

CSE 682: Animation

Winter 2012

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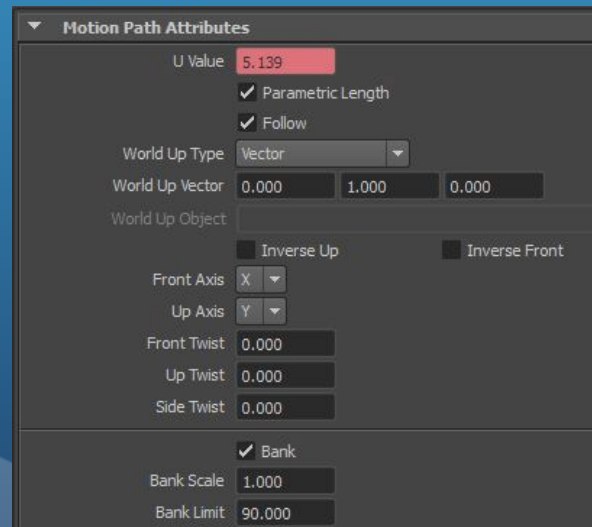
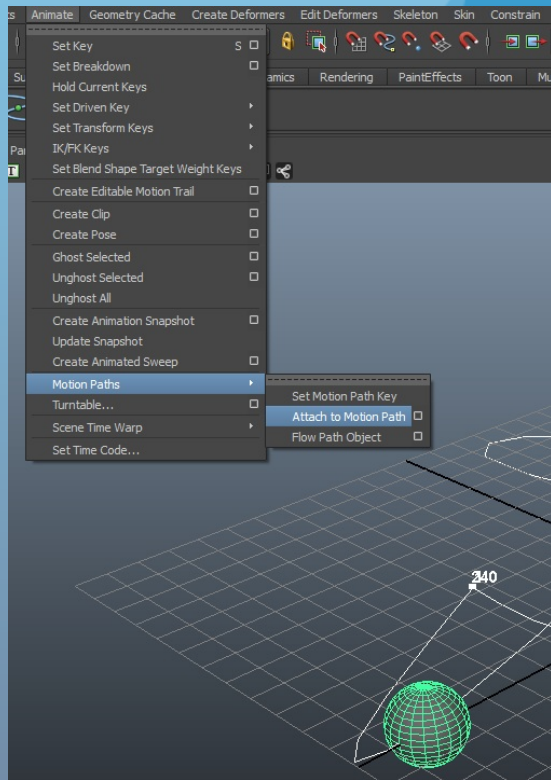
Topics:

- Path animation
- Camera animation
- Keys and the graph editor
- Driven keys
- Expressions
- Particle systems
- Animating FK & IK linkages
- Skinning
- Locators, deformers, manipulators
- Constraints
- Dynamics

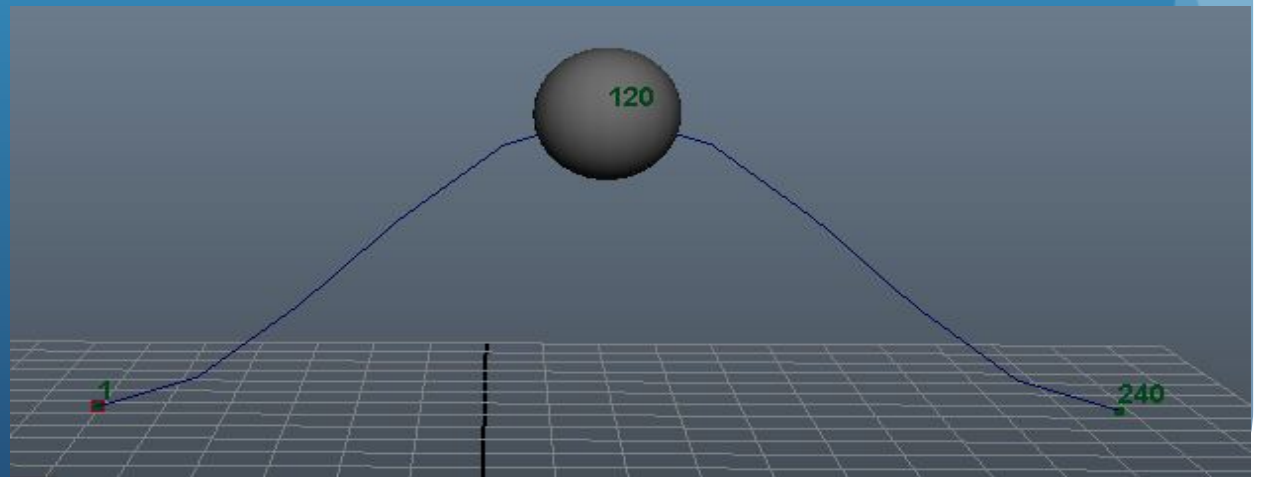
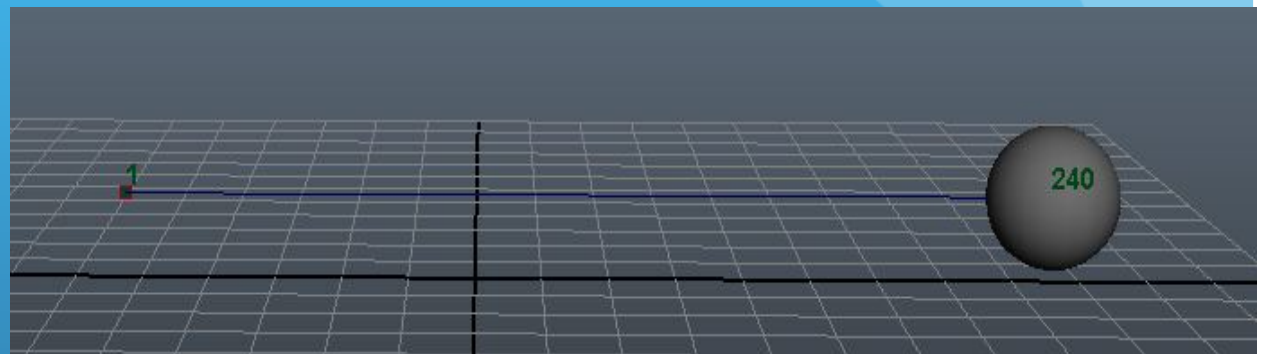
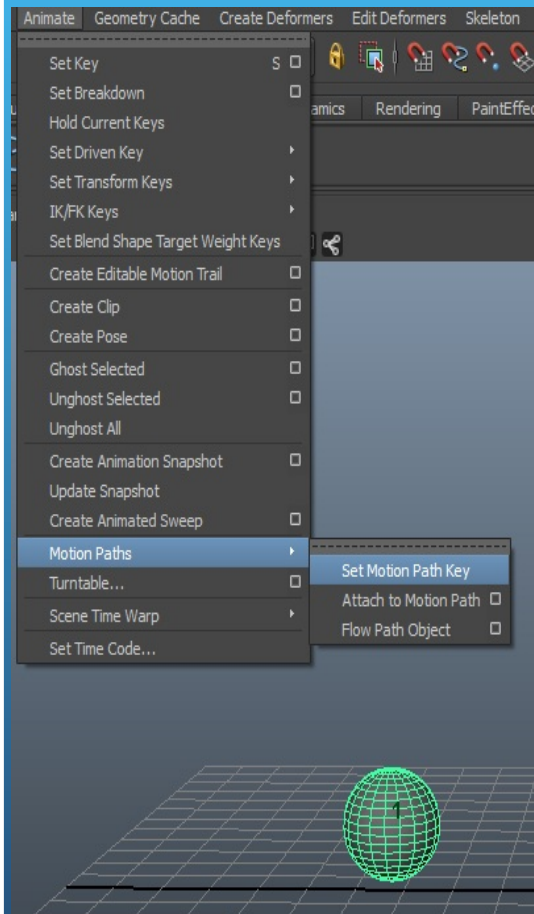
Path Animation

1. Attach object to curve
2. Set motion path keys
3. Flow path object

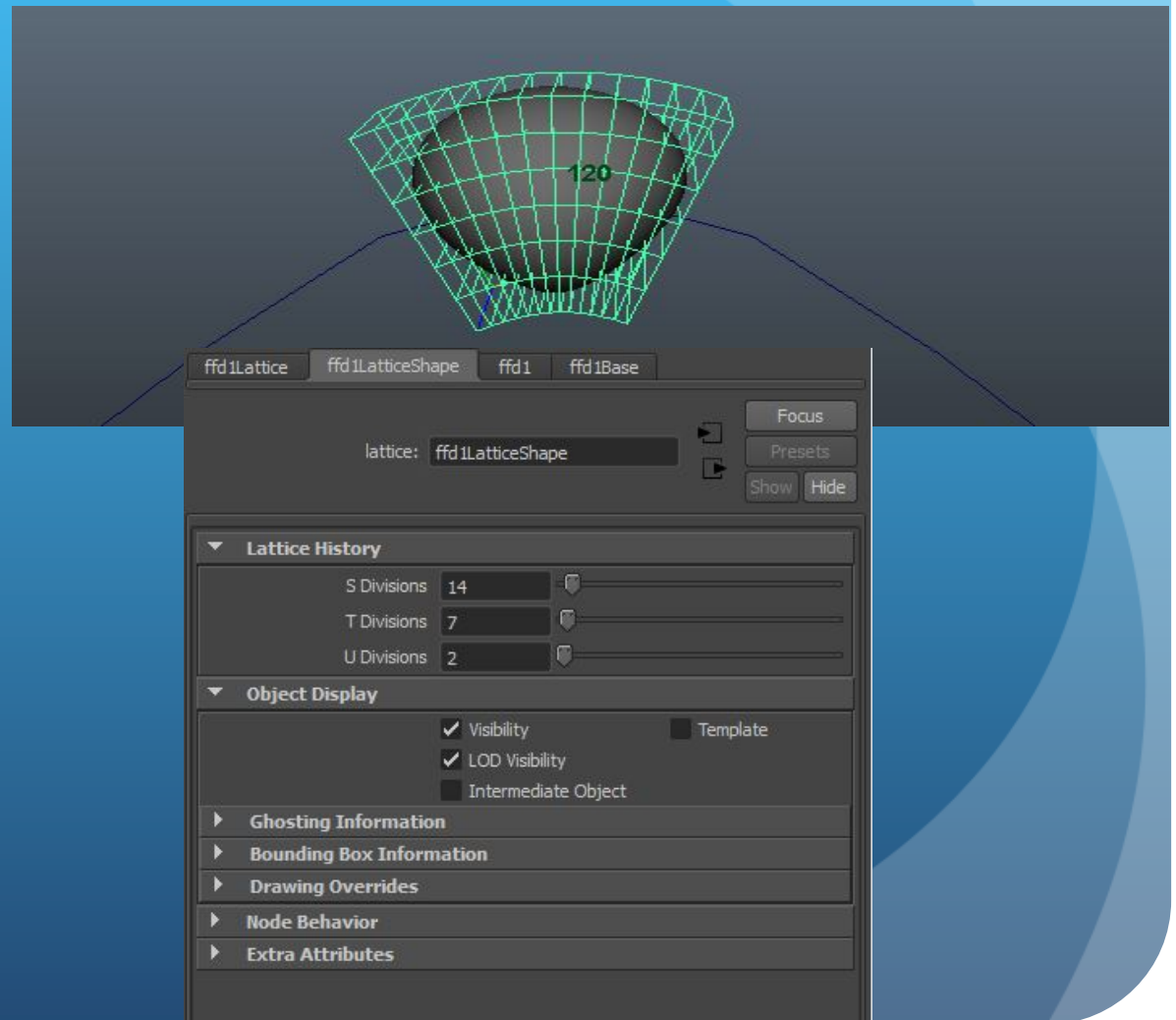
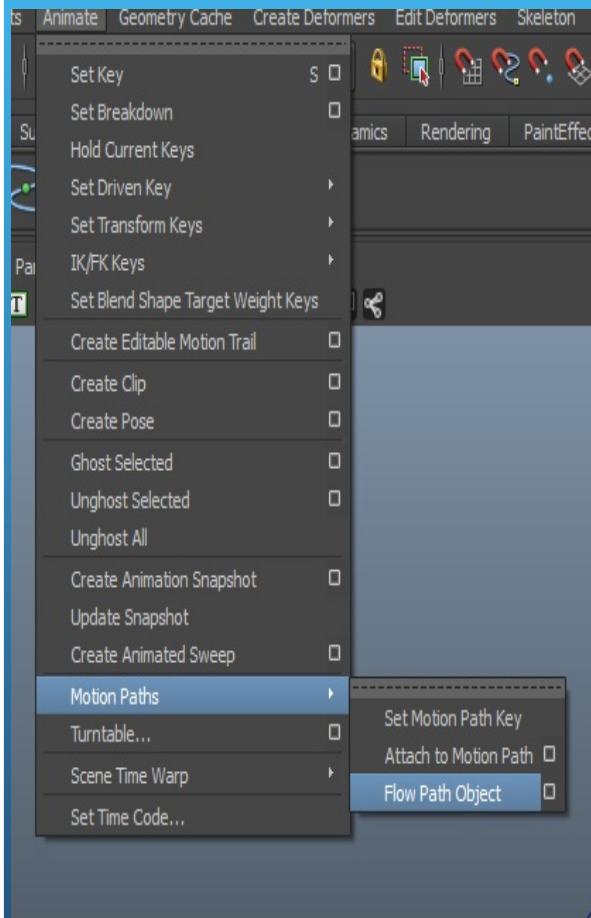
Attach object to curve



Set motion path keys



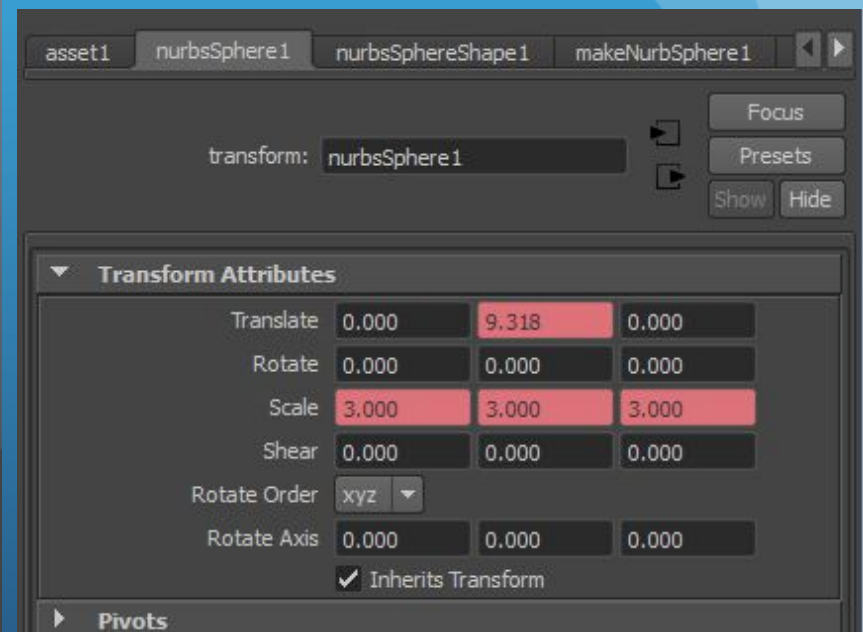
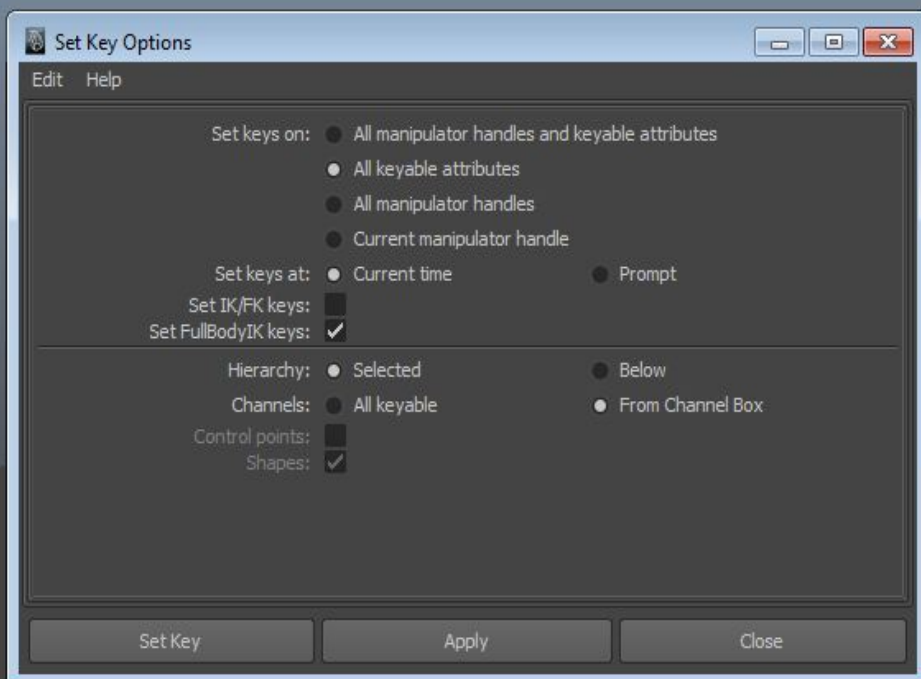
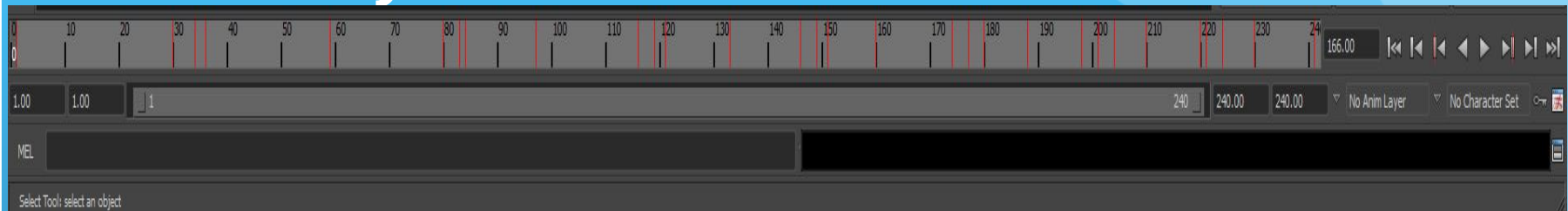
Flow path object



Keys

- Set Keys
- Auto Keys
- Hold Keys
- Driven Keys

Set Keys



Auto Keys

- After initial key is set for object, any transformation done to the object in a different frame will automatically set a another key

Auto key is currently off:

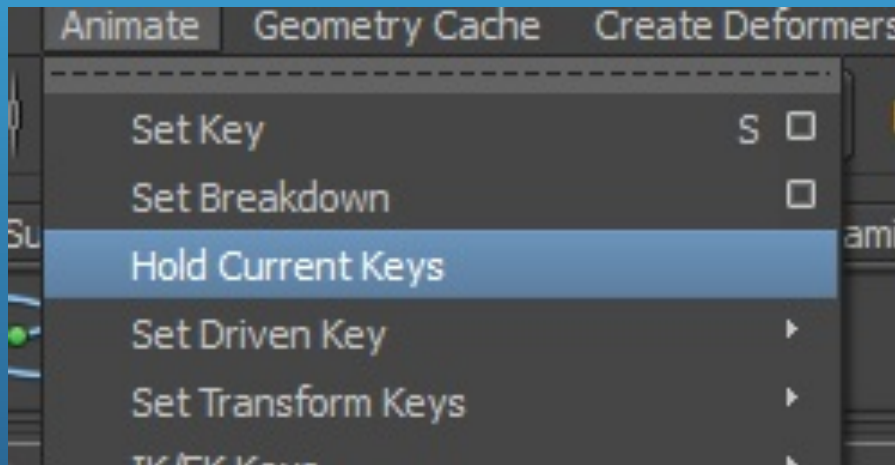


Auto key is currently on:



