

Lesson 01

Primitives

This lesson teaches you how to build and transform primitives in 3D space in order to create a rudimentary environment, in which you will set-up some animation shown in this book. You will explore the Maya user interface (UI) as you learn how to build and develop your scene.

In this lesson, you will learn the following:

- How to set a new Maya project
- How to create primitive objects
- How to move objects in 3D space
- How to duplicate objects
- How to change the shape of objects
- How to delete polygonal faces
- How to use the Maya view tools
- How to change the display of your objects
- How to name your objects
- How to save your scene

Setting up Maya software

The first step is to install the Autodesk® Maya® software. Once that is done, you should copy the Learning Maya support files to your Maya *projects* directory. The support files are found in the *support_files* directory on the DVD-ROM included with this book.

In order to find your *projects* directory, you need to launch Maya software at least once so that it creates your user directory structure. Here is where the *projects* directory is typically located on your machine:

Windows: *Drive:\Documents and Settings\[username]\My Documents\maya\projects*

Mac OS X: *Users/[username]/Documents/maya/projects*



Note: *To avoid the Cannot Save Workspace error, ensure that the support files are not read-only after you copy them from the DVD-ROM.*

When Maya software is launched for the first time and you have other Maya versions installed, you will be asked if you want to copy your preferences or use the default preferences. In order to follow the course, you should be using default preferences. If you have been working with Maya software and have changed any of your user interface settings, you may want to delete or back-up your preferences in order to start with the default Maya configuration.

Creating a new project

Maya software uses a project directory to store and organize all of the files (scenes, images, materials, textures, etc.) related to a particular scene. When building a scene, you create and work with a variety of file types and formats. The project directory allows you to keep these different file types in their unique sub-directory locations within the project directory.

1 Launch Maya software

2 Set the project

To manage your files, you can set a project directory that contains sub-directories for different types of files that relate to your project.

- Go to the **File** menu and select **Project** → **Set...**

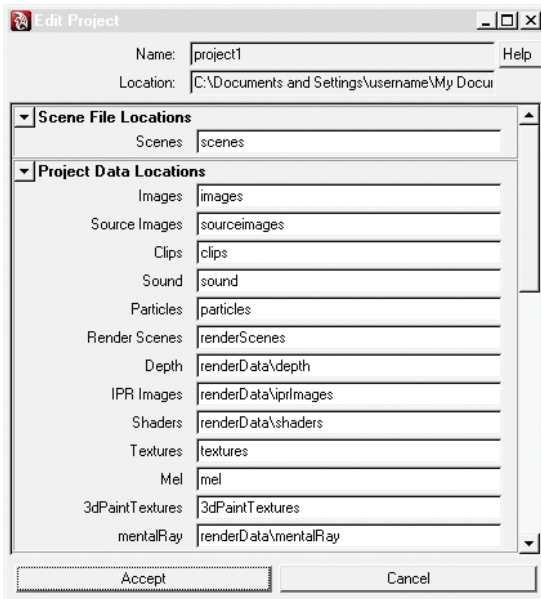
A window opens that directs you to the Maya projects directory.

- **Open** the folder *support_files*.
- Click on the folder named *project1* to select it.
- Click on the **OK** button.

This sets project1 as your current project.

- Go to the **File** menu and select **Project** → **Edit Current...**

Make sure that the project directories are set-up as shown below. This ensures that Maya software is looking into the proper sub-directories when it opens up scene files.



Edit Project window

- Click the **Accept** button when done.

3 Make a new scene

- Select **File** → **New Scene**.

This will create a new scene in the current directory when you save it.

Build the environment

Every scene you create in Maya software will most likely contain objects such as surfaces, deformers, skeleton joints, or particle emitters. For this scene, you will build a throne room, but first, you will need a large outdoor environment.

To start, you will build a ground plane surrounded by a large sky dome. These first objects will be a primitive polygonal plane and a primitive NURBS sphere. You can view the finished scene to get an idea of what you are about to create by opening the file called *01-room_01.ma*.

1 Launch Maya software

2 Change menu sets

There are five main menu sets in Maya software: *Animation*, *Polygons*, *Surfaces*, *Dynamics*, and *Rendering*. These menu sets are used to access related tool sets.

- From the drop-down menu at the left edge of the Status Line (Toolbar), select **Polygons**.

As you change menu sets, the first six menu items and the Help menu item along the top of the viewport remain the same while the remaining menu items change to reflect the chosen menu set.



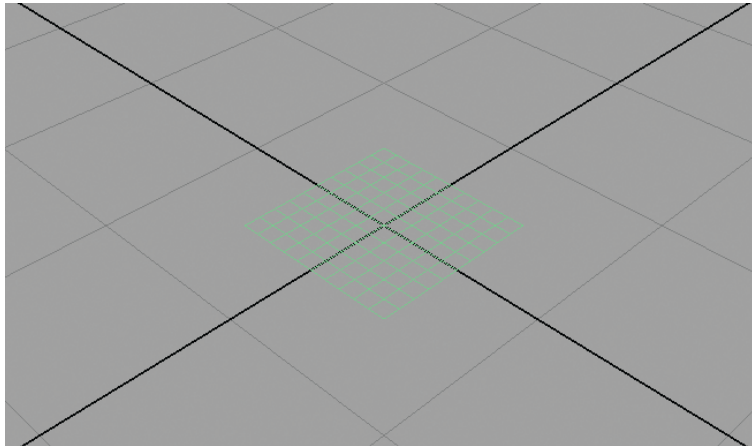
Menu set pop-up menu

3 Create a polygonal plane

A primitive plane will be used as a large ground plane on which you will build the house. It will be built using polygonal geometry. Throughout this lesson and in the next project, you will learn more about this geometry type.

- **Disable** the interactive creation mode of models (which is enabled by default), by selecting **Create** → **Polygon Primitives** → **Interactive Creation**.
- From the **Create** menu, select **Polygon Primitives** → **Plane**.

A small plane is created at the origin.



