: A View of Render Node Connection

Note: Pointing to one of the lines connecting two nodes by their attributes will display information about the connection.

The Connection Editor

Each node has a default attribute and a list of commonly connected attributes that allow for interactive node connections (dragging and dropping in Hypershade). The Connection Editor is the most efficient tool for fine-tuning a shading network and making non-default connections **(Figure 2.7)**.

The Connection Editor displays node network information in a side-by-side layout, enabling the user to view two connected nodes at once. This layout facilitates easy navigation between nodes, allowing the user to see the outputs or inputs of each node. Connections can be made in either direction within the node network, simplifying the process of creating complex node relationships.

The blending mode, specified in the options bar, controls how pixels in the image are influenced by a painting or editing tool. Understanding the blending mode helps

visualize how colours interact and affect the final result of the applied image adjustments.

Figure 2.7: A View of Connection Editor

Activities

Activity 1: Apply different texture on a 3D model like Doll.

Objective: The objective of this activity is to practice applying various textures to different parts of a 3D doll model using Autodesk® Maya®.

Materials Required: computer system, Autodesk®Maya®

Procedure:

- Develop Texture Mapping Skills: Enable participants to effectively apply and adjust textures on different parts of a 3D model, enhancing their understanding of Texture Mapping.
- Enhance Realism in 3D Models: Encourage participants to create realistic representations by using specific shaders tailored to each part of the doll, such as skin for the face, fabric for the dress, and more.
- Foster Creativity: Allow participants to express their creativity through the choice of colours, patterns, and textures that define the doll's appearance.
- Understand Shader Properties: Help participants explore various shader properties and their impact on the final rendered appearance, emphasizing how different materials can affect the look of surfaces.

- Gain Experience in 3D Modelling Workflow: Provide participants with hands-on experience in the workflow of creating and texturing a 3D model, reinforcing their skills in using Autodesk® Maya® effectively.

Check Your Progress

A. Multiple Choice Questions

1. What is a shading network in Autodesk® Maya®?
a) A collection of lighting setups in a scene
b) A group of connected rendering nodes defining how surfaces look
c) A tool for animating objects
d) A set of key frames for object movement

2. How can you prevent redundant shading networks when importing a scene?
a) Turn on Remove Duplicate Shading Networks during import
b) Use Edit > Delete Shading Networks
c) Manually delete each duplicate network in the Outliner
d) Adjust settings in the Render View

3. What does the Shading Group Node represent in a shading network?
a) A node that generates final rendered images
b) A combination of materials, textures, and lights for shading
c) A node to create new materials
d) A node that connects directly to the geometry

4. What should you do if you need to adjust connections in a shading group node?
a) Manually edit the shading group connections
b) Delete and recreate the shading group
c) Use the higher-level interfaces like Hypershade
d) Edit using the Outliner

5. Which of the following best describes a render node?
a) A node used only for animating objects
b) A building block used for rendering effects
c) A type of Texture Mapping tool
d) A lighting node

6. How can you connect nodes in Maya's Hypershade?
a) By using the Connection Editor or dragging and dropping
b) Only by using default attribute connections
c) Only through the Attribute Spread Sheet
d) By scripting in MEL

7. What information does the Connection Editor in Maya provide?
a) Only the colour of a node
b) The side-by-side view of connected nodes' inputs and outputs
c) The frame rate of the scene
d) The shading group hierarchy

8. Which tool is best for fine-tuning non-default connections in a shading network?
a) Attribute Editor
b) Outliner
c) Connection Editor
d) Graph Editor

9. What type of information is passed through a green connection line in Maya's Hypershade?
a) Single values (e.g., Out Alpha)
b) Triple values (e.g., RGB or XYZ)
c) Boolean data
d) Array data only

10. What does the blending mode in the options bar control?
a) The render speed of an image
b) How pixels in the image are affected by a painting or editing tool
c) The transparency of 3D objects
d) The animation path of an object

Session 3: Creating & Assigning Material to Surface

To create a new material, attach a surface shader and assign it directly to an object. For comprehensive details on creating materials, refer to the sections on applying colour and shading to objects, as well as building materials using Hypershade.

Creating a Material

Use one of the following methods to create a material in Hypershade:

i. Right-click in Hypershade, then select a material from the pop-up menu (Create > Materials).
ii. Select a material from the Create menu in the menu bar.
iii. In the Create Bar, middle-drag a material swatch into Hypershade.
iv. Choose a material from the Create Render Node window.
v. Opening the Create Render Node Window.

Assigning a Material to Surfaces

Multiple methods exist for assigning a material to one or more surfaces.

Option 1:

- Right-click the object(s).
- Select Assign Existing Material, then choose among the existing materials in the scene.

Alternatively:

- Right-click the object and select Assign New Material, which opens the Assign New Material window to choose from available materials.
- Right-click the object and select Assign Favorite Material to choose from the Favorites list.

Option 2:

- In the scene view, select the surface(s) for material assignment.
- In Hypershade, middle-drag the material swatch over the selected surface(s).

Option 3:

- In the scene view, Shift-select the object, then click the material swatch in Hypershade.
- Right-click the material swatch in Hypershade and select Assign Material to Selection from the pop-up menu.

Option 4:

- Middle-drag and drop a Hypershade swatch onto an object in the IPR Render View.
- Assigning a Material to Multiple Surfaces

Select the surfaces in the view.

In Hypershade, right-click the material swatch and select Assign Material to Selection from the pop-up menu.
Assigning a Material to a Group of Faces on Polygonal Surfaces
Several methods are available for assigning materials to faces on polygonal surfaces.

Option 1:

Right-click the surface.
Select Face from the marking menu.
Choose Select by Component Type icon (or press F11).
Assigning a Material to Selected Faces:

i. Select the faces by dragging or Shift-clicking.
ii. In Hypershade, right-click the material and select Assign Material to Selection from the pop-up menu.
iii. Maya applies the material to the selected faces **(Figure 2.8)**.

Assigning Shaders to Polygon Faces

A shader can be assigned to faces on a polygonal surface using a Maya Artisan brush. This feature is useful for applying different shaders to different faces of the same model, such as texturing a building that is part brick and part glass.

Assigning a Shader to Faces with an Artisan Brush:

In the view, select the object for material assignment.
In Hypershade (Window > Rendering Editors > Hypershade), right-click the material swatch and select Paint Assign Shader from the marking menu.
An Artisan brush appears in the scene view. Drag the brush over the faces to apply the shader **(Figure 2.9)**.

Figure 2.8: Hypershade window

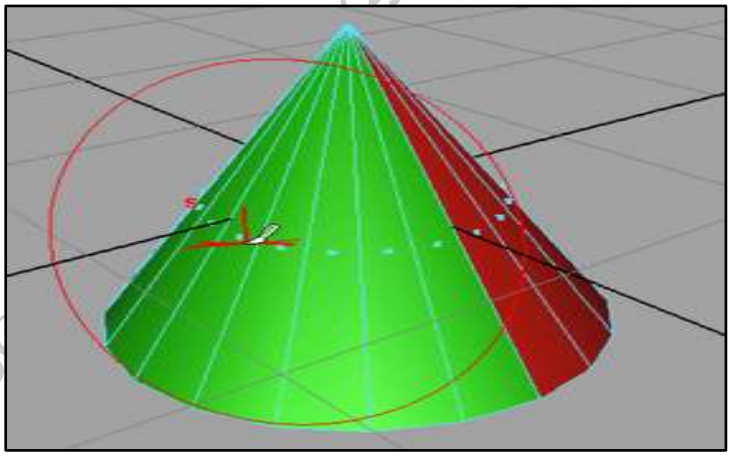


Figure 2.9: Example on how Paint assign shader allows you to assign a shader to faces using artisan brush.

Activities

Activity 1: Explain the process of creating material

Materials Required: Computer system, and Autodesk®Maya®

Procedure

- Open Hypershade: Launch Autodesk Maya and navigate to the Hypershade panel, which is where you create, modify, and manage materials and textures.
- Create a Material: Right-click in the Hypershade workspace and select a material from the pop-up menu by going to Create > Materials. Alternatively, you can also use the Create menu from the menu bar to choose a material.
- Use the Create Bar: In the Create Bar, find a material swatch, then middle-drag it into the Hypershade workspace. This action places the material into the workspace, ready to be adjusted.
- Open the Create Render Node Window: You can also open the Create Render Node window to select a material. This window allows you to choose from various material types and options to create the material suitable for your project.

Check Your Progress

A. Multiple Choice Questions

1. Which of the following is NOT a method to create a material in Hypershade?
a) Right-click in Hypershade and select a material
b) Drag and drop a material swatch from the Create Bar
c) Select a material from the Assign Material menu
d) Choose a material from the Create Render Node window

2. How can a material be assigned to multiple surfaces in Maya?
a) By right-clicking and selecting "Assign New Material"
b) Middle-drag the material swatch over the selected surface(s) in Hypershade
c) Using the Channel Box
d) By adjusting the material's properties in the Attribute Editor

3. To assign a material to a selected group of faces on a polygonal surface, which of the following is the correct order?
a) Right-click the object, select "Assign New Material," and choose faces
b) Shift-select the faces and then drag the material to the selection
c) Right-click the material and choose "Assign Material to Selection"
d) Press F11, select faces, and apply the material using the Attribute Editor

4. When using an Artisan brush to assign a shader to polygon faces, what is the first step?
a) Select the shader in the Attribute Editor
b) Select the object for material assignment
c) Right-click and assign a material from Hypershade
d) Use the Paint Assign Shader option from the marking menu

5. Which method is used to assign a material to an individual face on a polygonal surface in Maya?
a) Use the Channel Box to assign material
b) Right-click the face and assign material from the marking menu
c) Right-click the object and select "Assign Existing Material"
d) Use the "Assign Material to Selection" from the Hypershade menu

6. In which scenario would you use the "Assign Favorite Material" option in Maya?
a) To assign a shader to a polygonal surface
b) To quickly apply a frequently used material to an object
c) When you need to apply different shaders to different faces
d) When importing a new material into the scene

7. Which of the following is the purpose of the "Assign Material to Selection" option in Hypershade?
a) To assign a material to a group of faces on a polygonal surface
b) To create a new material in the scene
c) To delete a material from the scene
d) To duplicate a material from one object to another

8. What happens when a material is middle-dragged over a selected surface in Hypershade?
a) The material is applied to the entire scene
b) The material is assigned to the selected surface(s)
c) The material is copied to the clipboard
d) The material properties are adjusted in real-time

9. What is the primary benefit of using the Artisan brush for assigning shaders to polygon faces? a) It allows automatic Texture Mapping
b) It enables the application of different shaders to different faces of a model
c) It creates a realistic lighting effect for each face
d) It assigns a single shader to all faces in the scene

10. Which method can be used to apply materials to multiple objects simultaneously?
a) Right-click on each object and assign the material separately
b) Middle-drag the material over each object individually
c) Use the "Assign Material to Selection" option after selecting all objects
d) Use the Attribute Editor to apply the material to each object

Session 4: Texture Maps

Texture Maps are used on the surfaces of 3D models to add repeating textures, patterns, or unique visual effects. They help define intricate details and surface characteristics on computer-generated graphics or 3D models.

Types of Map

Diffuse Map

i. This is the most commonly used Texture Mapping technique, which projects a Bitmap image onto a 3D geometry surface, preserving its original pixel colours.
ii. Any Bitmap image, including scanned photos or images taken with a digital camera, can serve as a Diffuse Map to achieve a photorealistic quality.
iii. Image editing software can also be used to create pre-rendered texture effects like shadows, bevels, bumps, lighting, or weathering. This method efficiently simulates real-world 3D effects while significantly reducing system resources and rendering time.

Opacity Map

i. Make transparency and cut-out effects from grayscale images. The black part will get cut out; the white part will be fully displayed; the gray values determine the transparency (alpha) level of the object **(Figure 2.10 and 2.11)**.

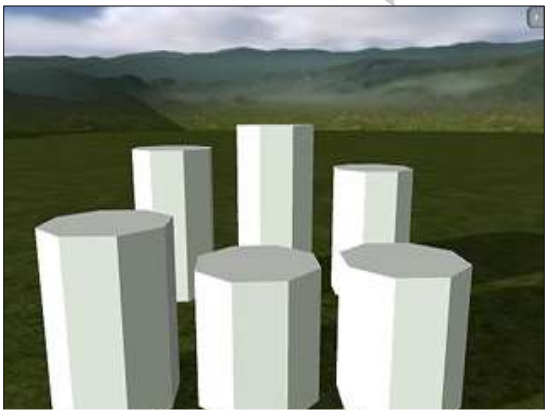


Figure 2.10: Props with no texture

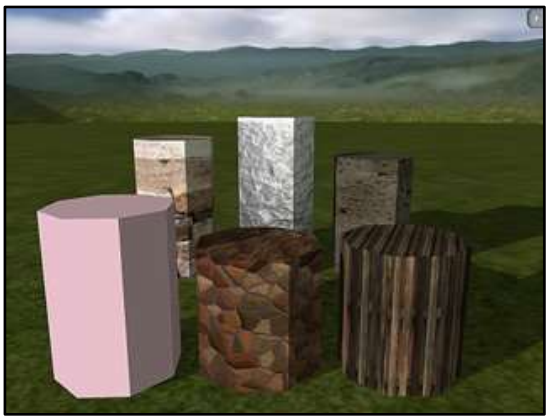


Figure 2.11: Props with different textures

- Use bright gray RGB (253,253,253) on the Opacity Map to make 2-sided 3D Surface from the Plane mesh **(Figure 2.12 and 2.13)**.

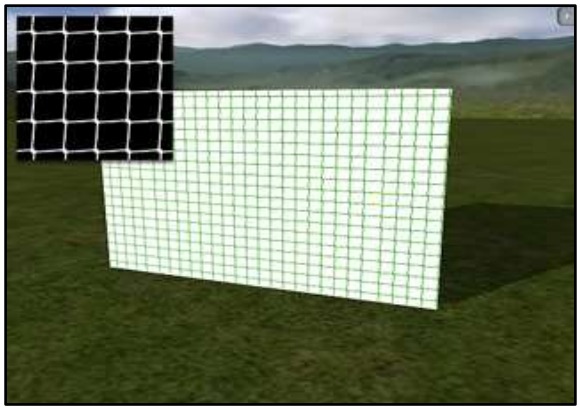


Figure 2.12: Prop with texture and an image as the mask

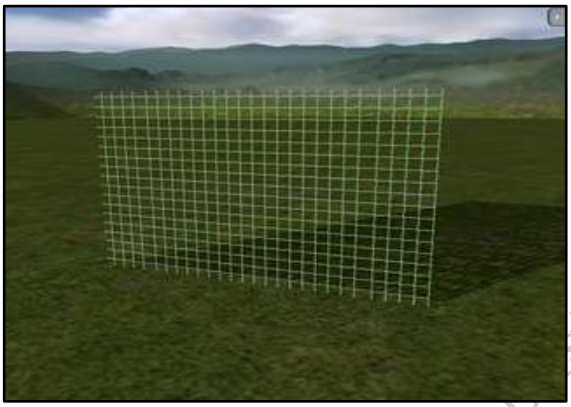


Figure 2.13: Transparent prop masked out

Bump Map

Bump Mapping uses the grayscale values of an Image Map to create variations in the shading of the surface to which the map is applied. It adds details to 3D models without increasing the number of polygons. White areas of a Bump Map are shown as high and black areas are shown as low **(Figure 2.14)**.

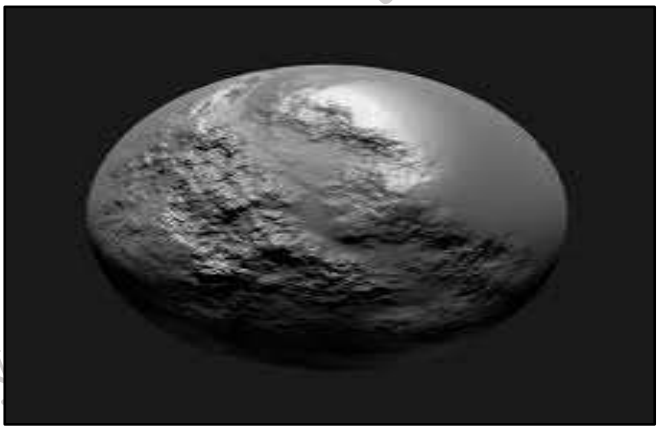


Figure 2.14: Sample showing Bump Map

By moving around the light source we can see how the angular light projection changes the bump look.
If the light is facing the surface from a straight 90 degrees angle it the bump effects are the least noticeable. Bump is an edge blur from the bump source image causes a softer bevel effect.

