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My First 3D Animation
Introductory
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Prof. Sumant Rao and Sachin Meshram
IDC, IIT Bombay

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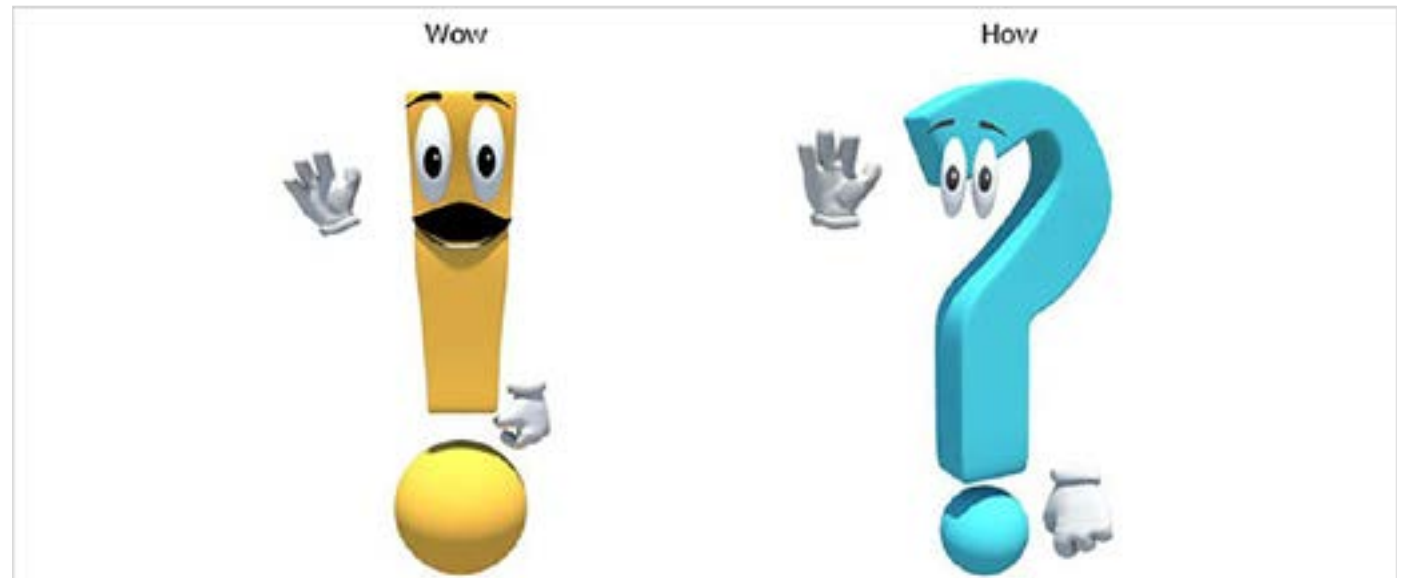**https://www.dsource.in/course/my-first-3d-animation**

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introduction

Introduction

What is it about animation that makes us love it? If you understand this, you are already on your way to becoming good animators. There are two simple aspects that you need to appreciate for this.

The first is simply the wonderful WOW! feeling that it gives you when you see these drawings, cutouts, objects, clay or computer generated images come to life. What makes them look alive? What are the principles that help create this WOW effect?
The second is the technique and/or technology to create it i.e. HOW are they created?

So our two mascots
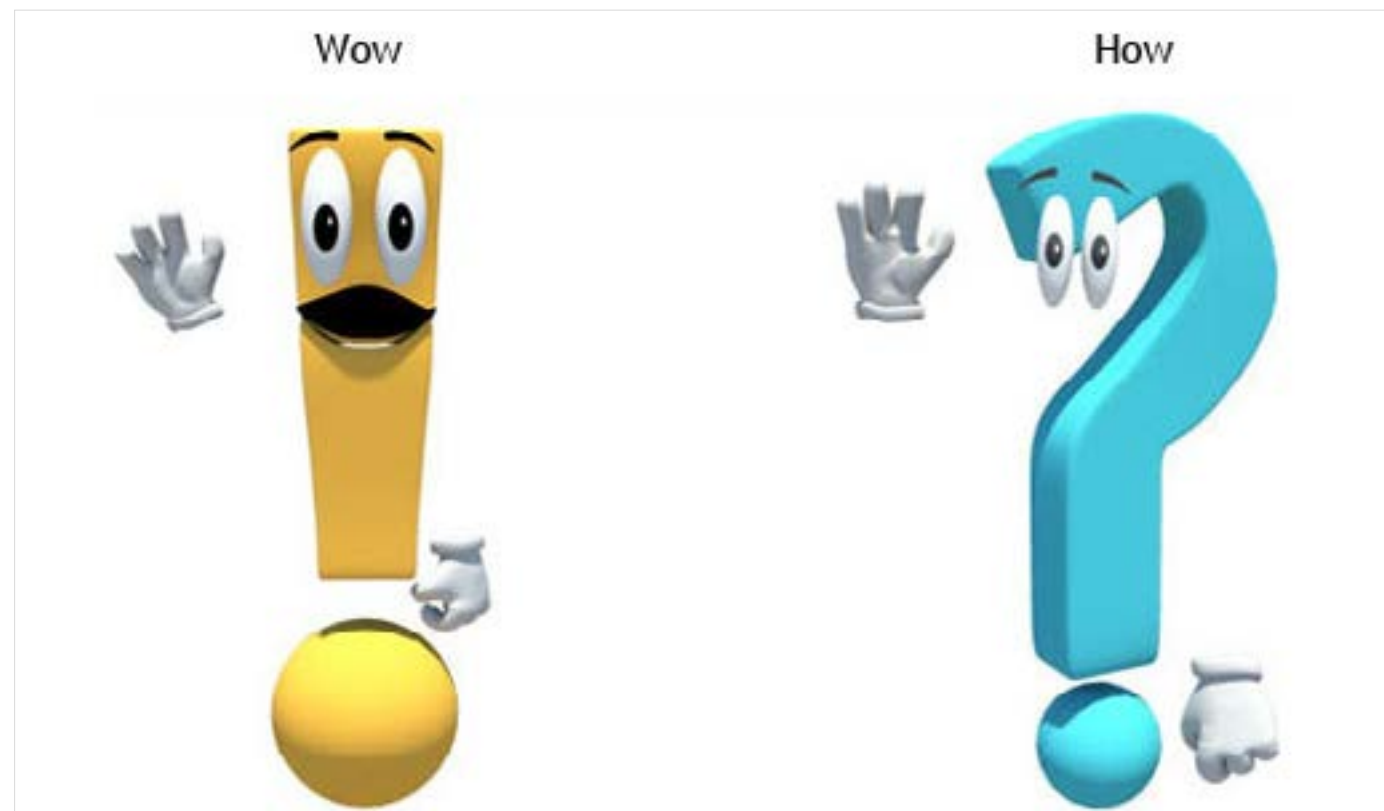
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Will help you focus on the important things as you try to learn to become a 3D Animator.

So let's start with creating a very simple animation in a 3D software. Please remember that the modules here are not software tutorials, but teach you animation in general and how to do it using any 3D software of your choosing. Even though we have shown it using the software Maya, functionally it is similar to most 3D software you would like to use. We have tried to keep the module as generic as possible, so that you know what to look for in any other software you wish to or need to use. If you do need to know the software (Maya included) in more detail, you can always refer to the Help that accompanies that software or refer to software tutorials plentifully available on the Internet.

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3D Software Interface

First we need to be able to feel comfortable with 3D software and know our way around it. This part will give you the basics of the Interface of 3D software.

At first, the interface of the software will look a little daunting as a good 3D software can be very complex and do a lot of different things. But if you know what you are looking for, this will start looking a lot simpler. These are the most common elements you will see in any software.
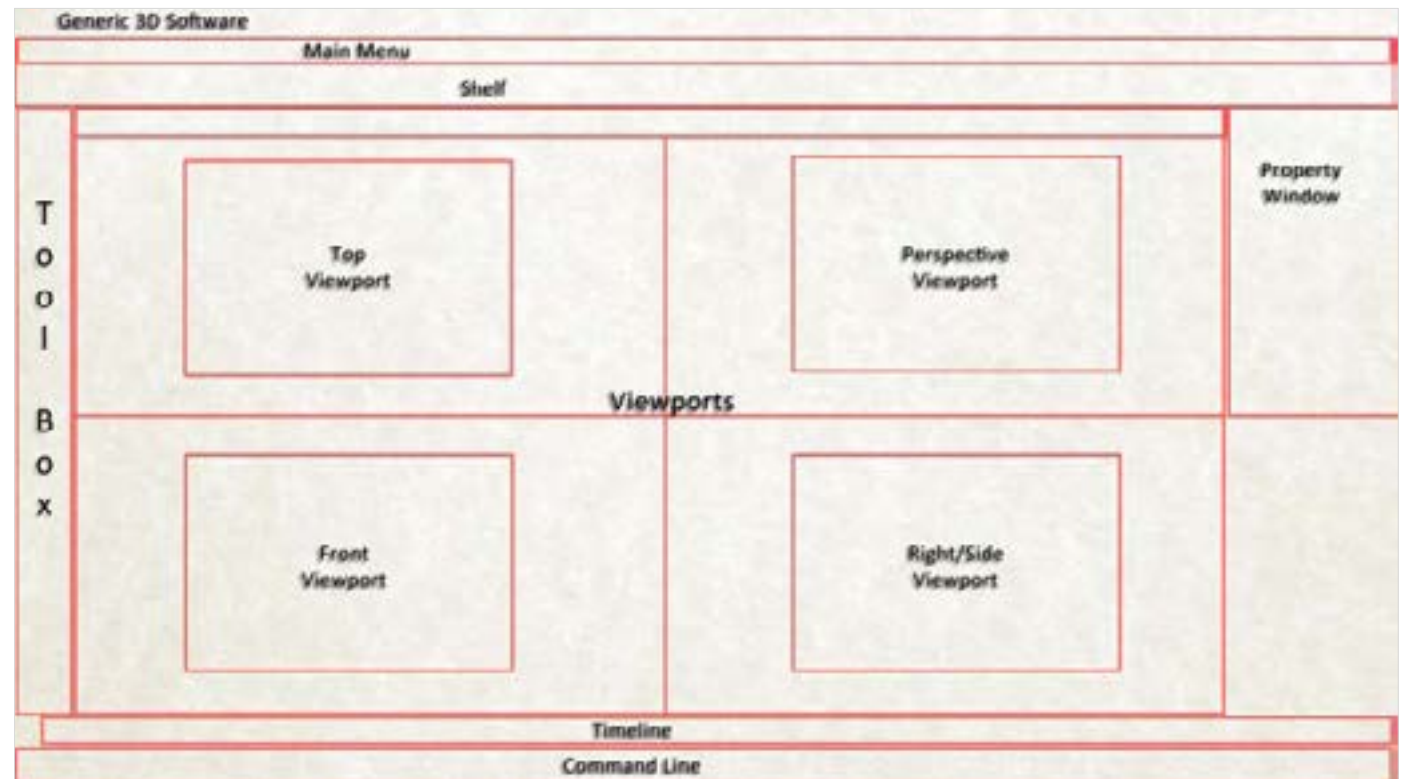
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1. **The Menu Bar:** This will have functions like Open, Save, Import, Export, etc. which are common in every software as well as some other functions which are specific to 3D.