Perspective view of pPlane1

4 Change the plane's dimensions

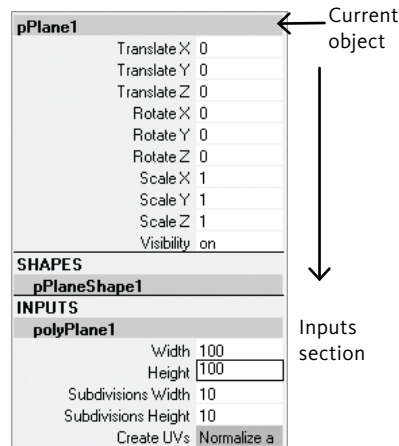
The plane is a procedural model. This means that it is broken down into parts called *nodes*. One node contains its positioning information, one contains its shape information, and another contains input information that defines the plane's construction history using attributes such as width, height, and subdivisions. You can edit this Input node's attributes in the Channel Box in order to edit the plane's basic shape.

The Channel Box is found at the right side of the screen and lets you make changes to key attributes very easily.

Note: If your Channel Box is not along the right side of the screen, you can access it by selecting **Display → UI Elements → Channel Box/Layer Editor**.

- From the Channel Box's **Inputs** section, click on *polyPlane1*.
This will make several new attributes available for editing.
- Type **100** in the **Width** entry field and press the **Enter** key.
- Type **100** in the **Height** entry field and press the **Enter** key.

Now the plane is very large in the Perspective view, but this is intended since you don't want to see any ground plane edges as you are working.



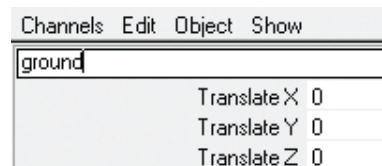
Channel Box

Note: Another method for increasing the size of the plane would be to scale it. In Maya, you can often achieve the same visual results using many different methods. Over time, you will begin to choose the techniques that best suit a particular situation.

5 Rename the Plane node

You should rename the existing Transform node to make it easier to find later.

- Click on the *pPlane1* name at the top of the **Channel Box** to highlight it.
- Type the name *ground*, then press the **Enter** key.



Renaming the node in the Channel Box

6 Create the sky

You will now create another object to be used as a large sky dome.

- **Disable** the interactive creation mode of models by selecting **Create** → **NURBS Primitives** → **Interactive Creation**.
- Select **Create** → **NURBS Primitives** → **Sphere**

7 Modify the sphere

- With the *pSphere1* still selected, set the **Scale X, Y, and Z** in the **Channel Box** to **50**.
The sphere should now be as big as the ground plane.



Note: You can dolly out in the **Perspective** view to see the entire scene by holding the **Alt** key and **click+dragging** the **RMB**.

- Click on the *makeNurbSphere1* node in the **Channel Box**.
- Set the following:

End Sweep to **180**;

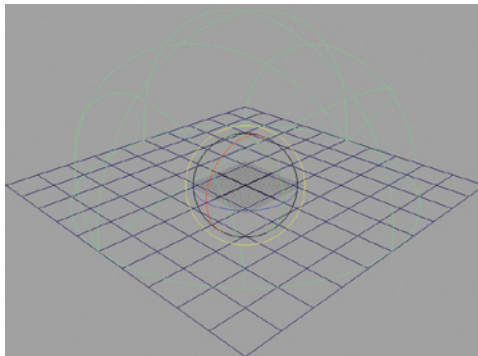
Sections to **4**.

By changing the sphere's input, the sphere automatically updates. The sphere is now half a sphere with fewer sections.

8 Rotate the sphere

- With the *pSphere1* still selected, set **Rotate X** and **Y** in the **Channel Box** to **-90** degrees.

Doing this rotates the sphere so it covers the ground plane. You now have a closed environment in which you will create the rest of the scene.



The ground plane with a sky dome

9 Rename the sphere

- Rename the *pSphere1* to *skydome*.

Viewing the scene

When you work in 3D space, it is important to see your work from different angles. The different view panels let you see your work from the front, top, side, and perspective views.

You can also use the view tools to change the views in order to reposition how you see your scene. In some cases, a view change is like panning a camera around a room, while in other cases a view change might be like rotating an object around in your hand to see all the sides. These view tools can be accessed using the **Alt** key in combination with various mouse buttons.

1 Edit the Perspective view

You can use the **Alt** key with your mouse buttons to tumble, track, and dolly in your Perspective view.

- Change your view using the following key combinations:

Alt + LMB to tumble;

Alt + MMB to track;

Alt + LMB + MMB or **Alt + RMB** to dolly.

*You can also combine these with the **Ctrl** key to create a bounding box dolly where the view adjusts based on a bounding box. This is useful when you want to dolly on a precise section of the view or quickly dolly out to get the general look of the scene.*

Ctrl + Alt + LMB to box dolly.

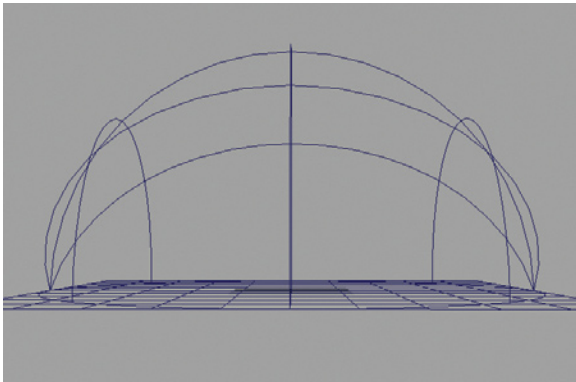
Click+drag from left to right to dolly in, and from right to left to dolly out.

You can also undo and redo view changes using the following keys:

To **undo** views use [;

To **redo** views use] .