Hold Keys

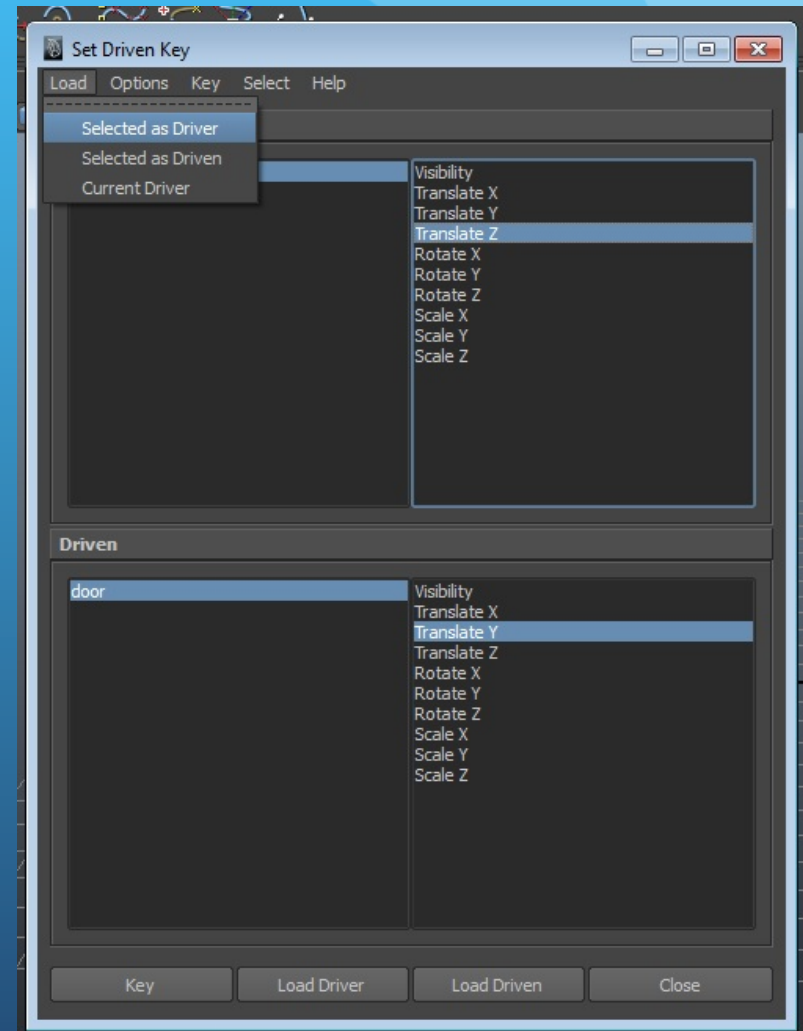
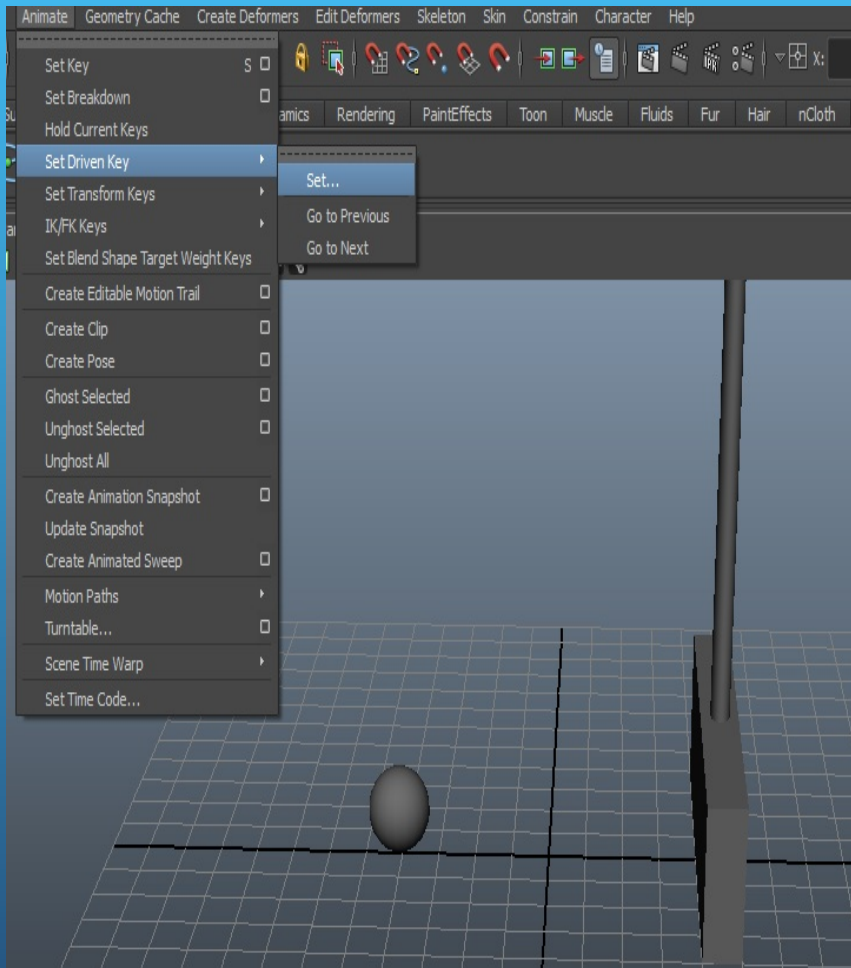
- Useful when using auto keys. It locks the objects attributes so it cannot be transformed.



Driven Keys

- Does not use time slider for animation
- Attributes of one object change relative to how attributes of another object change
- Useful when you have complex movement:
 - Hand movement
 - Door opening
 - Groups of objects

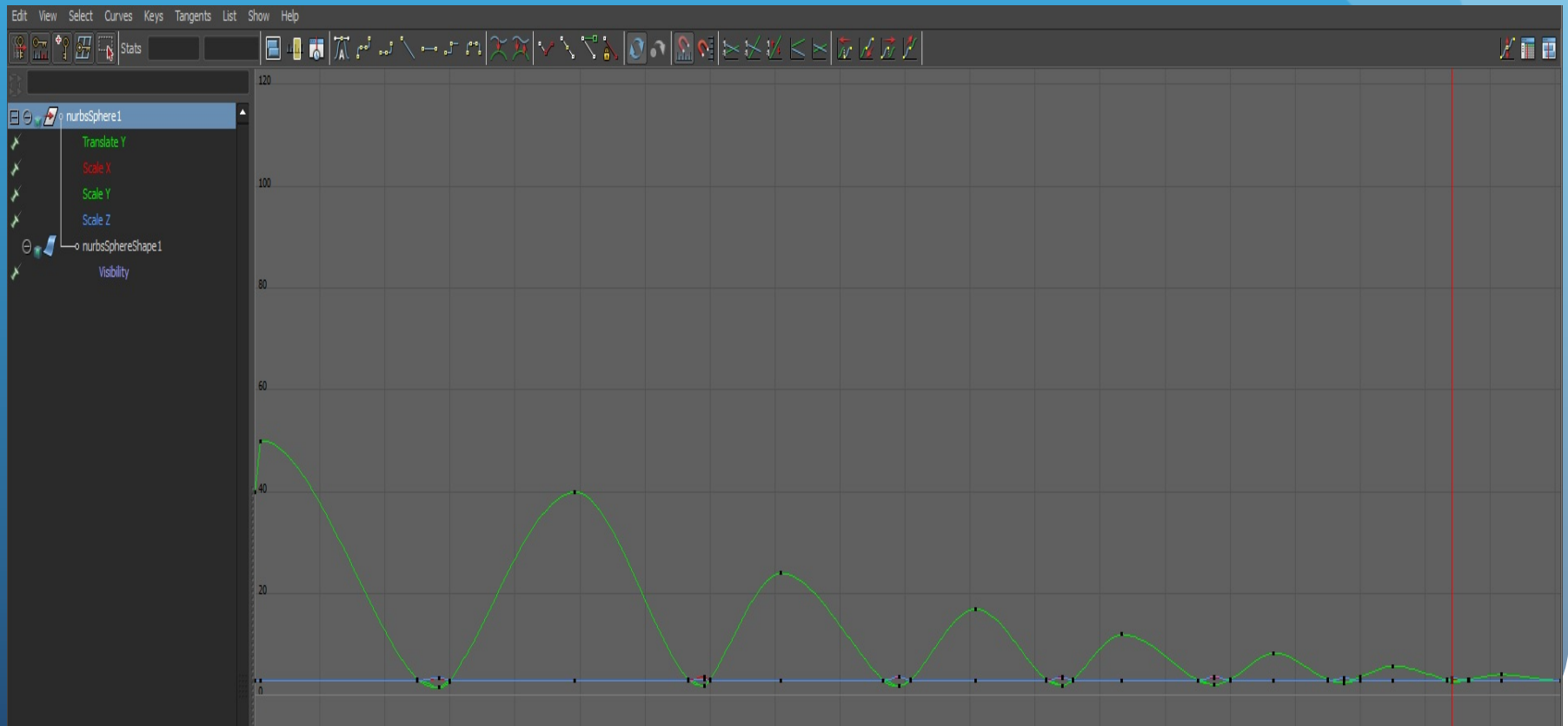
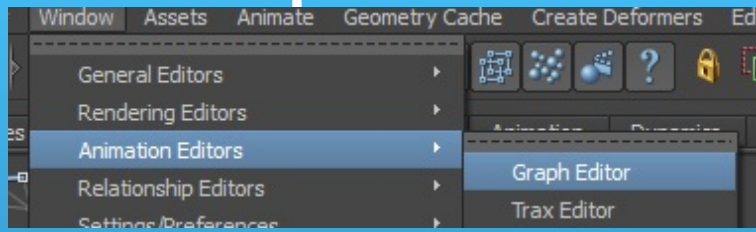
Driven Keys



Driven Keys

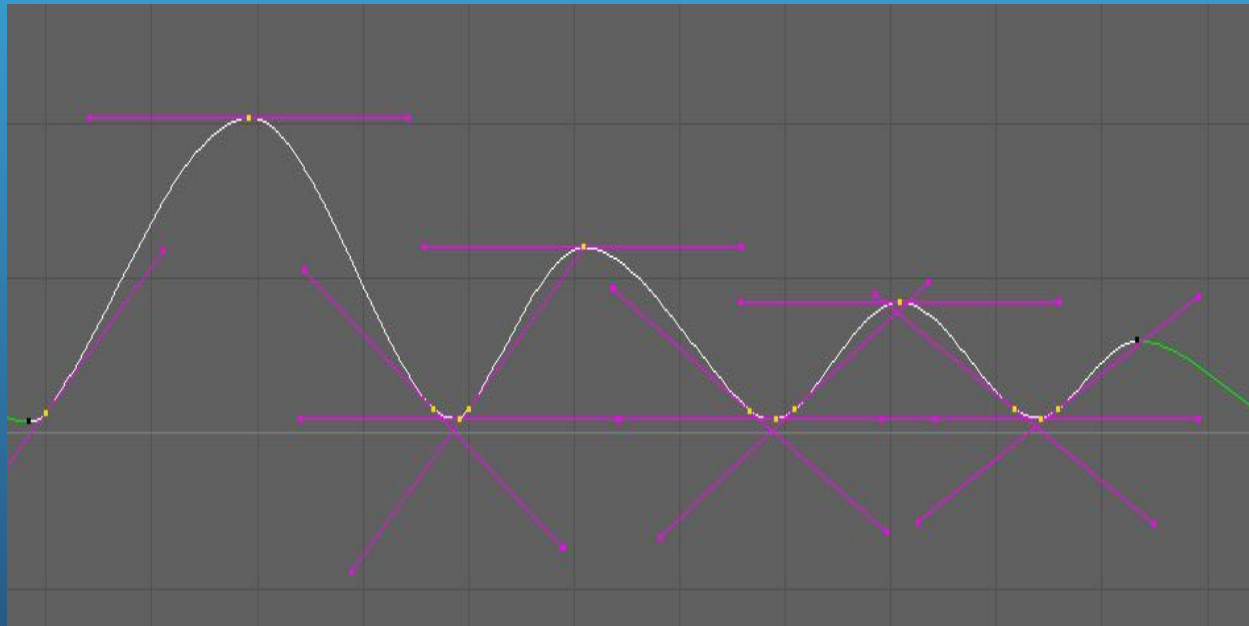
- Be sure to put the driven keys in different frames for accurate results
- Then animate the ball with key frames or motion paths!

Graph Editor



Graph Editor

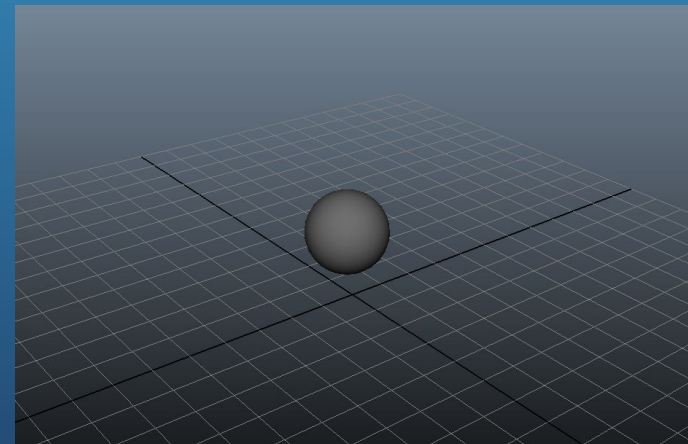
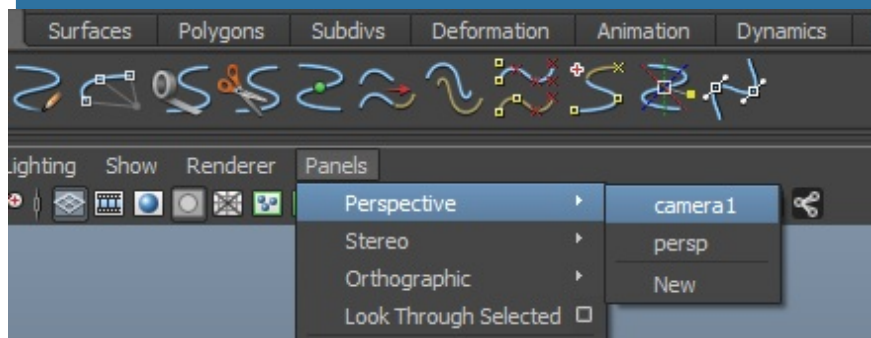
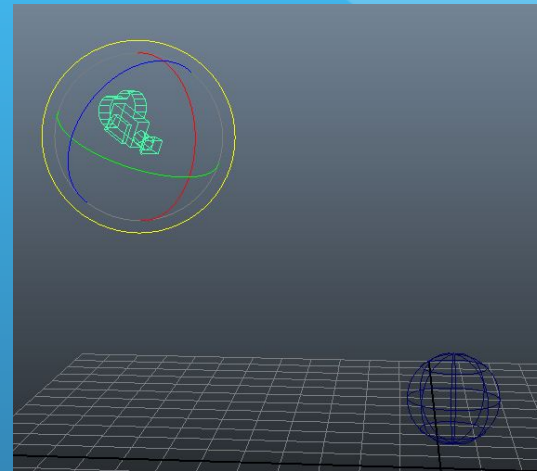
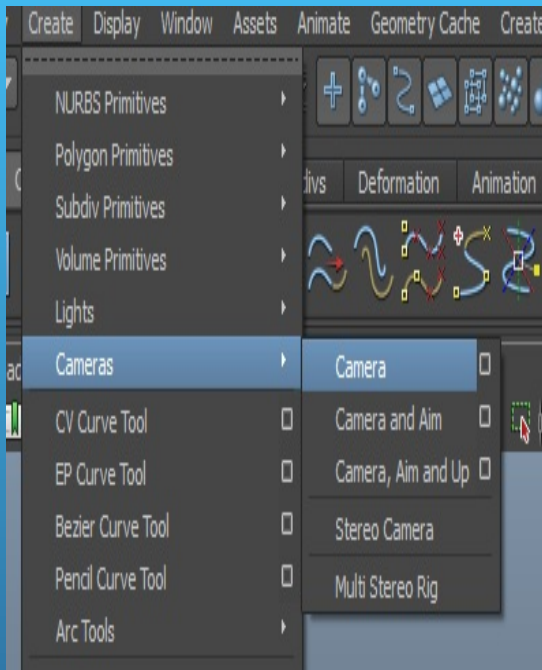
- Highlight attributes on graph you want to edit
- Middle click and drag to change it



Cameras

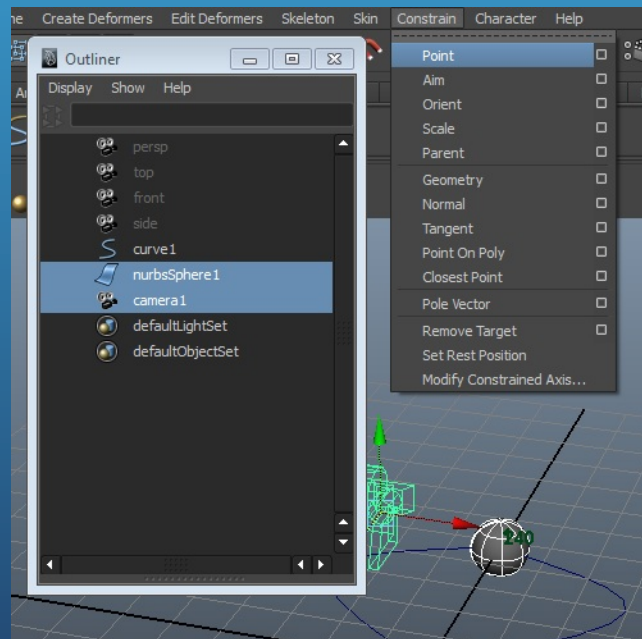
- 3 different types:
 - Camera: Acts like a regular object
 - Camera and Aim: Has location and pointer
 - Camera, Aim, and Up: Acts as a real camera

Camera Basics



Camera Animation

- Control camera with constraints or use motion paths and key frames



Expressions

What are expressions?