2. **The Toolbox:** This will have some of the important tools that you will need very often to animate. The most important among these are the Select, Move, Rotate and Scale tools. The software will also give you the option to select these using short-keys i.e. specific letters on the keyboard for each tool. For example, in Maya these are Q, W, E and R for Select, Move, Rotate and Scale respectively. Find out where these tools are on your interface and the short-keys for them and thoroughly familiarize yourselves with them.

3. **The Shelf:** This is a collection of some important tools that you may need and so they are organized in a logical manner, so that you can easily find what you are looking for and select it.

4. **The Timeline:** Since you are creating animation, you will create a series of images in time. The timeline allows you to create, see and modify animation interactively in time. Here you will set keys i.e. fixed values for various tools like position, rotation, scale or any other parameter that you want to change in time. It will also give you tools to preview in motion that you have created, so that you can know whether your animation is right. You can modify it appropriately if it doesn't.

5. **The Viewports:** These windows are literally the windows of your virtual 3D world. Using these you can actually see the scene that you are animating. This is dealt in more detail in the next section.

6. **Various Property Windows:** You will also see other windows conveniently placed on the interface, which shows you the properties and their values of the objects and elements in your scene.

7. **Other important windows:** Besides these, there are other windows that you will open and close as and when required while doing animation, but are otherwise not visible in the interface. For example, the Graph Editor, the Material Editor, Render Window, etc. We will deal with these in this and other modules later at appropriate times. But for now, let's keep it simple.

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Check out this video and you will understand the interface better.

Video - The Interface

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Viewports

Windows to your 3D World
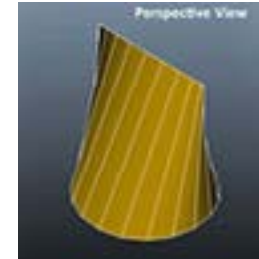
Understanding and Navigating

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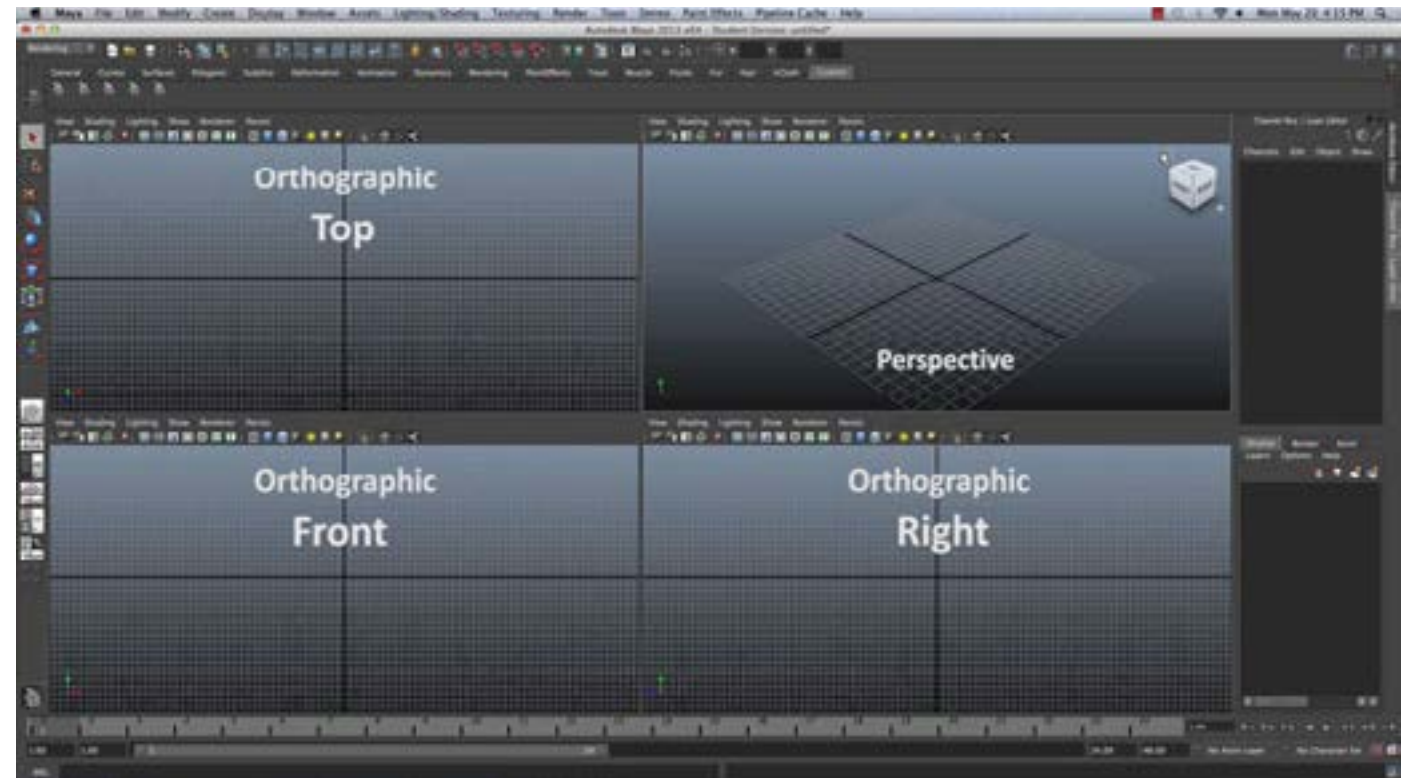Prof. Sumant Rao and Sachin Meshram
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Windows to your 3D World

If you were to create a virtual 3D world on your computer display, what properties will it need to have? Think about this a bit before continuing. You will find that the Viewport windows will have most of these. But the most important property for simulating the world as we experience it is Perspective i.e. Things look smaller as they go away from the viewer and larger when they come closer. But would you need to see your world without Perspective? And what does that mean? Why do you need this type of world and how to use it will be dealt with, in a later part. But for now, believe me, you do need views which do not have perspective! This sort of view is called Orthographic View.

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So there are two types of windows that you will find in 3D software
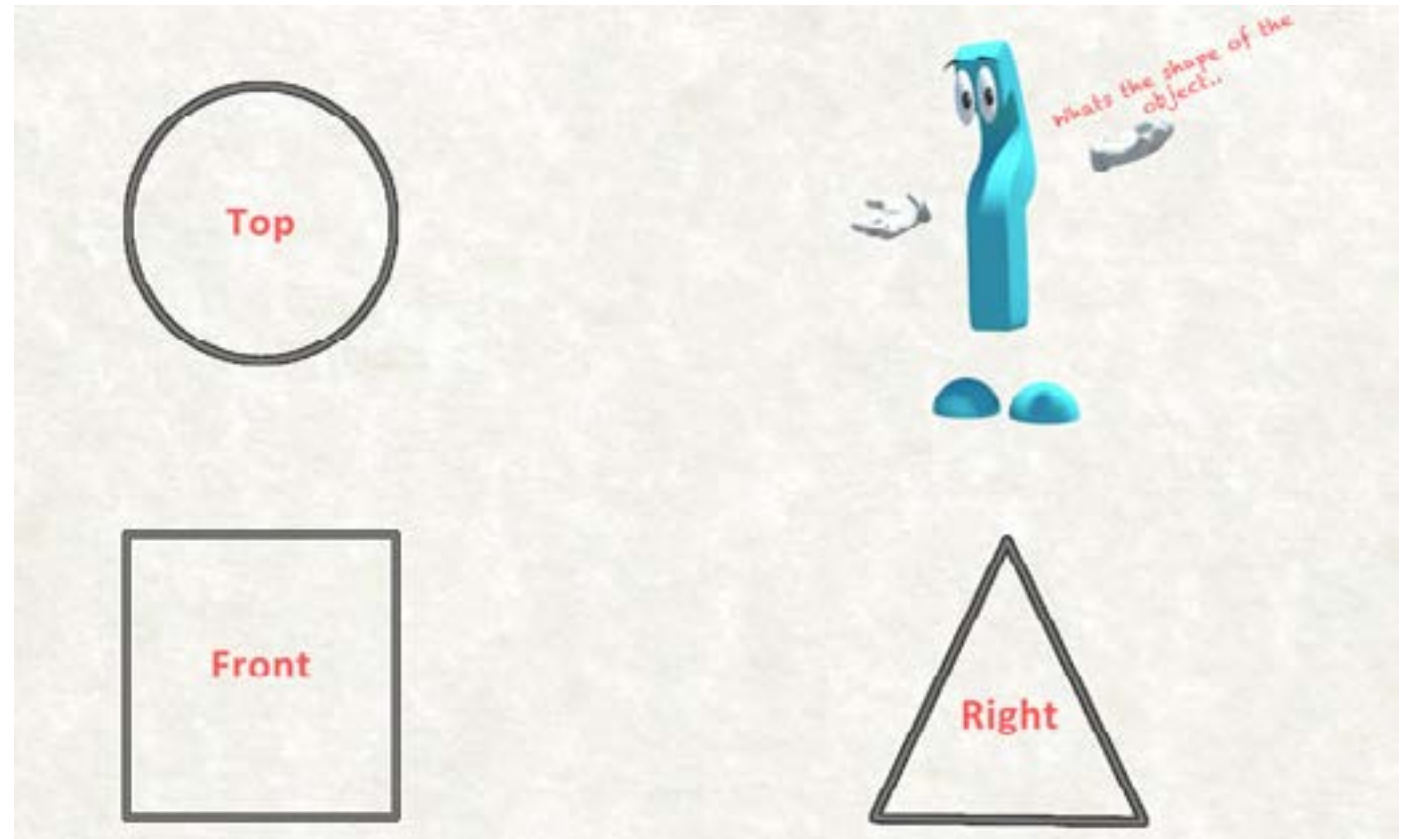
1. Orthographic i.e. without perspective - like the Front, Top and Side (Left or Right) Views
2. Perspective i.e. like we see in the real world. Note that you can have Front, Top and Side views also in perspective, except like mentioned, things become larger or smaller as the come closer or move away from the viewer.

To get your brain cells moving, here is a perspective visualization exercise.

If an object has a circular outline when seen from the top, a square outline when seen from the front and a triangular outline from the side, what is the actual form of the object?