Bump Maps are grayscale textures applied to objects to create the illusion of surface relief such as elevations and depressions on a flat surface. Unlike Displacement Maps, Bump Maps do not alter the actual geometry of the surface. Instead, they simulate depth by adjusting the direction of the surface's normals according to the Bump Map's Alpha gain value (**Figure 2.15)**. This effect makes the surface appear textured without increasing the polygon count or modifying its shape.

Figure 2.15: Prop with texture and an image as the bump

Use Bump Maps to create very shallow reliefs. For example, one can make objects look like they are embossed, have shallow rolling hills, and so on. Because Bump Maps are not true surface relief, they

- cannot cast or receive shadows
- cannot be seen if you silhouette the mapped object
- take less time to render than Displacement Maps

Note:

File textures that are used for Bump Mapping are usually connected via their out Alpha attribute. If the corresponding texture image file does not provide an alpha channel, then the bump effect may be missing when using certain image formats. To avoid this, turn on the Alpha is Luminance attribute in the Colour Balance section of the File Texture node **(Figure 2.16)**.

Figure 2.16: Example of an object without and with Normal Map

Map surface relief (bumps or displacements) to the Blinn surface material to reduce highlight roping or flickering. The soft highlights on Blinn surfaces are less likely to cause roping or flickering than the harder highlights on Phong surfaces. Although scratches are like little depressions, 2D textures can be easily achieved.

Normal Map

- Clicking the Import Bump button opens options to import a map. If the map being loaded is a Normal Map, check the designated box.
- A Normal Map (used with pixel shaders only) is generated from a high-polygon model. It impacts the surface's appearance similarly to a Bump Map but offers finer levels of detail.
- iClone supports importing Normal Maps created in software like ZBrush or 3D Studio Max. Using Normal Maps allows simple, low-poly models to display as highly detailed 3D objects.
- If the image being loaded is not a specifically designed Normal Map, the resulting effect may be less effective.

Displacement Maps

Displacement Maps are grayscale textures applied to objects to create actual surface relief such as elevations and depressions on a flat surface. Unlike Bump Maps, displacement maps modify the object's geometry, producing a realistic 3D effect by physically altering the surface **(Figure 2.17)**.

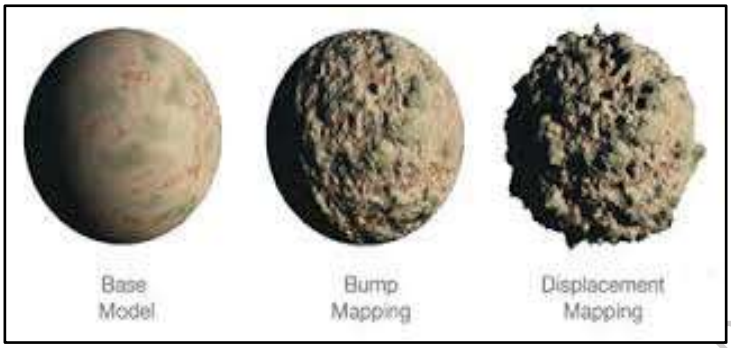


Figure 2.17 Displacement Maps

With Displacement Maps, depressions and elevations become part of the geometry of the object, changing the topology, unlike Bump Maps that only create the illusion of surface relief.

Note:

- Because displacement changes the geometry of an object, Displacement Mapped objects usually require further tessellation (more triangles, which the renderer uses to approximate the smoothness of the surface). By default, Maya uses Feature-based Displacement Mapping to automatically add more triangles where required **(Figure 2.18)**.
- File textures that are used for Displacement Mapping are usually connected via their outAlpha attribute. If the corresponding texture image file does not provide an alpha channel, then the displacement effect may be missing when using certain image formats. To avoid this, turn on the Alpha is Luminance attribute in the Colour Balance section of the File Texture node.

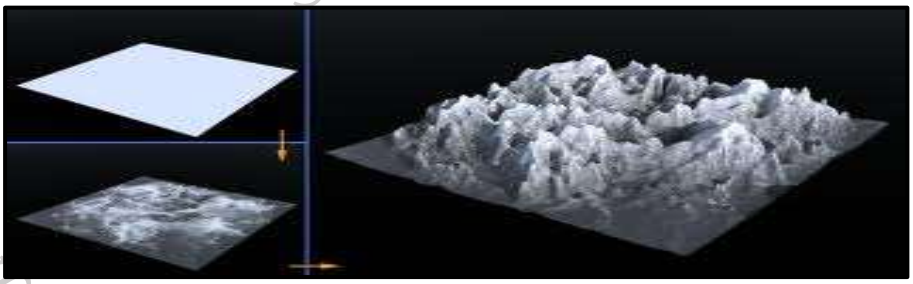


Figure 2.18: Another example of Displacement Map

Displacement Maps move an object's vertex. By default, the height of the displacement is determined by the Alpha Gain value in the Displacement Map's Attribute Editor **(Figure 2.19)**. When Alpha is Luminance is enabled, the transparency effect is determined by the brightness or intensity of the pixels, rather than by their colour information. Use Displacement Maps to create shallow or deep surface relief. For example, creating embossing, mountain peaks and valleys, spikes, and so on. Because Displacement Maps create true surface relief, they:

- can cast or receive shadows
- can be seen if you silhouette the object
- take more time to render than Bump Maps, which create the illusion of surface relief.

Figure 2.19: Prop with Texture and a specular image

Note:

A texture can be used as a Displacement Map by connecting it to the displacement mat attribute within the material's shading group. This setup allows the texture to modify the surface geometry, creating realistic surface relief effects.

Specular Map

This Texture Mapping method allows parts of an object to have a Specular effect.

Glow Map

A Glow Map is a type of Texture Map used in 3D graphics to simulate areas of an object or scene that appear to emit light. This Texture Mapping technique allows users to control the glow shape, Colour and strength **(Figure 2.20)**.

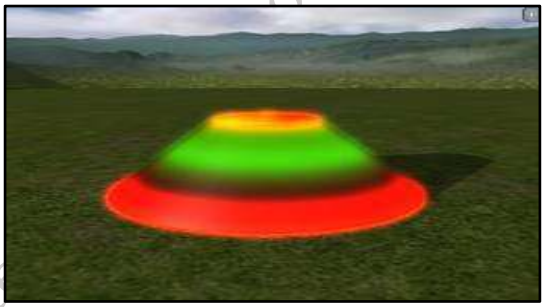


Figure 2.20: Prop with Glow Map

i. Glow Maps will blend with your original Diffuse Maps, so the lighter the diffuse Colour (or glow Colour), the stronger the glow effect.

ii. A bright Diffuse Map in combination with a bright Glow Map might cause overexposure.

Note:

To create a subtle and effective glow effect:

- Choose a diffuse image which could ideally glow in the real world.
- Prepare the Glow Map, pattern, and Colour design
- Start by testing from a darker Glow Map, then increase the brightness step by step to see the best brightness setting
- Decrease the overall ambient light

Reflection Map

Reflection Map is also referred to as Environment Map. The Image Map is projected onto a 3D surface to represent a reflection of the environment **(Figure 2.21)**.

Figure 2.21: Props with Reflection Map

Notes:

To create a good Reflective effect, one should start by using an object that has high specular highlight and gloss values. Then apply black or darker images as the Diffuse Map to help to make the surface work like a mirror which can fully reflect the Reflective Map content. If the Diffuse Map itself is too bright the front light plus reflective setting could cause the result to be overexposed.

Adjust the camera and light direction to see the natural changes to the reflective surface. Placing a reflective object on a simple 2D background can be enhanced by using high-contrast scenery images imported as a Reflection Map to mimic the reflective appearance. This technique involves applying a Reflection Map to the reflective object, which simulates reflections of the environment in the object's surface. The high-contrast nature of the scenery images helps to create a more realistic and dynamic reflection effect.

Activities

Activity 1: Create a Texture Map an object

Materials Required: Computer system, and Autodesk®Maya®

Procedure

1. **Create a 3D Object:**
   - Launch Autodesk® Maya®.
   - Design a **Steel Kettle** as your 3D object. Use the appropriate modeling tools to shape it into the desired form.
2. **Apply Texture Map:**
   - Select a Texture Map (e.g., a steel or metallic texture) and apply it to the surface of the 3D steel kettle model.

- Adjust the texture coordinates and mapping to ensure proper alignment on the object.

3. **Composite with 2D Textured Background:**
   - Import a 2D textured background image (e.g., a kitchen or countertop image).
   - Position the 3D kettle in the scene to match the perspective of the background.
   - Composite the 3D kettle onto the 2D background, ensuring realistic blending of shadows, light, and reflections.
4. **Render the Scene:**
   - Set up the camera and lighting to enhance the scene's realism.
   - Render the final composition with both the 3D kettle and 2D background.

Check Your Progress

A. Multiple Choice Questions

1. Which of the following describes the Diffuse Map in Texture Mapping?
a) It creates transparency and cut-out effects.
b) It simulates surface relief by changing the geometry.
c) It applies a Bitmap image to a 3D surface, preserving original pixel colours.
d) It adds actual surface relief to the geometry.

2. What is the primary function of an Opacity Map?
a) To simulate light reflections on a surface.
b) To create transparency and cut-out effects using grayscale images.
c) To define the colour of a 3D object.
d) To add bumps and dents to a 3D surface.

3. Which of the following is a characteristic of Bump Maps?
a) They modify the geometry of a surface.
b) They use grayscale values to simulate surface relief without increasing polygon count.
c) They require more rendering time than Displacement Maps.
d) They cast shadows and receive light like actual surface relief.

4. What is the key difference between Bump Maps and Displacement Maps?
a) Bump Maps alter the geometry, while Displacement Maps simulate surface relief.
b) Displacement Maps modify geometry, while Bump Maps simulate surface relief without changing geometry.
c) Both Bump and Displacement Maps modify surface geometry.

d) Displacement Maps are only used in 2D images, whereas Bump Maps are used in 3D models.

5. Which of the following maps uses grayscale images to modify the surface of a model and creates the illusion of depth?
a) Diffuse Map
b) Specular Map
c) Normal Map
d) Bump Map

6. What does a Normal Map do in 3D graphics?
a) It modifies the actual geometry of a surface.
b) It uses pixel shaders to simulate fine details and surface appearance.
c) It adds lighting effects based on the intensity of pixels.
d) It alters the specular highlights on a surface.

7. Which map is used to create actual surface relief by altering the geometry of a 3D model?
a) Bump Map
b) Displacement Map
c) Opacity Map
d) Specular Map

8. What effect does turning on the "Alpha is Luminance" attribute have on a Texture Map?
a) It makes the surface appear more reflective.
b) It alters the transparency effect based on pixel intensity, not colour.
c) It creates a bump effect on the surface.
d) It enhances the specular highlights.

9. Which of the following is true about Reflection Maps?
a) They modify the geometry of a 3D object.
b) They simulate the reflection of the environment on a surface.
c) They add glow effects to the surface.
d) They are used to create shadows on objects.

10. To create a subtle glow effect in 3D graphics, what should be done?
a) Increase the brightness of the Glow Map rapidly.
b) Use a bright Diffuse Map with a bright Glow Map.
c) Start with a darker Glow Map and gradually increase the brightness.
d) Decrease the Diffuse Map's brightness significantly.

Session 5: UV Texture Mapping

UV Mapping is the 3D modelling process of projecting a 2D image to a 3D model's surface for Texture Mapping. UV Maps or the Texture coordinates decide where the 2D Texture Map will fit into the 3D Object. It is a 2D representation of a 3D Object to be more precise.

By default, most 3D software automatically UV Maps the 3D objects we create. However, to gain more precise control over the placement of textures, it is necessary to manually map the UVs **(Figure 2.22)**.

Figure 2.22: Example of a box

i. Create a Polygon Cube using Create/Polygon Primitives/ Cube.
ii. This box is a cube measuring 1 foot which will results in 30 centimeters after the conversion of foot into the centimeters.
iii. One Foot = 30 Centimeters
iv. Set the height, width and depth parameters to 30 each.
v. Now we will apply, the texture for the wooden box as we have planned.
vi. To assign the textures on to the POLY CUBE, we need to examine the UVW Map coordinates.
vii. UVW Map coordinates will help in analyzing the texture placement for each side of the cube.
viii. Open up UV texture editor using window/UV texture editor. Select the cube to see the default UV coordinate points.
ix. One can see that software has already mapped the cube for you. It is because every Primitive Geometry is mapped with default set of UV coordinates **(Figure 2.23)**.

NOTE: Since the Maya application's default unit setup is in centimeters, we have calculated the same unit setup for measurement.

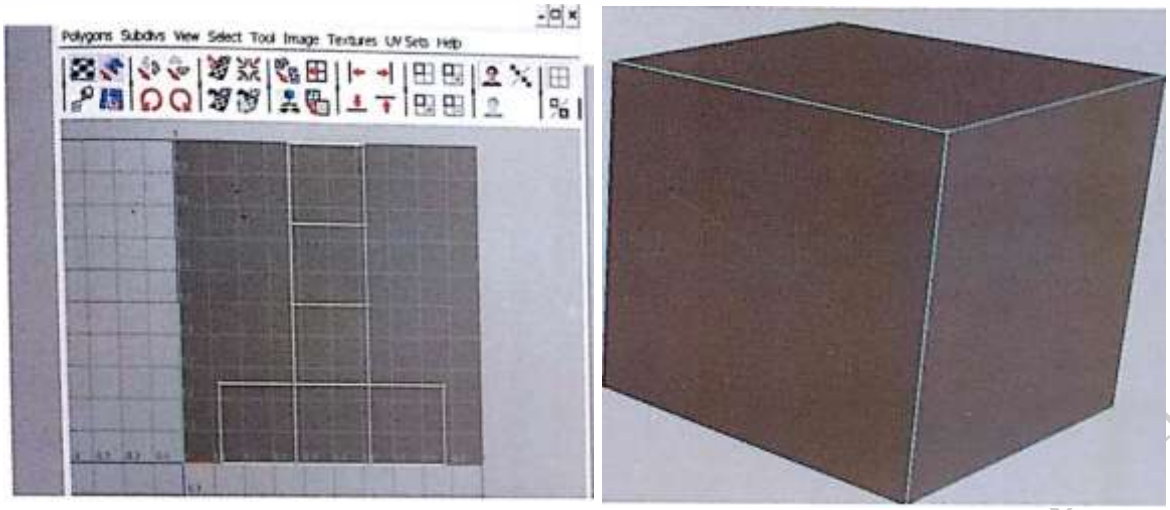


Figure 2.23: A view of UV texture editor (on Left) with opened UV's of the cube (on right)

NOTE: Observe the UV points in the UV Texture Editor. There are six quads. each representing side of the cube. To know the particular side and its UV points highlight the Face or UV points in the viewport. So whatever texture information will be filled into the UV points spacing. Same will be displayed in the viewport.

i. To map a desired texture Bitmap, various techniques can be employed. UV coordinates can be saved as a Bitmap, allowing each square of the UV space to be painted with a custom design or texture. Alternatively, texture Bitmaps from other files can be cut and pasted. When a single texture Bitmap is assigned to a poly cube, it is shared across each side, resulting in partial visibility of the Bitmap image **(Figure 2.24)**.