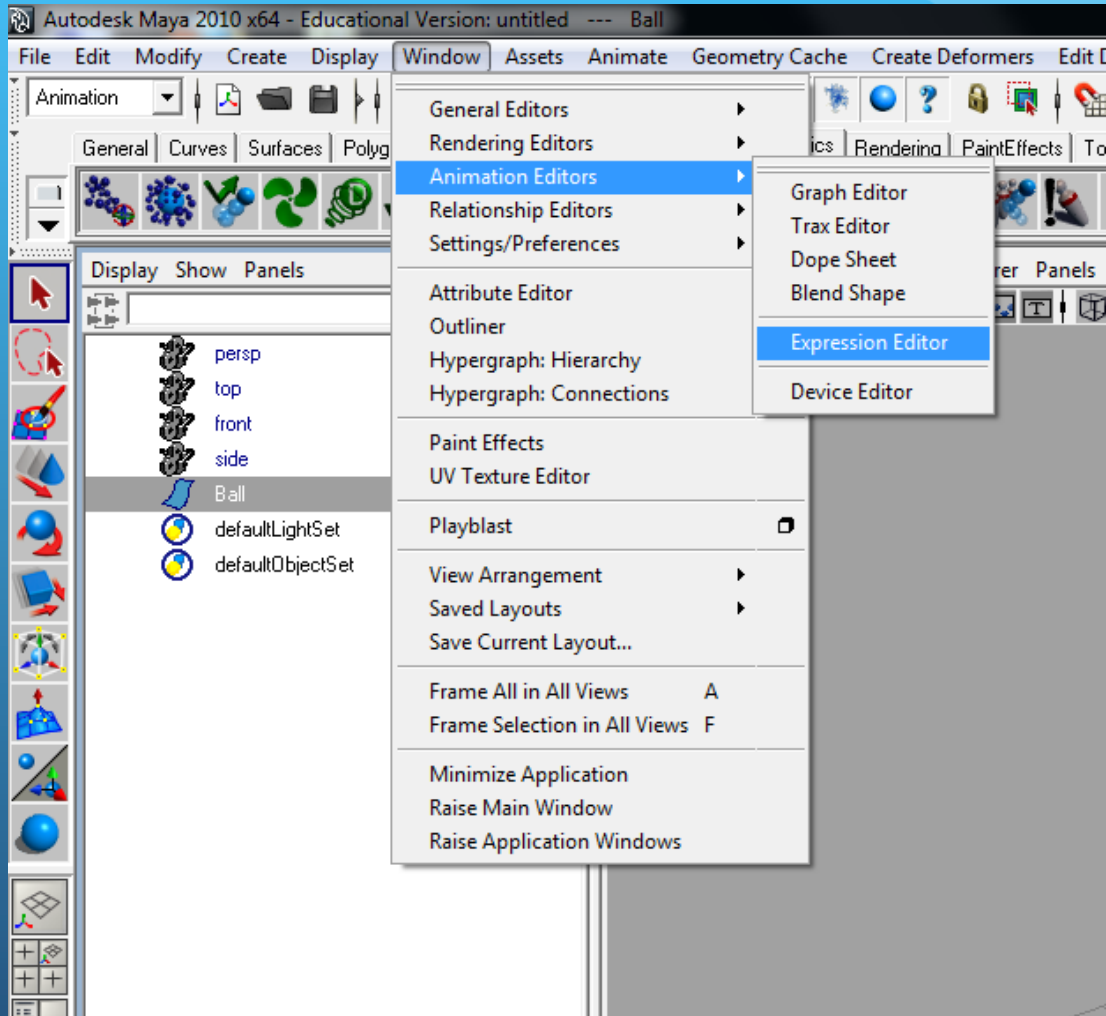
- Program-like instructions that you write to control keyable attributes over time

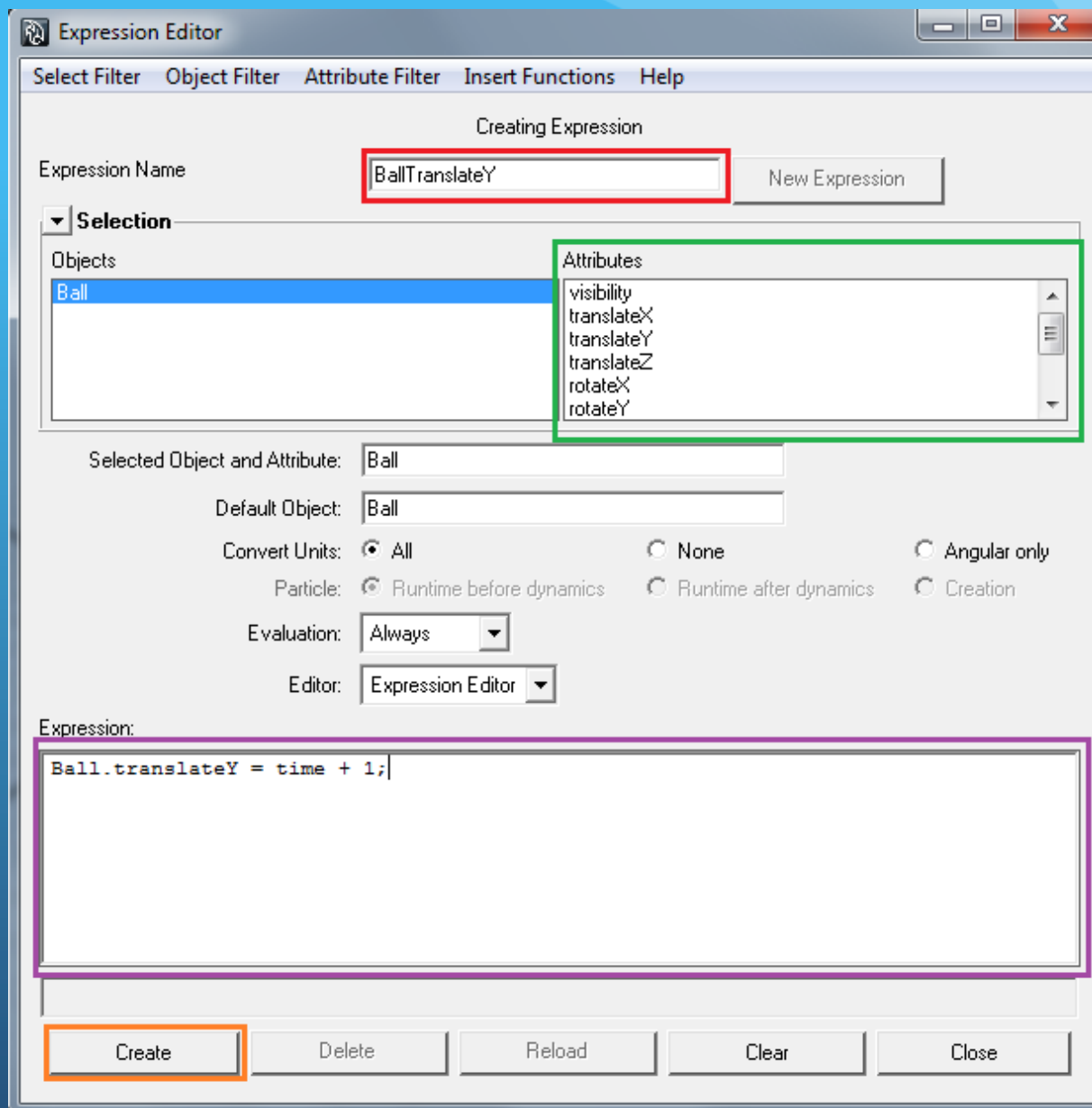
- Can be comprised of:
 - Mathematical equations
 - Conditional statements
 - MEL commands

What are expressions?

- Ideal for attributes you want to change incrementally, randomly, or rhythmically over time
- Cannot be mixed with other animation techniques for the same attribute of an object

Window >> Animation Editors >> Expression Editor





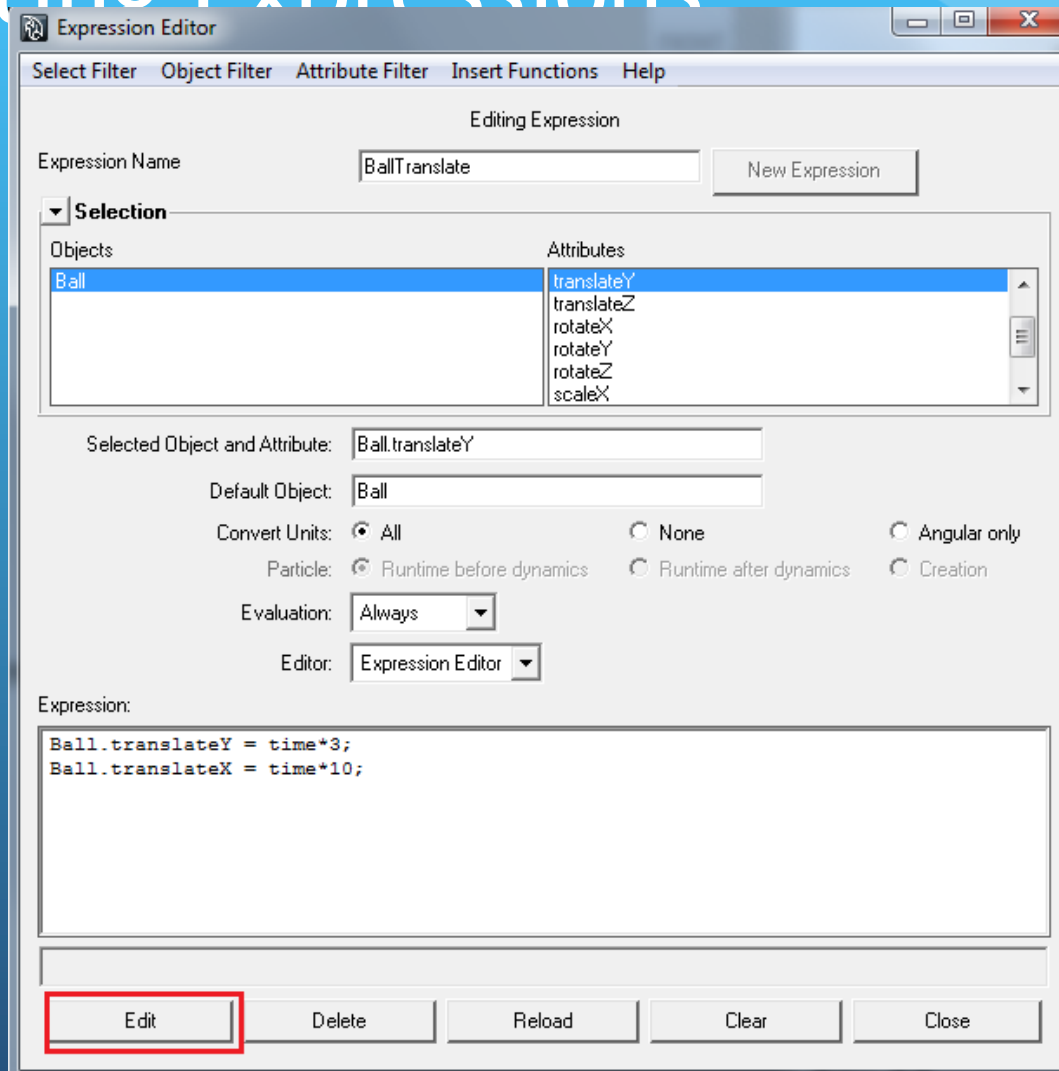
time

- Predefined variable that updates as an animation plays
- Contains the elapsed number of seconds from the first frame to the current frame


```
Ball.translateY = time*5;
```

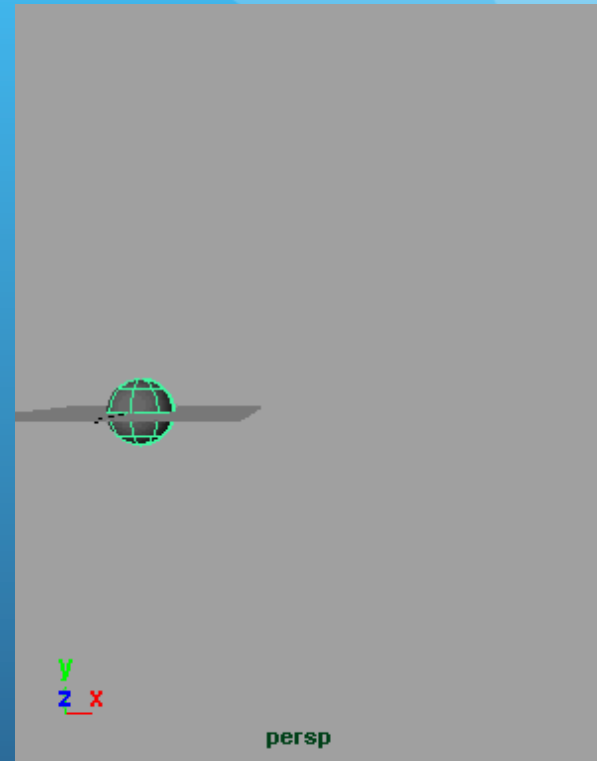


Editing Expressions



Controlling two or more attributes

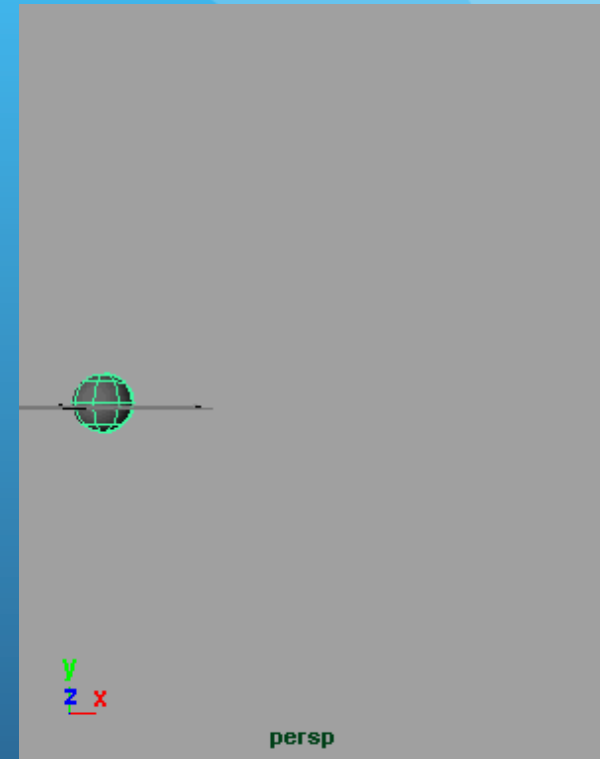
```
Ball.translateY = time*3;  
Ball.translateX = time*10;
```



Linking attributes

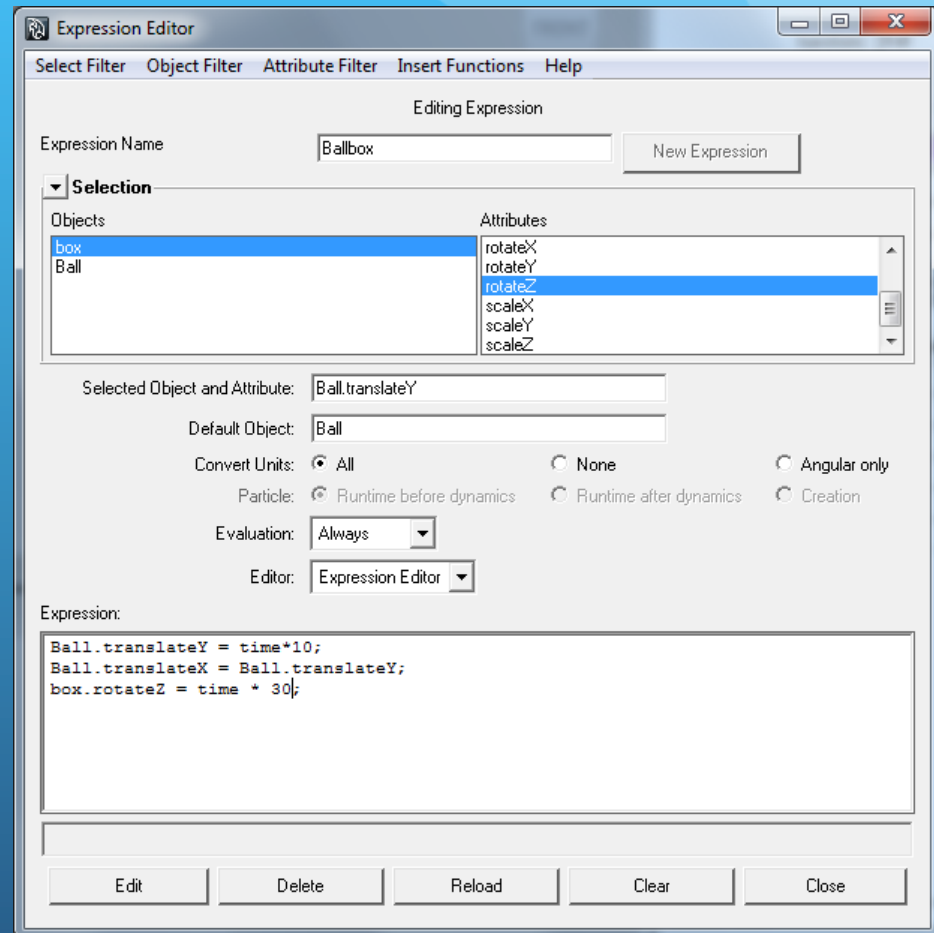
```
Ball.translateY = time*15;  
Ball.translateX =  
Ball.translateY;
```

Advantage: assigning new value updates other values



Multiple Objects

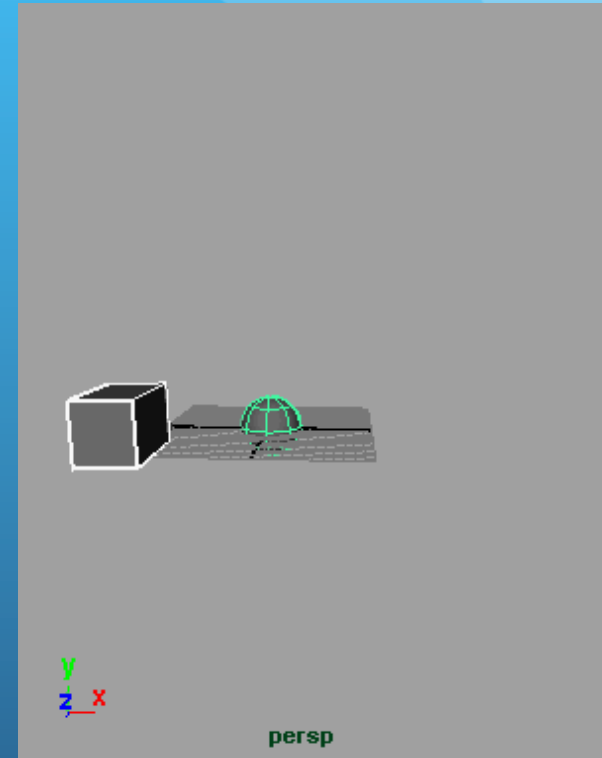
- Can use a single expression to control the attributes of multiple objects



Example with single expression

```
Ball.translateY = time*10;  
Ball.translateX =  
Ball.translateY;  
box.rotateZ = time*30;
```

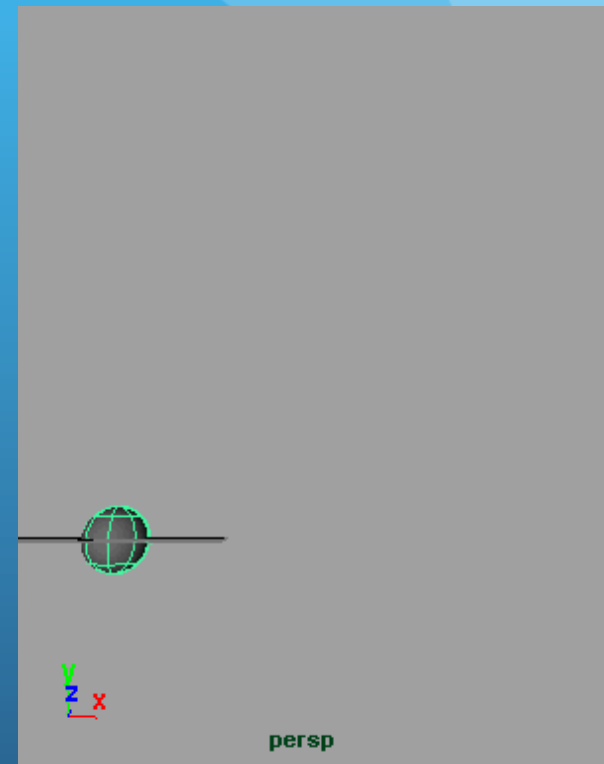
Advantage: having all of your statements in one expression