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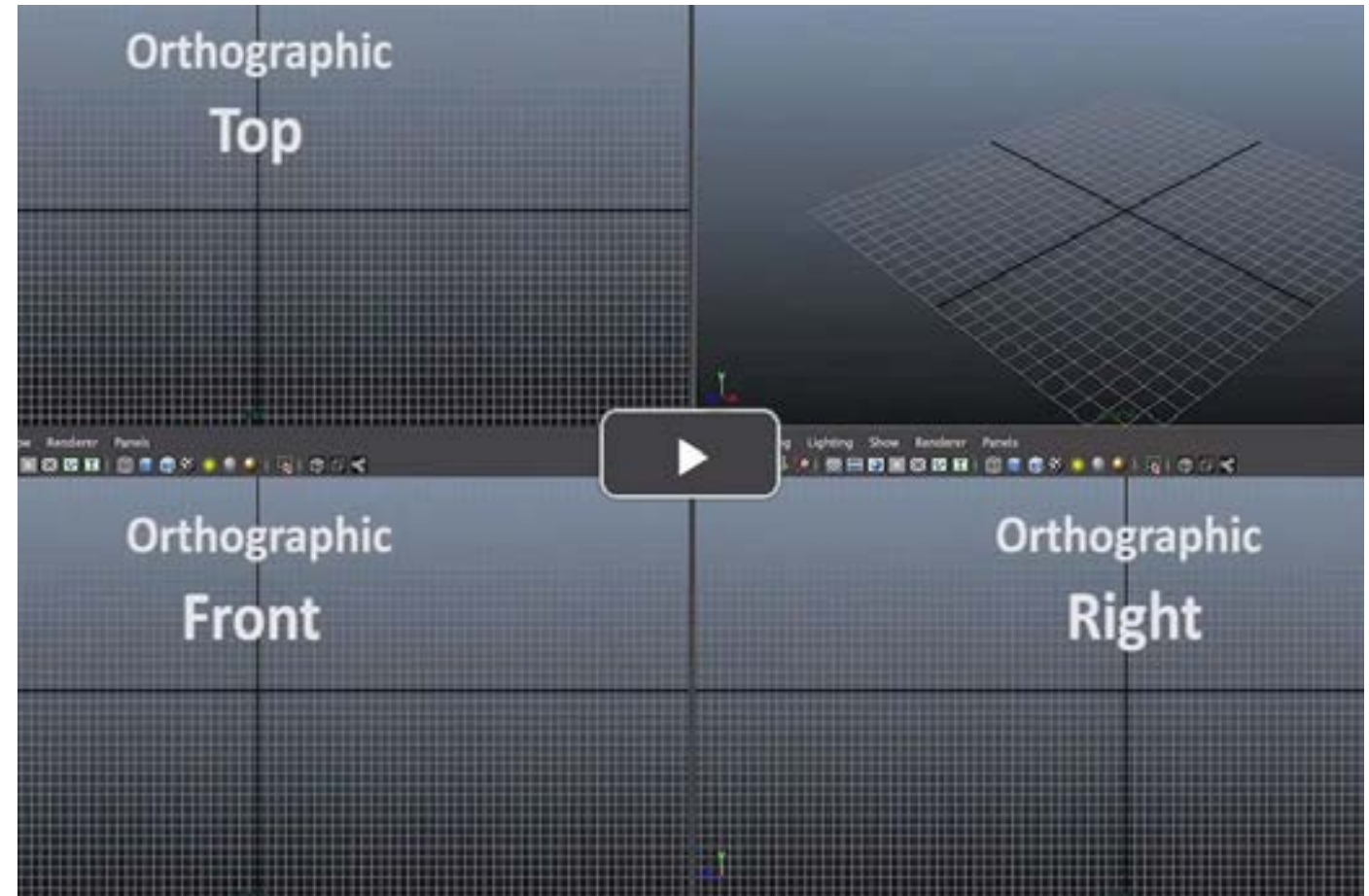by
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Try your best to figure out the way the object will look before going on to the next part. Best of luck!

Check out this video.
Video - The Viewports

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Understanding and Navigating

Understanding the Viewports:
I hope you have tried getting the answer to the problem given in the previous module.
If you haven't then please try it. Here is the problem again.

Problem: -
If an object has a circular outline when seen from the top, a square outline when seen from the front and a triangular outline from the side, what is the actual form of the object?

Check out the answer here: Visual_View
Download: Visual Exercise

If you can visualize the problem as the intersection of the 3 shapes i.e. the square, circle and triangle extruded along the 3 axes, you will get an object that looks like this.

It was not that easy to visualize, was it?
This is not the only solution though. So you may have come out with an object which looks different, but still is correct.
You can download this and a second solution for the problem and study it in your software.
Download: Other Solution

See how different they look in the perspective viewport and the other 3.

Other solution:

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Front Orthographic   Right Orthographic
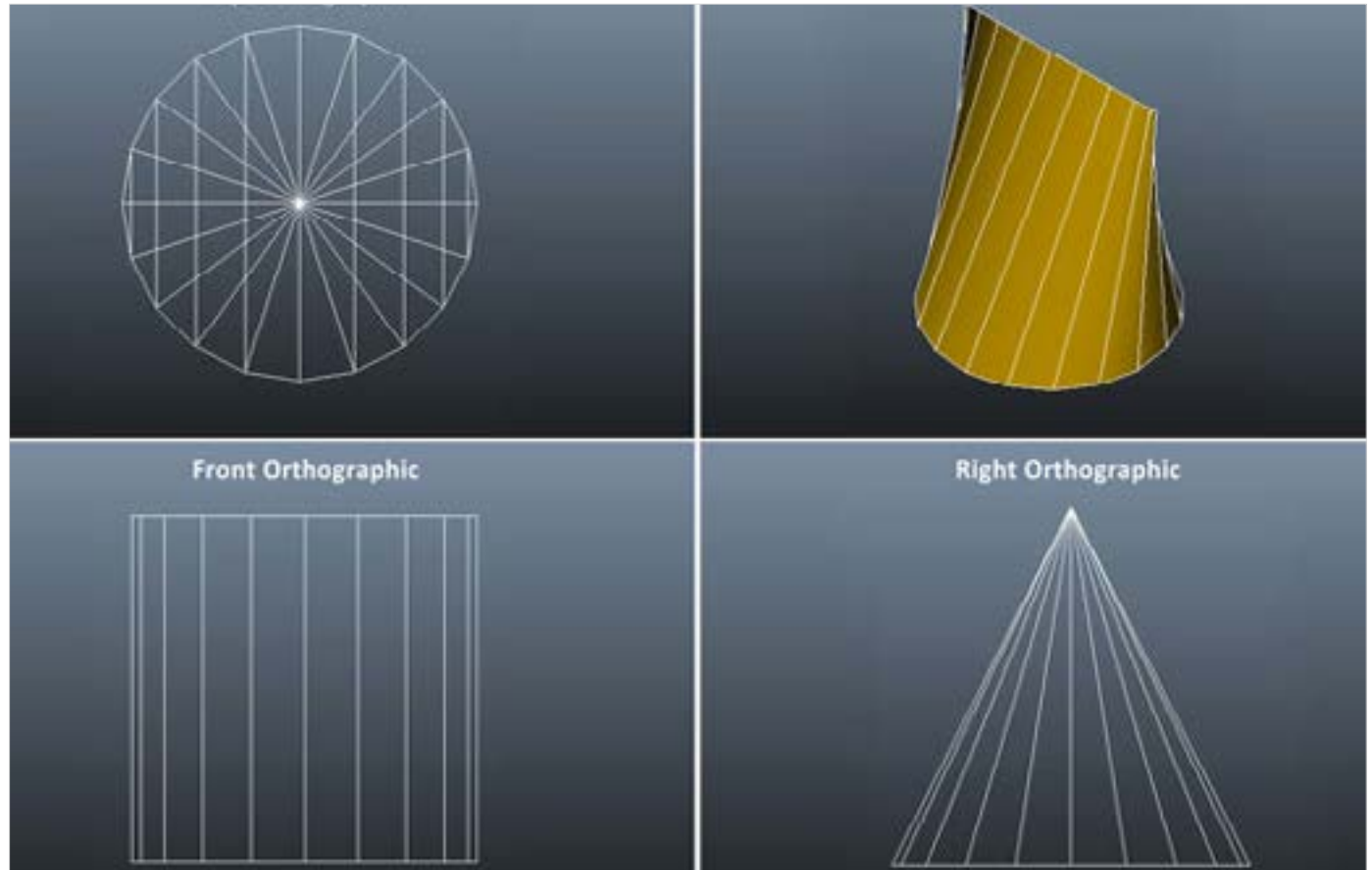
This will make you hopefully appreciate that -

1. Sometimes, while creating 3D objects, you may find it easier to visualize what you are doing in the perspective viewport and others in the appropriate orthographic viewport.

2. Since shapes do not become smaller as they are further away from the viewer, the orthographic view is good for creating and modifying objects which are of a specific size that you desire.

3. It is easier to get a feel of what is near and what is further away from you when working in the perspective view and you get a better feel of what the object would look like in the real world.

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Navigating in the Viewports:
You will obviously want to move around in the viewports, see your scene from different angles and magnifications to create, modify and animate it. So before starting with animation it will be extremely helpful to understand how to do this. All software will allow some easy methods of doing functions, using icons and shortkeys, like **pan** and **zoom** in all the viewports and in addition, **rotate** or **orbit** around the object or scene in the perspective viewport.