- Alter your Perspective window until it appears as shown below:



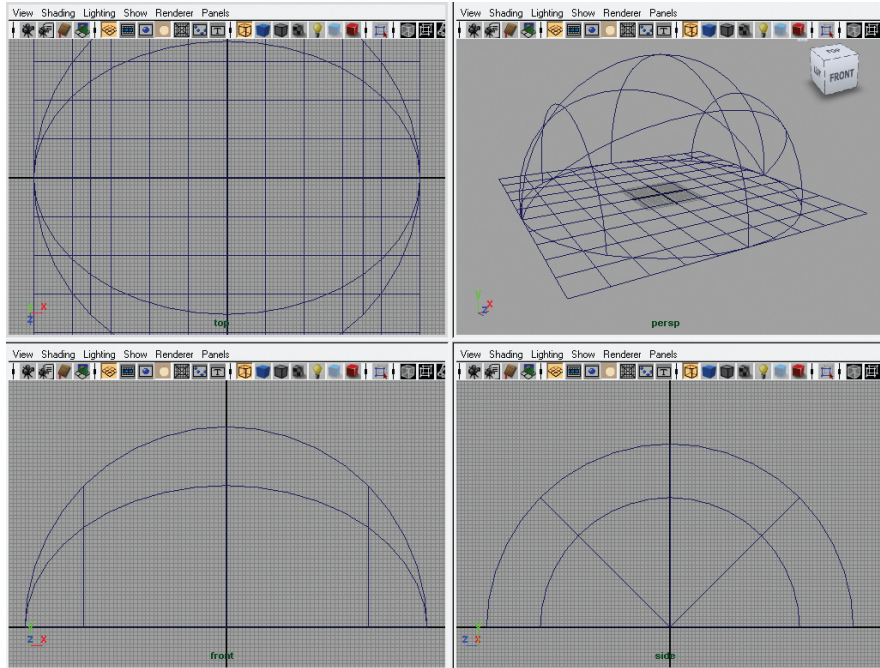
Changed Perspective view

2 Four view panels

By default, a single Perspective window is shown in the workspace. To see other views of the scene, you can change your panel layout.

- At the top of the Perspective view panel, go to the **Panels** menu and select **Saved Layouts** → **Four View**.

You can now see the environment using three Orthographic views—top, side, and front—that show you the models from a projected view. You can also see them in a Perspective view that is more like the everyday 3D world. This multiple view setup is very useful when positioning objects in 3D space.



Four view panels



Tip: Tapping the keyboard **spacebar** will switch from a single view panel to a four-view panel.

3 Edit the view in the side view

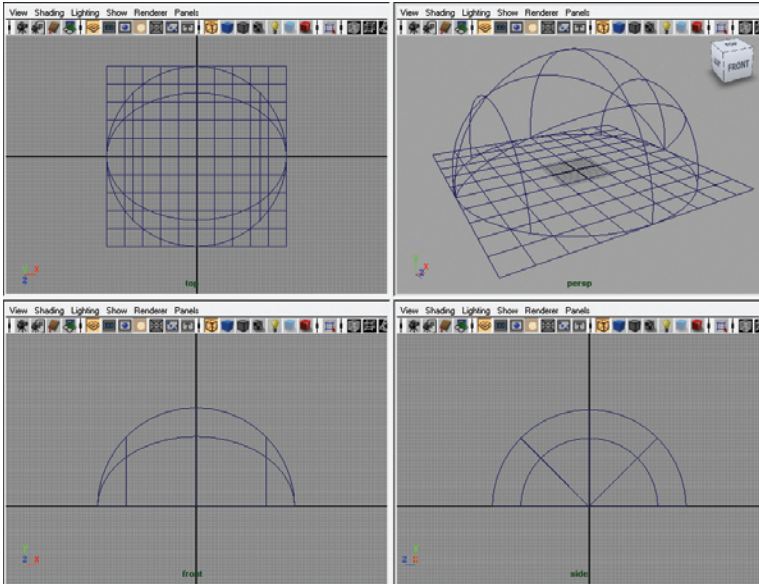
Orthographic views use similar hotkeys, except that you cannot tumble by default in an Orthographic view.

- In the side view, change your view using the following key combinations:

Alt + MMB to track;

Alt + LMB + MMB or **Alt + RMB** to dolly.

- Keep working with the *Orthographic* views until they are set-up as shown:



New Orthographic views

4 Frame Selected and Frame All

Another quick way to navigate in the different views is to use the **Frame Selected** or **Frame All** hotkeys for the active view.

- Select the *ground* plane.
- While in the *four-view* panels, move your mouse over a view.
- Press the **f** hotkey to frame the selected geometry in the view under your mouse.
- Press the **a** hotkey to frame everything visible in the view under your mouse cursor.
- Press the **Shift+a** hotkey to frame everything in all views at once.

Setting display options

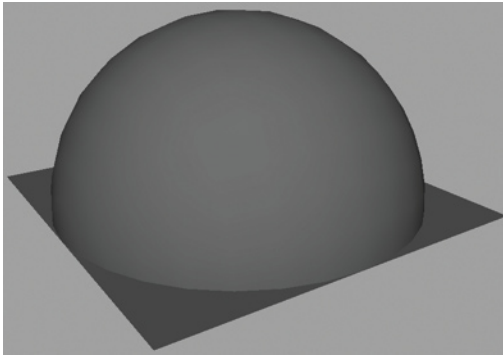
The view panels let you interactively view your scene. By default, this means viewing your scene as a wireframe model. To better evaluate the form of your objects, you can activate hardware shading.

1 Turn on hardware shading

To help visualize your objects, you can use hardware shading to display a shaded view within any panel.

- From the Perspective view's **Shading** menu, select **Smooth Shade All**.

This setting affects all of the objects within the current view panel.



Smooth shaded view



Tip: You can also turn on Smooth Shading by moving your cursor over the desired panel, clicking with your middle mouse button and pressing the **5** key. The **4** key can be used to return the panel to a wireframe view.

2 Hide the grid

You can hide the world grid to simplify your view using one of two options:

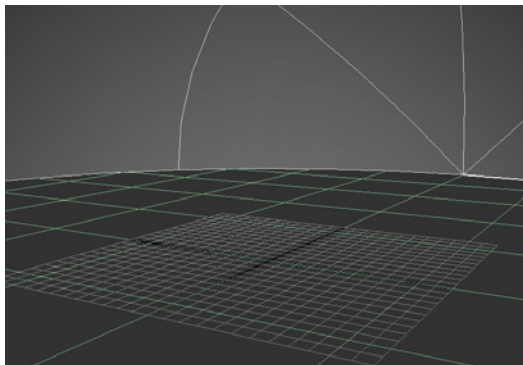
- From the view panel's **Show** menu, select **Grid** to hide the grid for that view only.