Conditional Statements

```
if (time < 0.1)
{
    Ball.translateY = 0;
}
else if (time < 1.5)
{
    Ball.translateY = Ball.translateY + 1;
}
else
{
    Ball.translateY = Ball.translateY - 1;
}

Ball.translateX = time*15;
```



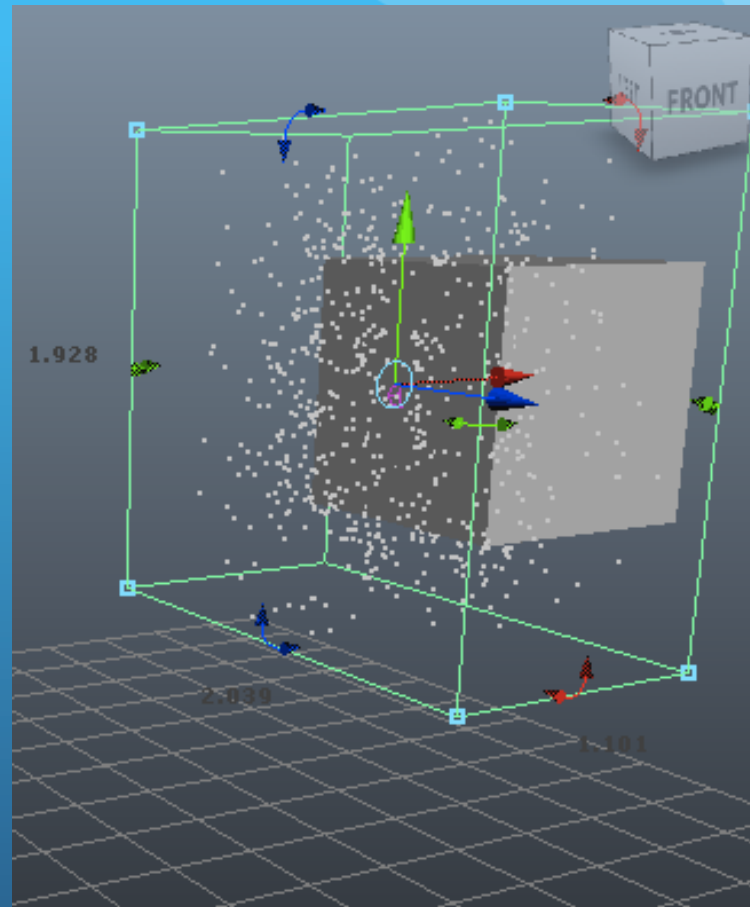
Summary

- Good practice to name expressions
- Full name of attribute
 - Object.Attribute
- Case sensitive
- Semicolon (;) signifies the end of an expression statement
- Keep your conditional statements readable

Particle Systems

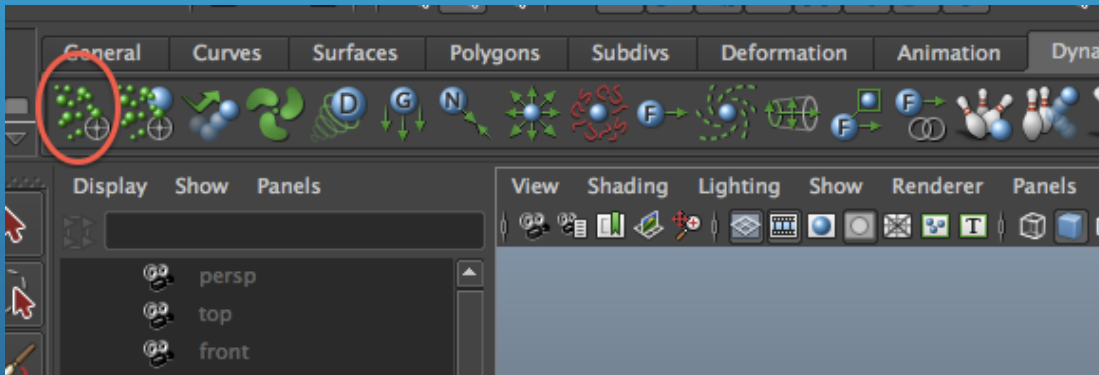
Useful for...

- Water
- Smoke
- Fire
- Explosions
- Etc



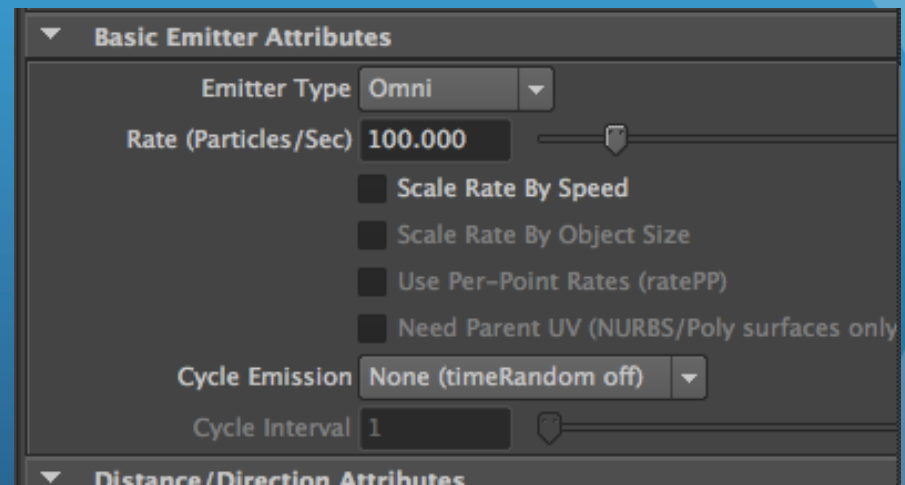
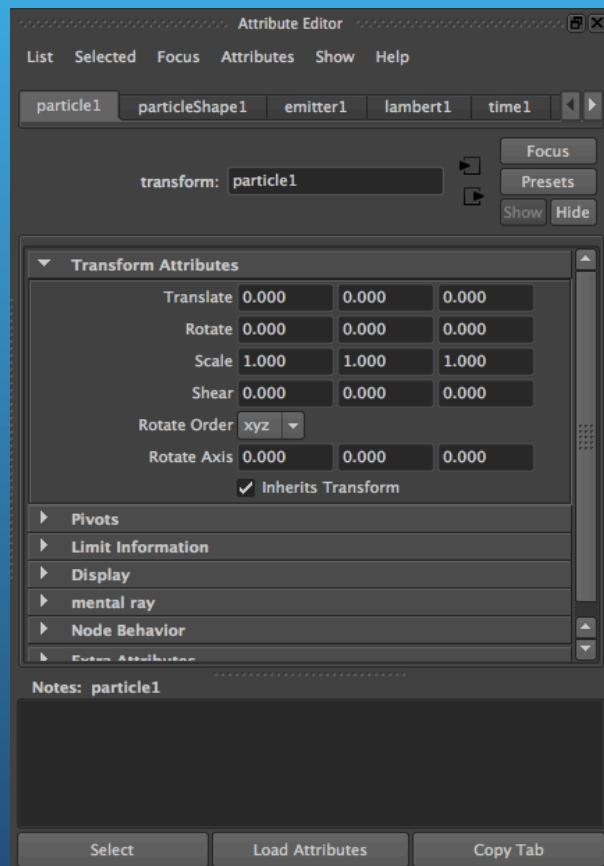
Particle Systems

- Under Dynamics tab, select “Emitter” (or “Emit from object”)



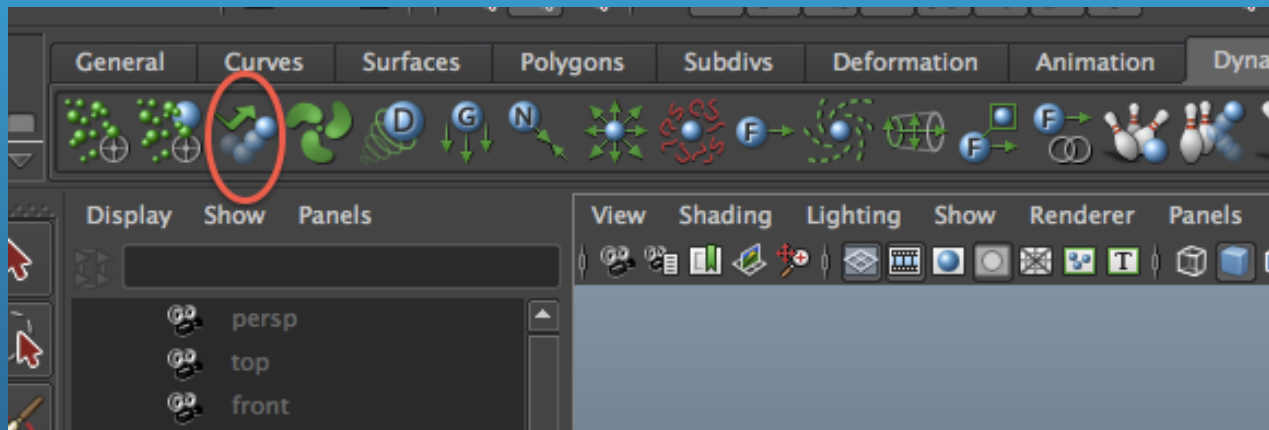
Particle Systems

- Modify Emitter and particle attributes



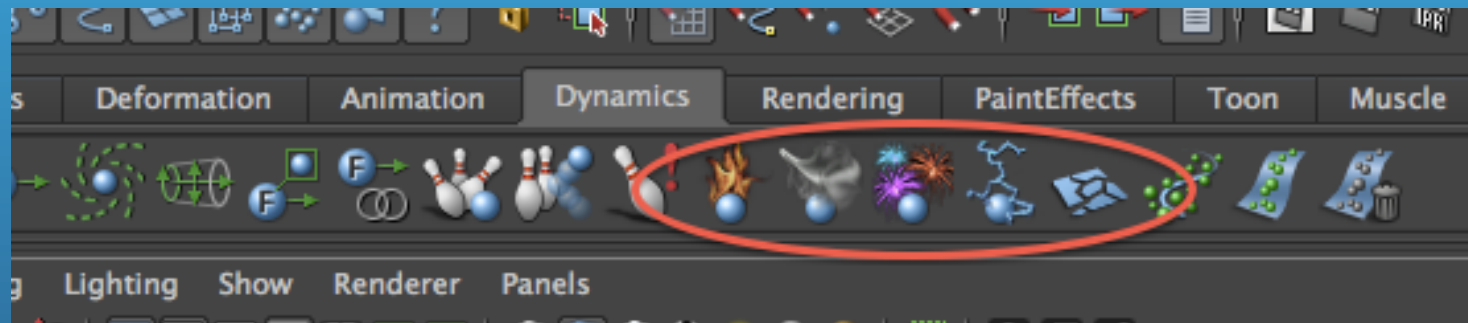
Particle Systems

- For colliding surface, select a particle, then a surface, then select the “Make Collide” button



Particle Systems

- For fire, smoke, fireworks, electricity, broken glass: use specified buttons under Dynamics tab (Maya 2011)



Animating FK & IK Linkages

FK vs. IK

Forward Kinematics

- Joints inherit transformations from parent joints
- Useful for crane-like objects

Inverse Kinematics

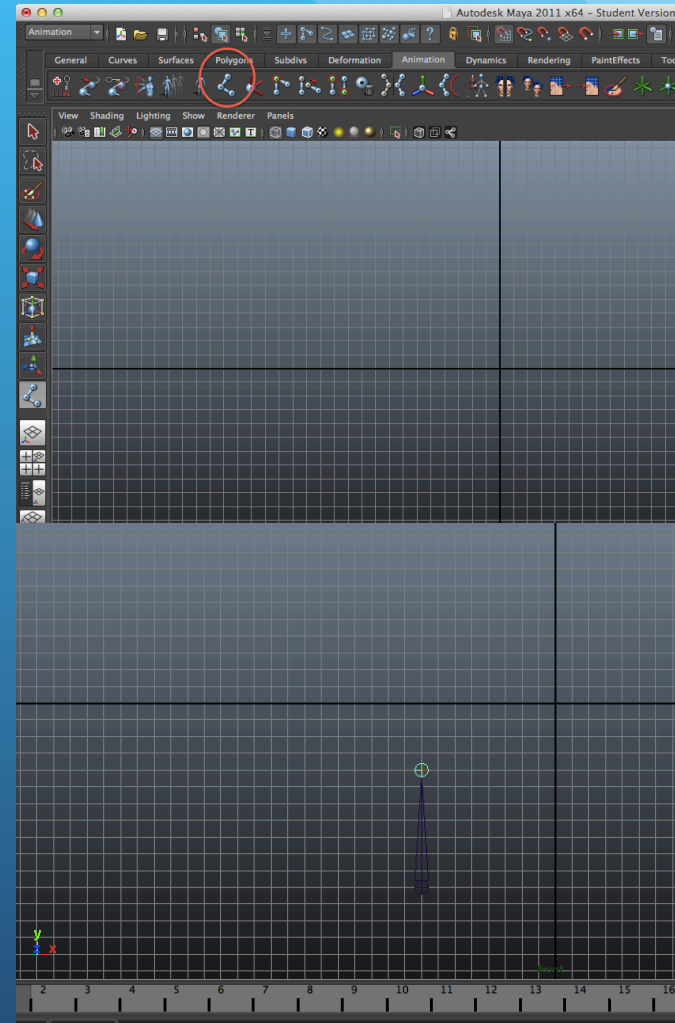
- Parent joints are transformed based upon transformations to specified child joint
- Useful for body parts

Using Forward Kinematics

- Select “Joint Tool” under the Animation tab

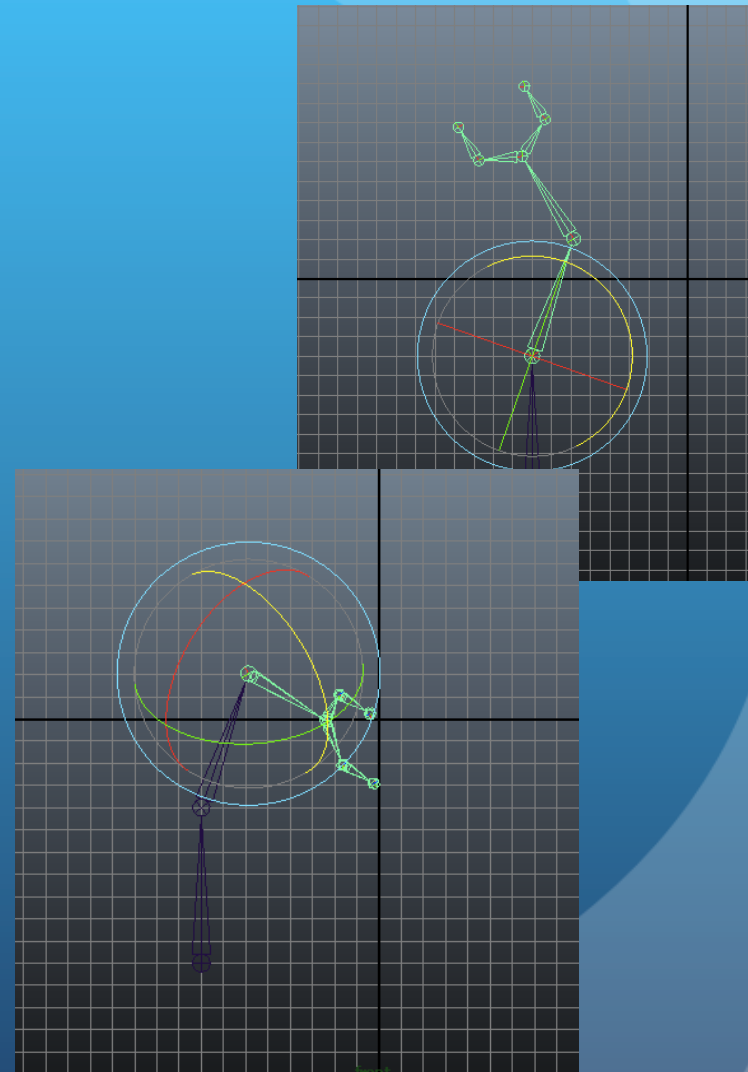
Create Joint Chain:

- Click to place start of joint
- Click again to place end of joint
- Continue for multiple nodes
- Press Enter to finish



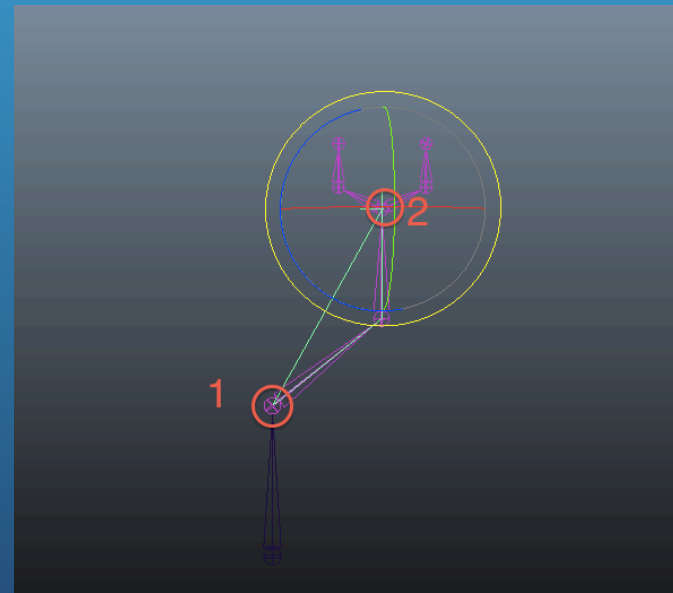
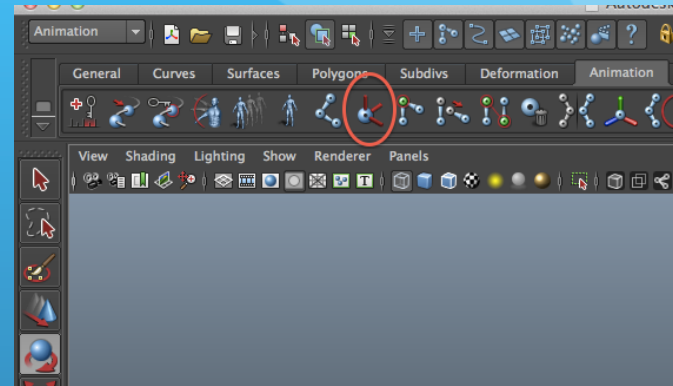
Using Forward Kinematics