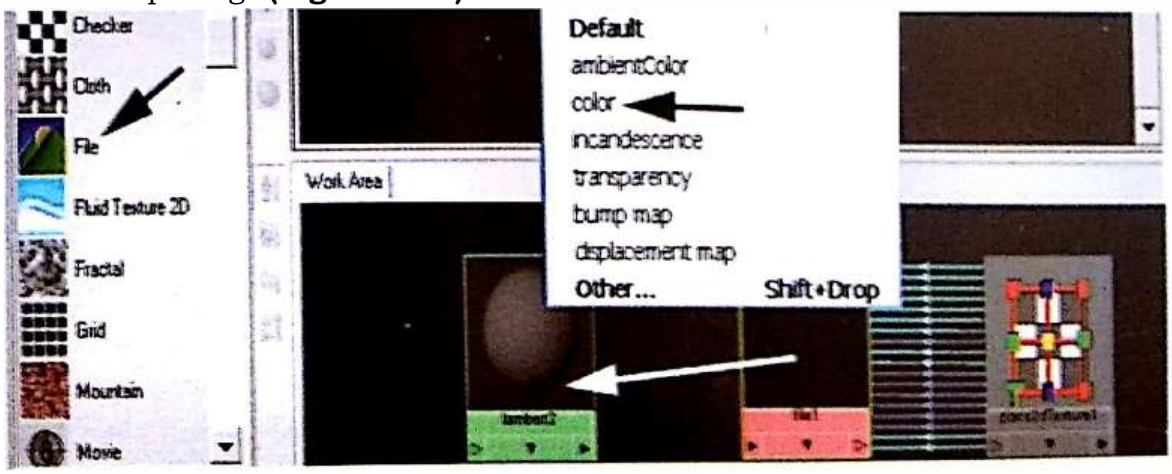


Figure 2.24: A view of Hypershade to assign material on the cube

ii. Let us work on the approaches to texture the Cube. Go to Hypershade, under Window/Rendering Editors/ Hypershade. Select the Lambert surface shader.

iii. To assign the texture Bitmap, there are two ways, first open the Lambert surface attributes and choose texture using Colour attribute and second, click on the File Node under 2D Texture nodes. Use the MMB, drag the File texture node onto Lambert surface shader node and select the Colour attribute channel from the options **(Figure 2.25)**.

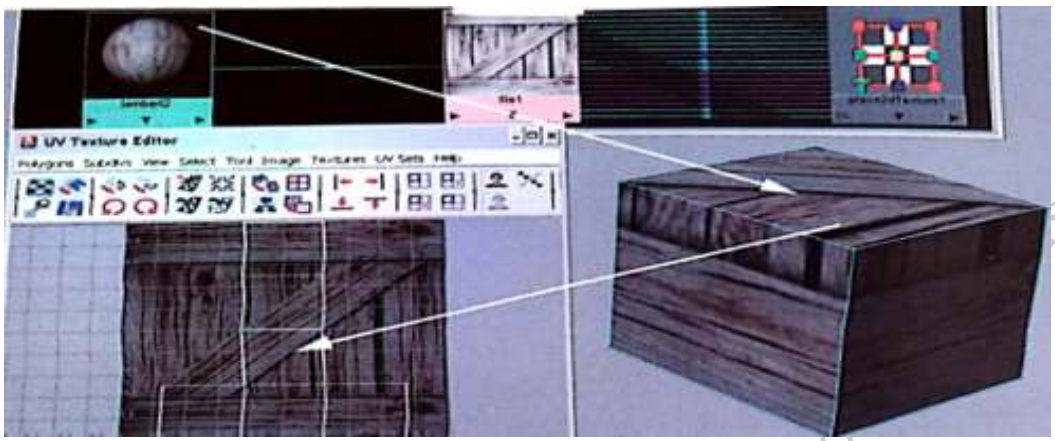


Figure 2.25: A view of UV texture window to compare UV points

iv. To assign the texture, double click the File texture node and browse the wooden texture file.

v. One can assign the Surface shader along texture to the Poly Cube in two ways, first select the Poly Cube in the viewport and assign the Poly Cube in two ways, first select the Poly Cube in the viewport and assign the texture by LMB (Left Mouse Button) and Assign material to selection or second MMB (Middle Mouse Button) drag the lambert node to the poly cube in the viewport.

vi. Open UV texture window and compare the UV points placement and texture placement in the viewport.

vii. If we observe the viewport for texture display on the Poly Cube, it's completely stretched on the whole Cube surface. To correct it we can either increase the tiles or translate the UV placement or scale and fit the each of the square space onto UV co-ordinate area (0-1). To do that, select the UV points in the UV Texture Editor and Split the UVs by going to menu Polygons/Split UVs. Scale up the each of the square up to 0-1 UV space **(Figure 2.26)**.

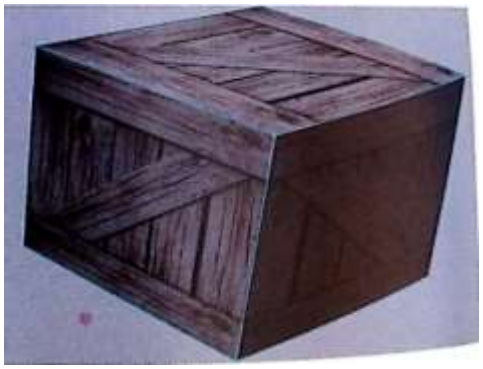


Figure 2.26: A textured box

viii. Go to step 5 and capture the UV's placement coordinated using UV snapshot under polygons menu of UV texture editor. Under the UV Snapshot settings specify the target path for saving the Bitmap.

ix. Set the desired resolution, (we have set it to 1024x1024 for medium quality). Keep the aspect ratio for square texture (you can change it for other proportions). Anti –Alias techniques is used for softer thin lines. Image file formats PNG (according to project requirement it can be changed) and UV range to 0-1 **(Figure 2.27)**.

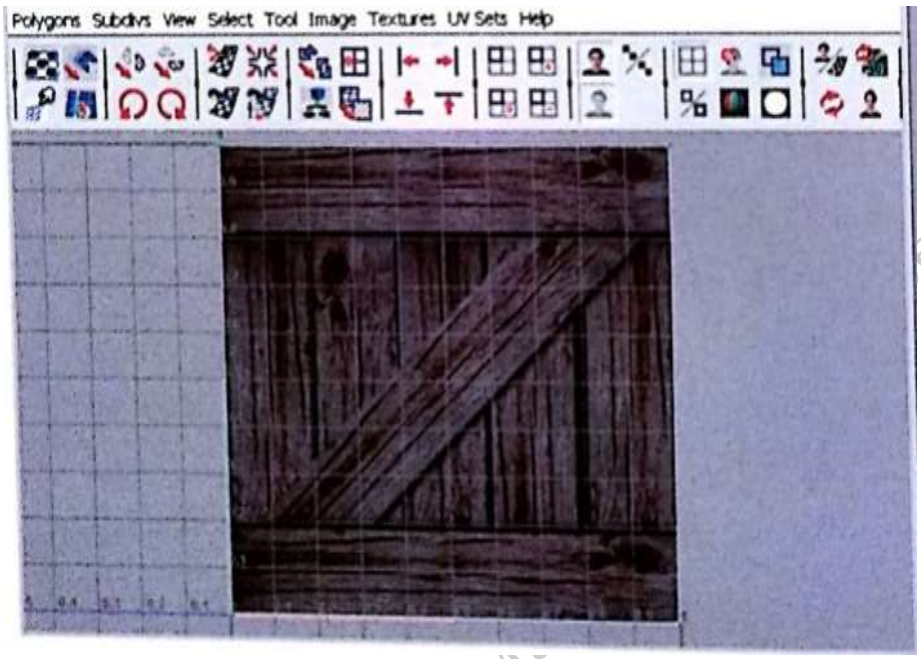


Figure 2.27: Displacement of UVs

x. Open the UVs Bitmap snapshot image in the Photoshop and map the desired texture Colours **(Figure 2.28)**.

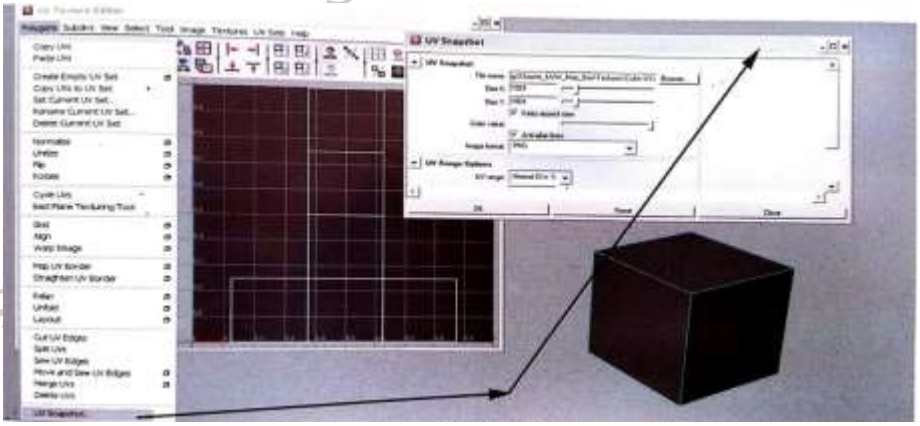


Figure 2.28: A view of UV texture editor to capture UV snapshot

We have completed the basic learning on how to map a texture on standard primitive geometry **(Figure 2.29)**. This procedure can be repeated for any other form of box.

The processes of the digital and matte painting are already well known to you as it is described earlier. Now, texturing in Photoshop is just like painting the required Colour Information on the right place according to the UV snapshot.

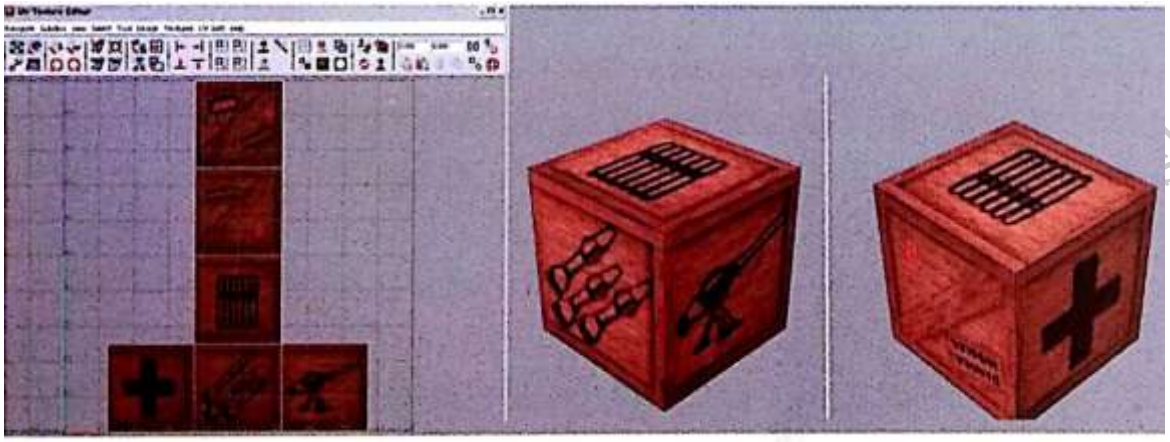


Figure 2.29: Edited captured UV snapshot applied on 3D cube

Figure 2.30: 3D cube final

Here, an image of creating diffuse or Colour Map in Photoshop is given for you.

Figure 2.31: Colour Map in Photoshop

Get your UV and create the textures

Open the UV snapshot in Photoshop.

If saved in PNG format, the transparency information is embedded within the image. Otherwise, the blending mode must be set to "Screen" to view only the UV.

Create a new layer.

Paint or apply realistic texture images to the appropriate sections based on the UV Mapping.

Use multiple layers for different texture parts, allowing for easy modification, colour correction, and transformation if necessary. Gather and analyze a wide range of images related to the model and texture to achieve a realistic and accurate result.

The Importance of Pixels

Pixels define the resolution and clarity of textures applied to 3D models, and their management directly affects both the visual quality and performance of a scene. When creating textures in Maya, texturing artists rely on high-resolution images to capture fine details such as bumps, creases, and surface imperfections. The more pixels available, the sharper and more detailed the texture will appear. However, higher pixel resolutions, like 2K or 4K, can increase rendering times, memory usage, and can potentially slow down the viewport performance. Efficient use of pixels is crucial, as a texturing artist must strike the right balance between resolution and performance, ensuring that textures are detailed enough for realism while keeping the project manageable for rendering and editing **(Figure 2.32 and 2.33)**.

Figure 2.32: Example of UV Map of objects

Figure 2.33: Example of UV Map of a character

Activities

Activity 1: Create UV Texture Map on box

Materials Required: Computer system, and Autodesk®Maya® software

Procedure:

- Create 3 to 4 wooden boxes, each made from textured wood planks.
- Stack the boxes on top of each other, ensuring that the bottom box is the largest in size.
- Position the bottom-most box on the floor, which should be textured with a marble surface.

Check Your Progress

A. Multiple Choice Questions

1. What is the purpose of UV Mapping in 3D modeling?
a) To increase the polygon count of a model
b) To define how a 2D texture will be applied to a 3D model
c) To create a light source for the model
d) To adjust the size of a 3D model in the scene

2. When assigning textures to a 3D model in Maya, what is the first step after creating the geometry?
a) Apply the texture directly to the object
b) Open the UV Texture Editor to view the UV coordinates
c) Adjust the lighting setup in the scene
d) Create a material shader for the object

3. What happens when a single texture Bitmap is applied to a cube in Maya without adjusting UVs?
a) The texture will perfectly fit each face of the cube
b) The texture will be stretched across the entire cube, distorting it
c) The cube will become invisible
d) The texture will appear in grayscale

4. In Maya, which tool allows you to adjust the placement of UV coordinates for better texture alignment?
a) Hypershade
b) UV Snapshot
c) UV Texture Editor
d) Polygon Split Tool

5. Why would you use the “Split UVs” function in Maya?
a) To merge multiple UV islands into one
b) To break the UVs apart and scale them for better texture fitting
c) To convert UVs into polygons
d) To rotate the entire 3D model

6. What is the significance of using a 1024x1024 resolution when taking a UV snapshot in Maya?
a) It results in the highest possible texture resolution
b) It balances texture quality with rendering performance
c) It is the default setting for all 3D models
d) It produces the smallest file size

7. In Photoshop, when working with a UV snapshot, what should you do to ensure transparency is preserved?
a) Save the image in JPEG format
b) Use the "Screen" blending mode if not saved as PNG
c) Apply a gradient layer
d) Set the image mode to RGB

8. When texturing a 3D model in Maya, why is it important to use multiple layers for different texture parts in Photoshop?
a) To make the texture process faster
b) To allow easy modifications, colour corrections, and transformations
c) To reduce memory usage during rendering
d) To prevent UV distortion on the model

9. How does the resolution of the texture (e.g., 1K, 2K, 4K) affect the final result in Maya?
a) Higher resolutions improve rendering speed
b) Higher resolutions provide more detail but can slow down performance
c) Lower resolutions result in more detailed textures
d) Texture resolution does not affect render time

10. What should a texturing artist focus on when managing pixel density in a 3D scene?
a) Maximizing the resolution for the entire scene
b) Striking a balance between texture detail and system performance
c) Using only low-resolution textures
d) Ignoring the resolution to focus on other aspects of modeling

Session 6: Creating 3D Bump Map

Bump Mapping is a Texture Mapping technique in computer graphics for simulating bumps and wrinkles on the surface of an object. 3D Bump Maps are maps used in 3D modelling to artificially create raised textures without having to model the individual details. Trying to model detailed textures can create a mess of thousands of extra polygons, multiply the time to model exponentially, create unrealistic looking models, and increase rendering time and processing power to ridiculous amounts. Without realistic 3D textures, though, 3D models look flat and lifeless.