OR

- From the **Display** menu, deselect **Grid** to hide the grid for all views.

Moving inside the environment

In order to have the feeling of being inside the environment in the Perspective view, you need to move the Perspective camera inside the sky dome geometry. You will soon realize that even if you can see inside the sky dome, sometimes its geometry will appear in front of the camera while moving, thus hiding the interior. The following steps will prevent this from happening.



Perspective inside the environment

1 Change the sky's display

To simplify your scene interaction, there is a way of seeing inside the sky dome even when the camera is outside of it. To do so, you will have to change the way the geometry is displayed. The following actions are somewhat more advanced than what you will undertake in this project, but they will allow you to see inside the environment more easily.

- Select the *skydome*.
- Select **Window** → **Attribute Editor**.

The Attribute Editor is similar to the Channel Box, but with many more accessible attributes.

- **Expand** the **Render Stats** section by clicking the small arrow button.

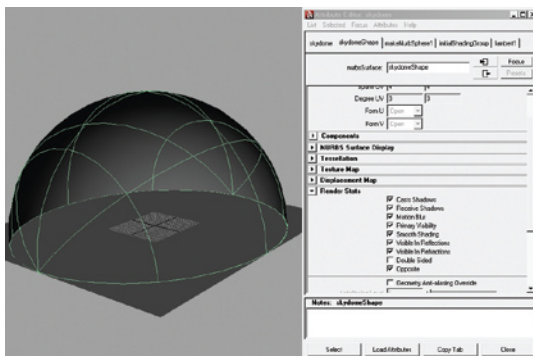
This section controls how the models are displayed in the viewports and render time.

- **Disable** the **Double-Sided** attribute.

This tells Maya to hide the sides of the geometry facing away from the camera.

- **Enable** the **Opposite** attribute.

This tells Maya that you want the geometry to be displayed inside out.



Seeing inside the environment

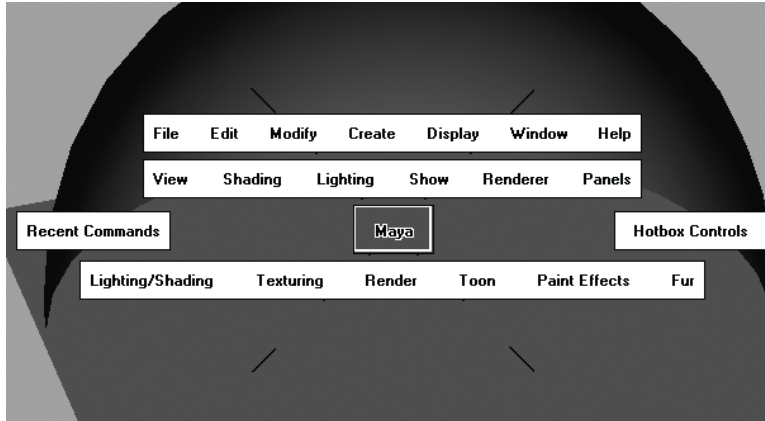
Create the room

Now that you have established a proper sky dome and ground plane, you will create the actual throne room. In this example, you will build the room from primitives.


1 Create a polygonal cylinder

Here, you will use the hotbox as an alternative method for accessing tools.

- Press and hold the **spacebar** anywhere over the interface to display the hotbox.



Hotbox access to menu items

- In the hotbox, select **Create** → **Polygon Primitives** → **Cylinder** → .
- In the option window, set the **Normalize** option to **Off**.

This option will make it easier for you to texture the floor later in the project.

- Click the **Create** button.

A small cylinder is placed at the origin.

Tip: You can access all functions in Maya using either the main menus or the hotbox. As you become more familiar with the hotbox, you can use the UI options found in the **Display** menu to turn off the panel menus and, therefore, reduce screen clutter.

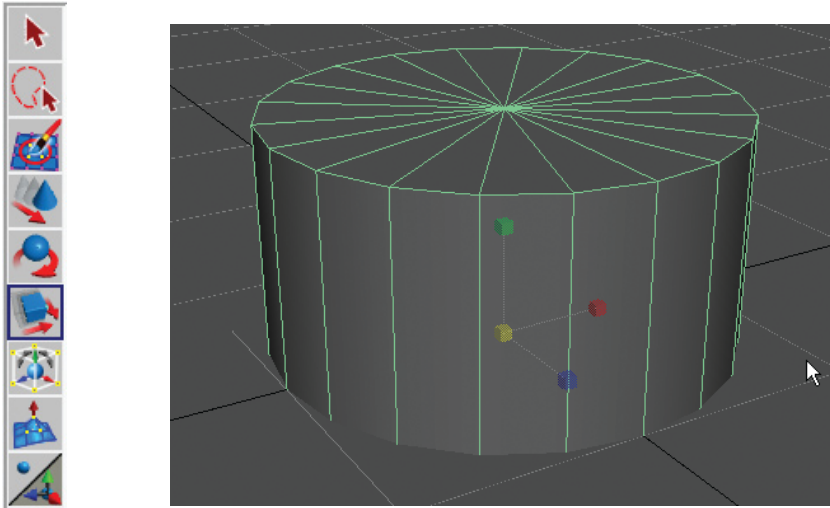
2 Rename the cylinder

- Click on the *pCylinder1* node's name at the top of the **Channel Box** and type the name *floor*.

3 Scale the floor

You can now use the Scale Tool to resize the floor in the scene.

- Select the **Scale Tool** in the toolbox on the left of the interface, or press **r**.



Toolbox

Manipulator handle

Tip: The transform manipulator has three handles that let you constrain your motion along the X, Y, and Z-axes. These are labeled using red for the X-axis, green for the Y-axis, and blue for the Z-axis. The Y-axis points up by default, which means that Maya is “Y-up.”