- Manipulate joints and set keys



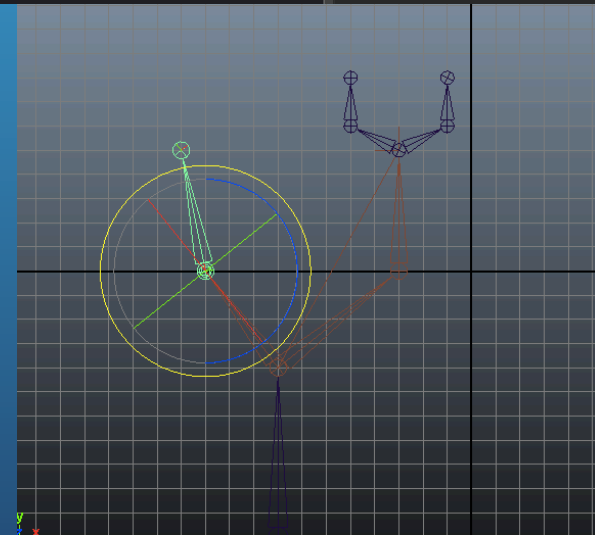
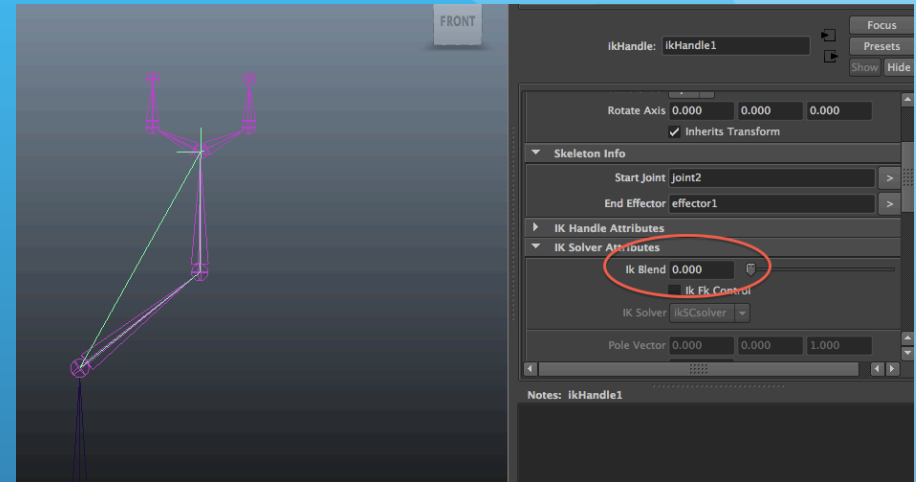
Using Inverse Kinematics

- Must have joint chain
- Select “IK Handle Tool” under the Animation tab
- Click start joint
- Click again on end joint
- Manipulate and set keys



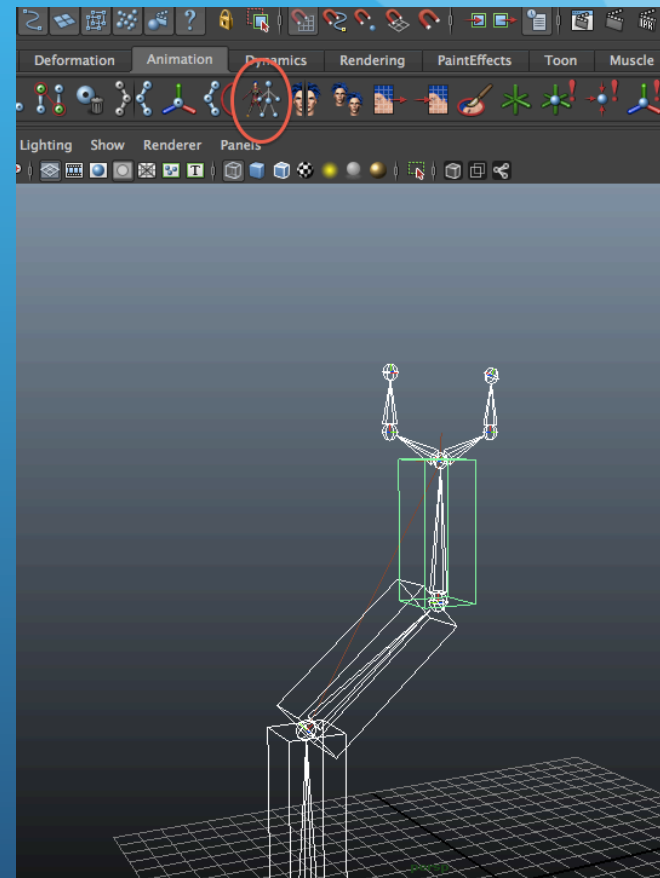
Using Forward *and* Inverse

- Must have an IK handle
- Manipulate and set keys
- Under “IK Solver Attributes” set IK Blend to 0 when using FK, and to higher values for IK



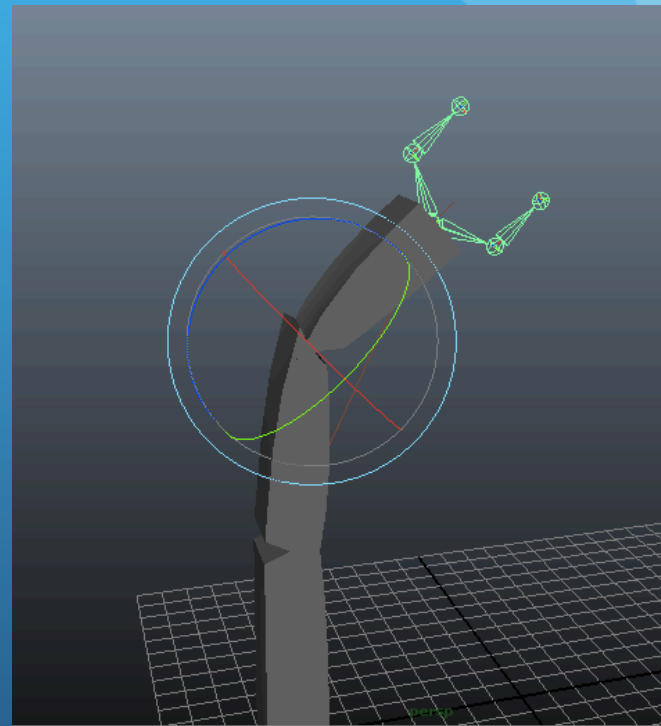
Skinning

- Draw objects over joints
- Shift-click to select joints and objects
- Select “Blend Tool” under the Animation tab
- Click to place start of joint
- Click again to place end of joint
- Continue for multiple nodes
- Press Enter to finish



Skinning

- Interact with joints to manipulate objects
- Set keys



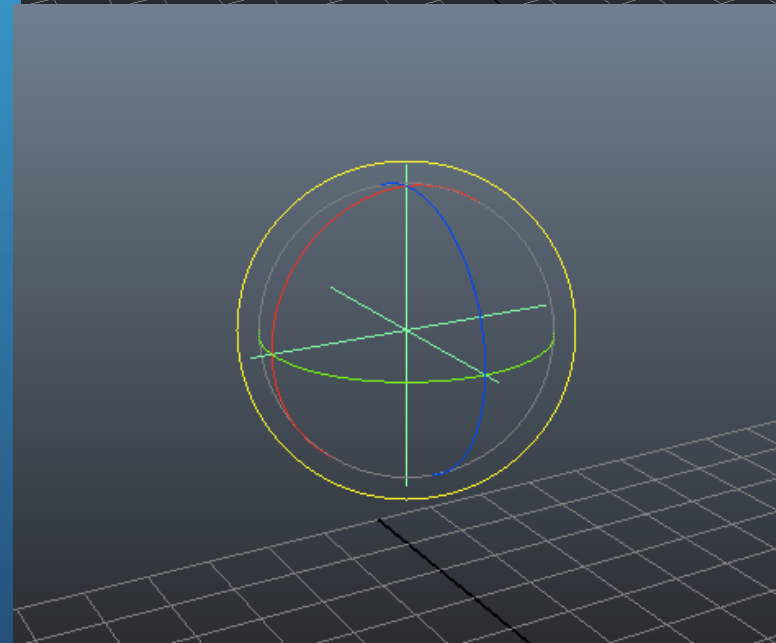
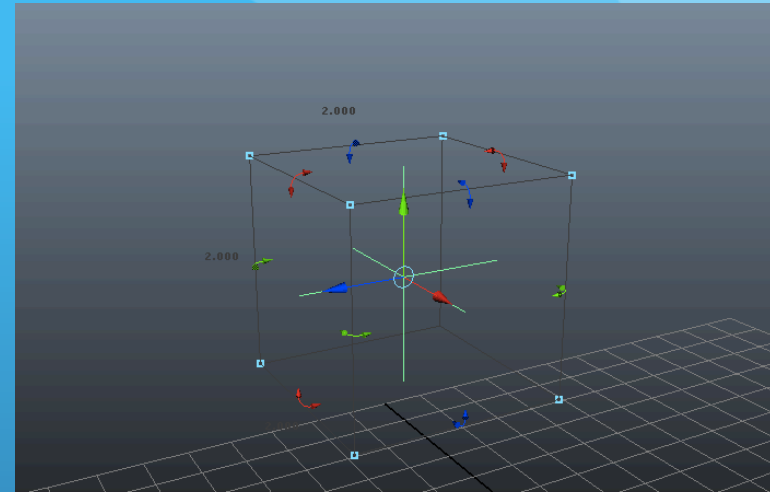
Locators, Deformers, Manipulators

Useful for...

- Creating a pivot or reference point (locators)
- Transforming the position and shape of an object (deformers and manipulators)

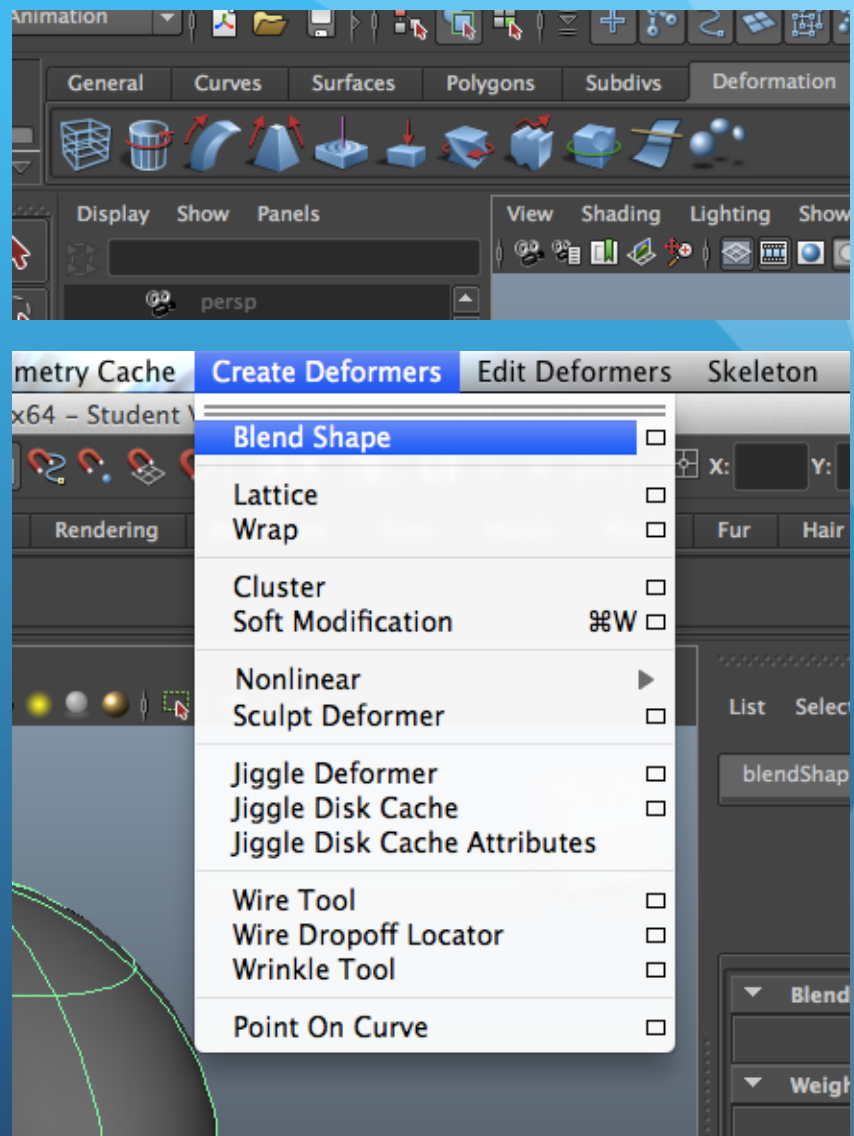
Locators

- Select “Locators” under the Create menu to place a locator on grid
- Can use to manipulate object from a specific point (similar to a pivot)
- Can also be used as a reference for directed objects (eyes, spot lights, etc)



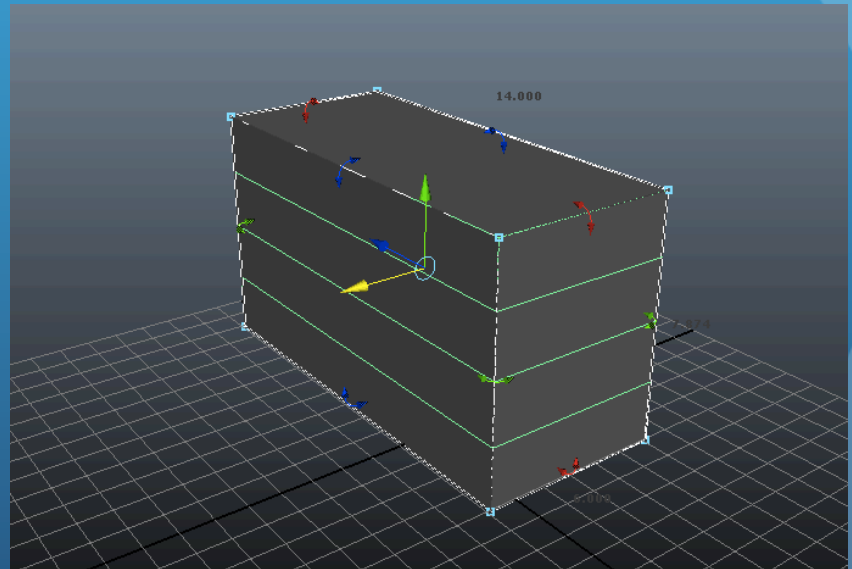
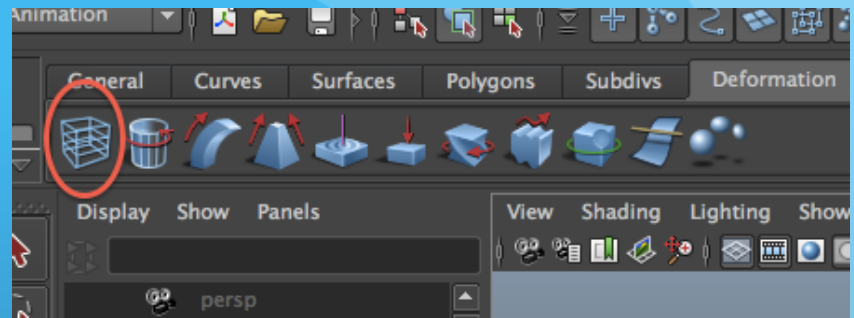
Deformers

- Deformers can be created using the buttons under the Deformation tab, or by using the “Create Deformers” menu
- Useful for any object which can be deformed (NURBs, polygonal surfaces, etc)



Deformers

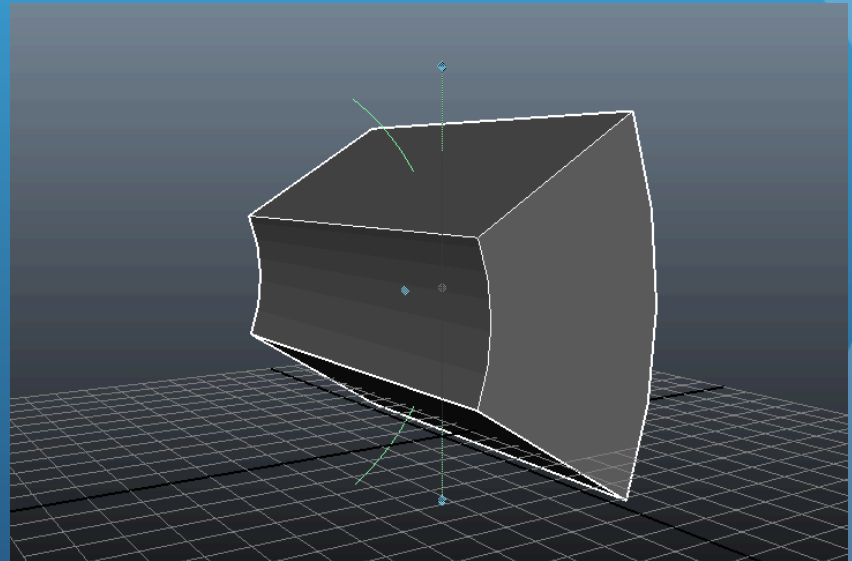
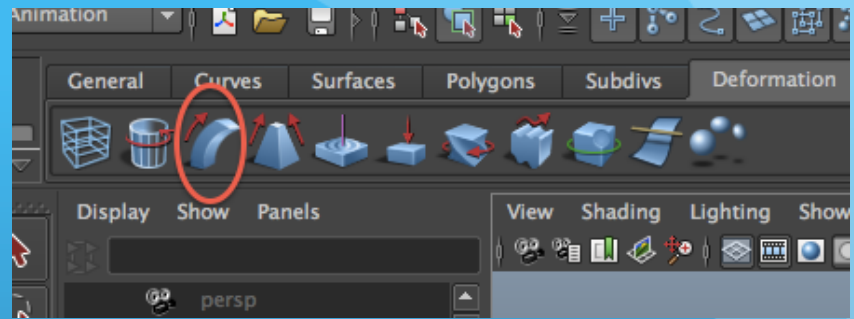
- Lattice
- Creates a grid around an object that can be used to deform an object more precisely