Bump Maps are used as layers beneath fully painted colour Texture Maps and employ grayscale to instruct 3D modeling programs on how to extrude polygonal surfaces **(Figure 2.34)**. White indicates the highest level of extrusion, black signifies the flattest areas, and various shades of gray represent intermediate levels. For instance, when texturing a lizard's skin, a Bump Map might use mid-level gray as a baseline for the skin surface, black for deep cracks, and lighter gray spots to show raised, pebbled areas achieving detailed surface effects without modeling each bump or crack. This technique can also enhance facial highlights and shadows, as well as add realistic details like folds and wrinkles to clothing or armor. Visual difference between the two steps, before and after applying Bump Map to model

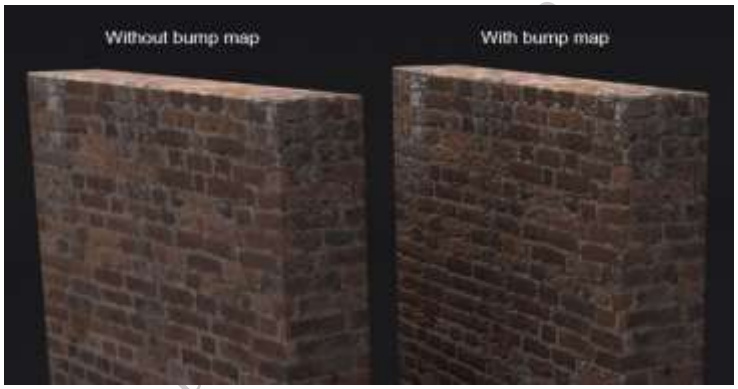


Figure 2.34: Sample Bump Map to create a wall texture

Creating a Bump Map in Photoshop is easy, especially if already created a Texture Map with highlights and shadows painted in Colour. The basic steps are:

i. Either open your existing Coloured Texture Map or create one in Photoshop using paint tools. If you are just looking for a generic texture and not something specific like facial shading, you can use layer styles such as the Pattern Overlay to generate a repeating texture.

ii. For specifically painted detail, you will need the exact Map to make sure that the Colour-painted highlights and shadows line up with the bump Map's texture extrusions.

iii. Save a grayscale copy of the map. To turn a Colour version into a grayscale version, use the Desaturate function under the Image->Adjustments menu. If you have generated your texture using layer styles and pattern overlays, you may need to flatten the layer so your adjustments affect the texture and not just the base Colour underneath.

Applying desaturase command on Colour map

One may need to tweak the Bump Map to increase the contrast between lighter and darker areas. Using it as is may not create the depth of detail that you are looking for in your texture. One can use the Brightness / Contrast tool under the Image->Adjustments menu to sharpen the image and increase the contrast **(Figure 2.35)**. Finally, you can apply High Pass filter to the final bump Map, going under the filter

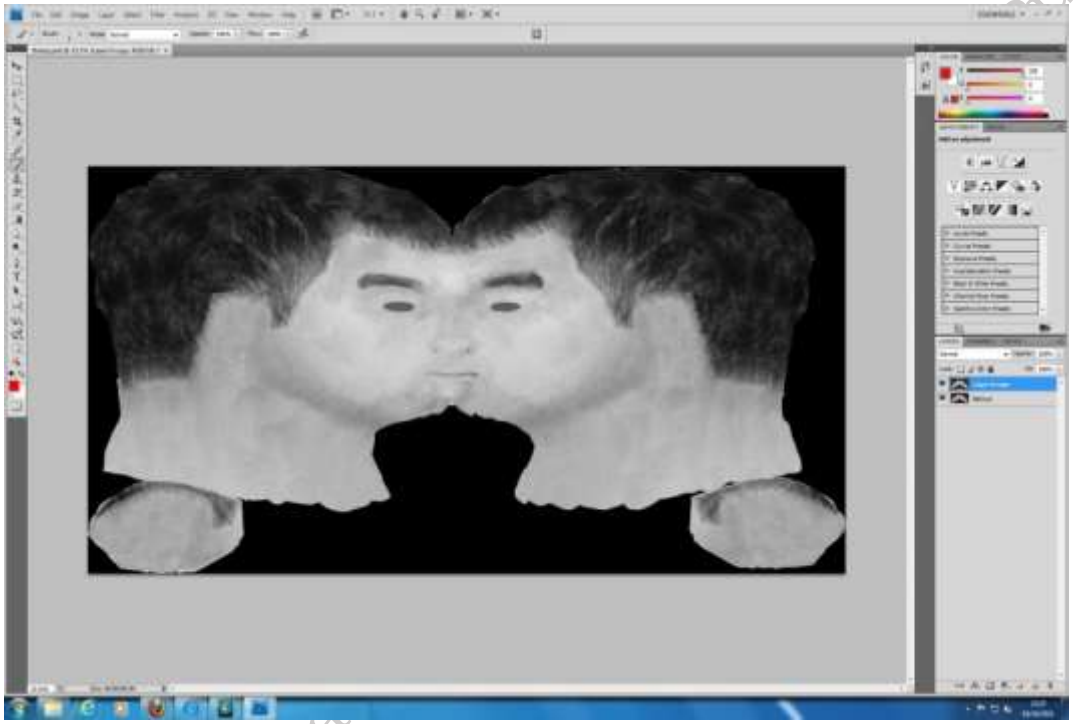


Figure 2.35: A view of editing Bump Map in Adobe Photoshop

menu-> Other -> High Pass, as it will help to show only the difference between the contrast areas. Bump Map cannot help in case of extreme displacement, as it is only for the making of minute details on the surface. Therefore, a large area of black or white Colour in the Bump Map does not mean to push or pull that area in an extreme manner.

Applying High Pass filter to one de-saturated image, we can get only the minute detail information of the surface.

Save the file-preferably in a lossless format with a high level of detail, like TGA/ PNG. Once you have created your Bump Map, all you need to do is import it into your 3D animation program. Different programs have different ways of integrating Bump Maps into a model or polygon surface, but the controls for the Bump Map should allow you

to define a range to make sure the raised textures and depressions donot extrude to extremes or scale down so small that they hardly show.

Activities

Activity 1: Explain Bump Mapping on human face

Materials Required: Computer system, and Autodesk®Maya®

Procedure

- Model a 3D human face in Autodesk® Maya®.
- Apply realistic Texture Mapping to the 3D face using the UV Mapping technique.
- Integrate Bump Mapping to enhance the surface detail, simulating the fine details and imperfections of a real human face.

Check Your Progress

A. Multiple Choice Questions

1. What is the primary purpose of Bump Mapping when applied to a 3D model?
a) To add realistic surface details without altering the geometry
b) To change the shape of the model
c) To create a wireframe of the model
d) To reduce rendering time

2. Which mapping technique is used to apply a texture accurately onto a 3D face in Maya?
a) Vertex Mapping
b) UV Mapping
c) Procedural Mapping
d) Shader Mapping

3. What does Bump Mapping simulate on a 3D surface?
a) Colour variations
b) Transparency
c) Surface roughness and depth
d) Lighting effects

4. When creating a 3D human face and texturing it, which tool in Autodesk® Maya® helps visualize the UV layout?
a) Outliner

b) UV Texture Editor
c) Hypershade
d) Attribute Editor

5. What file format is commonly used for exporting a UV snapshot for further editing in software like Photoshop?
a) .obj
b) .mp4
c) .fbx
d) .png

6. Which attribute should be modified to link a Bump Map to the texture of a 3D model in Maya?
a) Colour attribute
b) Bump Depth attribute
c) Transparency attribute
d) Specular attribute

7. Why is it essential to use high-resolution images when texturing a 3D face?
a) To decrease file size
b) To ensure detailed and realistic textures
c) To reduce modeling time
d) To increase render speed

8. What should you do if the Bump Mapping effect on the face appears too exaggerated?
a) Increase the model's polygon count
b) Decrease the bump depth value
c) Apply a different UV Map
d) Change the camera angle

9. In the context of Bump Mapping, what type of image file is typically used to create the effect?
a) Grayscale image
b) RGB colour image
c) Transparent image
d) Vector image

10. Which of the following techniques can enhance the realism of a 3D human face in Autodesk® Maya®?
a) Using only Colour Maps
b) Adding Bump and Normal Maps
c) Applying low-resolution textures
d) Ignoring the UV layout

Session 7: Specular Map

Specular Map

Specular Maps are the maps used to define a surface's shininess and Highlight Colour. The higher the value of a pixel (from black to white), the shinier the surface will appear in-game. Therefore, surfaces such as dry stone or cotton fabric would tend to have a very dark Specular Map, while surfaces like polished chrome or plastic would tend to have lighter Specular Maps.

The Colour of a pixel is also used, to calculate the resulting Colour of the surface. A very saturated specular Map will have a very different visual effect than a Gray specular Map. If you need a more "neutral" highlight on a surface, your specular Map should use the inverse of the Diffuse Map's colour. Using the same colour on the specular as on the diffuse will result in a more saturated highlight when viewed in the game.

Contrasts in specular can make a surface appear more visually interesting in the game. For example, a door with a very dark specular for the wood and lighter metal parts will make the metal stand out as a shinier surface when light hits it. This type of contrast helps make surfaces in the game appear more realistic.

Creating a Specular Map in Photoshop

Here we will study about a quick and easy way to generate a Specular Map for your objects in some easy steps using the Colour Map.

i. Open up the Colour Map for your object in Photoshop **(Figure 2.36)**.

Figure 2.36: A view of editing map in Adobe Photoshop

ii. Add a channel mixer and check the option box for Monochrome **(Figure 2.37)**.

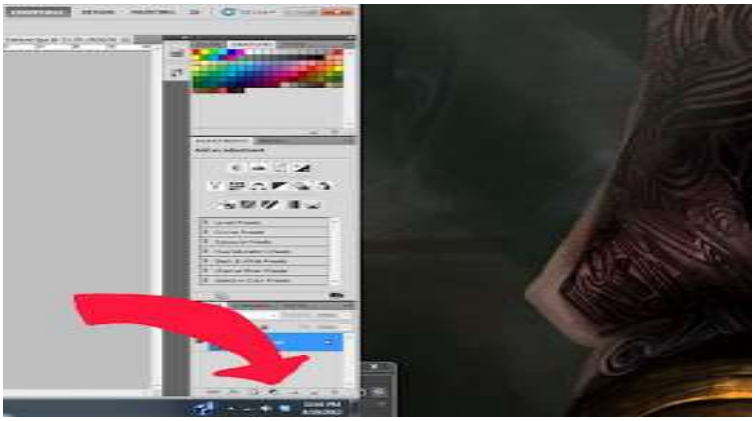


Figure 2.37: A view of editing map and adding channel mixer in Adobe Photoshop

iii. To make a Specular Map for this object, we have to create a Gray scale where white will produce the most intense specular reflection, Grays produce a little specular reflection and black produces no specular reflection. Just like creating a Bump Map.

iv. Add a Brightness /Contrast channel and a Levels Channel using the same button that we used earlier to add a Channel Mixer. Try and bring out the blacks and dark Grays more **(Figure 2.38)**.

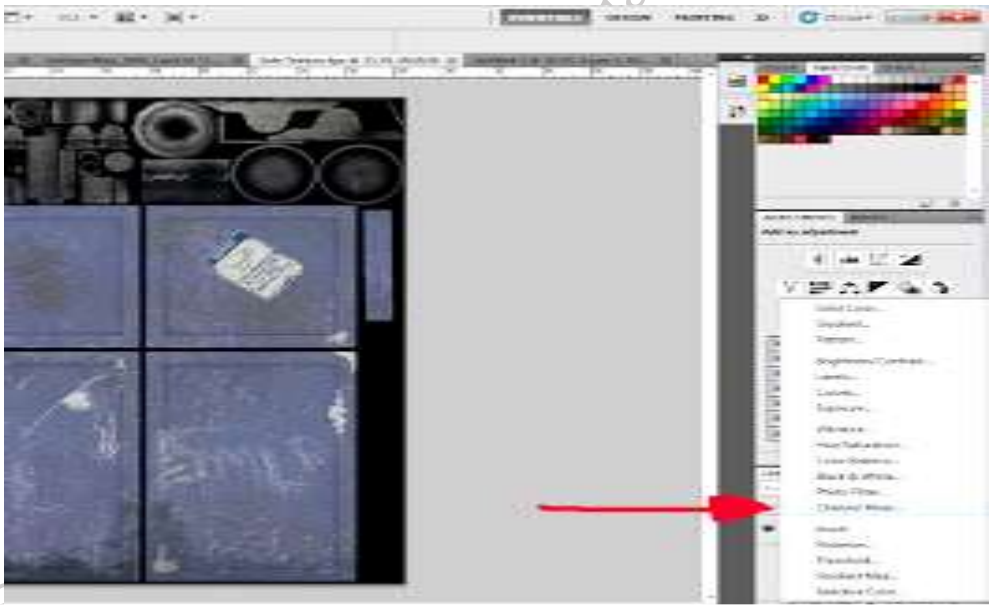


Figure 2.38: A view of editing map to reduce secularity in Adobe Photoshop

v. Select the dodge tool. Make sure that the exposure is not too high. Using this tool, paint out the areas where you want more specularity. Keep in mind that the corners and sharp edges of objects will always have specularity **(Figure 2.39)**.

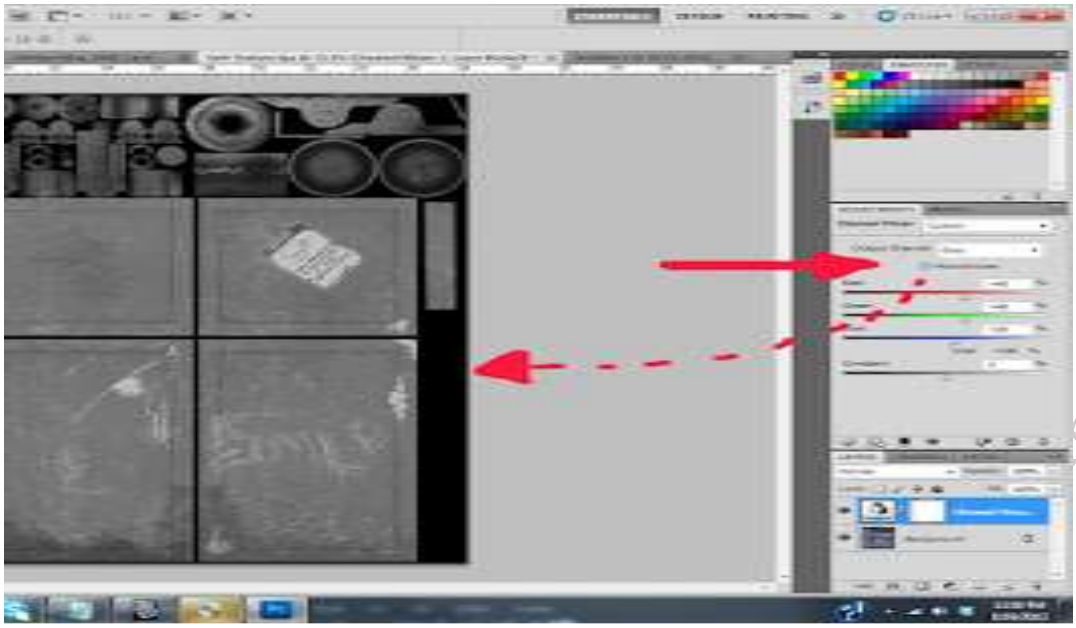


Figure 2.39: A view of editing map by using channel mixer in Adobe Photoshop

Now, this is your final Specular Map **(Figure 2.40)**.

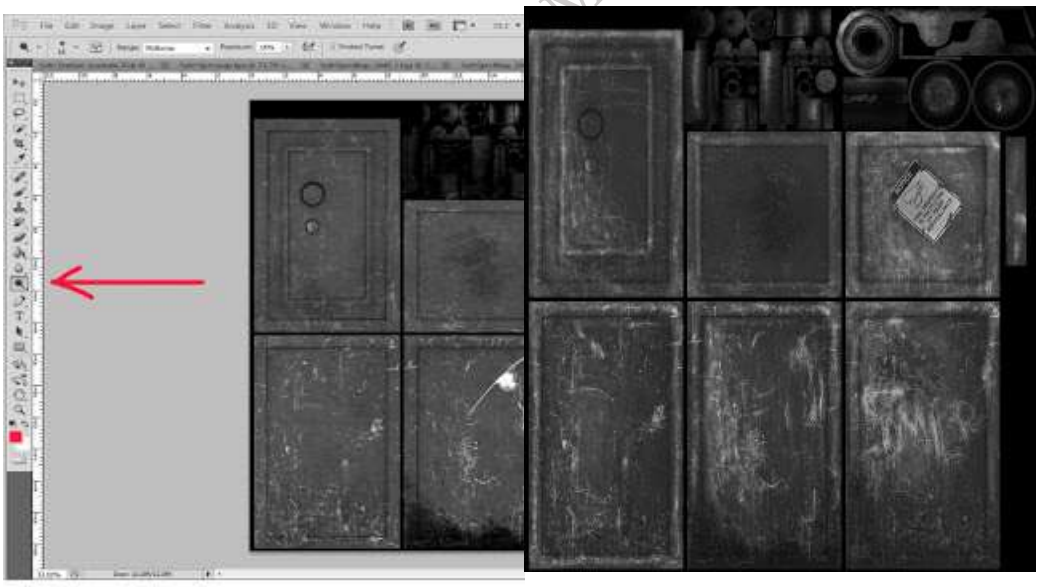


Figure 2.40: A view of final Specular Map (on left) and secularity

Activities

Activity 1: Creating a 3D Model with Specular Mapping

Materials Required: Computer system, and Autodesk®Maya®

Procedure

- Design a 3D model of a metal door, including detailed components such as hinges, handles, and latches, each using metallic textures.
- Apply a reddish wooden texture to the main door structure.
- Ensure that the components are textured using the UV Mapping technique for accurate texture placement.
- Demonstrate the use of Specular Mapping to highlight the reflective properties of the metal parts, creating realistic contrasts between the wood and metal surfaces.