Check this video to understand this better.
Video - Navigation in viewports
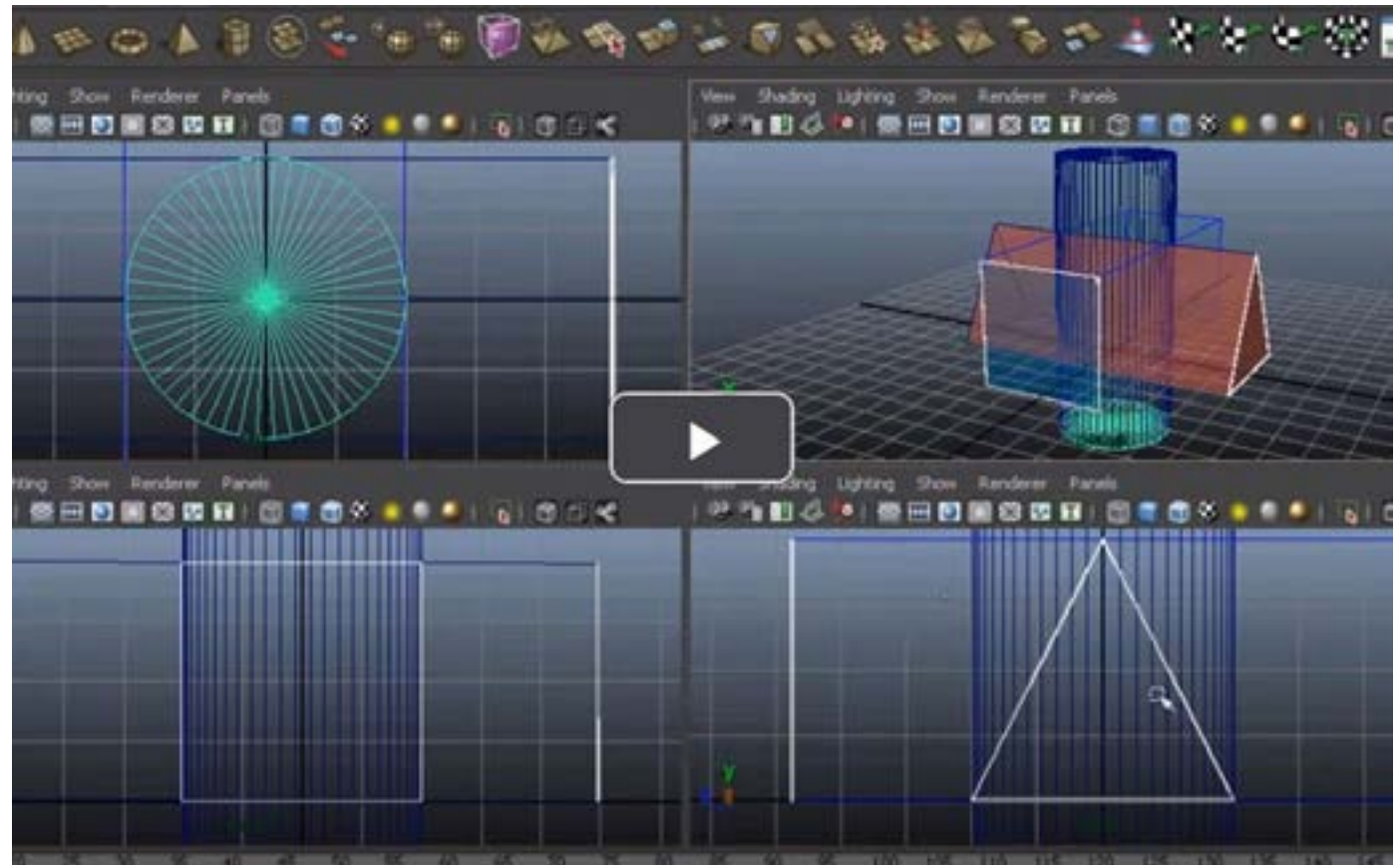
Find out from your software help about the icons and shortkeys for navigation in the viewports. Practice this well. Now that you are familiar with the software interface and navigation in the viewports, you are ready for the first step in animating using it - Creating objects.

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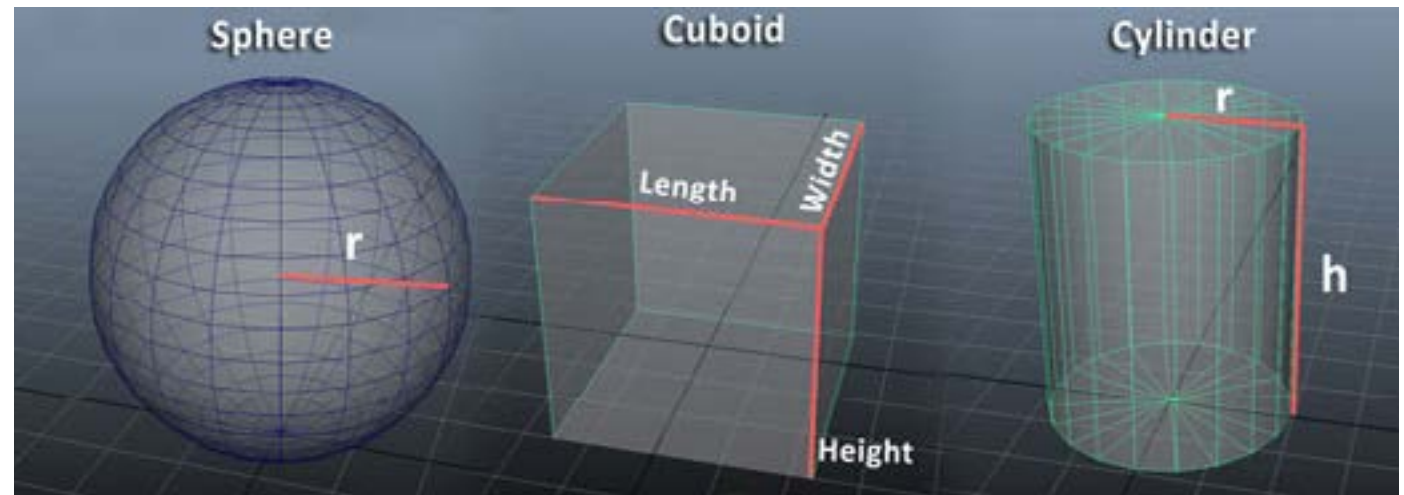by
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Primitive Solids - Creating 3D Objects

A 3D software will allow you to create some objects using simple dimension values. For example:

A **cuboid** can be created if you can specify its length, width and height.
A **sphere** can be created by specifying its radius
A **cylinder**, by its radius and height

These objects are commonly called **primitives** (though some software's may not mention them as such). You will find a whole set of such primitive objects that your software will allow you to create. These primitives form the basic building blocks for a lot of objects that you may need to create.

A ball, the earth, the sun and all the planets are nothing but spheres.
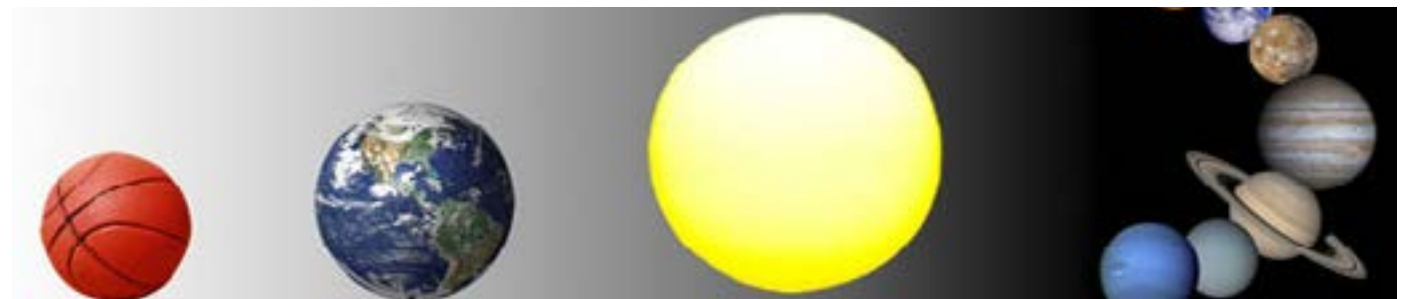
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Most cartons and packaging are nothing but cuboids. A tin can is a minor modification of a cylinder.

Many more complex objects can also be created as a combination of two or more primitive objects. This makes understanding primitives and using them cleverly in different cases very important.

Take a look at the body of Wow and you may grasp what I mean.

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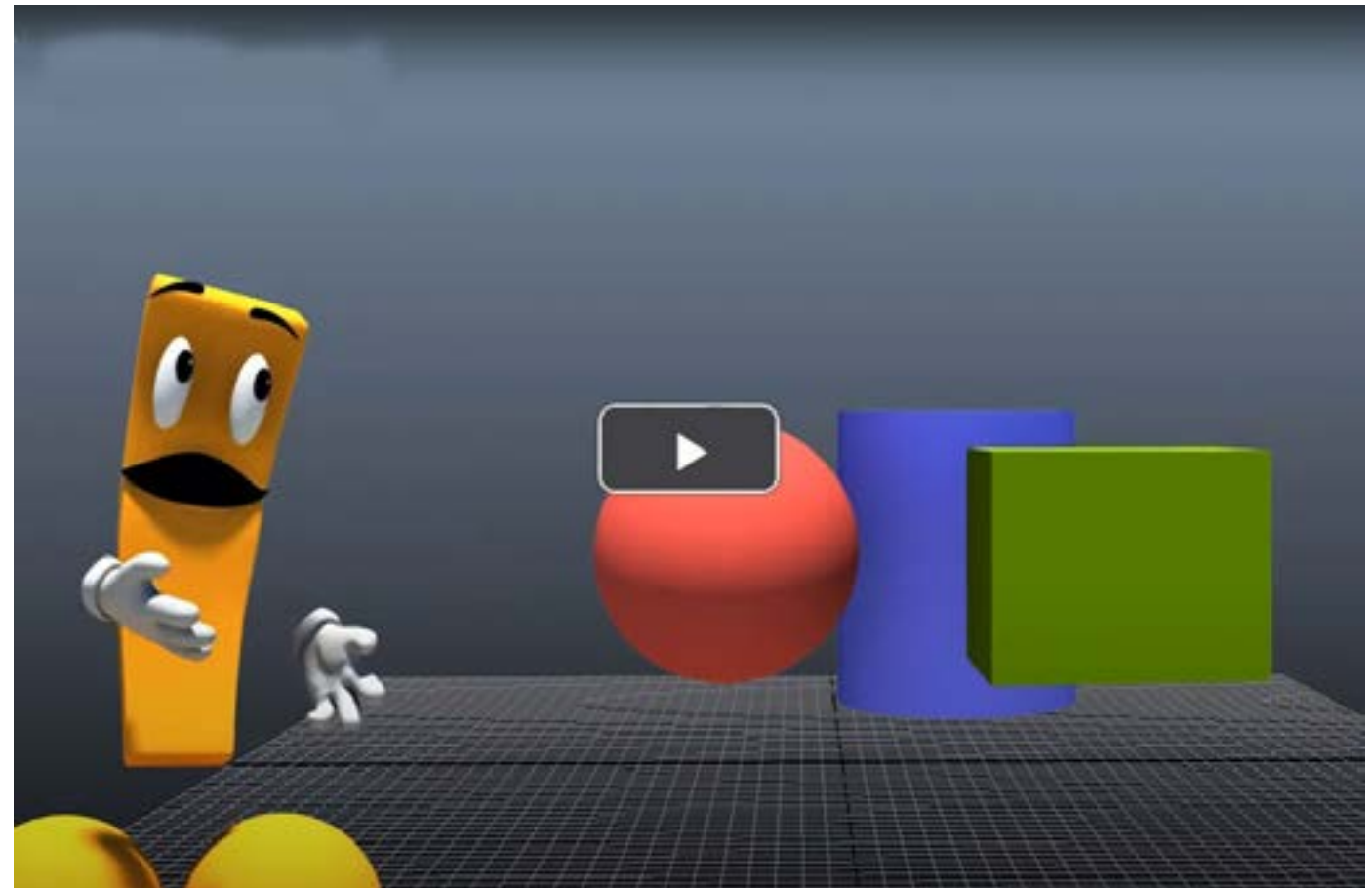IDC, IIT Bombay

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primitive-solids-creating-3d-objects**

Exercise: Try and make a list of more shapes like the cuboid and sphere that can be created using 3D software. Then go to the create primitives option in your software and see whether they are there. If you do not know how to do that, please refer to your software help.