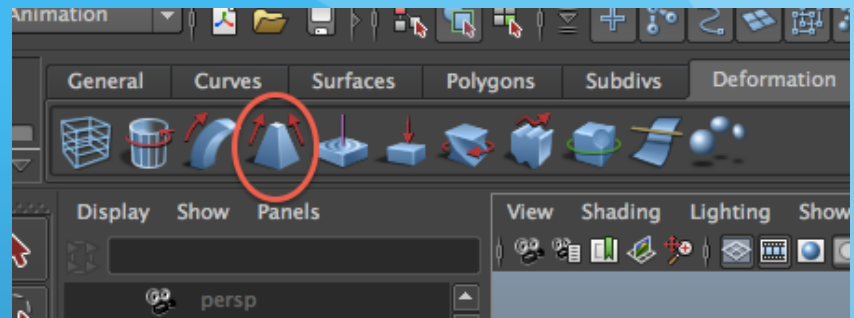
Deformers

- Bend

- Bends an object along a specified arc

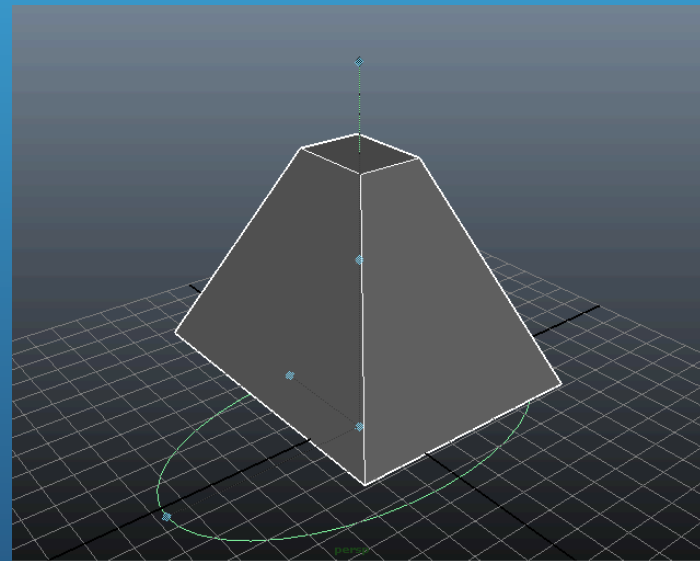


Deformers

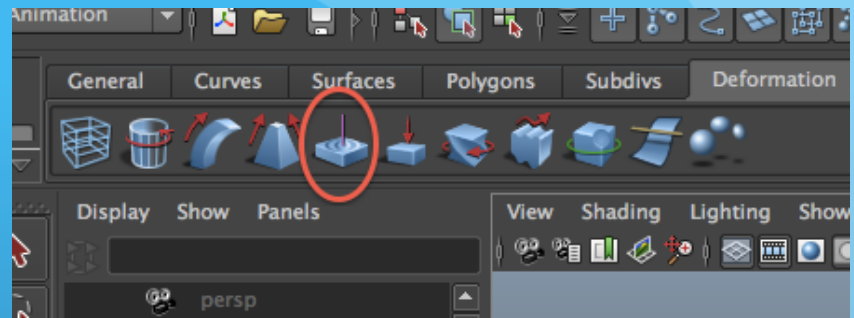


- Flare

- Modifies an object by resizing specified edges

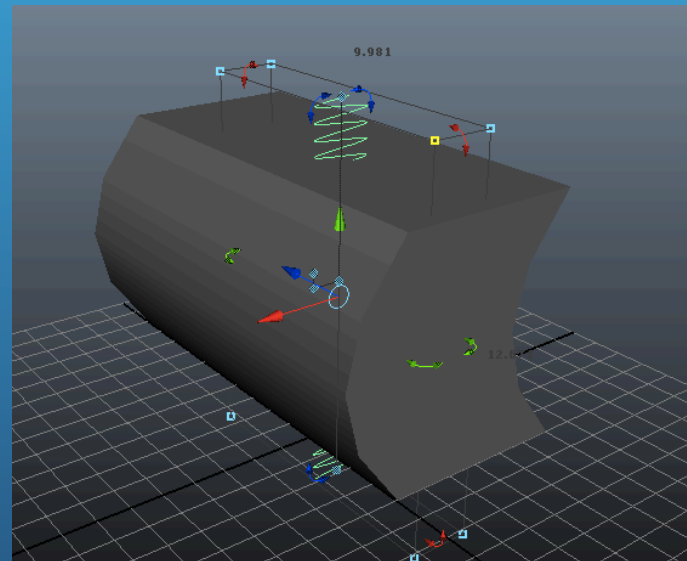


Deformers

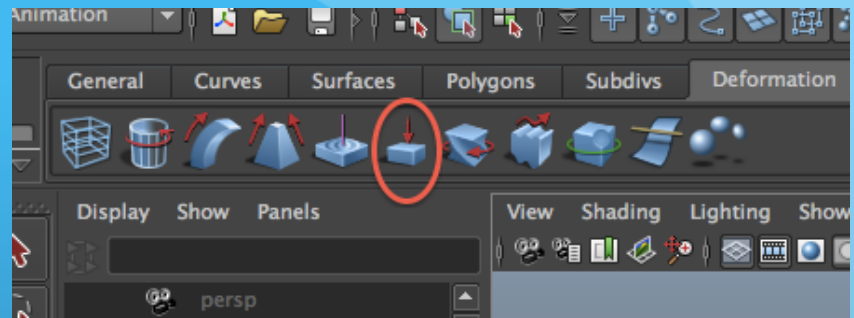


- Sine

- Creates a “sine wave” deformation along an object

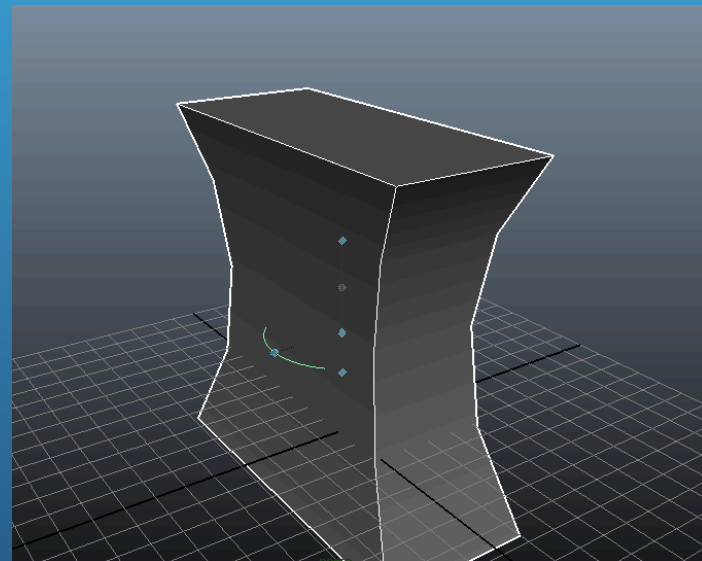


Deformers

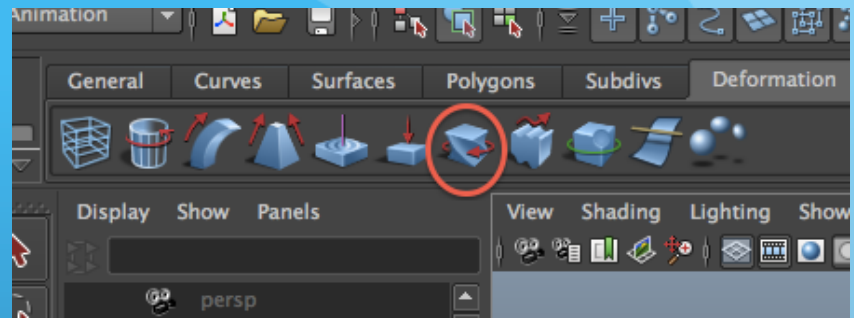


- Squash

- “Squashes” an object along a particular axis

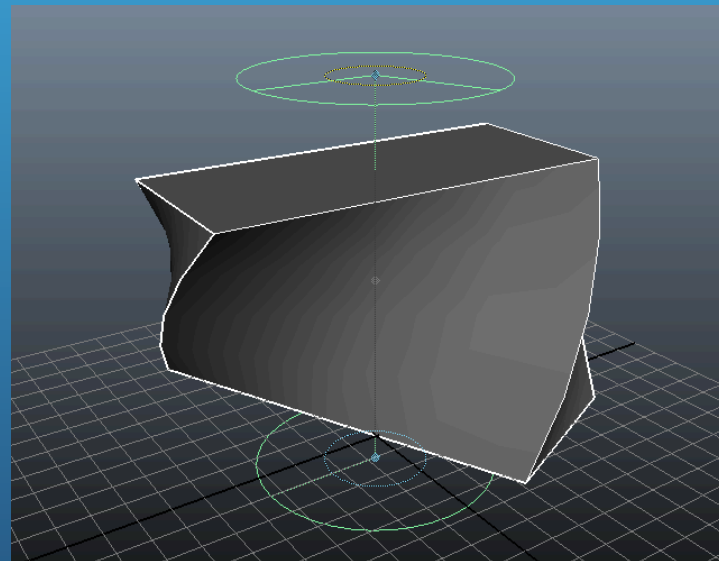


Deformers

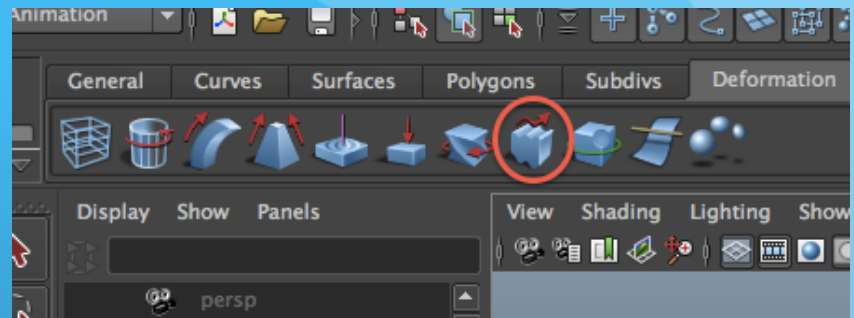


- Twist

- Twists an object in a specified direction

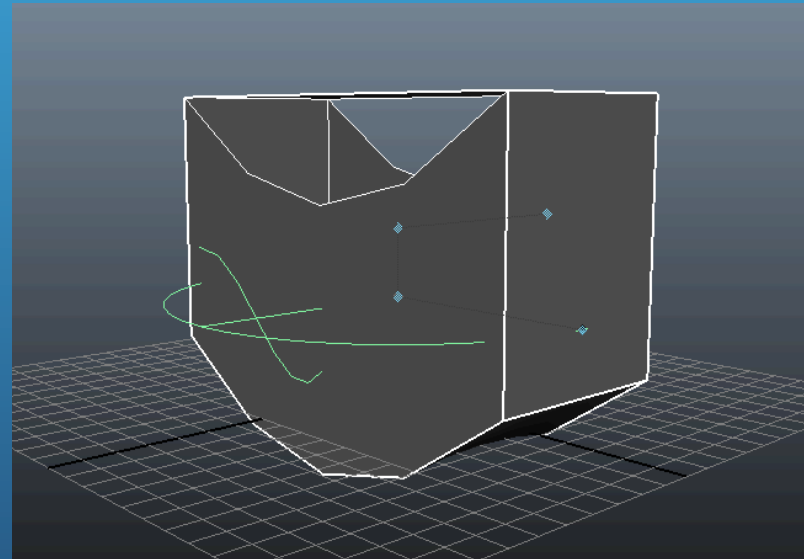


Deformers

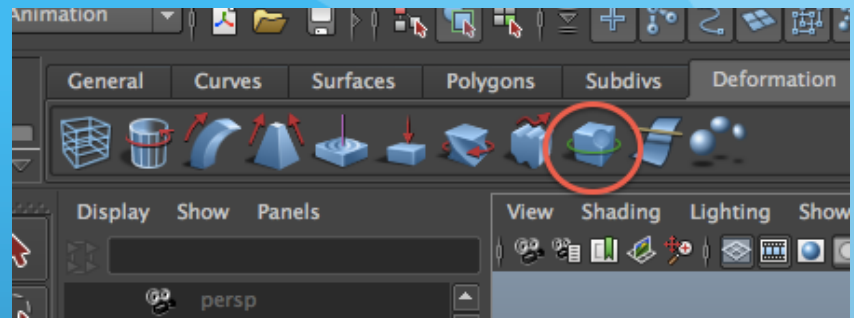


- Wave

- Creates a wave deformation along an object

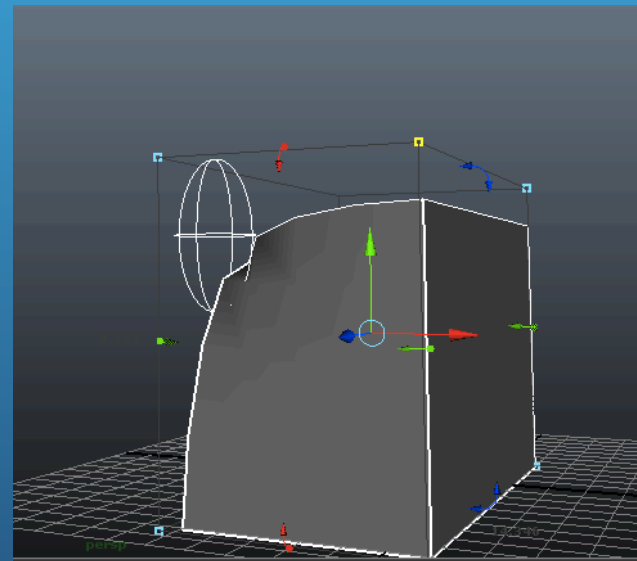


Deformers



- Sculpt

- “Sculpts” out part of an object

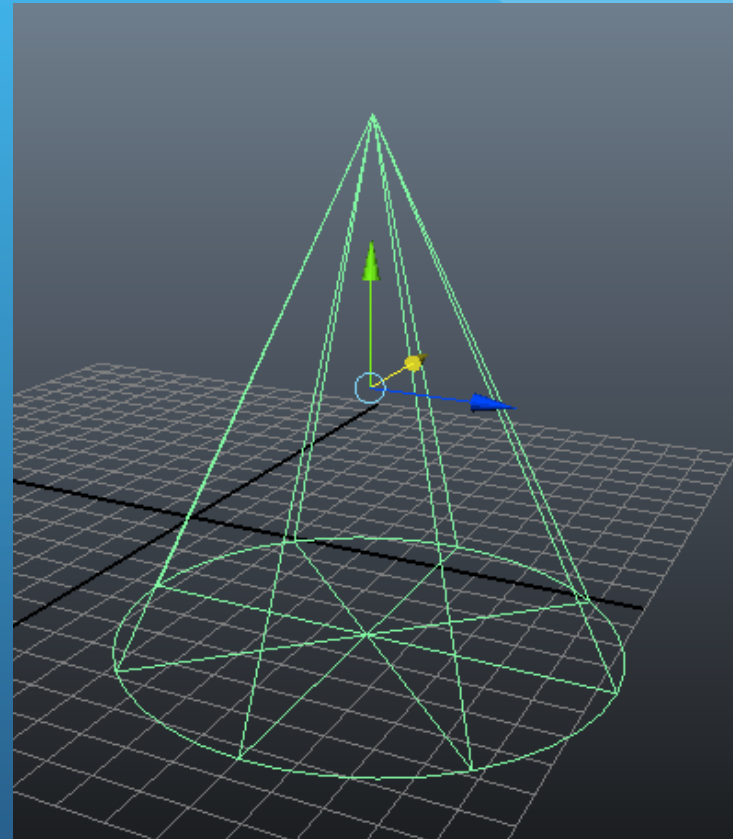


Manipulators

- Tools used to apply transformations to objects
- Move, Scale, Rotate are the main ones, but deformers are considered to be manipulators as well
- Select using icons on side tool bar, or by pressing the default “hot keys”

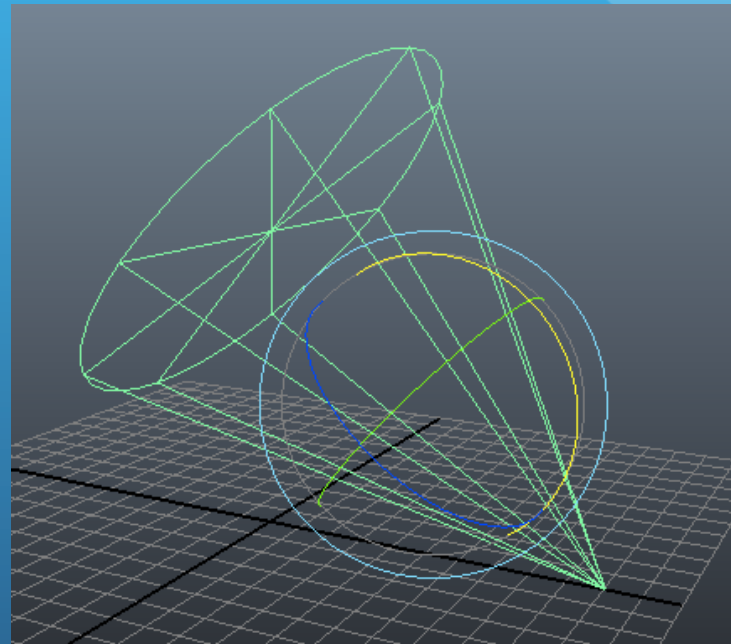
Manipulators

- Move
- Translates an object from a starting to an ending point
- Hot key: “w”



Manipulators

- Rotate
- Rotates an object around a specified point
- Hot key: “e”

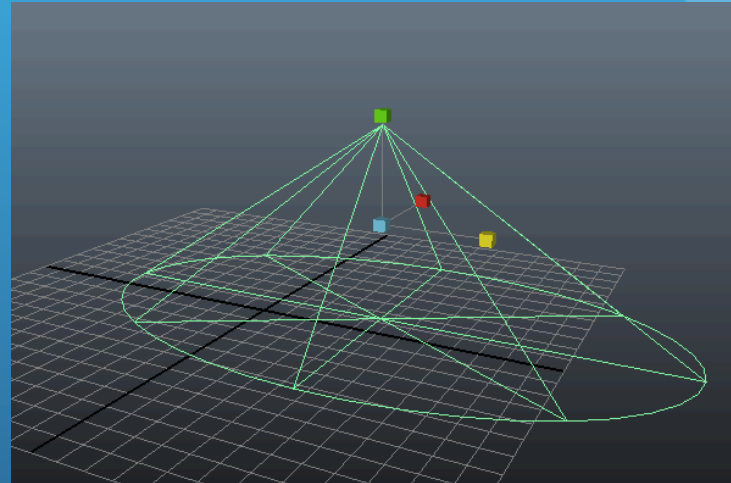


Manipulators

- Scale

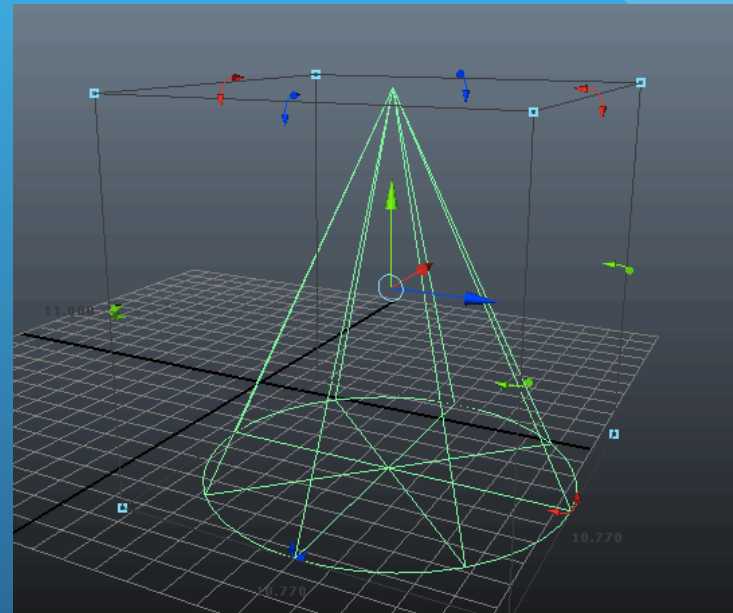
- Scales an object along a specified axis

- Hot key: “r”



Manipulators

- Universal manipulator
- Allows for using Scale, Rotate, and Move without switching between tools