Check Your Progress

A. Multiple Choice Questions

1. Which function in Photoshop is used to convert an image layer to grayscale when creating a Specular Map?

a) Brightness/Contrast
b) Hue/Saturation
c) Desaturate
d) Invert

2. What is the purpose of duplicating the layer before starting the Specular Map creation?

a) To save memory space
b) To maintain a non-destructive workflow
c) To apply filters faster
d) To increase contrast

3. When adjusting brightness and contrast for a Specular Map, what are you primarily trying to highlight?

a) The colour accuracy of the texture
b) Areas of the image with varying levels of reflectivity
c) Shadows and midtones
d) Edges and outlines only

4. Which Photoshop tool or adjustment is used to tweak the levels of brightness and contrast in an image?

a) Gradient Map
b) Levels
c) Brightness/Contrast
d) Curves

Session 8: Creating Seamless Textures in Photoshop

In this session, the concept of seamless textures is explored in depth. By examining the image, insight into its visibility and texture is gained, which are essential for ensuring proper application and utility.

First, examine the image carefully. Notice if one side appears significantly darker than the other. In this example, the top right corner is noticeably darker than the rest of the image. This uneven lighting can make it challenging to create a seamless texture, so the next step is to trim t he image to focus on the more uniform sections.

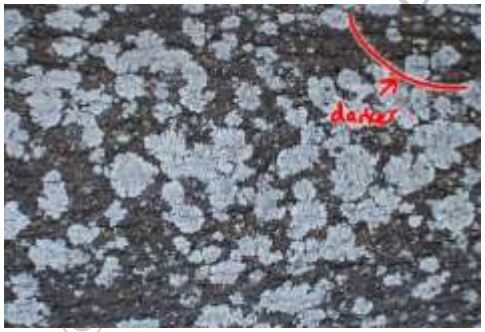


Figure 2.41: Example of a texture

i. It is trimmed it down to the lower left portion of the image **(Figure 2.42)**, which all looks pretty uniform in Colour. If you are not sure how to trim an image, the easiest way is going to be to use the Rectangular Marquee Tool (hit M) to select the part of the image that you want to keep. Then choose Image > Trim from the main menu. It should look something like this (but doesn't need to be exact).

Figure 2.42: Example of edited texture to remove darker offset

The parts of the image that are keeping our sample from being seamless are where the edges meet up, right? So, let us move those edges so that we can see them better **(Figure 2.43)**. Yes, we can do that! Photoshop has this wonderful feature for creating seamless textures, called "Offset." It is found under the main menu: choose Filter > Other > Offset

Figure 2.43: Settings view to use in texture to remove darker offset site

ii. Use settings similar to those that you see in my image here. What this is doing is taking the edge of the right side of the image and wrapping it around to the left side (and wrapping the bottom around to the top), effectively moving the previous "edges" into the middle of the image!

iii. See those lines where things don't meet up? That's where our old edges were. The *new* edges came from the middle of the image somewhere, so they're now entirely seamless. All we have to do is fix up those visible ones, and we're good to go!

iv. Now comes the hardest part. We need to clean up those visible edges somehow, and the Clone Stamp Tool is the way to do it. It's on your tools window where I highlighted it in red, or you can just hit "S" to make it active.

v. The brush that you choose to use with it is very important, as well. Do NOT just use a standard round brush, or anything with edges that are too "soft." Here are a few suggestions. Under "Natural Brushes 2," any of the 3 chalk brushes work well. Just about any of the brushes in "Natural Brushes" work. I tend toward a few of the brushes in the "Wet Media Brushes" set, as well. Drippy Water, Dry Brush on Towel, Paint on Rough Texture, and Rough Dry Brush are some of my favorites.

vi. Especially if you're working on an earthy texture, like this is. What brush you use will depend upon how rough your texture is. If it's something fairly soft, then you may be alright with a softer brush. I would still stay away from the round ones, though. They leave some very definable edges **(Figure 2.44)**.

vii. Make sure that your opacity is set somewhere between 50-85%, as you see here. 50% works good for those softer textures and up closer to 85% works great for those rough ones, like this one. I'm going to be using the "Rough Dry Brush" from the "Wet Media Brushes" set. As you can see here, I have the size at about 29, and my opacity is set at 82%.

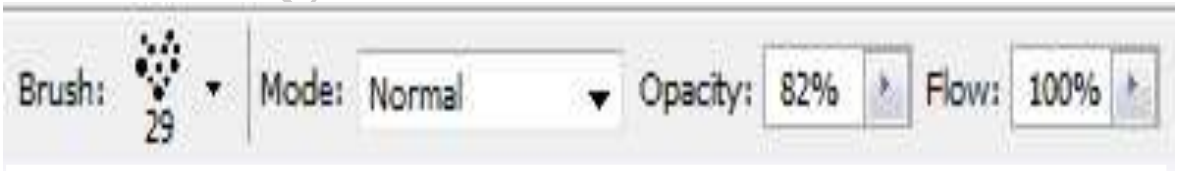


Figure 2.44: Brush properties in Adobe Photoshop

viii. If you have never used the Clone Stamp Tool before, it can be kind of fun. What it does is takes from one part of the image and paints a replica of it somewhere else on the image. So, what you are going to want to do is find a nice, clean portion of the image. A portion that does not have that ugly visible line running.Through it. Somewhere on the lower right, perhaps. Holding ALT, left click on that lower right part of the image.

Now, start painting over that line on the left side. See that small crosshair that shows up over on the lower right?

ix. That shows you what the clone stamp tool is using as a reference for what it is currently painting. Make sure that crosshair doesn't run off the edge of the page, or into the ugly visible line somewhere, or you are going to get a mess.

x. The easiest way that I have found to do this is to hit ALT and get your reference point, then paint a bit over the line. Then hit ALT somewhere else and get another reference point, then paint over the line somewhere else. Always keep your eye on that crosshair to make sure it's staying where you want it to be!

xi. When you move your brush up, the reference point/crosshair moves up. It will follow your movements exactly.

xii. That may sound complex, but just try it. You'll see what I mean. It may take a few tries before you really get the hang of the clone stamp tool. It is extremely handy once you do, though!

xiii. One thing to keep in mind. Do NOT do too much to those four corners where the lines meet the edges! Use a smaller brush around those areas and make sure that it doesn't overlap the edge of the image at all. Remember, those edges need to remain seamless, and if you mess with them too much, they won't be anymore!

xiv. So, you can paint it close to the edge, but not all the way up to it **(Figure 2.45)**. (That applies to all of the edges of the painting, not just the four where the lines meet it. But those unsightly lines are the only part of the image that you should be changing, which is why I highlighted just them).

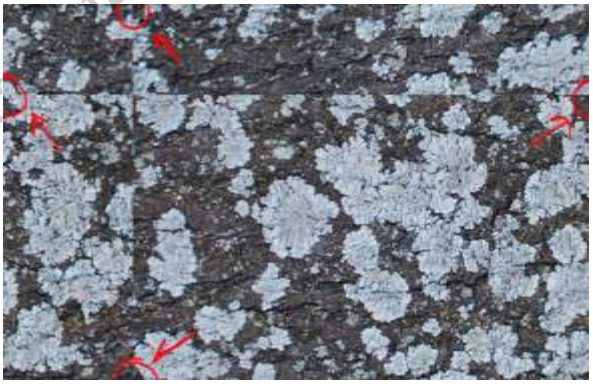


Figure 2.45: Clear image without dark lines representing seem less image

xv. This is what my image looks like when I am done. You can't see those lines anymore at all.Now, to check it. We need to make sure it looks seamless, right?

xvi. Choose Edit > Define Pattern from the main menu. Then open a new image. I made mine 1000 X 1000 pixels, 72 pixels/inch, RGB Colour mode, with the Background Contents as White **(Figure 2.46)**.

xvii. Now, create a new layer by clicking on the "Create a New Layer" at the bottom of the layers palette (if your layers palette isn't visible, choose Window > Layers from the main menu or hit F7).

xviii. Choose the Paint Bucket Tool from the tools palette, as shown here, and then click anywhere in the canvas. What Colour you're using doesn't matter.

xix. At the bottom left of the layer's palette, click on the "Add a Layer Style" button, as shown here. Choose "Pattern Overlay" from the menu.

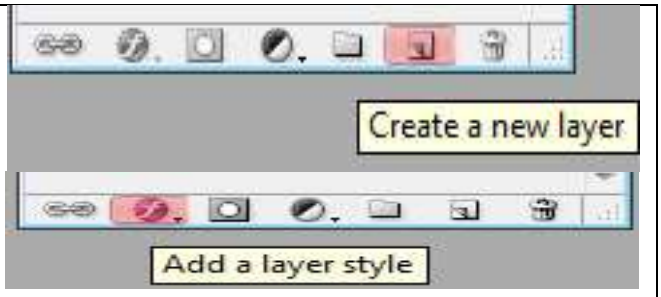


Figure 2.46: Layer style window in Adobe Photoshop

xx. On the window that pops up, click on the small arrow just to the right of the thumbnail of your currently selected pattern. Scroll to the bottom (if there's a scrollbar), and choose the very last pattern. Once you've selected that as your pattern, you should see it over on your canvas. Play around with the Scale slider, so that you are absolutely sure that you are seeing more than one instance of your texture. It needs to be small enough to be able to see the edges that are visible, if there are any **(Figure 2.47)**.

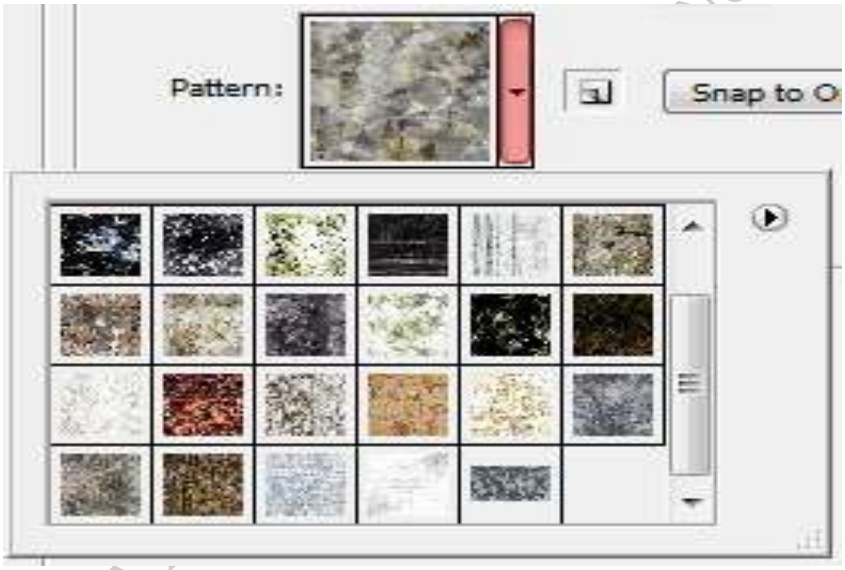


Figure 2.47: Patterns in Adobe Photoshop using filter gallery

Activities

Activity 1: Design a 3D Model and Apply a Photoshopped Texture

Materials Required: Computer system, and Autodesk®Maya®

Procedure

- Design a 3D model of an old castle featuring stone brick walls.
- Apply a textured Bump Mapusing the UV Texturing method to enhance the realism of the stone surface.
- Render the final castle model from a perspective view.

Check Your Progress

A. Multiple Choice Questions

1. What is the first step in ensuring that an image can be seamlessly used as a texture?
a) Apply a filter to the image
b) Trim the image to remove unwanted sections
c) Use the Clone Stamp Tool
d) Adjust the contrast and brightness of the image

2. Which Photoshop tool is used to select the portion of the image you want to keep for texturing?
a) Magic Wand Tool
b) Rectangular Marquee Tool
c) Crop Tool
d) Lasso Tool

3. After trimming the image, which Photoshop feature is used to move the edges and make them seamless?
a) Transform Tool
b) Offset Filter
c) Layer Mask
d) Gaussian Blur

4. When using the Clone Stamp Tool, what is the primary purpose of holding down the Alt key? a) To adjust the brush size
b) To sample a reference point for cloning
c) To invert the brush
d) To change the opacity

5. How should the opacity be set for the Clone Stamp Tool when working on rough textures? a) 10-20%
b) 25-40%
c) 50-85%
d) 100%

6. What type of brush is recommended for creating seamless textures with the Clone Stamp Tool?
a) Round Brush
b) Soft Round Brush
c) Chalk Brush or Wet Media Brushes
d) Square Brush

7. When painting over a visible line with the Clone Stamp Tool, what should you monitor to ensure the cloning is correct?
a) The layer opacity
b) The brush flow
c) The crosshair representing the reference point
d) The image resolution

8. What should you avoid when working with the Clone Stamp Tool on the edges of the image?
a) Cloning multiple times in the same area
b) Modifying the image's brightness
c) Overlapping the edge of the image
d) Using too large a brush

9. What is the purpose of selecting "Pattern Overlay" in the Layer Styles menu?
a) To apply a filter to the texture
b) To apply the texture as a pattern to a new image
c) To add a shadow effect to the texture
d) To apply a gradient to the texture

10. When checking the seamlessness of the texture, what action should be performed in Photoshop?
a) Use the Gaussian Blur filter
b) Define the pattern and apply it to a new canvas
c) Resize the image
d) Adjust the saturation of the image

Module 3	Rendering, Compositing and File Formats

Module Overview

This module focuses on the essential techniques and concepts related to rendering and compositing in 3D modeling. It will provide students with a comprehensive understanding of the various file formats used in the industry, along with trouble shooting strategies to resolve common issues encountered during the rendering process. Through practical applications and hands-on exercises, learners will gain the skills necessary to create high-quality visual outputs and effectively manage file types within their projects.

Session 1 is on "Rendering and Compositing". It introduces the fundamentals of rendering, including various rendering engines and techniques for producing high-quality images. It also explores compositing methods, focusing on how to combine multiple visual elements into a cohesive final image to enhance aesthetic impact. Through hands-on exercises, participants will set up render scenes, adjust lighting, and apply materials, gaining practical experience in achieving realistic visual results.

The Session 2 is on "Working with File Formats", and the focus shifts to understanding the different file formats used in 3D rendering and compositing. After this session understanding about the characteristics, advantages, and disadvantages of various formats such as JPEG, PNG, TIFF, and EXR, as well as their suitability for specific applications increases. Practical exercises will enable learners to effectively export and import files, ensuring compatibility and efficient asset management within their projects.

Session 3 on "Troubleshooting" focusses common issues encountered during rendering and compositing and develop effective troubleshooting techniques to identify and resolve problems such as rendering artifacts, performance bottlenecks, and compositing mismatches.

Learning Outcomes

After completing this module, you will be able to:

- Describe the various methods of rendering.
- Identify and perform basic rendering process.
- Identify and perform basic compositing process.

- Demonstrate the knowledge of various file formats used in the production pipeline.
- Determine the root causes of common texturing problems, such as uneven texture distribution, texture stretching, or visible seams.