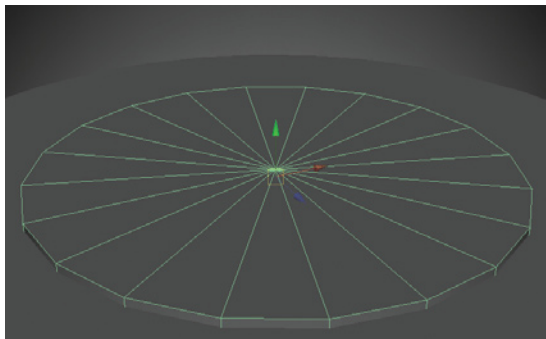
- **Click+drag** on the center manipulator handle to scale the floor along all axes to about 30 units.

Note: You will notice that as you are dragging the manipulators, the corresponding values are getting updated in the Channel Box.



- **Click+drag** on the green manipulator handle to scale down the floor along the Y-axis until the floor is just a little thicker than the ground plane.

You will notice that the manipulator handle turns yellow to indicate that it is active.



The floor geometry

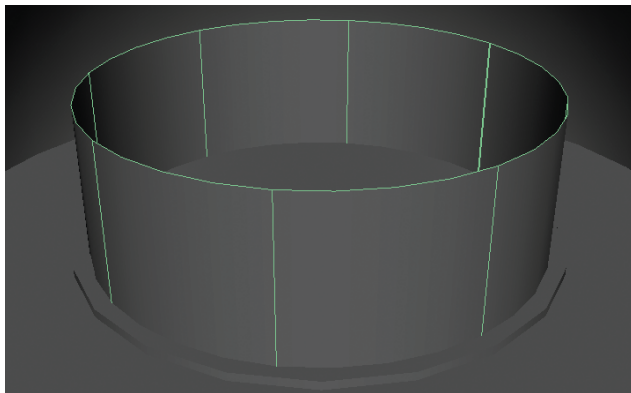


Tip: Each cube at the end of the scale manipulator represents a different axis except for the central one which controls all three axes at the same time. You can also hold down **Ctrl** and **click+drag** on an axis to proportionally scale the two other axes.

4 Create the wall

You will now use a NURBS cylinder to elevate the wall of the throne room.

- Select **Create** → **NURBS Primitives** → **Cylinder**.
- **Rename** the cylinder to **wall**.
- **Click+drag** on the center manipulator handle to scale the wall along all axes to about **28 units**.
- **Click+drag** on the green manipulator handle to scale down the wall along the Y-axis to about **10 units**.
- Select the **Move Tool** or press **w**, and then move the wall up on the Y-axis by about **10 units**.



The wall geometry

5 Adjust NURBS smoothness

The display of NURBS surfaces in a viewport can be adjusted by increasing or decreasing its smoothness.

- Select the *wall*.
- From the main **Display** menu, select **NURBS**.
- Select any of the menu items between **Hull**, **Rough**, **Medium**, **Fine**, or **Custom NURBS Smoothness**.

These settings will affect how selected NURBS objects are displayed in all view panels.

Tip: A NURBS object can have its smoothness set differently in each viewport using the following hotkeys:

- 1—rough
- 2—medium
- 3—fine



6 Create columns

In order to create the large columns that will surround the throne room, you will use polygonal cylinders.

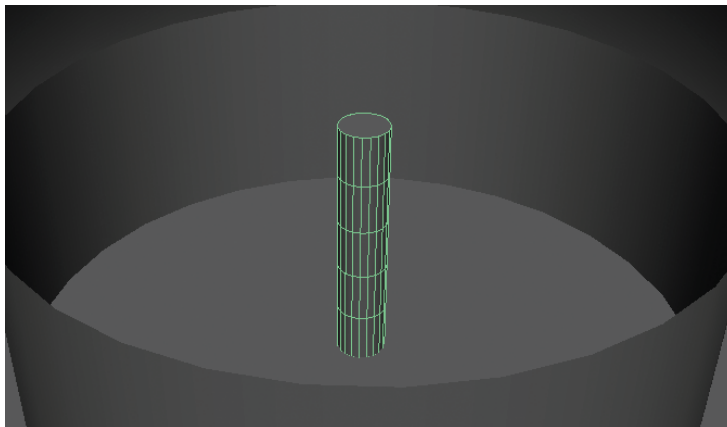
- Select **Create** → **Polygonal Primitives** → **Cylinder**.
- **Rename** the cylinder to *column*.
- **Click+drag** on the green manipulator handle to scale up the column along the Y-axis to about **10 units**.

Note: *Since you have been scaling everything so far from the origin, notice that your geometry is going through and underneath the ground plane.*



- Press the **w** hotkey to select the **Move Tool**.
- **Click+drag** on the green manipulator handle to move the column up on the Y-axis until the bottom of the column touches the top of the floor.
- With the *column* still selected, highlight the *polyCylinder2* node in the **Channel Box**.
- Set the following:
 - Radius** to **2**;
 - Subdivisions Axis** to **20**;
 - Subdivisions Height** to **5**;
 - Subdivisions Caps** to **1**.





The column geometry

7 Repositioning the column

When moving an object in an Orthographic view, the move manipulator is limited to work in two axes. You can move an object in these two axes at once by dragging on the center of the manipulator or constraining the motion along a single axis using the handles.

- In the *top* view, **click+drag** on the square center of the move manipulator to move the *column* along both the X and Y-axes.

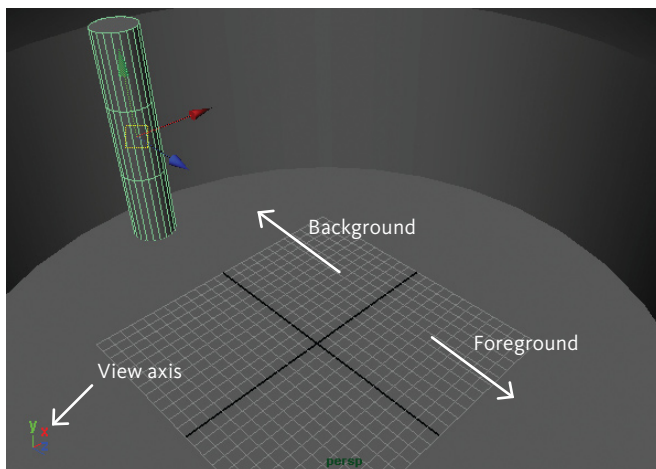
Note: If you **click+drag** on the center of the manipulator in the *Perspective* view, you will notice that it doesn't move along any particular axis. It is actually moving along the camera's view plane.