Constaints and Dynamics

Topics

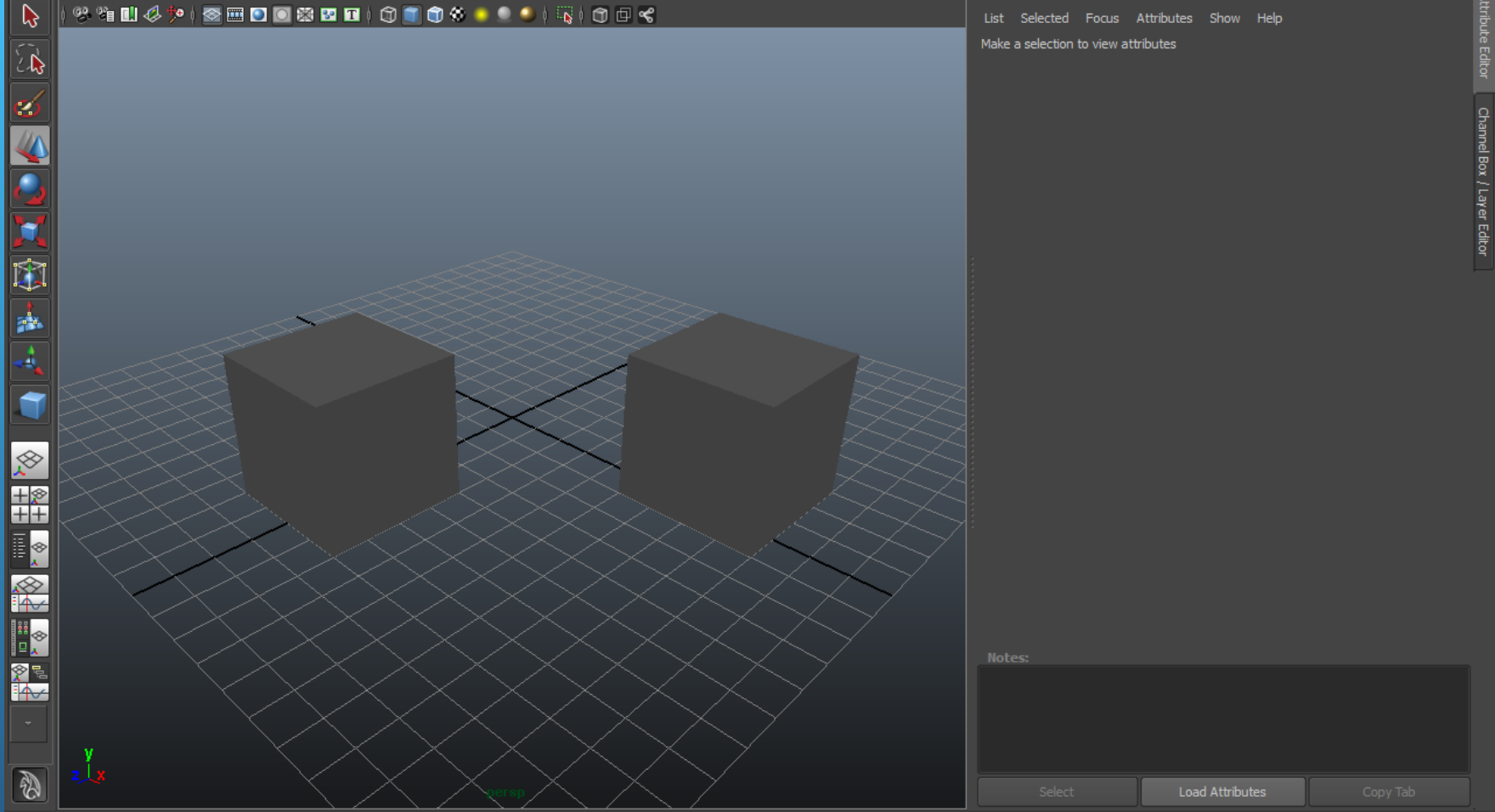
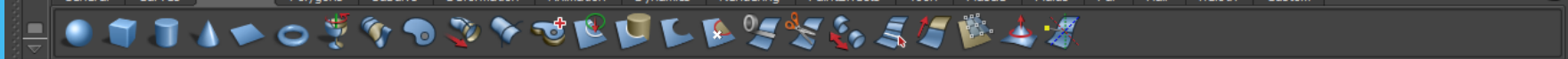
- Animation Constraints
- Dynamics
- Constraints in Dynamics

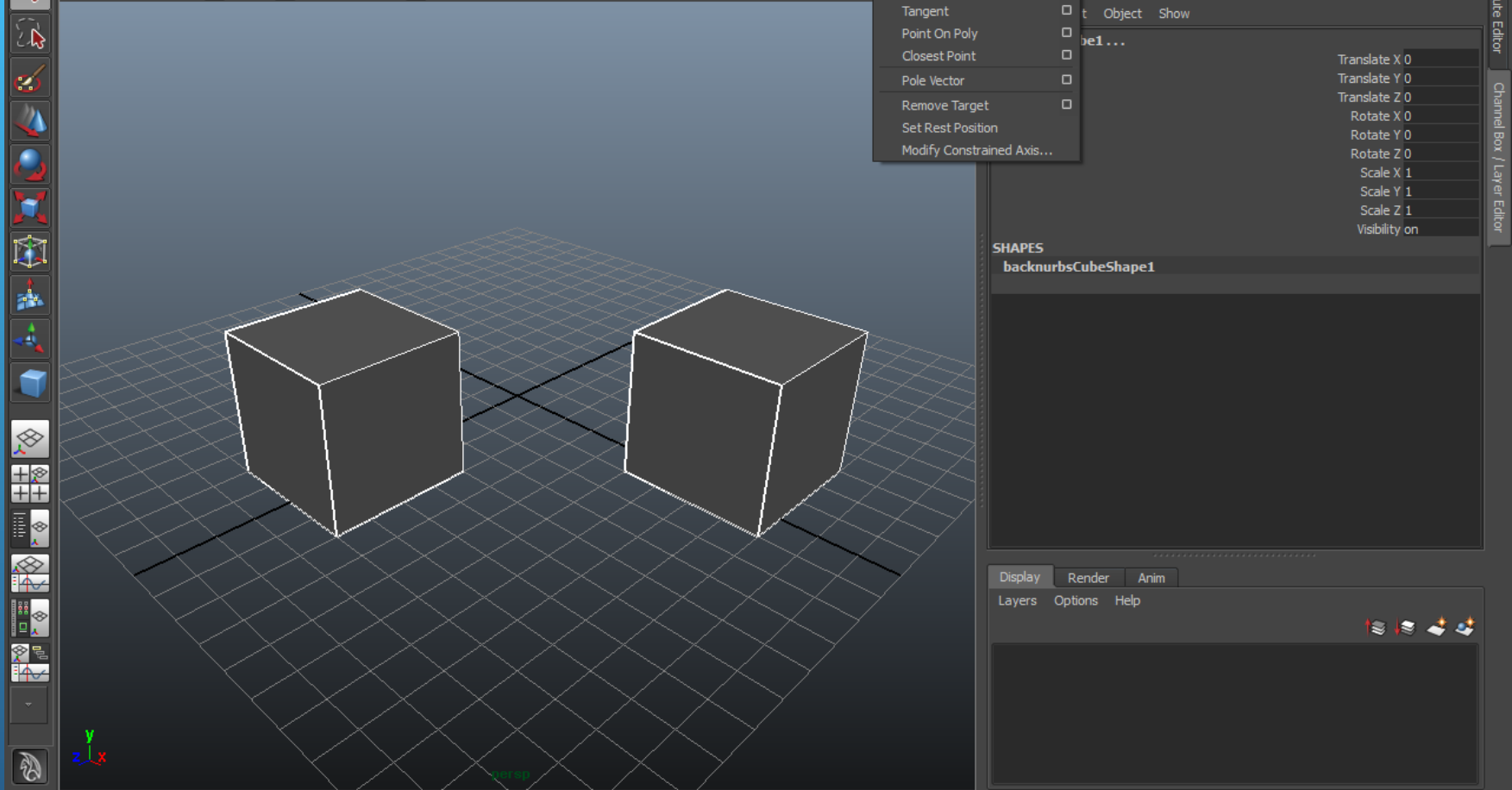
Constaints

- Integrate the environment
 - Link properties of objects
- Examples we will cover
 - Point
 - Aim
 - Orient
 - Scale
 - Parent

Point Constraint

- Ties the transform values of an object to one or more additional objects
- Steps
 - Select the parent object first
 - Select the objects to be constrained
 - Constrain->Point (set options first if needed)





- Point
- Aim
- Orient
- Scale
- Parent
- Geometry
- Normal
- Tangent
- Point On Poly
- Closest Point
- Pole Vector
- Remove Target
- Set Rest Position
- Modify Constrained Axis...

Hair nCloth Custom

Channel Box / Layer Editor

t Object Show

be1...

Translate X 0

Translate Y 0

Translate Z 0

Rotate X 0

Rotate Y 0

Rotate Z 0

Scale X 1

Scale Y 1

Scale Z 1

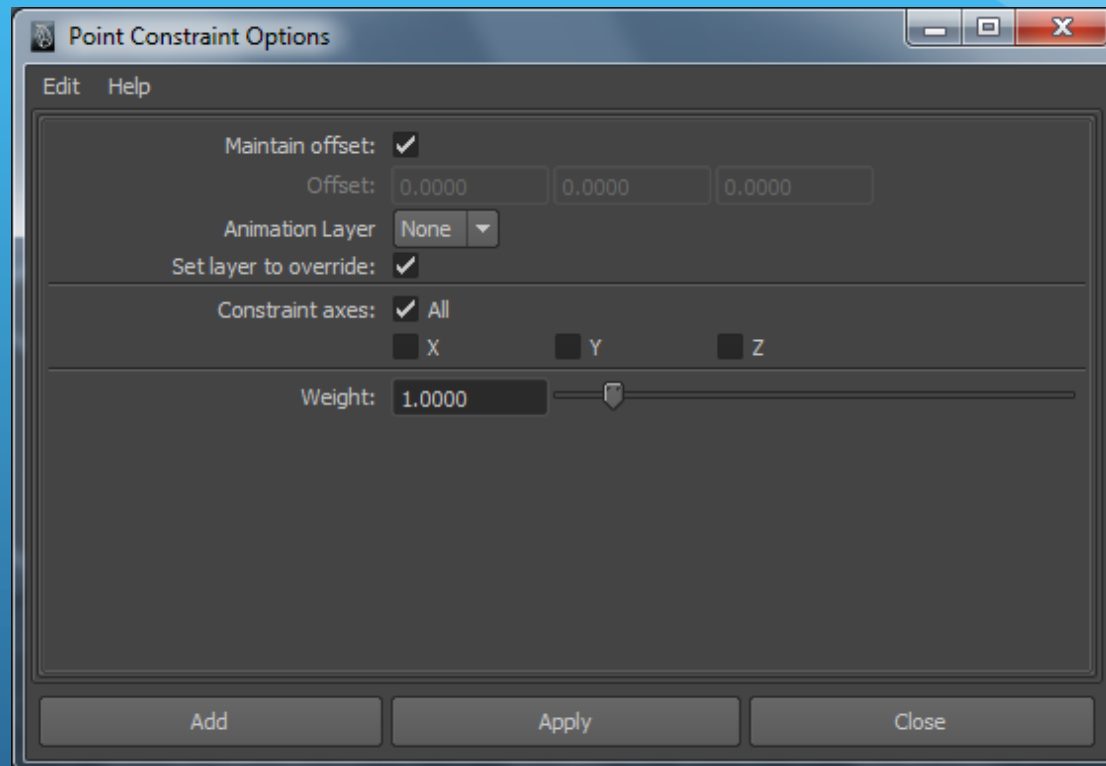
Visibility on

SHAPES

backnurbsCubeShape1

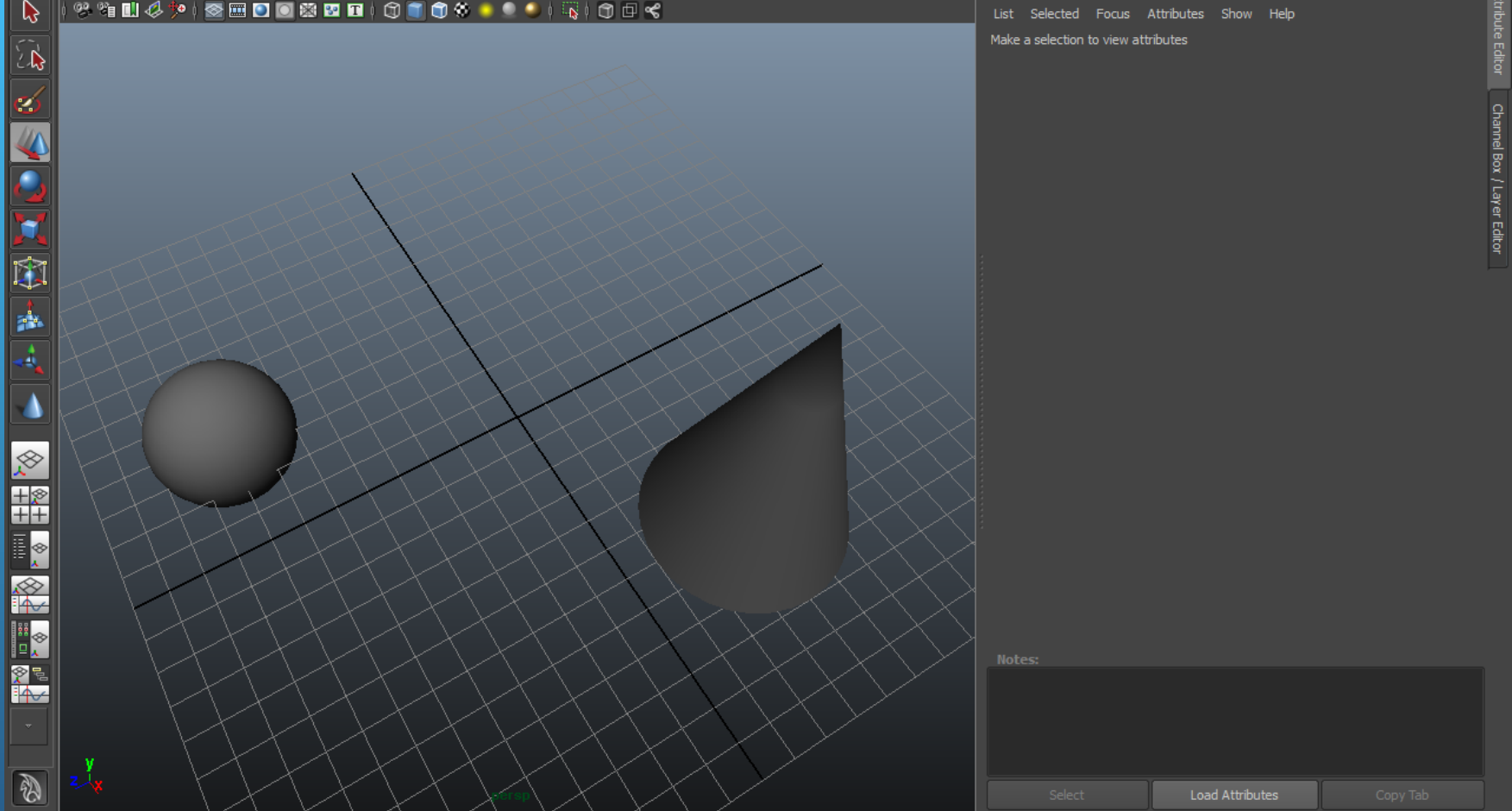
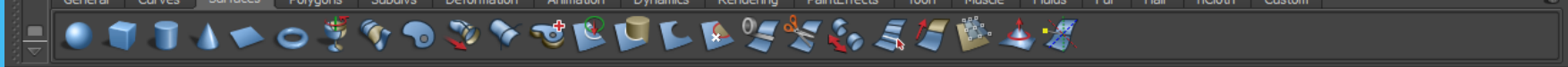
Display Render Anim

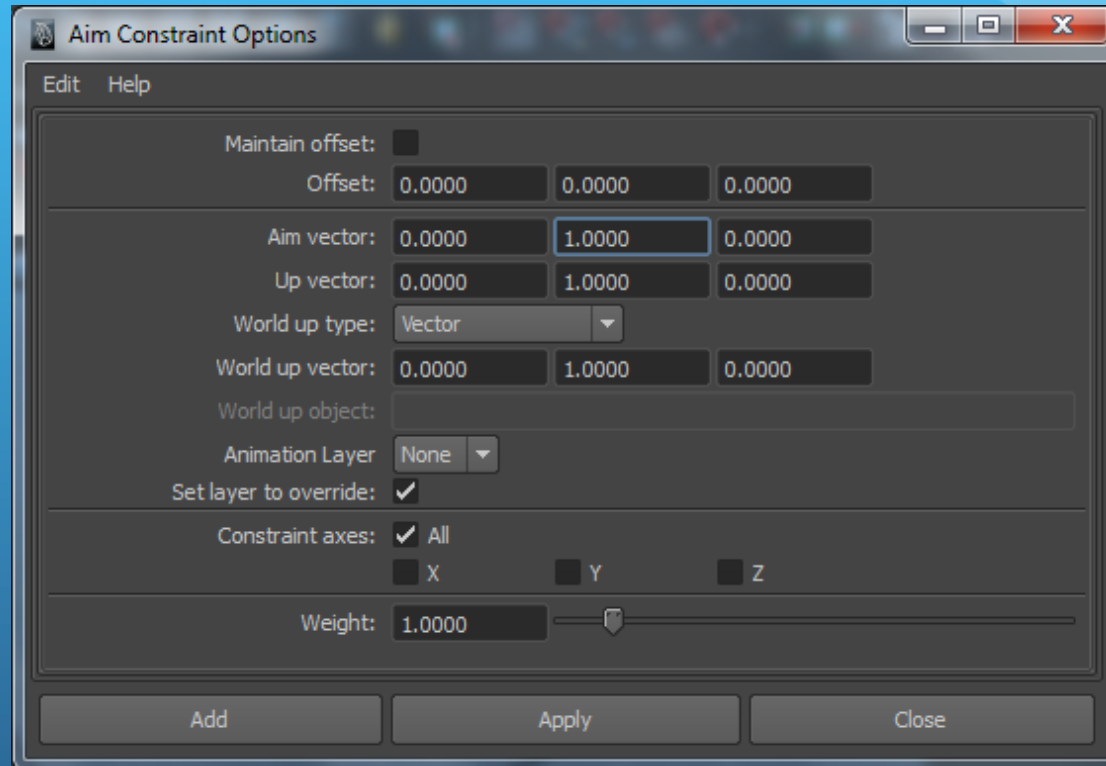
Layers Options Help

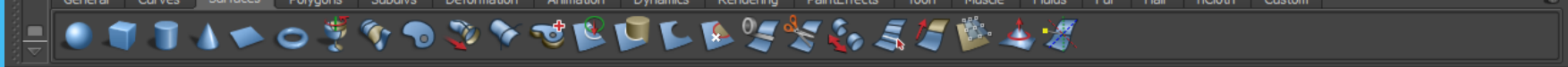


Aim Constraint

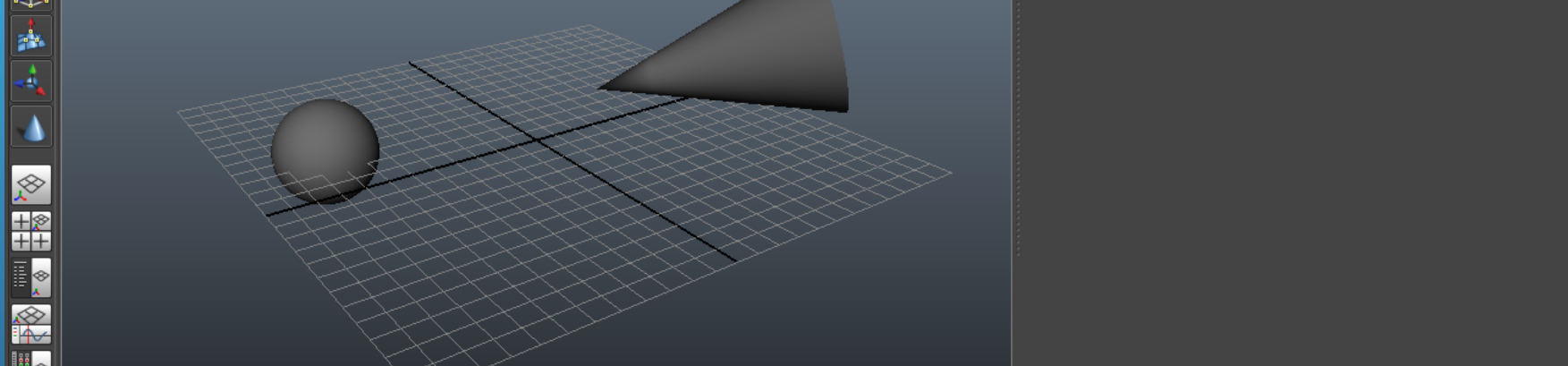
- Causes a child object to aim at a parent object