Module Structure

Session 1: Rendering and Compositing

Composition is a powerful tool for directing the viewer's attention toward the most significant elements of an image, often in a deliberate sequence. A well-crafted composition can transform even the simplest subjects in plain environments into compelling visual works. Conversely, a poorly structured composition can diminish the impact of a photograph, regardless of the subject's intrinsic interest. Unlike common issues like exposure or white balance, composition errors are challenging to correct in post-processing. While cropping can sometimes improve a composition, it is effective only when tighter framing or removal of certain elements enhances the overall image. Therefore, giving thoughtful attention to composition before capturing an image is crucial.

Composition involves the arrangement of visual elements in a scene and how these elements guide the viewer's gaze. Various techniques exist, such as using lines or curves to lead the viewer toward the focal point. The positioning of the main subject and other elements in the scene plays a significant role in shaping the viewer's experience. One popular compositional guideline, the rule of thirds, is loosely based on the Golden Ratio a mathematical principle found throughout nature in forms like seashells, leaves, and even the human body. This concept, often introduced in geometry, illustrates balance and harmony in visual arrangements.

Rendering

Rendering is the process of generating a photorealistic or non-photorealistic image from a 2D or 3D model by means of a computer program. The resulting image is referred to as the render.

Before rendering process, it is really necessary to understand camera angles its movements. The rendering stage is usually associated with computer-generated animation, although rendering can also refer to the process of creating final animation frames in traditional hand-drawn animation. Rendering is used in both 2D and 3D computer animation.

Rendering is the process of extracting the final assembled animation scenes or pieces from the computer in the format of a sequence of individual frames. The aim of rendering is to generate a series of pixel-based frames or a video clip.

Before rendering a scene, it is essential to diagnose it for common problems that can affect image quality and rendering times. While rendering provides a visual representation of the scene, visualizing it in alternative ways can often be a faster approach:

To...	**Do this...**
Changes to a still image or a single frame of an animation can be seen as they are made.	Use Interactive Photorealistic Rendering (IPR). IPR updates the display to show your most recent change, but there are limitations to what can be seen.
See what a still image or single frame of an animation (or a region of it) looks like as the render occurs.	Use Render View, especially Render Region. Render View has fewer limitations than IPR, allowing for a more comprehensive view, but it takes longer to render. Rendering regions of a scene can reduce the time spent visualizing the scene.
See lights, objects and textures in the scene view without rendering.	Use hardware texturing. This approach does not actually perform a render; it simply provides an approximation of what the scene looks like when rendered.
See what a fully rendered still image, single frame of an animation, or an animation looks like quickly.	Render at lower resolutions.

Perform a final render

To render...	**Do this...**
A still image or single frame of an animation.	Use Render View.
A still image or single frame of an animation, or an animation.	Batch render.

A still image or single frame of an animation, or an animation.	Command line render.

i. In the main Maya window, click the Render Current Frame button, or select Render > Render Current Frame. Maya renders the current scene and displays the image as it renders in Render View.

ii. To re-render a frame from within Maya

iii. Select Render > Redo Previous Render from the main menu bar.

iv. Maya renders the scene from the previous camera and displays the image as it renders in the Render View window.

Note: To set batch render options, select Render > Batch Render > to open the Batch Render window. For a description of the batch render options, see Batch Render Options. When using the Maya Batch Renderer on a remote machine the User Account information (i.e., username) must be consistent between the machines to ensure that User Authentication will function correctly.

v. To cancel the in-progress render Press Esc.

vi. To batch render from within Maya

vii. Do any of the following:

viii. Click Render > Batch Render to batch render.

ix. To cancel the render, click Render > Cancel Batch Render.

x. To show the image being rendered, click Render > Show Batch Render.

Note:

To set batch render options, select Render > Batch Render > to open the Batch Render window. For a description of the batch render options, see Batch Render Options. When using the Maya Batch Renderer on a remote machine the User Account information (i.e., username) must be consistent between the machines to ensure that User Authentication will function correctly.

Use a single processor when batch rendering a scene that contains a spotlight, material transparency, and raytrace shadows.

A scene can be rendered on a computer that has more than one processor, utilizing some or all of its available processors.To render on a computer with several processors from within Maya.

i. From the Maya window, select Render > Batch Render >. The Batch Render Frame window displays. To use all available processors on your computer for rendering, turn on Use all available processors.

ii. To use only some of the available processors on a computer for rendering, turn off "Use all available processors" and set "Number of Processors to Use" to the desired number of processors.

iii. Click Batch Render. Maya renders the animation. To render on a computer with several processors from a shell or command line (Maya software rendering only)

Type:Render -r sw -n <# of processors to render on><scene>

(If you do not use the -n option, only one processor is used for rendering.)

Examples (for Maya software rendering only):

To use one processor for rendering, type:

Render <scene>

To use two processors for rendering, type:

Render -n 2 <scene>

To use all processors on your computer for rendering, type:

Render -n 0 <scene>

Render View allows rendering a specific portion of a scene at any resolution, providing a sense of the changes made while shading, lighting, and texturing objects. Unlike rendering at a lower resolution, which reduces the size of the entire image, rendering a region can facilitate more efficient and rapid adjustments to specific areas of interest at full resolution.

Note: If Auto Render Region is enabled (Options > Auto Render Region), changes appear as the marquee is drawn anywhere in Render View. Only the marquee area of the surface re-renders, showing the results of the adjustment.

To render a region **(Figure 3.1)** of a scene:

i. Marquee select the area that needs to be rendered in Render View.
ii. If there is no representation of the scene in Render View for marquee selection, go to Render > Snapshot and select the desired camera (view) to capture.
iii. Click the Render Region button or select Render > Render Region.

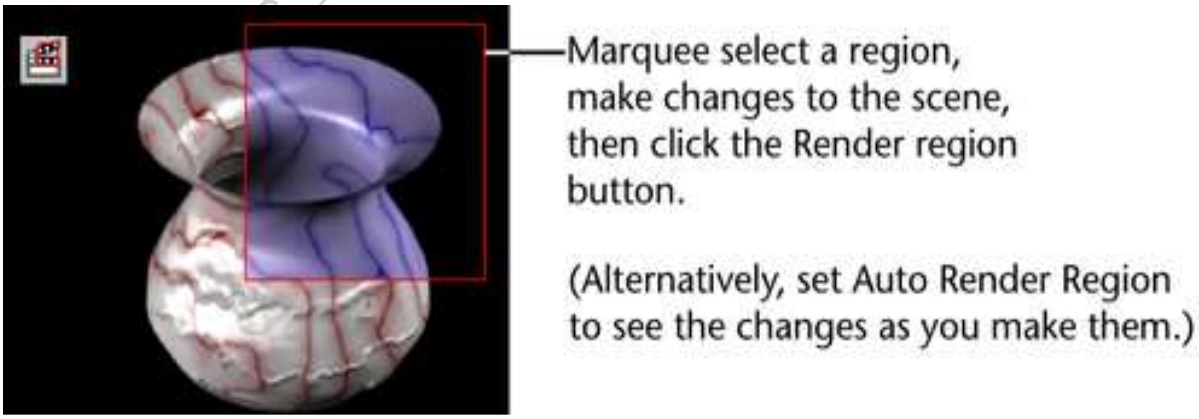


Figure 3.1: Render view of an object showing Marquee selected region to render specific region of the object

You can isolate specific objects to render. Note that when using IPR rendering, you must perform another IPR render before you can see the effect of this change.
To render selected surfaces

i. Select the objects you want to render.
ii. In the Render View window **(Figure 3.2)**, select Render > Render Selected Objects Only.
iii. Render the scene.

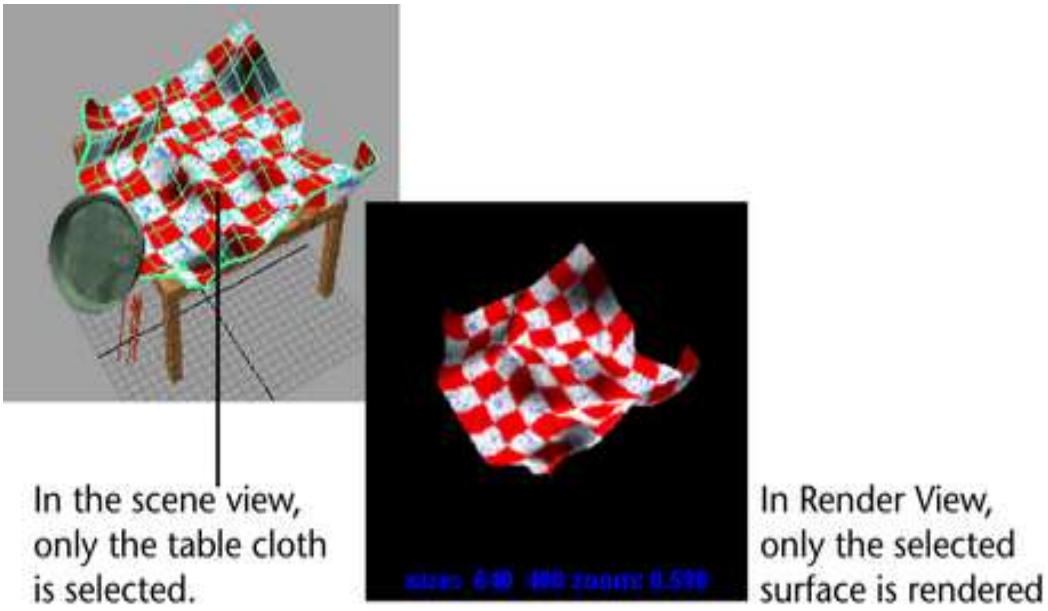


Figure 3.2: Render view of the object

Note: You can display a wireframe snapshot of your scene to use as a guide to select a region of your scene to render.

In Render View, select Render > Snapshot and select the camera (view) you want to capture.

The Maya Software renderer renders an image as a series of tiles. The renderer tries to use a tiling configuration that ensures memory is optimized. Thus, the tiles are smaller in the regions of the image where the geometry is dense. The renderer tries to ensure that the memory cap specified in the Render Settings window is respected.

The Image resolution is the total pixel size of a Bitmap image. For example, 720 x 486 for NTSC video output. Display resolution is the number of pixels in 1 inch on the screen. Display resolution is measured in pixels per inch (ppi). Most monitors have a display resolution of about 72 ppi. For print output, a display resolution of approximately 300 ppi is recommended.

Note: The terms pixels per inch (ppi), and dots per inch (DPI) are often interchanged freely. Pixels per inch, however, applies only to screen resolution, which display images in pixels. Dots per inch, applies only to paper-based images, which are printed with dots of Colour.

Subfolders and custom filenames for storing rendered images can be created using the File Output section. This section outlines the tokens that can be used to generate subfolders and filenames. If none of these tokens are entered, Maya will create default subfolders to save the rendered images.

Figure 3.3: A view of file output window

Default behaviour of rendered images and directories

By default, Maya saves rendered images to the following subfolders:

<RenderLayer>/<Camera>

Scenes with more than one render layer and renderable camera

If your scene consists of more than one render layer, then a subfolder is created for each layer.

Similarly, if your scene consists of more than one renderable camera, a subfolder will be created for each camera.

Creating subfolders and filenames for rendered images

The following rendered image filename options and tokens can be combined to create subfolders and custom image names for rendered images.

i. Enter these options in the File Name Prefix field of the Render Settings: Common tab. Use the tokens in conjunction with different separators between them. To create subfolders, use the slash (/) separator as in <Render Layer>/<Camera>/<Scene>. Use any other separator, for example, underscore (_) and dash (-), to separate the tokens in your image file name. You can repeat options within the specification, and you can also specify any text you like in the image file name or path (for example, .TEST or _final to indicate the kind of render that you are performing).

ii. Rendered image filename options (tokens)
<Render Layer>
Adds the layer name to the created subfolder or image file name (for example, layer1).When using render passes with the Maya software renderer, if more than one pass is created for the layer, then pass names are appended to the layer name. The format used is layer pass (for example, layer1_beauty). When using multi-render passes with the mental ray renderer, a directory is created for each pass.

iii. <Scene>

Adds the scene name to your subfolder or image file name.

iv. <Camera>
Adds the renderable camera name to the created subfolder or image file name (for example, camera1).If your scene is set to render fields, then field names are appended to the name; for example, camera_odd or camera_even.

v. <RenderPassFileGroup>
Adds the render pass file group name to the created subfolder or image file name (for example, IndirectIllum).

vi. <RenderPass>
Add the render pass node name to the created subfolder or image file name (for example, diffuseNoShadow).

vii. <RenderPassType>
Many different types of render passes are available for selection using the Render Pass Attribute Editor, for example, beauty, shadow, specular, and refraction. When you use this render token, a unique abbreviation of the pass type, of less than 6 characters, is appended to your output file name, for example, REFR for refraction pass.

viii. <Extension>
Adds the extension to the created subfolder or image file name.

ix. <Version>
Adds the version label that you have selected to the created subfolder or image file name. This option can be a numeric version number, the current date, the current time, or any custom version label. Customize this token using the Version Label attribute. Setting up your file name prefix using the command line.

x. In addition to setting up your file name prefix using the render tokens in the Render Settings window: Common tab, you can also use the command line to set up the file name prefix using the -imflag. You must include the angular brackets for each render token and wrap the string with quotation marks. Some of the shorthand notations, for example, %l for layer and %c for camera, are still supported for backwards compatibility. However, not all tokens have a shorthand equivalent.

xi. Create subdirectories by adding a / (slash). Any alpha numeric text, in addition to underscore (_) and dash (-), can be used to separate the tokens in your image file name. or example: Render–r-scene-filename-im "<Camera>/ <RenderLayer >/Draft _3_<Scene>_<RenderPass>"

OpenEXR file format

Among the available multi-channel file formats, OpenEXR is the only file format where multi-channel is being leveraged. Therefore, multiple render passes can be concatenated into a single-multi-channel .exr file. Use the Frame Buffer Naming and Custom Naming String attributes in the Render Settings: Common tab to customize the naming of your OpenEXR channels.

In order to use these attributes, your scene must contain at least one render pass. Also, you must select OpenEXR as your file format for these attributes to become active.

Select the Automatic mode under the Frame Buffer Naming attribute to use the <RenderPassType>:<RenderPass>. <Camera> tokens to name your channels. This is the default option.
Select the Custom mode under the Frame Buffer Naming attribute to customize your OpenEXR channel names. Choose from the render tokens listed in Rendered image filename options (tokens).

Note: EXR version 1.7 supports 252-character channel names. The limit is 252 characters to save room for an extension of up to 3 characters used to differentiate individual channels (for example.R for the red channel). However, EXR version 1.7 is currently supported by a few external applications, and embedding channel names longer than 31 characters may break compatibility with external applications that do not support it. By default, channel names are truncated to 31 characters for backward compatibility. You can create and set MAYA_EXR_LONGNAME to 1 to allow long channel names of 252 characters so that they are not truncated. See the Image format for more information on the OpenEXR format. See Rendering environment variables for more information about the MAYA_EXR_LONGNAME environment variable.

Note: Do not use the <RenderPass> token in your File name prefix field if you are using the multi-channel OpenEXR format. Using the <RenderPass> token creates a file for each render pass instead of writing to a multi-channel .exr file.
Frame/Animation Ext
In addition to the rendered image filename tokens discussed above, you can also use the Frame/Animation Ext drop-down list to customize your image name by adding the frame number to your image name. For example, if you choose name#.ext with a Frame padding of 4, and the scene name is MyScene, then the rendered image would be named MyScene0001.iff.

Examples
1. If you choose not to enter any tokens in the File Name Prefix attribute, the following subfolders are created by default:
<Layer>/<Camera>/IMAGENAME.iff

2. If you choose to use the Frame/Animation Ext field in conjunction with the File name prefix attribute, you can add the frame number to your image name also. Assume that you choose the name_#.ext option with a Frame padding of 2. The following entry produces a layer name subfolder and adds 1) the camera name, 2) the scene name, and 3) the frame number to the name of the rendered image. The -(dash) separator is added to separate the camera and scene names.
Layer>/<Camera>-<Scene>

For example, layer1/camera1-MyScene_01.iff

3. The following entry produces no subdirectories, but simply a flat file structure. The _(underscore) separator separates the scene, layer and camera names **(Figure 3.4)**.