How many of these objects were available as primitives in your software? Most likely all of them and perhaps some more.

This video will give a brief introduction to creating primitives. We have used Maya, but it will not be too different in most other software.

Video - Creating Primitives

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Let us get a bit more familiar with the actual process of object creation. Though we are talking of primitives, this is essentially the same for the geometry of all objects.

Inputs - i.e. some method of telling the software what you want to create. In our example, to create the cuboid, we first let the software know it's length, width and height, either interactively in the viewports or by entering values in the fields that the software provided. What the software does is create the geometry for you. This geometry is essentially made of

• Vertices in 3D space, each with its x, y, and z coordinates, which are all grouped together as your object
• Polygons which connect these vertices to create the faces of the object

Modifying the object - This collection of vertices and polygons can be then changed in various ways to get other shapes. We will look at this in more detail in the coming parts.

The body of Wow is a cuboid, which has been tapered so that it is narrower at the bottom to resemble an exclamation mark.

Placing it in the Virtual World - This geometry is a part of a virtual world and hence the software needs to know what are it's 'world co-ordinates' in terms of position, orientation and scale. It will also need to know some other properties like visibility. This way, it can be placed in relation to other objects and becomes a part of the 3D environment.

You can see how this works in the title sequence of our modules, where Wow is standing on the diving board, which again is nothing but a cuboid shape!

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This process of Creation of geometry, Modification and Placement in the World is essentially the same even if there are innumerable methods of going about it.

Please note: There is a difference in increasing the size of the object by scaling it as compared to changing the parameters of the primitive object even though both might look the same.
For example: Creating a cube with length, width and height of all 10 and scale values of x, y, and z all 1 as compared to length, width and height of all 5 and scale values of x, y, and z all 2.

So as you become more familiar with the techniques of 3D, it will also be important when you are creating a 3D object to first explore and figure out what is the best method of creating the object that you desire.

Practice creating various primitives and then modifying their values. Familiarize yourself with how and where the object properties are displayed in your software. This will be a great help later, a lot more than you can imagine.

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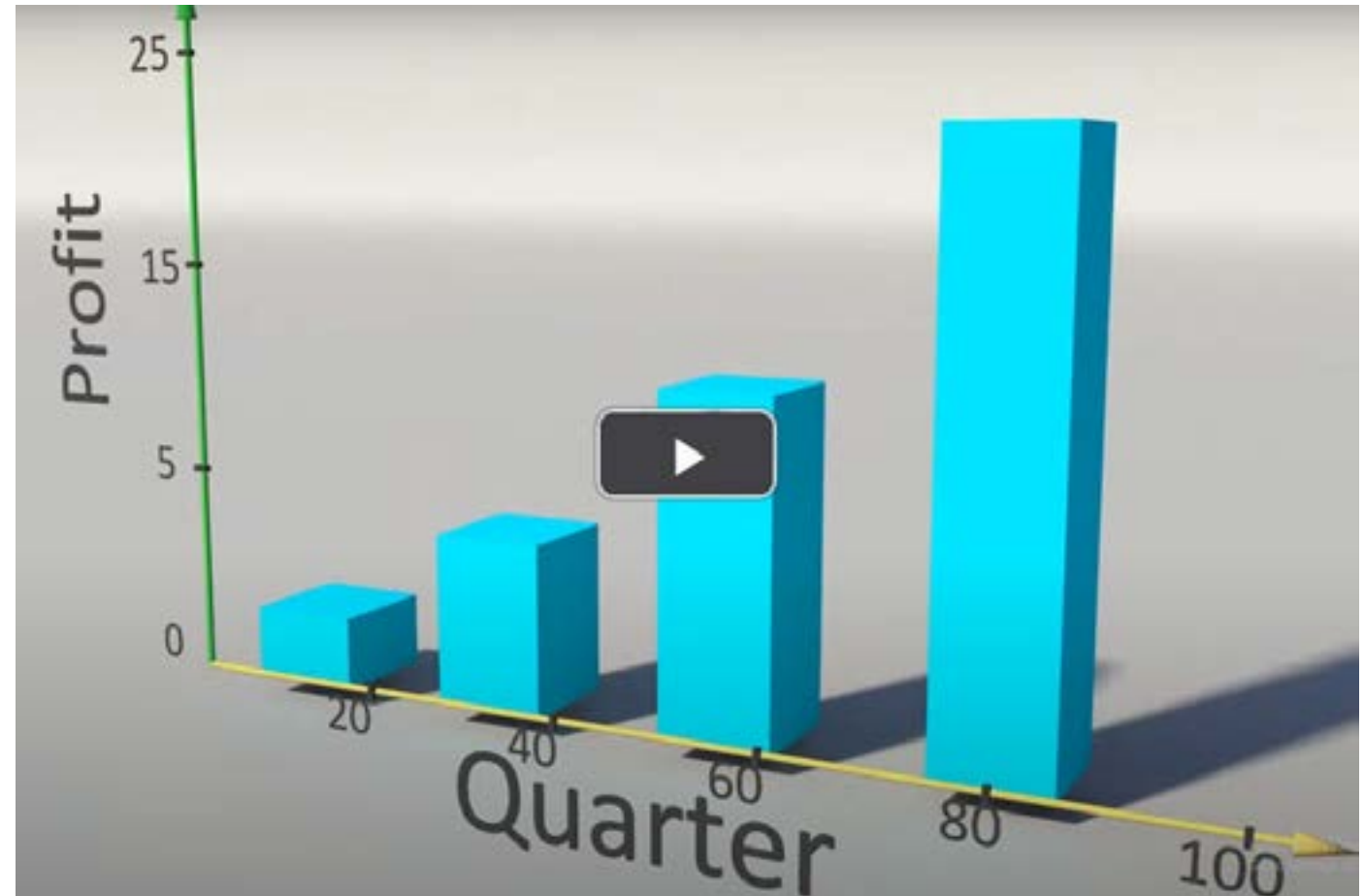
Interacting with 3D Objects

Before going further, take a look at this video.

Video - Interacting with 3D objects

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When working in 3D, you may need to view your objects in different ways based on what you need to do. All software offer several display modes to choose from like these:
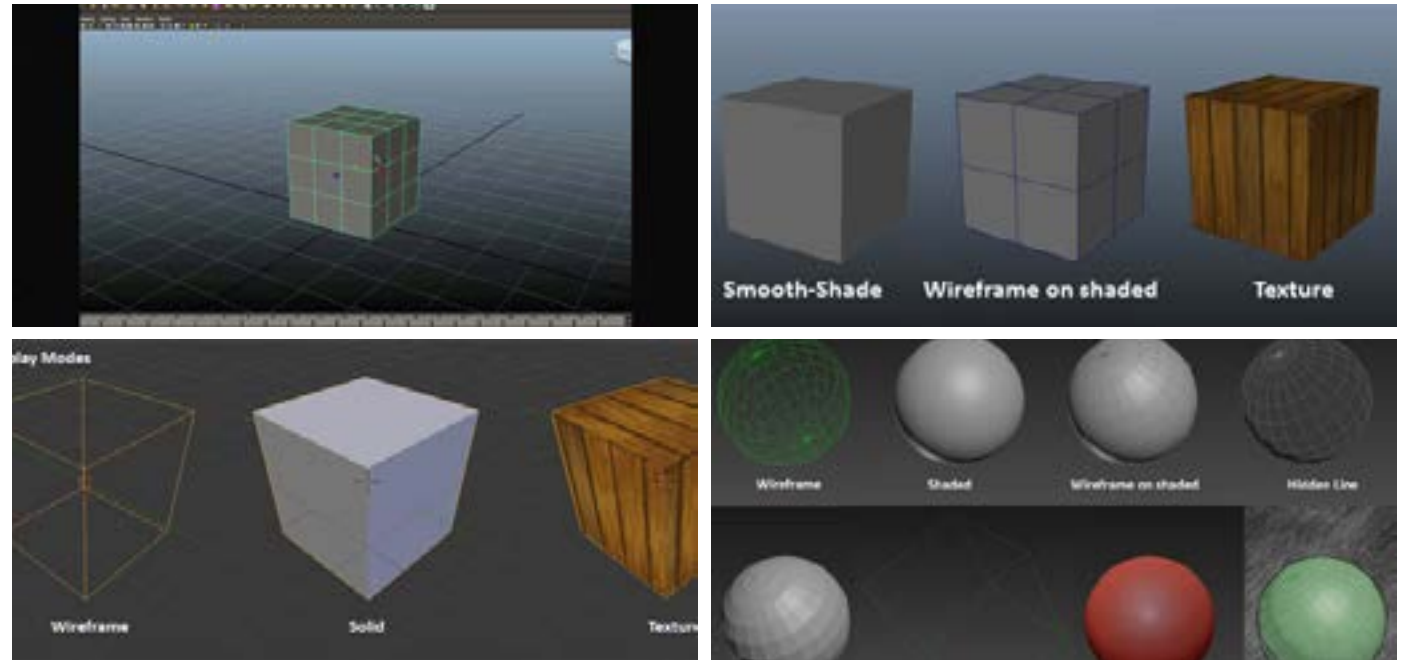
Wireframe, smooth shade, wireframe on shaded, textured mode and X-ray would most probably be available in any good 3D software of your choice (though they may be called by another name).

Wireframe shading shows you **how the object is constructed**. You will need this to see and manipulate the object and it's components like vertices, curves, polygons or surfaces.

Smooth shading shows you quickly **how the object looks** with the current scene lighting and surface color and shading properties.

Wireframe on Shaded is exactly that - the wireframe combined with the smooth shaded display.

Textured mode allows you, in addition to the shading, to see the texture of the object.

X-Ray mode gives a semi-transparent display of the selected object so that you can see the hidden surfaces of the object too.

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Animating your Object

The 3 most used animation functions in animation are Select, Move, Rotate and Scale. As mentioned in the Viewport section, all good 3D software will have the buttons for these in a way that they can be accessed very quickly and also have hotkeys for them.

Here are the hotkeys for Maya

Q = Selection Tool

W = Move Tool

E = Rotation Tool

R = Scale Tool

If you are using another software, before going ahead, make sure that you are totally familiar with the buttons and hotkeys for these functions.

Move - allows you to change the position of an object from one point to another.