Tip: Be sure to always refer to more than a single view to verify that the object is positioned properly.

- Use the move manipulator to position the *column* in the background of the scene.

By convention, a 3D scene is always facing at the positive Z-axis. This means that objects with greater Z-axis values will be closer to the foreground of the scene and objects with smaller Z-axis values will be further in the background.

Note: You can refer to the view axis in the bottom left corner of the *Perspective* view to find the positive Z-axis.



The column placed in the background

8 Change the shape of the column

At this time, the column is very round and could use some details. Now that you are familiar with transforming an object, you will learn how to modify the shape of an object.

- With the *column* selected, press the **f** hotkey to frame it in the view.
- In the Status Line located at the top of the interface, click the **Component Mode** button.

*Working in this mode will display the components of the currently selected geometry. You can then select and transform the points defining a surface's shape. Polygon points are called **vertex/vertices** and NURBS points are called **control vertices** or **CVs**.*



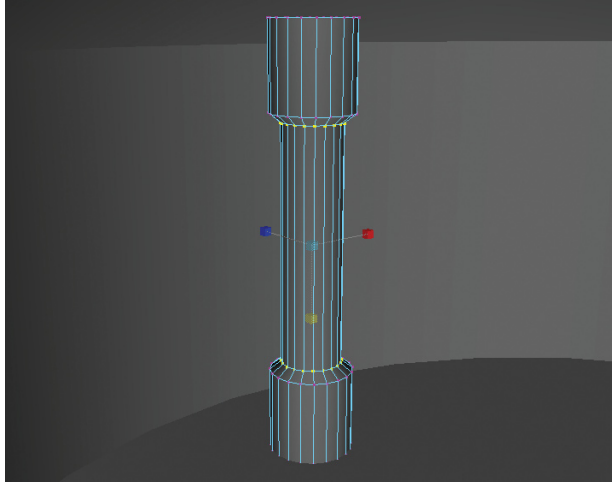
The Component Mode button

- **Click+drag** around vertices in the viewport to select them.
- Select only the two rings of vertices in the middle of the column.

Tip: When selecting components, hold down **Shift** to toggle the new selection, hold down **Ctrl** to deselect the new selection, and hold down **Ctrl+Shift** to add the new selection to the currently selected group of components.



- Select the **Scale Tool**, then hold down the **Ctrl** key, and **click+drag** on the Y-axis. *Doing so will equally scale the vertices about the X and Z-axes.*
- Let go of the **Ctrl** key, then **click+drag** on the Y-axis to make the central geometry as follows:



Shaped column

- Click on the **Object Mode** button in the **Status Line** to exit the Component mode.



Object mode

9 Make more columns

Instead of always starting from a default primitive object, you can duplicate an existing one, preserving its position and shape.

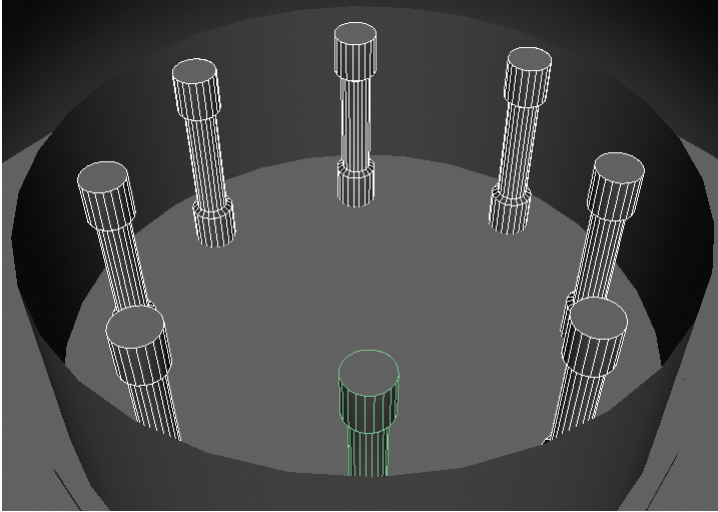
- Select your *column* and select **Edit** → **Duplicate**.

When using the duplicate function, the new objects will be renamed to column1. Subsequent duplicates will be named column2, column3...



Tip: You can use the **Ctrl+d** hotkey to duplicate the selected geometry without going into the menu each time.

- **Duplicate** the columns **seven** times and place them all around the throne room from the *top* view.



The columns in place

Tip: If any pieces of geometry get in the way when you select and modify objects, you can temporarily hide them. To do so, select the geometry to hide, then select **Display → Hide → Hide Selection**. To show the last hidden objects, select **Display → Show → Show Last Hidden**. To show all hidden objects, select **Display → Show → All**.



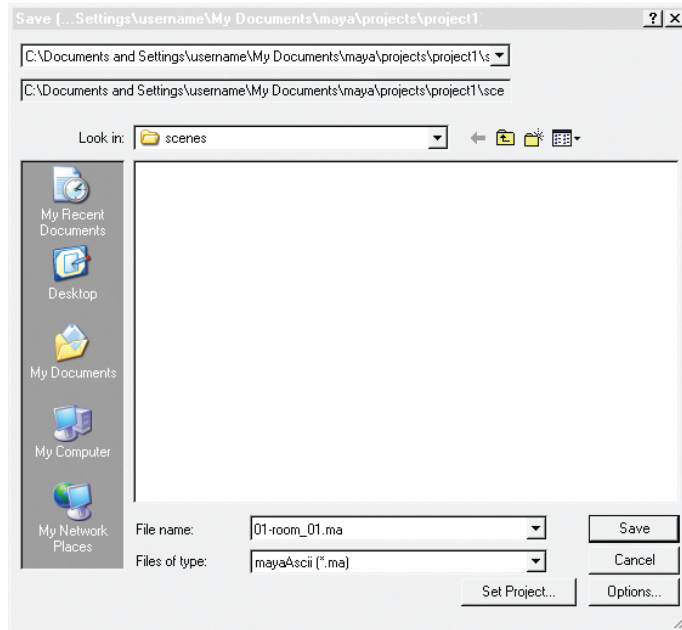
10 Move the columns

In order to make it easier to select or move all the columns at once, you will now group them.