<Scene>_<Layer>_<Camera>

For example, MyScene_layer1_camera2_01.iff

4. The following entry produces a scene name subdirectory, then the layer subdirectory, then a camera subdirectory, and then adds the scene name to the name of the rendered image, and adds 'TEMP' to the image name:

<Scene>/<Layer>/<Camera>/<Scene>TEMP

for example, MyScene/layer1/camera1/MySceneTEMP_01.iff

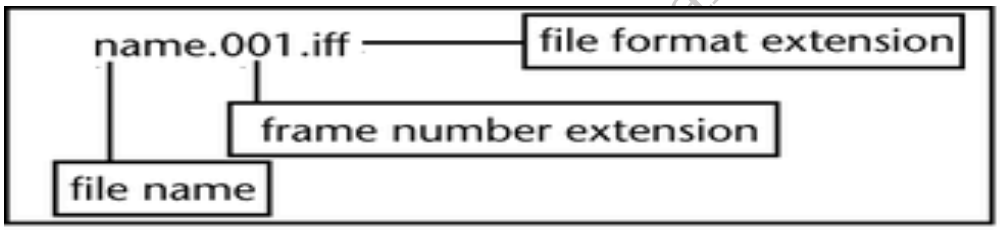


Figure 3.4: A view of file output structure

Compositing

The Compositing Department brings together all of the 3D elements produced by the previous departments in the pipeline, to create the final rendered image ready for the film. After the animation has been rendered it may be necessary to add some special effects or to combine separate rendered elements together into one final animated sequence. This process is known as Compositing.

Compositors are responsible for constructing the final image by combining layers of previously-created material. They receive material from various sources including rendered computer animation, special effects, graphics, 2D animation, live action and static background plates. The compositor's job is to assemble the different characters and backgrounds into single frames and sequences and so is often the first to begin to see the animation as intended for the final audience.

The compositing stage also allows for the addition of other elements such as special effects which have been created using other equipment and processes. General compositing tasks include rendering the different passes delivered by a lighting department to form the final shot, paint fixes and rotoscoping, although compositors sometimes rely on mattes created by a dedicated rotoscoping department), as well as the compositing of final elements and general Colour grading.

Activities

Activity: Explain simple render process

Materials Required: Computer system, and Autodesk®Maya®

Procedure:

- Choose the objects in your scene that you wish to render.
- In the Render View window, navigate to Render > Render Selected Objects Only to focus the rendering on the selected objects.
- Execute the render to generate the final image or animation for the chosen objects.

Check Your Progress

A. Multiple Choice Questions

1. What is the primary goal of composition in photography?
a) To create random placements of objects
b) To direct the viewer's attention toward the most significant elements
c) To focus only on the subject's features
d) To use bright colours to distract the viewer

2. Which compositional guideline is based on the Golden Ratio?
a) Rule of Thirds
b) Leading Lines
c) Framing
d) Symmetry

3. What is the purpose of Interactive Photorealistic Rendering (IPR)?
a) To batch render multiple frames at once
b) To update the display to show the most recent change in a scene
c) To visualize scenes in low resolution
d) To increase rendering time significantly

4. What does "Render View" allow in Maya?
a) Rendering only at full resolution
b) Viewing a specific portion of a scene as it renders
c) Rendering with reduced pixel quality
d) Quick adjustments without rendering the scene

5. What does the term 'batch render' refer to in Maya?
a) Rendering a specific frame only
b) Rendering an entire scene in one process
c) Repeating the render process for an individual object
d) Adjusting the scene's lighting

6. What does the "Render Region" function in Maya help with?
a) Rendering the entire scene at once
b) Isolating specific areas of the scene for quicker rendering
c) Displaying the scene without any visual changes
d) Saving the rendered image

7. How can a user render selected objects only in Maya?
a) Use the "Interactive Rendering" option
b) Select Render > Render Selected Objects Only
c) Use hardware texturing
d) Enable Auto Render Region

8. What is the purpose of 'Render Pass' in Maya's rendering process?
a) To create subfolders for images
b) To specify different visual effects applied to objects in a scene
c) To change the resolution of the output file
d) To render the entire scene without any alterations

9. Which file format is used for multi-channel rendering in Maya?
a) JPEG
b) TIFF
c) OpenEXR
d) PNG

10. What does the token <RenderLayer> in Maya's render settings refer to?
a) The camera angle used for rendering
b) The name of the render layer being used
c) The type of image resolution selected
d) The render pass type being applied

Session 2: Working with File Formats

A file format is a standard way in which information is encoded for storage in a computer file. It specifies how bits are used to encode information in a digital storage medium. File formats may be either proprietary or free and may be either unpublished or open.

There are various file formats that can provide ease in work to whole chain in the production pipeline Some of the commonly used file format are JPEG (Joint Photographic Experts Group), PNG (Portable Network Graphics), GIF (Graphics Interchange Format), PDF (Portable Document Format), SVG (Scalable Vector Graphics) and MP4 (Moving Picture Experts Group), TIF (Tagged Image File) and TARGA (True vision Advanced Raster Graphics Adapter).

This section provides an overview of general file format support, noting that there may be slight variations in compatibility depending on the platform and specific file format variations. For instance, TIFF is a loosely defined format, and while it may be possible to save TIFF files in certain programs, Maya may not be able to open them. The following tables detail the supported data export file types, associated plugins, supported operating systems (OS), and file extensions, offering a thorough guide for industry use.

Support Data Export Formats

Data Export	Plugin Name	Windows	Extension
Maya Ascii		✔	ma
Maya Binary		✔	mb
MEL		✔	mel
OBJexport	objExport	✔	obj
move (ascii motion)		✔	mov
apex-Clothing-Exporter	physx	✔	ctp
PhysX	physx	✔	
MayaBullet	bullet.mll	✔ *1	bullet
animExport	anim-Import-Export	✔	anim

Note: Starting in Maya 2014, Maya Binary (. mb) files use 64-bit indices and can be larger than 2.0 GB. Scenes exported as. mb files are not compatible with earlier versions of Maya.*1 For Windows 64 bit only

Support Data Export Formats

Data Import	Plugin Name	Windows	Ext.
Maya ASCII		✔	ma
Maya Binary		✔	mb
MEL		✔	mel
audio		✔	
animImport	anim-Import-Export	✔	anim
OBJ		✔	obj
studioImport	studioImport	✔	wire
move (ascii motion)		✔	mov
EPS		✔	eps
Adobe®Illustrator®		✔	ai
OpenFlight®	flt-Translator	✔	flt

Supported image output and viewport display formats

Image Output	Windows (Maya Software/Hardware/Hardware 2.0/Vector)	Extension
Adobe ® Illustrator ®	✔ *3	ai
ALIAS PIX	✔	als
AVI	✔ *1, *5	avi
CINEON	✔ *1	cin
DDS	✔ *1	dds
EPS	✔ *2	eps

GIF	✔ *1	gif
JPEG	✔	jpg
MacPaint		pnta
Macromedia SWF	✔ *3	swf
MAYA IFF	✔	iff
MAYA 16 IFF	✔ *1	iff
PSD		psd
PSD Layered	✔	psd
PNG	✔	png
OpenEXR	✔ *6	exr
Quantel	✔ *1	yuv
Quantel PAL		yuv
Quantel NTSC		yuv
Apple® QuickDraw®		pict
Apple® QuickTime Image®		gtif
Apple® QuickTime Movie®	✔	mov
RLA	✔ *1	rla
SGI ®	✔	sgi
SGI 16 ®	✔ *1	sgi
Softimage ®	✔	pic
Targa	✔	tga
TIFF	✔	tif
TIFF 16	✔ *1	tif
Windows Bitmap	✔	bmp
Sony PlayStation	✔ *1	tim
SVG		svg

XPM	✔ *1	xpm

1: For Windows > Maya Software, Maya Hardware, Maya Hardware 2.0, and Vector
2: For Windows > Maya Software, Maya Hardware, and Maya Hardware 2.0
3: For Windows > Vector
4: For Mac > Vector
5: Export of .avi files limited to a size of 2GB.
6: Batch render to. exr using the Maya Hardware 2.0 renderer. Save your rendered image from any renderer to Open EXR from the Render View Window File > Save Image menu.

Activities

Activity 1: Understanding File Format Compatibility

Materials Required: Computer with access to 3D modeling software (e.g., Maya, Blender), Image editing software (e.g., Photoshop, GIMP), Sample files in different formats (JPEG, PNG, TIFF, SVG, MP4), Internet access for research on file format plugins and documentation

Procedure:

Research File Format Specifications:

- Identify and list the properties of each file format (e.g., JPEG, PNG, GIF, etc.).
- Note the typical use cases, advantages, and limitations of each format.

Test File Compatibility:

- Open sample files in relevant software (e.g., import a PNG into a 3D modelling tool or open a TIF in an image editor).
- Check if any plugins or additional settings are needed for importing specific file types.

Evaluate File Behaviour:

- Observe how each file format behaves in different software environments (e.g., does TIFF load with all properties intact in Maya?).
- Note any issues or limitations encountered, such as unsupported variations of a format.

Document Findings:

- Record results for each file format, detailing compatibility, required plugins, and any adjustments needed.
- Summarize observations in a table for clear comparison between formats.

Check Your Progress

A. Multiple Choice Questions

1. What is the default extension for a Maya Binary file?
a) .ma
b). mb
c) .obj
d). mel

2. Which file format is commonly used for exporting UV snapshots for editing in Photoshop?
a) .png
b) .obj
c). exr
d) .jpg

3. In Maya, which plugin is required for exporting OBJ files?
a) objExport
b) anim-Import-Export
c) physx
d) bullet.mll

4. Which of the following file formats can be used for saving rendered images in Maya?
a) .avi
b) .tga
c) .bmp
d) All of the above

5. Which of these file formats is used for saving a motion file in Maya?
a) .mov
b) .avi
c) .gif
d) .png

6. Which extension is used for exporting a file in Maya ASCII format?
a). mb
b) .ma
c) .mel
d) .obj

Session 3: Trouble Shooting

Troubleshooting is a systematic approach to problem-solving often used to identify and correct issues with complex machines, electronics, computers, and software systems. The first step in troubleshooting involves gathering information on the issue, such as undesired behaviour or a lack of expected functionality. The most important factor in troubleshooting is identifying the error and rectifying it by eliminating the issue involved in any of the functions.

Texture Library

Texture Library is a collection of pre-made textures that can be used in 3D modeling, animation, and visual effects projects. These libraries contain various surface textures, such as wood, metal, fabric, stone, and more, which can be applied to 3D models to enhance realism.

An important task for successful texturing is the creation of a texture library. This holds true for professionals as well as independent or student animators. A thoroughly stocked texture library can save a tremendous amount of time and supply a great deal of diversity for any texturing project.

A Texture library is generally stocked with three types of Bitmaps: photos, scans, and hand-painted maps. With current technology, high-resolution digital cameras and flatbed scanners are relatively inexpensive and should be part of an animator's toolkit. Hand-painted Bitmaps, due to their labor-intensive nature, represent the pinnacle of texturing. Feature, visual effects, and game studios regularly employ full-time texture painters. Regardless, the best hand-painted textures usually start with photos and scans.

Animators can either create their own Bitmaps, purchase them, or download them for free. Texture-library CDs, such as Total Textures are available with hundreds of images at a reasonable price. However, due to low resolutions and a lack of useful diversity, such library Bitmaps are generally inferior to those created independently. When using a pre-made library or downloading Bitmaps, awareness of copyright issues is essential. For photographing textures, it is advisable to avoid strong lighting situations to prevent heavy shadows or intense light colours that indicate the time of day.

A bright, noonday sun is not the best light source for photographing a chunk of rusty metal or a brick wall. Instead, a bright but overcast day, where the light and shadows are diffuse, yields the best results.

Ideally, the textures in a library should be usable in a wide range of 3D lighting situations, so their integral lighting should be neutral. Avoid wide-angle lenses, such

as 24mm or 28mm, as they introduce significant perspective distortion, making the resulting texture difficult to apply in Maya.

In terms of texture resolutions, larger is better. Although scaling down an image is straightforward, scaling up can lead to quality-degrading artefacts. If possible, keep all Bitmaps between 512 and 2048 (2K) lines of resolution.

Resolutions should be high enough to maintain quality during full-screen renders. When rendering for video, a 1024 texture resolution, which is twice the resolution of the 480 lines dedicated to standard television, is a safe.

Textures created for 35mm feature films may reach resolutions as large as 4096 (4K) lines. For small items that will never appear close to the screen, such as a button or sticker, the resolution can be reduced to twice the number of vertical lines the texture might occupy. For example, a button on a character's shirt may never take up more than 10 vertical lines in the render, so a 20×20-pixel size will suffice.

Quick Texturing

Tight production deadlines often necessitate quick texturing jobs. One method is to combine generic textures within Maya. The Colour Gain and Colour Offset attributes, common to every texture, provide an efficient means of achieving this. For example, combining a Bitmap featuring a clean brick wall with rusty metal and asphalt Bitmaps can yield a more complex and interesting result.

Technically speaking, Colour Gain functions as a multiplier. Whatever is mapped to Colour Gain is multiplied by the Original Map. In contrast, Colour Offset acts as an offset factor; whatever is mapped to Colour Offset is added to the Original Map. Thus, Colour Gain Maps tend to darken the result, while Colour Offset Maps tend to lighten it, creating a washed-out appearance.

Colouring Particles

Particle texturing can be divided into two main categories: hardware-rendered and software-rendered.

Hardware-rendered particles: It includes MultiPoint, MultiStreak, Points, Spheres, and Streak, which can be assigned to any material. However, only the colour information is utilized. Additionally, rendering must occur using the Hardware Render Buffer window or the Hardware renderer; otherwise, the particles will not appear. Although the texturing capability of hardware-rendered particles is limited, unique colours can be assigned to individual particles.

Cloud and Tube particles must be assigned to a Particle Cloud material. The colour, transparency, and incandescence of Cloud and Tube Particles can be based on their lifespan by mapping a Ramp texture to the Life Colour, Life Transparency, and Life

Incandescence attributes of the assigned Particle Cloud material.

Maya automatically provides an Array Mapper utility and all the necessary connections. In contrast, Blobby Surface particles can be assigned to Lambert, Blinn, Phong, PhongE, and Anisotropic materials. Blobby Surface particles support all standard attributes of these materials, including specularity, transparency, and the application of Colour Maps. However, to colour Blobby Surface particles individually, a Particle Sampler utility must be connected to the particle network.

Activities

Activity 1: Arranging the texture

Materials Required: Computer system, and Autodesk®Maya®

Procedure:

1. **Create a Custom Texture Library:**
   Begin by organizing a collection of textures that suit your specific project needs. This can include images, patterns, and other resources that you can reuse across multiple projects.

2. **Select the Textures:**
   Choose textures that match the aesthetic or style you wish to achieve in your 3D models. This might include a variety of materials such as wood, metal, fabric, stone, or any custom designs.

3. **Organize Textures into Categories:**
   Arrange your textures into logical folders based on their types (e.g., rough, glossy, metallic, etc.), which will help streamline your workflow when accessing them during the modelling process.

4. **Import Textures into Autodesk® Maya®:**
   Once organized, you can begin importing your textures into Maya. You can apply these textures to your models using the appropriate material nodes such as lambert, phong, or blinn, depending on the desired effect.

5. **Customize Textures if Needed:**
   If necessary, adjust the textures within Maya to better fit your models. This may involve scaling, tiling, or editing their UV Mapping to ensure they blend seamlessly with the geometry of your 3D objects.

6. **Save and Back Up Your Texture Library:**
   Ensure that your library is saved in a secure location and backed up

regularly, especially if it contains textures you've customized or created. This will prevent the loss of valuable resources and ensure quick access in future projects.