Rotate - allows you to rotate the object along any of its axes or to freely rotate it in the viewport.

Scale - changes the size and proportion of an object along all 3 axes (proportional) or along any particular axis (disproportionate scale).

Software will display manipulators when move, rotate or scale tools (in fact for most tools) are selected. These will allow you to make changes to the object in a visual and interactive manner instead of by numbers as seen in

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animating-your-object

the previous section. The following image shows the manipulators in Maya.

Manipulators in 3ds Max
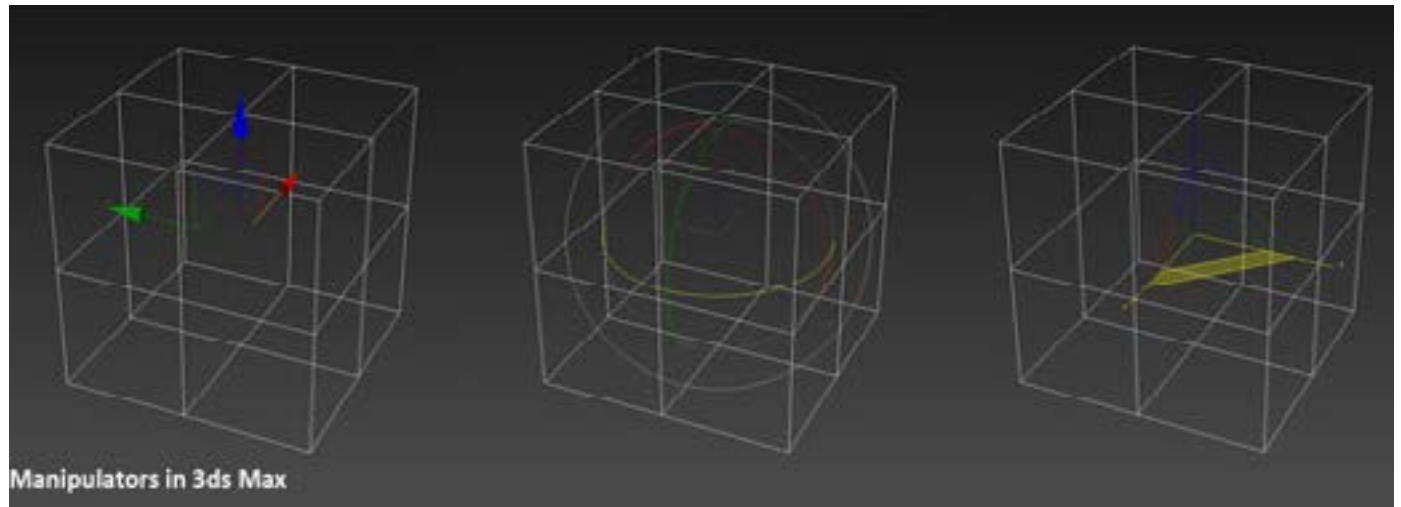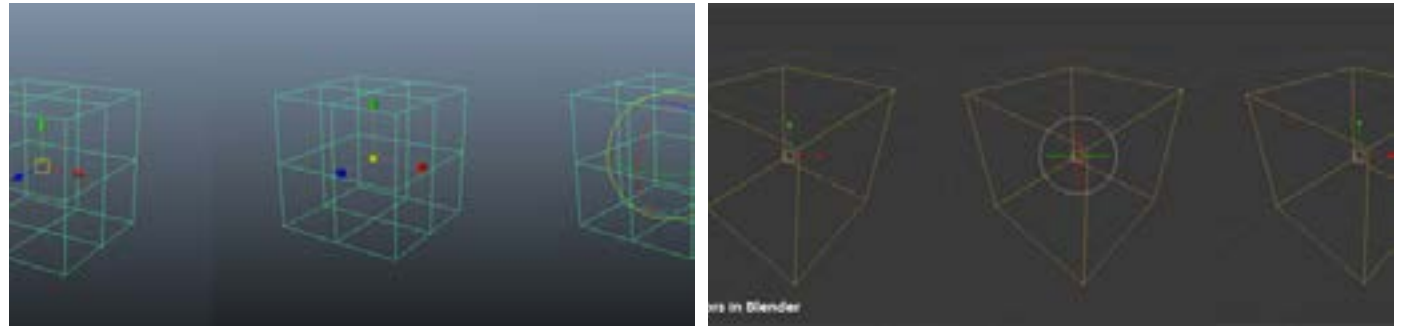
Another important function is the point around which you want to move, scale or rotate an object. Often you may want this in the centre of the object. At other times at a corner or edge of the object or somewhere else altogether, even outside the object (for example, the point of the moon's rotation around the earth is at the earth's centre!). This point is the **Pivot**.

You can change the pivot of the object in Maya by holding D down while moving the manipulator of the object to the desired position.
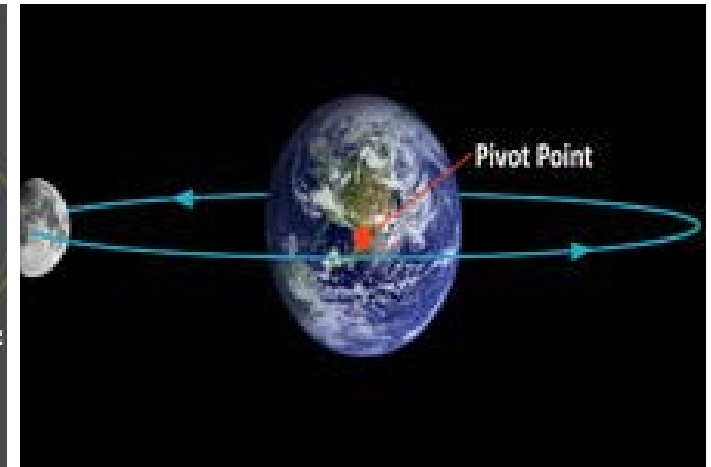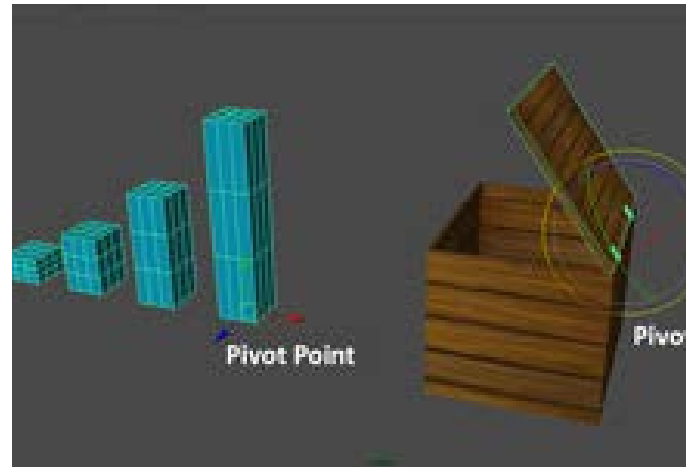
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If you understand these 3 tools and how to set the pivot position for an object, you will be equipped to do more than 50% of all animation. Believe me, that is true!

Familiarise yourselves with the Move, Rotate and Scale tools and their manipulators with simple primitive objects. Try changing the Pivot to different positions and see how it affects the object movement when you scale and rotate it.

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Creating My First Animation
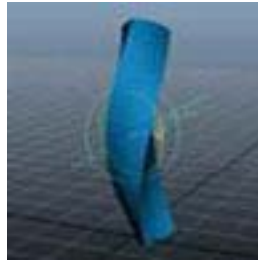
The Bend Modifier

Animating

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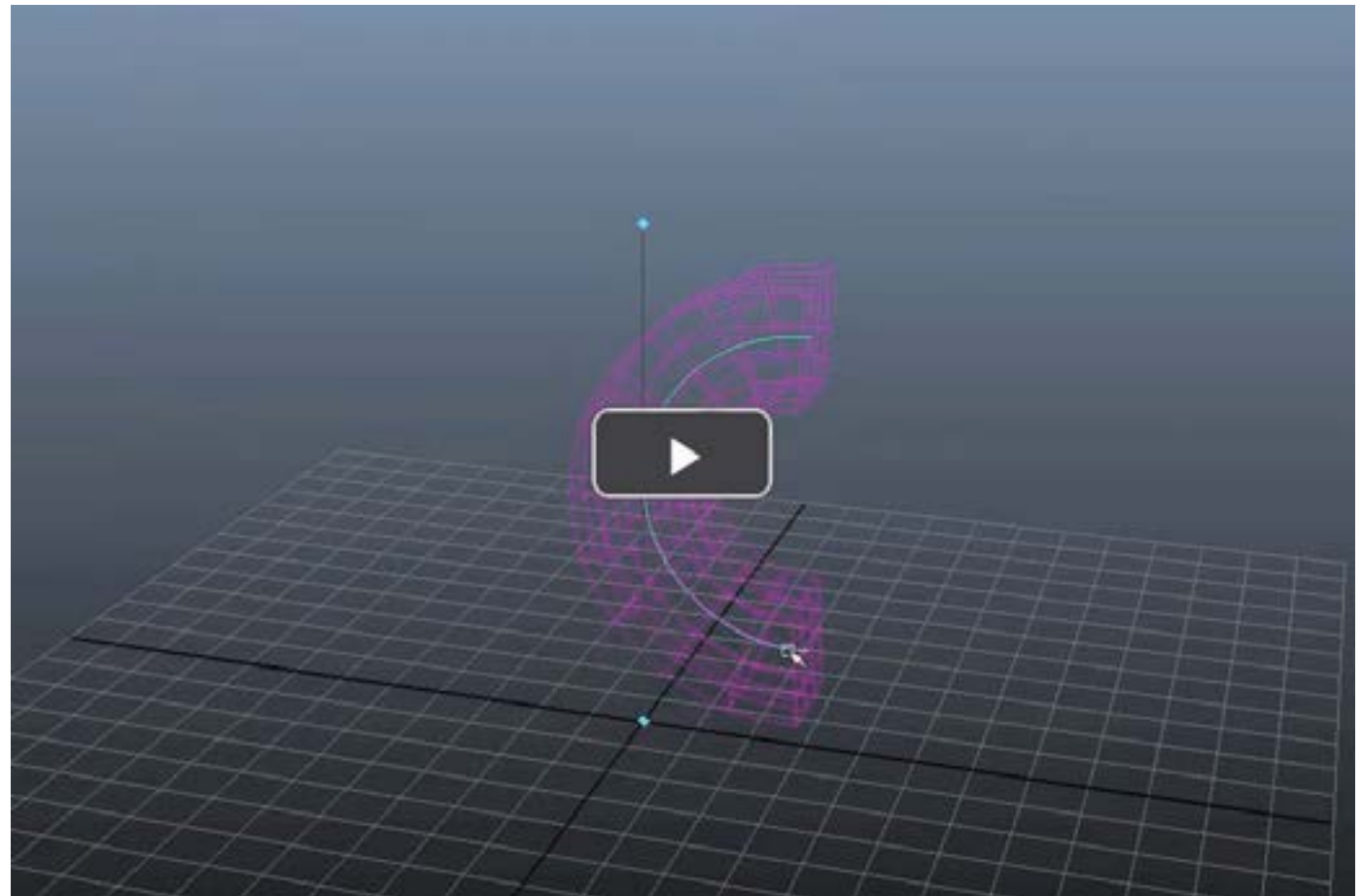Prof. Sumant Rao and Sachin Meshram
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The Bend Modifier

So you know how to make simple primitive objects. But can they be used to make more complex shapes? Can they be used as the basic building blocks for your actual objects?
Yes of course. One way is to use what are called as **deformers**. Most of the 3d software have a set of deformation tools. For example: In Maya we have bend, twist, sine, etc. which are called non-linear deformers. You can apply these deformers to any object. Check out this video and you will be surprised how complex your objects can get with just a little modification.