- Click on one *column* to select it, then hold down the **Shift** key and click the remaining columns one by one until they are selected.
- Press **Ctrl+g** to group them all together so you can move them all at once.
- **Rename** the group to *columns*.
- **Rotate** the new group to see the effect of grouping geometry.

11 Save your work

- From the **File** menu, select **Save Scene As...**
- Enter the name *01-room_01.ma*.



Windows Save As dialog box

- Click the **Save** button or press the **Enter** key.

More details

Now that you know how to place objects and interact with the Perspective view, you will add more details to the inner room by making a cathedral ceiling and adding decorative drapes coming down from it.

1 Create a roof

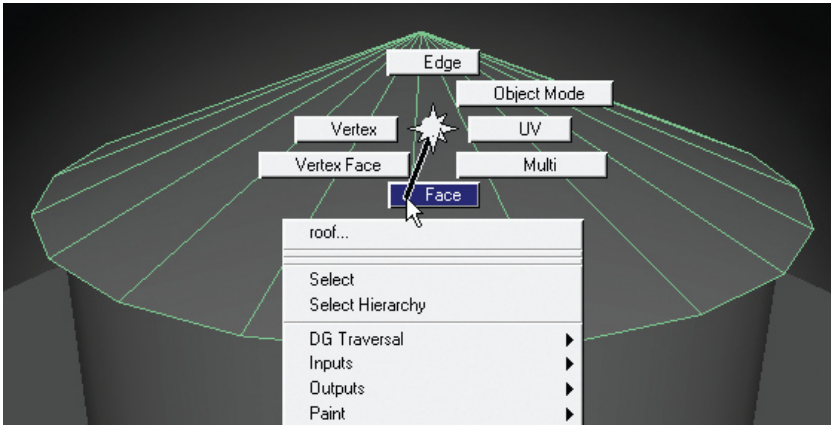
The last thing missing to complete the room is a roof.

- Select **Create** → **Polygon Primitives** → **Cone**.
- **Rename** the cone to *roof*.
- **Translate** the *roof* up on the Y-axis to about **25 units**.
- **Scale** the *roof* up on the Y-axis to about **6 units**.
- **Scale** up the *roof* in both the X and Z-axes by holding down the **Ctrl** key to about **30 units**.

2 Delete a polygonal face

If you move the Perspective camera inside the throne room, you will notice that the polygonal cone used to create the roof has a cap polygon covering its base. It would be nice to remove this face in order to get a cathedral ceiling.

- Select the *roof*.
- **RMB** on the *roof* to pop up its contextual radial menu, and select **Face**.



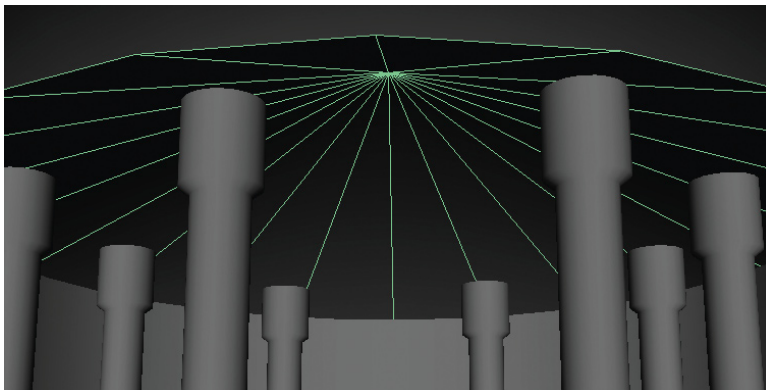
Polygon context menu

- Move the *Perspective* view to look at the ceiling from inside the room.

Tip: *If you are having a hard time moving the perspective inside the room, you can use the same trick you used for the sky dome to have it not displayed as double-sided in the Attribute Editor.*



- Select the polygon by clicking on the **blue** square located in the center of the face.
Notice that when you move your cursor over the face's center, the face turns red to specify the face that will be selected. Once selected, the face gets highlighted.
- Press the **Delete** key on your keyboard to delete the selected face.
- To exit the Component mode, **RMB** on the *roof* to pop up its contextual radial menu, and select **Object Mode**.



The cathedral ceiling

3 Create a decorative drape

Now that you are getting familiar with the Component mode, you will use this knowledge to create a decorative drape.

- Select **Create** → **NURBS Primitives** → **Plane**.
- **Rename** the plane to *drape*.
- In the **Channel Box**, highlight the *makeNurbPlane1* node and set **Patches V** to **4**.
- Set the following for the *drape* object:
 - Rotate X** to **90**;
 - Scale X** to **2**;
 - Scale Z** to **20**.
- **Move** the *drape* up so it interpenetrates with the center of the ceiling.

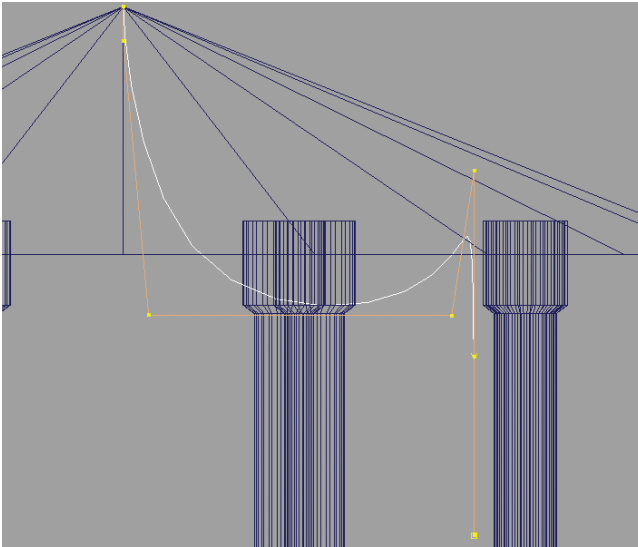
4 Change the shape of the drape

- Go into Component mode by pressing the **F8** hotkey.