Check Your Progress

A. Multiple Choice Questions

1. What is the purpose of a Texture Library?
a) To store textures for quick access during texturing
b) To store 3D models
c) To store rendered images
d) None of the above

2. What are the three types of Bitmaps commonly found in a Texture Library?
a) Photos, videos, and scans
b) Photos, scans, and hand-painted maps
c) Photos, animations, and textures
d) None of the above

3. What should be avoided when photographing textures for a library?
a) Overcast days
b) Bright sunlight causing heavy shadows
c) Nighttime lighting
d) Diffuse light sources

4. What resolution is considered optimal for textures in a library?
a) 256 lines
b) 512 to 2048 lines
c) 1024 lines only
d) 2048 to 4096 lines

5. What feature in Maya helps speed up texturing by adjusting attributes like Colour Gain and Colour Offset?
a) Texture Mapping
b) Colour Gain and Colour Offset attributes
c) Texture Library
d) Particle Sampler

6. Which of the following types of particles in Maya can be assigned materials such as Lambert, Blinn, or Phong?
a) MultiPoint particles
b) Cloud and Tube particles
c) Blobby Surface particles
d) Points particles

Answer Key

MODULE 1: 3D ANIMATION

Session 1: Mastering the Essential Skills Tutorial Window in Maya

A. Multiple Choice Questions

1. b
2. c
3. b
4. a
5. a
6. c
7. c
8. b

Session 2: Introduction to 3d Modelling

A. Multiple Choice Questions

1. b
2. c
3. b
4. c
5. b
6. c
7. c
8. b

Session 3: Texturing Using Shaders

A. Multiple Choice Questions

1. b
2. c
3. b
4. c
5. c
6. b
7. b
8. b
9. b
10. b

Session 4: Maya Material

A. Multiple Choice Questions

1. b
2. a
3. b
4. b
5. b
6. b
7. b
8. b
9. b
10. a

Session 5: Real Life 3 D Model

A. Multiple Choice Questions

1. c
2. b
3. b
4. c
5. a
6. b
7. a
8. b

Session 6: Properties of Surface Materials

A. Multiple Choice Questions

1. b
2. b
3. b
4. a
5. b
6. b
7. b
8. b
9. a
10. b

Session 7: Effect of Lighting Conditions on Surfaces

A. Multiple Choice Questions

1. b
2. b
3. c
4. b
5. b
6. b
7. b
8. a

MODULE 2: SURFACE SHADING AND MAPS

Session1: Surface Shading and its Properties

A. Multiple Choice Questions

1. c
2. d
3. c
4. b
5. c
6. c
7. c
8. b
9. b
10. b

Session 2: Shading Network

A. Multiple Choice Questions

1. b
2. a
3. b
4. c
5. b
6. a
7. b
8. c
9. b
10. b

Session 3: Creating and Assigning Material to Surface

A. Multiple Choice Questions

1. c
2. b
3. b
4. b
5. b
6. b
7. a
8. b
9. b
10. c

Session 4: Texture Maps

A. Multiple Choice Questions

1. c
2. b

3. b
4. b
5. d
6. b
7. b
8. b
9. b
10. c

Session 5: UV Texture Mapping

A. Multiple Choice Questions

1. a
2. c
3. a
4. d
5. a
6. b
7. a
8. d
9. a
10. a

Session 6: Creating Bump Map

A. Multiple Choice Questions

1. a
2. b
3. a
4. b
5. d
6. b
7. b
8. a
9. a
10. b

Session 7: Specular Map

A. Multiple Choice Questions

1. c
2. b
3. b
4. b

Session 8: Creating Seamless Textures in Photoshop

A. Multiple Choice Questions

1. b
2. d

3. b
4. b
5. a
6. c
7. c
8. c
9. b
10. b

MODULE 3: RENDERING, COMPOSITING AND FILE FORMATS

Session1: Rendering and Compositing

A. Multiple Choice Questions

1. b
2. a
3. b
4. b
5. b
6. b
7. b
8. b
9. c
10. b

Session2: Working with File Formats

A. Multiple Choice Questions

1. b
2. a
3. a
4. d
5. a
6. b

Session 3: Trouble Shooting

A. Multiple Choice Questions

1. a
2. b
3. b

Glossary

2-Sided Polygon: A polygon with two surface normals, facing opposite directions, like a playing card.

3D Object: An entity with a position in 3D space; can be geometric objects (polygon meshes, curves) or special roles (camera, light).

3D Studio Max (3ds Max): 3D Studio Max, now called 3ds Max, is a 3D modelling, animation, and rendering software developed by Autodesk. It is commonly used for creating 3D assets for games, film, architectural visualization, and product design.

aiStandardSurface: It is a physically-based shader used in Autodesk Maya's Arnold renderer for creating realistic materials. It is part of the Arnold shading system and allows artists to create a wide range of materials with accurate light interaction.

Alpha Channel: One of four pixel channels (RGB + alpha) specifying transparency, allowing foreground/background visibility when images are overlaid.

Alpha is Luminance: Alpha is Luminance is an option in Texture Mapping that treats the grayscale value of an image as the alpha (transparency) channel. Instead of using the image's colour information to define transparency, the brightness or luminance of the pixels is used to control the transparency.

Ambient Component: Part of the reflection-illumination model; simulates consistent ambient light across surfaces.

Ambient Light: Uniform light illuminating objects from all directions.

Animation: Creating sequential images to simulate continuous motion.

Anti-aliasing: It is a technique used in computer graphics to reduce the visual defects, such as jagged edges (also known as "aliasing"), that occur when representing a high-resolution image in a lower-resolution format.

Array Mapper: It is a tool or technique used to apply a function or transformation to each element in an array or list, and it creates a new array based on the results.

Array: A set of ordered copies of an object in 3D space.

Aspect Ratio: Ratio of an image's width to height (e.g., 4:3 for 35 mm slides).

Attribute Editor: The Attribute Editor is a central interface in Maya for viewing and editing the attributes of selected objects, materials, or nodes. In the context of texturing, it is used to fine-tune the attributes of shaders, textures, and other material components.

Attribute Spread Sheet: The Attribute Spread Sheet is a powerful tool in Maya that allows users to view and edit attributes for multiple objects or nodes in a tabular format. This tool is particularly useful when working with large scenes or multiple objects that share the same material or texture.

Autodesk Maya: It is a powerful 3D computer graphics software used widely for creating interactive 3D applications, animations, visual effects, and models.

Ball: A sphere defined by user dimensions.

Bevel: Softening sharp edges by extending object faces.

Bit: Basic unit of data (1 or 0).

Bitmap : It is a type of image file format that represents a digital image using a grid of individual pixels. Each pixel in the grid holds a specific colour value, which collectively makes up the complete image. The term Bitmap comes from the fact that the image is essentially a "map" of bits, where each bit or group of bits corresponds to the colour or grayscale value of a single pixel.

Black Hole: A region in spacetime with gravity so strong that nothing can escape.

Blending: Mixing multiple textures into a final texture.

Blobby Surface: It refers to a type of surface representation used in 3D graphics and computer modelling, typically to create smooth, organic shapes. It is often used in modelling soft, gel-like, or organic forms, such as liquids, flesh, or other deformable objects.

Bump Map: Illusion of surface depth created without altering the mesh.

Byte: Unit of digital storage (8 bits).

Camera: Device for capturing images; in 3D, it transforms scenes into visuals.

Channel Box: The Channel Box is a panel in Maya where the most commonly used attributes (e.g., translation, rotation, scale, visibility) of a selected object are displayed and can be edited. For texturing artists, it is useful for quick adjustments to parameters like transparency, diffuse colour, and other basic material attributes that affect the object's appearance.

Child Object: An object influenced by a "parent" object.

Clipping: Excluding parts of graphics outside the camera viewport.

Clone: Tool for creating copies with variations.

Compositing Department: It is a key part of the visual effects (VFX) pipeline in film, television, video games, and animation production. This department is responsible for combining multiple visual elements (such as live-action footage, computer-generated imagery (CGI), and other assets) into a final, cohesive image or shot.

Compositing: Combining separate elements into a final image.

Curve: Representation of curves in graphics (e.g., NURBS, Bezier).

Decal: A decal is a design, image, or graphic that is printed onto a special paper or material, allowing it to be transferred and applied onto surfaces. Decals are often used for decoration or branding and can be applied to various materials like glass, metal, or plastic.

Density: Mass per unit volume (d = M/V).

Depth of Field: Range of distance in focus in an image.

Depth Sorting: Ordering triangles by depth for proper rendering.

Desaturate function: The Desaturate function in image editing and 3D texturing software converts a colour image into a grayscale image by removing all colour information while retaining the image's brightness values. This function reduces the saturation of an image to zero, effectively transforming it into black, white, and shades of gray.

Diffuse Light: Result of direct illumination.

Diffuse Map: Texture Map simulating painted surfaces.

Dimension: Measure of spatial extent (width, height, length).

Dimmer: A device used to lower the brightness of light fixtures.

Directional Light: A light that shines evenly in one direction with parallel rays, also known as distant light.

Displacement Map: Modifies the actual mesh to create detailed surface features like wrinkles and creases.

Dolly: Movement of the camera along its line of sight in a straight line.

Dots per Inch (dpi): Measurement of pixel density in an image, affecting image quality during resizing.

Edge Loop: A modeling technique that creates circular flows around features on organic shapes.

Edge: A line connecting two points on a polygon, fundamental to polygon structure.

Environment Map: Simulates reflections of the surrounding world without ray tracing.

Extrude: Creates 3D objects from 2D shapes by adding depth.

Face Normal: A line perpendicular to a face indicating its direction in one-sided polygons.

Face: The polygon shape formed by bounding points; supports 3 or 4 vertices for subdivision.

Fields: Components of interlaced video, with each field containing half the scan lines.

Flag: A device to create shadows by blocking light from specific areas.

Frame: A static image in animation; multiple frames create the illusion of motion.

Frame-rate: Speed of displaying frames, expressed in frames per second (fps).

Gamma-Correct Blending: When gamma correction is enabled, colours are adjusted according to a non-linear curve (often set to a gamma of 2.2). This means the texture's colours are processed to look consistent under different lighting scenarios and on various displays.

Geometry: The points and structure of an object in 3D space, excluding nulls.

Global Illumination: Image generation method that accounts for both direct and indirect light effects.

Glow: An optical effect producing a fuzzy halo around light sources.

Graphical User Interface (GUI): Visual interface allowing intuitive interaction between user and computer.

Grayscale images: Grayscale images are images that contain varying shades of gray, with each pixel representing a specific intensity level.

High Dynamic Range Image (HDRI): An image with a wide intensity range, capturing more detail in highlights and shadows.

Hypershade: The Hypershade panel in Autodesk Maya is a powerful tool used for creating, editing, and managing materials, textures, and shaders for 3D models. It

is a visual node-based editor where you can create complex shading networks that define the appearance of your 3D objects.

iClone: iClone is a 3D animation software developed by Reallusion, used for creating animated characters, scenes, and videos. It allows users to design and animate 3D characters, props, and environments with ease, offering real-time animation creation and rendering.

JPEG (JPG): JPEG is a widely used Bitmap image format primarily designed for photographs and images with smooth colour transitions.

Material: The underlying substance applied to objects, defining their appearance (e.g., wood, metal).

Mesh: An object made up of triangular faces.

Misss_fast_shader: This is a shader in Maya used primarily for rendering realistic skin. The **misss_fast_shader** is a part of Maya's Mental Ray rendering system and is optimized for simulating subsurface scattering, which is a key property of materials like skin, wax, and marble.

Motion Path: The trajectory an object follows during movement.

Node: A fundamental graph element representing items like vertices and faces.

NTSC: A video standard in the U.S. and Japan with a frame rate of 30 fps and a resolution of 720x486.

Null: A non-renderable object used for manipulating 3D objects and Texture Mapping.

NURBS: Non-Uniform Rational B-Splines, a mathematical model for curves and surfaces in graphics.

Object: A model representing a real-world item in a scene.

Opacity Map: Controls transparency based on pixel intensity; black is transparent, white is opaque.

Opacity: The degree of transparency.

Opaque Material: Materials like wood and metal that do not allow light to pass through.

Optical Light Effect: Visual phenomena caused by bright light sources or refraction.

Origin: The absolute center (0, 0, 0) of a 3D space.

outAlpha attribute: The outAlpha attribute is commonly used in 3D graphics and shading networks, particularly within programs like Autodesk Maya, to control the transparency or opacity of an object or material.

PAL: A European video standard with a frame rate of 25 fps and a resolution of 720x576.

Particle Sampler: It is a tool or technique used to simulate, sample, or manipulate particles in various digital applications such as computer graphics, physics simulations, and procedural generation.

Particles: 2D objects used in large quantities to create effects (e.g., rain, explosions).

Pivot Point: The central point around which an object rotates or transforms.

Pixel: The smallest unit of a digital image.

Plane: A two-dimensional flat surface.

PNG: PNG is a lossless image file format used for storing digital images.

Polygon: A geometric shape with multiple faces; used in polygonal modeling.

Primary Colours: Red, Green, and Blue (RGB); combine to create white light.

Primitive: Basic geometric shapes like spheres and cubes used in modeling.

Raytrace Options: It refers to settings in 3D rendering software that control how light rays are traced to simulate realistic lighting and shadows.

Raytracing: A rendering technique for calculating reflections, refractions, and shadows.

Reflection Map: Simulates reflections on surfaces without full ray tracing.

Reflection: Light bouncing off a surface; varies based on material properties.

Refraction Index: A value indicating how much light bends in a transparent material.

Refraction: The bending of light as it passes through different media.

Render Pass: Divides a scene into aspects (e.g., highlights, shadows) for rendering.

Render: The process of generating an image from a 3D model with applied properties.

Resolution: The detail of an image, defined by the number of pixels.

Riggers: The correct term is **riggers** (with an "r"). In 3D animation and modelling, riggers are professionals who create and set up the "rig" for characters or objects.

Rigging: Preparing an object for animation by creating a bone structure.

Rotoscoping: It is a technique used in visual effects (VFX) and animation where elements of a video or film are manually traced or cut out from a live-action scene to create a matte or mask.

Rotoscoping: Tracing over video frames to create animation.

Scattered: The deflection of light as it passes through a medium with particles.

Seamless: Textures that tile without visible transitions.

Settings: Configurations for various aspects of a project.

Silhouette: It refers to the outline or shape of an object, typically viewed as a solid, dark shape against a lighter background. In 3D graphics and visual effects, the silhouette is often used to highlight the contour of an object, particularly when it is backlit or when the focus is on its shape rather than its internal details.

Space: The three-dimensional area where objects exist.

Specularity: The quality of surface reflections; determines how shiny an object appears.

Spotlight: A light source projecting in a specific direction.

Subdivision surfaces: Subdivision surfaces are a type of polygonal surface modelling technique used in 3D computer graphics to create smooth, curved surfaces by subdividing and refining a polygonal mesh (usually a low-resolution mesh) into a higher-resolution surface.

Swatch label: It in 3D graphics, particularly in software like Maya, refers to a small preview or sample of a material, texture, or colour used to visually represent the properties of that material.

Targa (TGA): It is a raster graphics file format that supports 32-bit colour, commonly used for rendering still images and video sequences.

Texture Coordinates: Coordinates that define how a Texture Maps onto an object.

Texture Map: A two-dimensional image applied to the surface of a 3D object.

Texture Mapping: Projecting a 2D image onto a 3D surface for added detail.

TIFF: TIFF is a flexible and highly versatile Bitmap image format commonly used in professional photography, desktop publishing, scanning, and printing. It

supports both lossless and lossy compression, allowing for high-quality images with either minimal or no loss of data.

Timeline: A slider used to represent time in animation.

Transformation: Changing the position, scale, or orientation of an object.

Translucence: Allowing some light to pass through while obscuring details.

UV Mapping: UV Mapping is a process in 3D computer graphics used to map a 2D image (texture) onto the surface of a 3D model.

Viewport: The window displaying a 3D model in a specific projection.

Wireframe: A visual representation of geometry using lines between vertices.

X-Axis: The left-right axis in a three-dimensional coordinate system, typically representing horizontal movement. In 3D modeling and graphics, this axis runs from left to right when viewing a standard front-facing object.

Y-Axis: The up-down axis in a three-dimensional coordinate system, usually representing vertical movement. This axis runs from bottom to top, helping to define height or vertical positioning in space.

Z-Axis: The in-out axis in a three-dimensional coordinate system, representing depth. This axis runs from front to back, indicating how far an object or point is from the viewer's perspective.

ZBrush: ZBrush is a digital sculpting software developed by Pixologic, primarily used for creating highly detailed 3D models.

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