Video - Adding Bend Modifier

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After you have applied the deformer you should fool around with it to check out what the attributes do.
**Curvature:** The actual bending Value of the deformer
Low Bound: Defines how much of the mesh that shall bend below the deformer's pivot
High Bound: Defines how much of the mesh that shall bend above the deformer's pivot.

Play with it to learn how it works. Always do this when using new stuff.

These deformers are great to learn basic animation functions in 3D as well as help you understand some animation principles without getting bogged down with too much technical details. The following video should help you do that. We have used the Bend deformer in Maya for this. This deformer should be available in virtually any software of your choice. So try it out in your software and you will have successfully gone through the entire process of animation and will find the more complex stuff coming up much simpler.

Video - Animating Bend Modifier
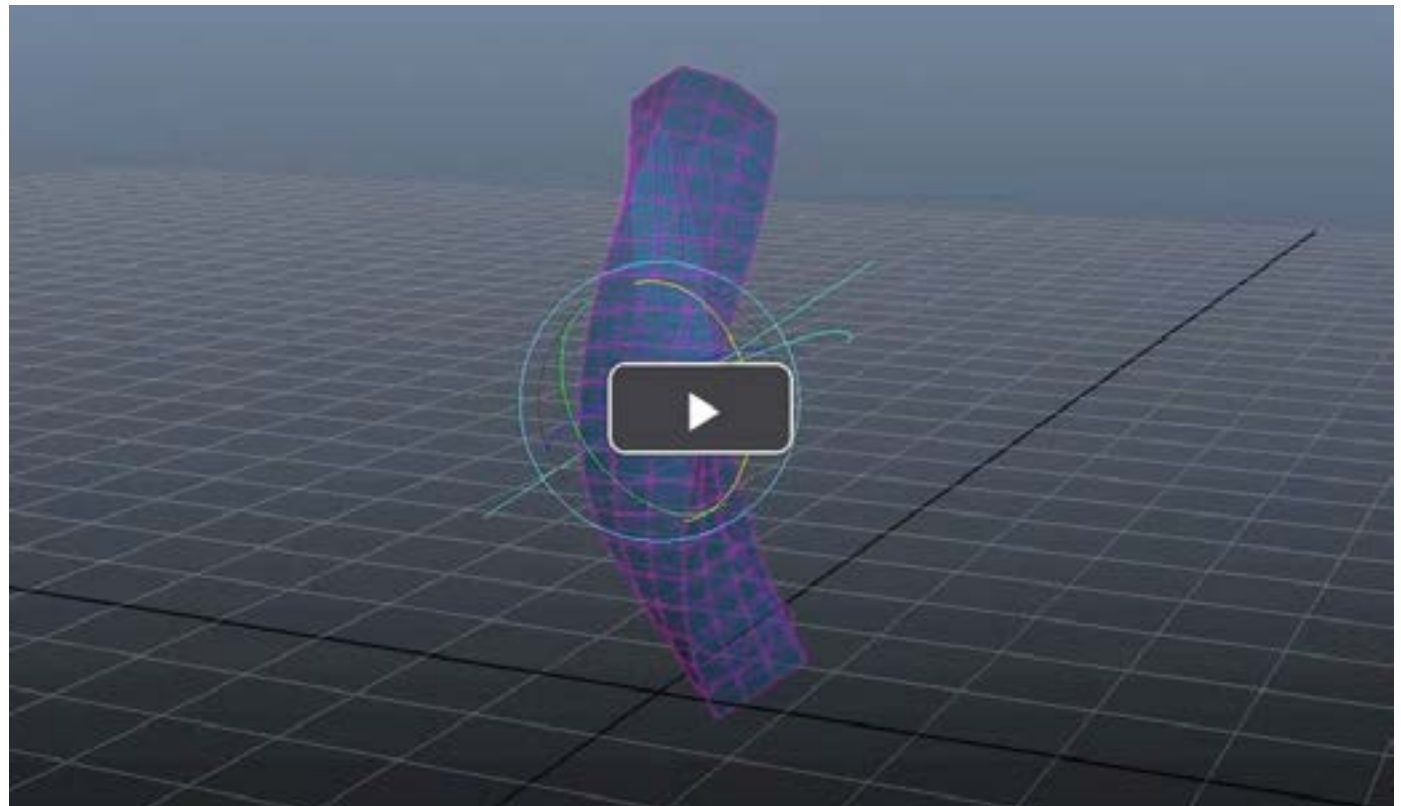
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Download: Bend_animation.mb
Isn't it wonderful, what you can do with a simple modifier like bend? With just a few keyframes, we can give life to an object as simple as a box. But what makes it work?
Here's the secret. Most objects that try to come back to their natural position of rest when 'deformed' spring back when released. Because of inertia though, they do not stop immediately, but continue moving further, slow to a stop and then change direction creating a sort of springy action.

This is one of the fundamental principles of animation in action- **'follow through and overlapping action'**.

You can observe this sort of movement in all sorts of things. Try noticing this in all the things around you. To know more about this check out
Link - principles of animation - follow through and overlapping action

There is another principle of animation that you can observe in our bend animation. If you observe closely, the cuboid bends back and seems to sort of prepare itself to spring back just before actually doing so. i.e. it is sort of anticipating the next action. This also creates an anticipation for the viewer. '**Anticipation**' is another principle of animation. Check out more about this here.
Link - principles of animation - Anticipation

Download: Demo videos of other modifiers

Let us look at some things from the video in greater detail.

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Animating

The Time Slider and the Playback controls:

The Time slider shows a range of frames, the current frame of your scene, keyframes that you may have set, the autokey toggle, the animation preferences button and many other features. Once more, these are very similar in all animation software (not just 3D software). Go to your software help and familiarize yourselves with these features. For now, how to set the length of your animation, setting keyframes and using the playback controls is all you need to know well, but there is no harm in knowing more.
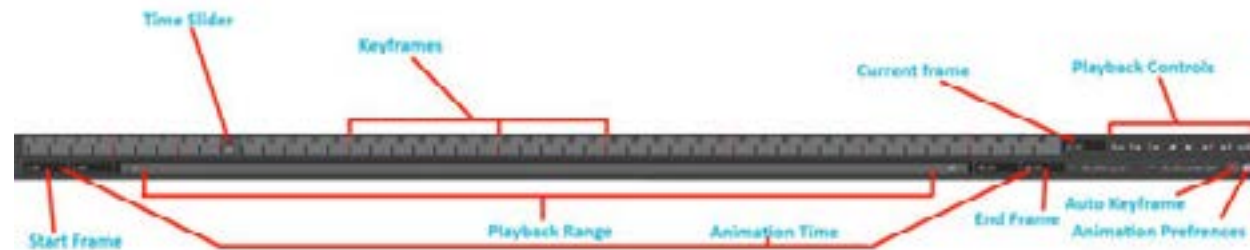
3ds Max Timeline

Blender Timeline

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IDC, IIT Bombay

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https://www.dsource.in/course/my-first-animation/
creating-my-first-animation/animating

What is a **keyframe**?
It is an important value of any property like Shape, position, rotation, etc. needed at a particular frame in order for the animation to work well. To put it simply, it is the 'key' for that specific 'frame' to achieve good animation.

To become a good animator, the most important thing that you need to learn before anything else is identifying the keyframes that are needed for your animation and setting them. You need to decide firstly, what is the shape, position or Value (as in the bend deformer) that you want to set as the keyframe and secondly the Timing for that keyframe i.e. which frame do you set it on.

In Maya : Hotkey- **s** sets a keyframe on the current frame of animation

Keep in mind that doing this will set a keyframe for all the animatable channels of the selected object. This may become a problem later as you could end up with unwanted keyframes in the channels that you are animating.

If you want to set keyframes only for specific values, then highlight the particular parameter in the channel box, right click and select the 'Key Selected' option from the drop down menu. This will only set the keyframe for the highlighted parameter and keep all other channels clean of unwanted keyframes.

Subsequent to the first keyframe, you can use the autokey toggle to set the remaining keyframes (Autokey off-) or automatically (Autokey on-) If the Autokey is off, do remember that no keyframe is being set and unless you set it manually, you will lose any changes that you made.

Find out how setting keyframes can be done in your software and recreate this Bend animation. Experiment with the amount of bend, the timing between keyframes. Learn this well, as this is what you will need to do all the time.

So you have created your first animation. Before you go ahead, let's recap the process.

1. Creating the Model: For any animation, you need to keep in mind what is the animation you want the object to do. If the way you have created the object does not allow you to do that, you may just have to start from scratch. For example, we had several vertical subdivisions for the cuboid used in the bend animation, but to achieve the normal shape of the object, we actually just needed the two ends. But what would happen if you did not have the subdivisions? How would the bend look?