This is just another way of going into Component mode besides using the button in the Status Line or the contextual menu.



- From the *side* view, **click+drag** to select groups of CVs and tweak the shape of the drape as follows:



The shape of the drape

Tip: You might want to go into wireframe mode (hotkey **4**), in order to select components more easily.

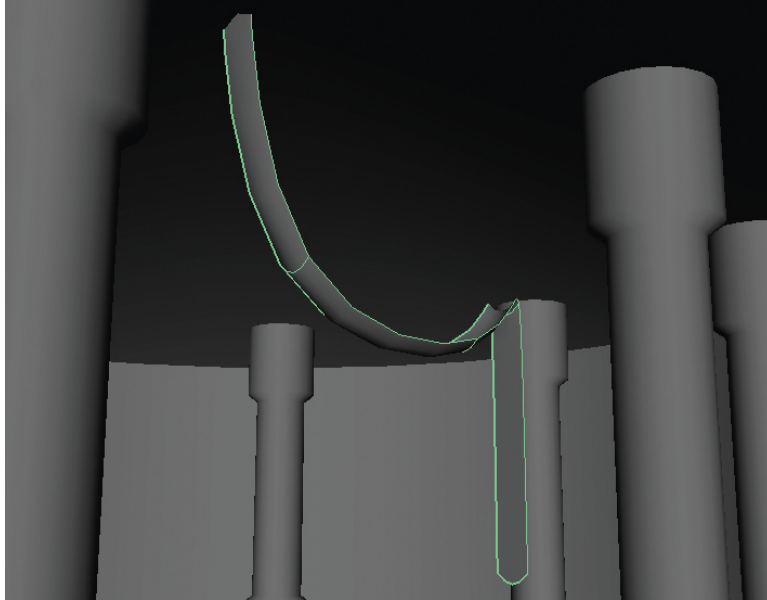


- From the *Perspective* view, **RMB** on the drape and select **Hull**.
Hulls define a continuous line of CVs. By selecting a hull, you can tweak the shape of several CVs at the same time.
- Click on the first hull along the length of the drape, then hold down the **Shift** key and select the opposite hull.
- Use the **Move Tool** to move the hulls up on their **Y-axis**.
Doing so will give a nice dangling look to the drape.

5 Place the drape correctly

- Go back in **Object mode**.
- **Rotate** the *drape* so it is aligned with a *column*.
- **Tweak** the shape of the drape in Component mode as needed so the drape almost touches the column.






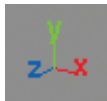
The final drape shape

6 Duplicate the drape

The Duplicate Tool has options that allow you to duplicate multiple copies of the same object, separated by a fixed translation or rotation value. For example, if you make one drape, you can make many other copies separated by 45 degrees, all in one easy step.

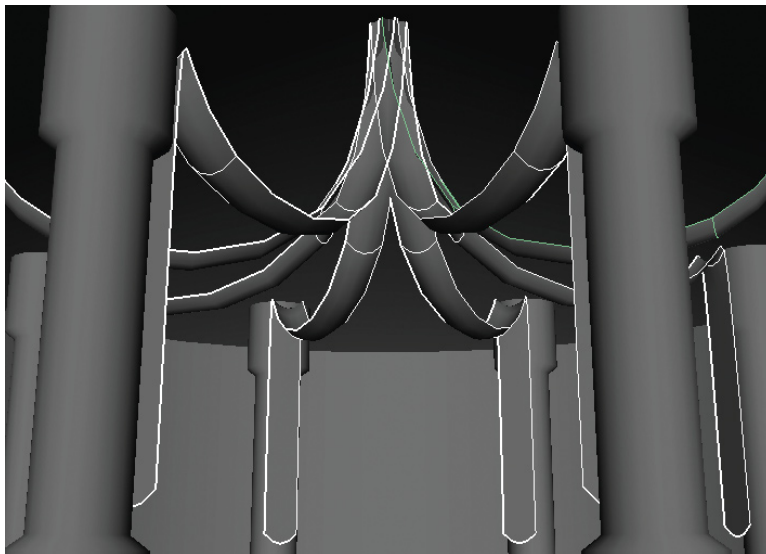
- With the *drape* selected, select **Edit** → **Duplicate Special** → .
- Set the **Number of Copies** to 7.

In order to determine the proper rotation axis, look at the view axis located at the bottom left corner of each view. If you want the copies to be created around the positive Y-axis, enter a value in the second field of the rotate vector. If you would like to create copies to be created along a translation axis, enter a value in the fields of the translate vector.



Axis letter points toward its positive values

- Set the second **Rotate** value to **45** and leave the others at **0**.
- Click the **Duplicate Special** button.



The duplicated drapes

- Select **Edit** → **Undo** or press **z** to undo the action and try again if the drape was not duplicated as expected.
- From the *top* view, make sure all the columns are properly placed behind each drape.

7 Save your work

- From the **File** menu, select **Save Scene As...**
- Enter the name `01-room_02.ma` and click the **Save** button.

Make sure you save this file since you will be continuing with it in the next lesson.

Note: *Throughout this book, you will be using the final saved file from one lesson as the start file for the next, unless specified otherwise. Save your work at the end of each lesson to make sure that you have the start file ready. Otherwise, you can use the scene files from the support files.*

Conclusion

Congratulations! You have completed your first exercise using Maya software. You should now be able to easily navigate the different views and change the basic hardware display settings. You should also be confident in creating, duplicating, transforming, and renaming objects, along with using the translation, rotation, and scale manipulators. At this point you should also understand the difference between Component mode and Object mode. As well, be careful to save scene files.

In the next lesson, you will explore in greater depth how to model objects and details.