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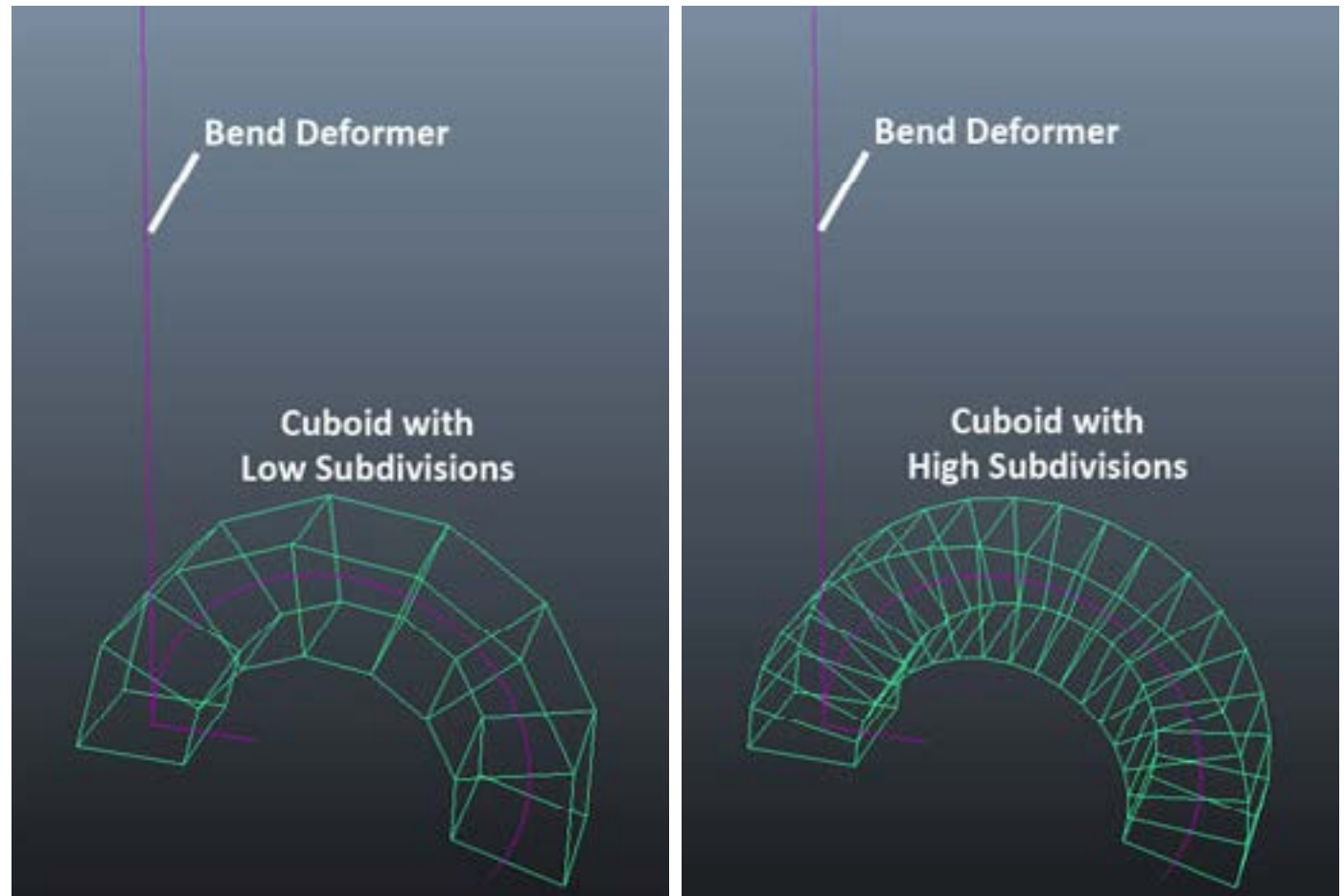## My First 3D Animation
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It is not much work to add the additional subdivisions to the cuboid as required. But with a more complex object? So when creating the model always find out how the model is going to be used.

2. Preparing the object for Animation: With complex characters, this can get quite detailed and is also called Rigging. For this, often controls are created on the object so that the animator can animate intuitively and not worry about the technical problems of the character to be animated. We have simply used a Bend deformer to do the task, but principally we are doing the same thing, creating an animation 'rig' for our character.

3. Setting Keyframes: Before setting keyframes, try and visualize the animation, whenever possible, understand and plan the timing in advance and only then proceed to set them. You can always change and improve the key-

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frames and their timing later, but planning will considerably increase the quality of your animation and believe me, make the process truly enjoyable.

4. Watching the Playback and Improving the Animation: Though, in the video, we have not shown it, we hope you do this when you try animating. It is wonderful to see your animation play, but even better if you can push it to be as good as you can make it. So don't be lazy. If you consistently do this, your animation skills will improve very quickly with each animation you do.

This has been a taste of the animation process. You can learn the next steps and revisit some of the stuff you have seen in this module in the 'Bouncing Ball Animation' module.

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References

Maya Help file available at:
http://download.autodesk.com/global/docs/maya2013/en_us/index.html

Maya student education version software:
http://students.autodesk.com/?nd=download_center

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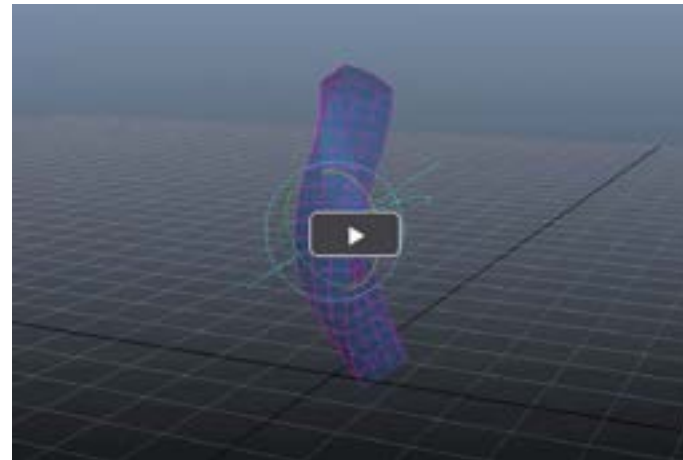**https://www.dsource.in/course/my-first-animation/video**

Video

The Interface

Viewports
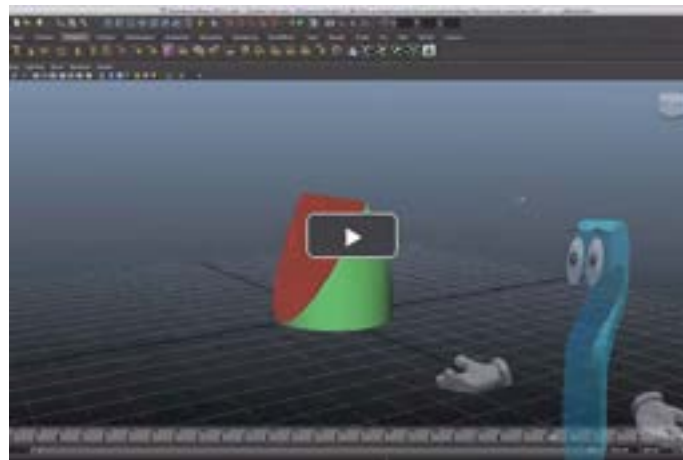
Navigation in Viewports

Primitives

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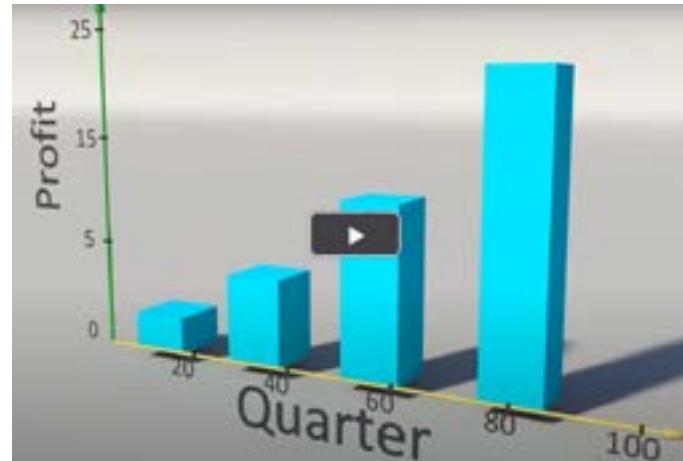
Interacting 3D Objects
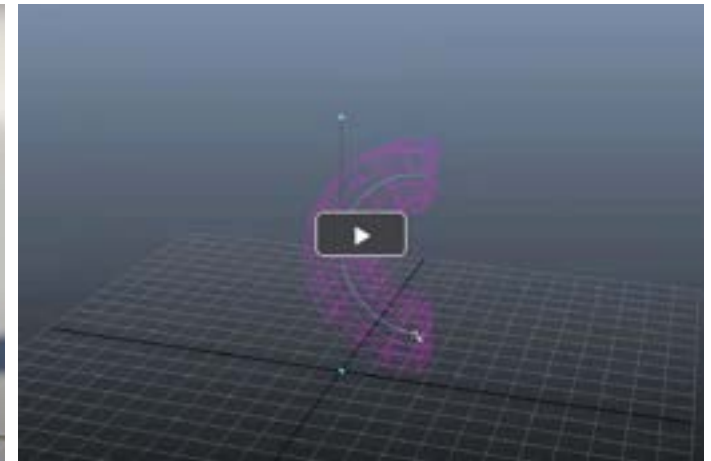
My First Animation

Animating the Bend Modifier

Sine Demo

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Twist Demo

Wave Demo

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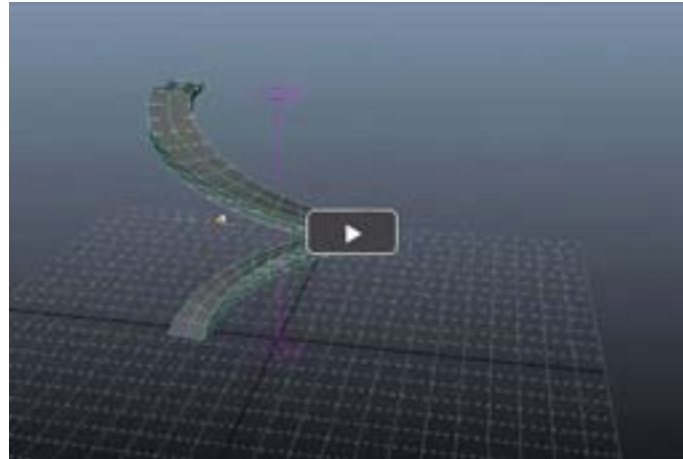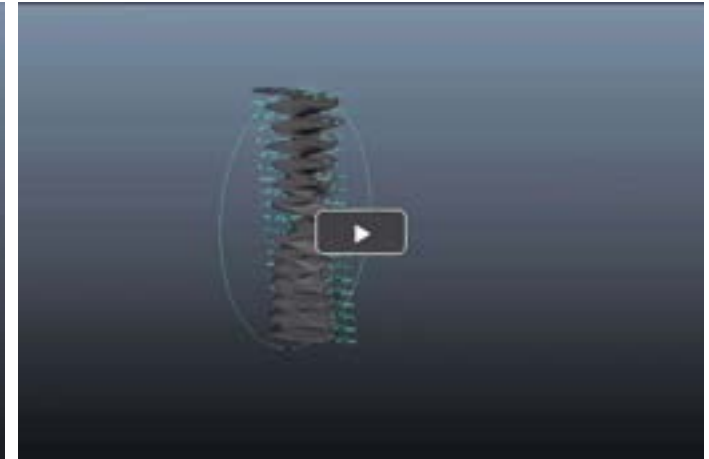
Contact Details

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