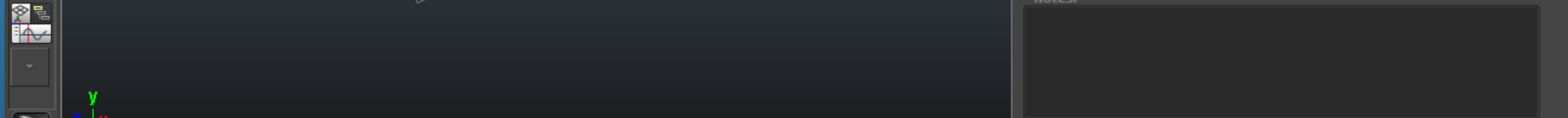




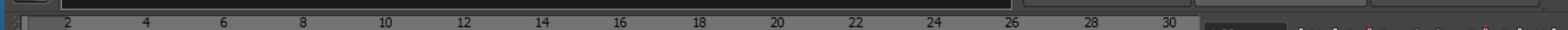
Make a selection to view attributes



Notes:

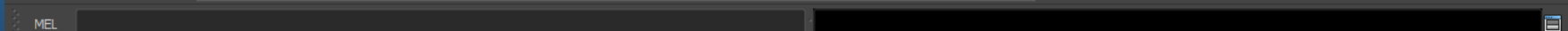


Select Load Attributes Copy Tab



1.00 1.25 1.25 30 30.00 48.00 No Anim Layer No Character Set

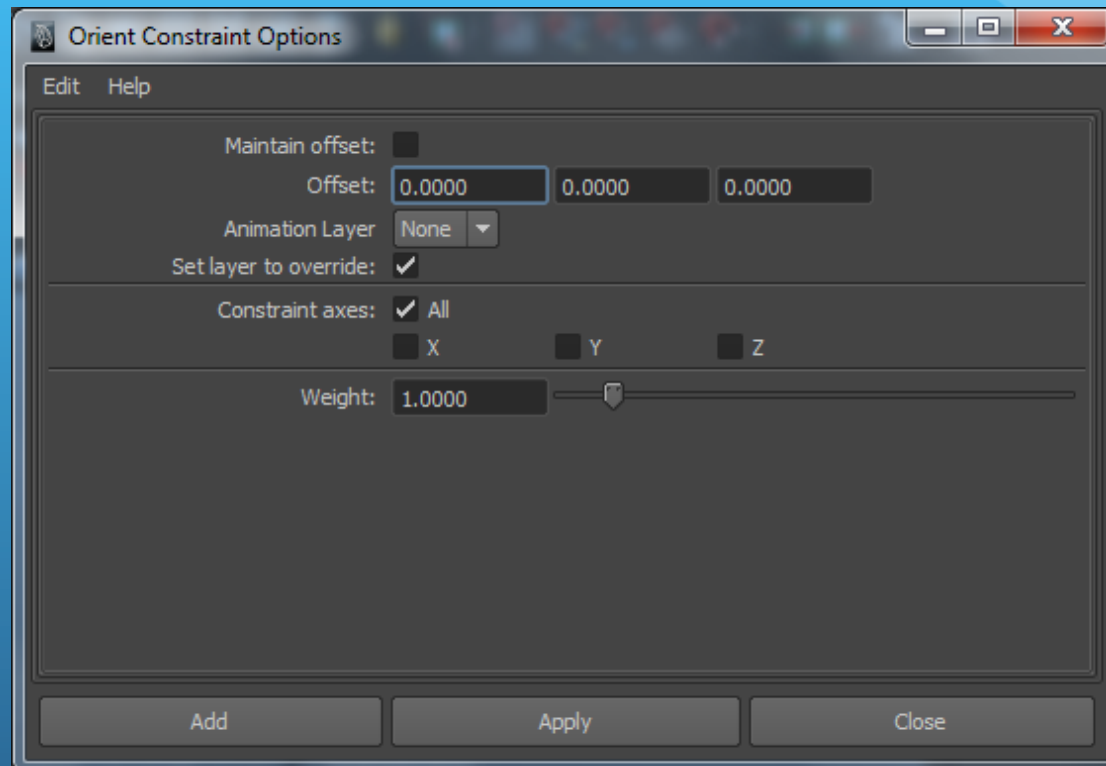
MEL



Move Tool: Select an object to move.

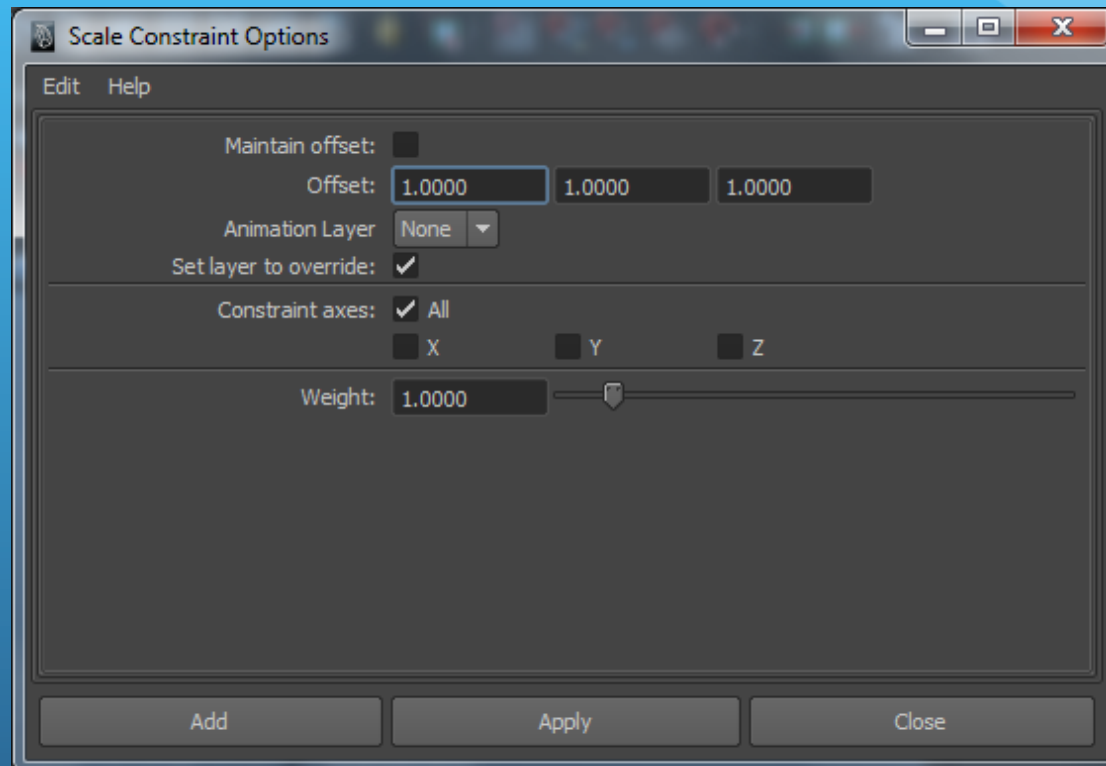
Orient Constraint

- Makes a child have the same rotation as a parent
- Different from the aim.



Scale Constraint

- Ensures that the size is mirrored.



Parent

- Constraints rotation and translation
 - Not Scale
- Rotation has its pivot on the parent
 - Not like the orient
 - Causes an orbit effect.

Dynamics

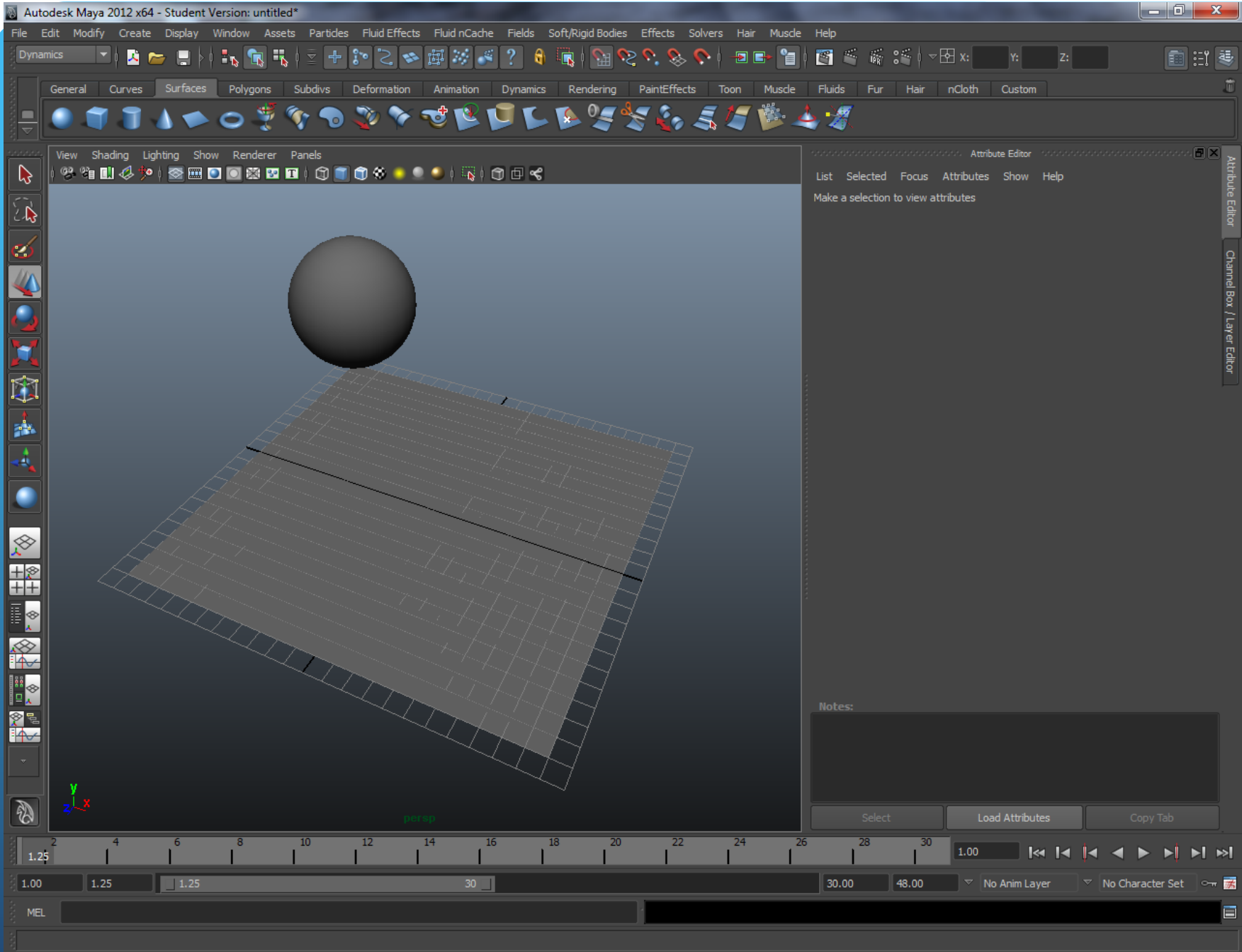
- Allow animation to be handled by software with more high level input from user
- Key framing
 - State where something should be
 - Software interpolates
- Dynamics
 - Explain how objects should interact
 - Software extrapolates

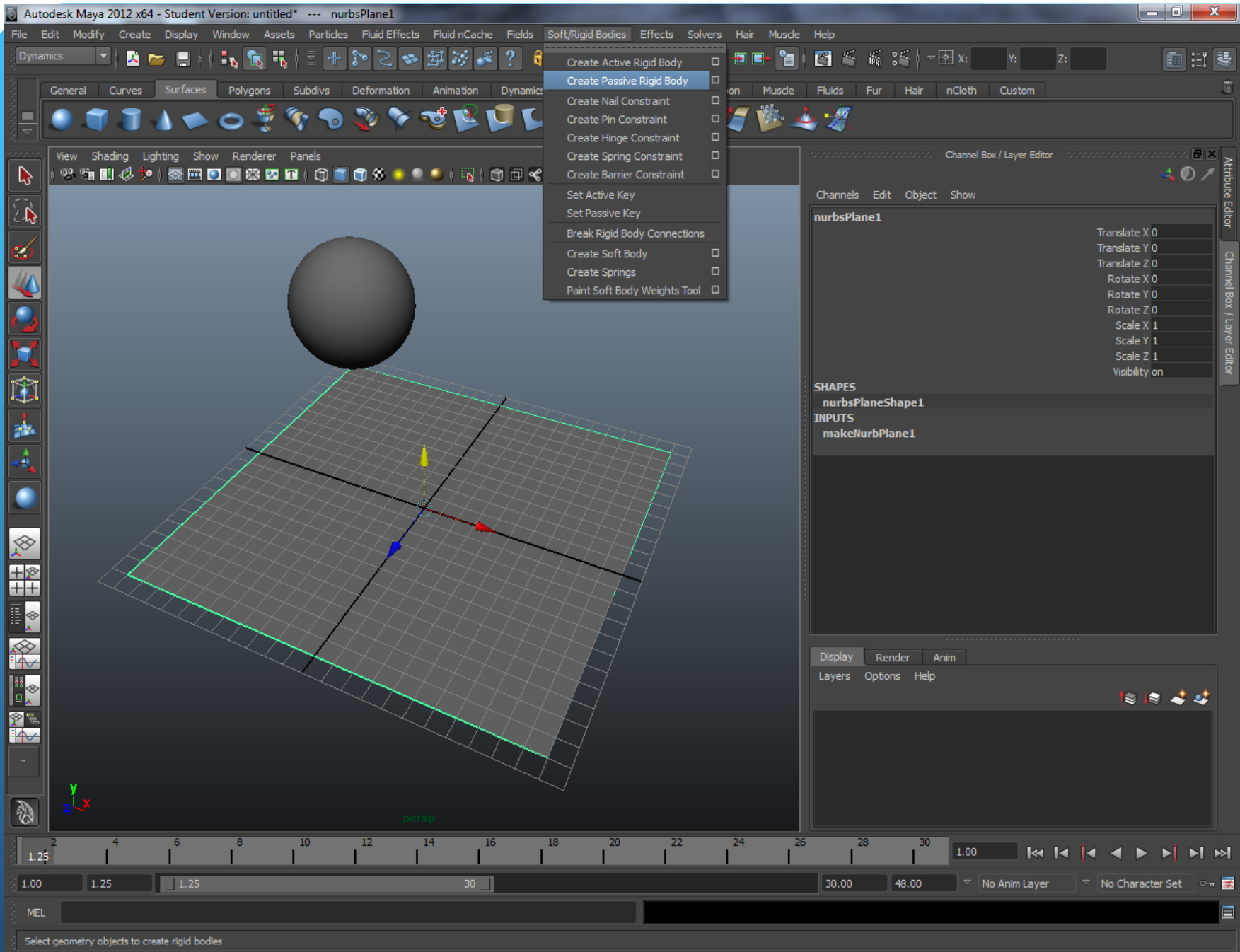
Overview

- Types of Objects
 - Particles - modeling of individual particles
 - Soft bodies - solid geometry which is updated based on a particle object
 - Rigid bodies - Solid bodies (book, ball)
 - Focus of today
 - Fields - Gravity, air, fields such as this which act on other objects.
- Solve updates transforms

Basic Example - Dropping a ball

- Steps to make a ball drop
 - Create a floor
 - Create a ball
 - Move ball above floor
 - Make floor passive solid body
 - Make ball active solid body
 - Add gravity field to ball
 - Press play





Passive vs Active

- Passive do not move
 - Active can collide with passive
 - Passive still do not move, but active do
- Active move
 - Active objects are transformed by interactions with active, passive, and fields.

Context Menu:

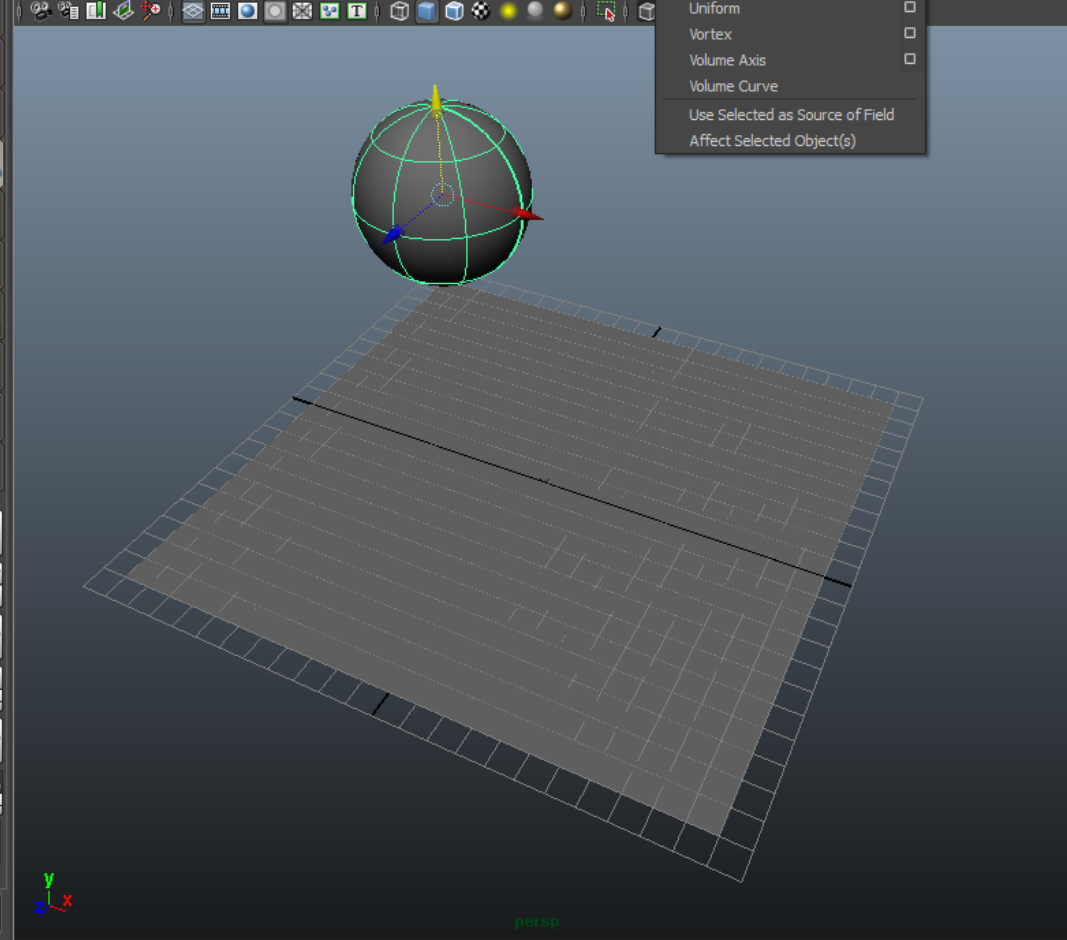
- Create Active Rigid Body
- Create Passive Rigid Body
- Create Nail Constraint
- Create Pin Constraint
- Create Hinge Constraint
- Create Spring Constraint
- Create Barrier Constraint
- Set Active Key
- Set Passive Key
- Break Rigid Body Connections
- Create Soft Body
- Create Springs
- Paint Soft Body Weights Tool

Attribute Editor (nurbsSphere1):

Channels	Edit	Object	Show
Translate X	-5		
Translate Y	10		
Translate Z	-2		
Rotate X	0		
Rotate Y	0		
Rotate Z	0		
Scale X	1		
Scale Y	1		
Scale Z	1		
Visibility	on		

SHAPES
nurbsSphereShape1

INPUTS
makeNurbSphere1



- Air
- Drag
- Gravity
- Newton
- Radial
- Turbulence
- Uniform
- Vortex
- Volume Axis
- Volume Curve
- Use Selected as Source of Field
- Affect Selected Object(s)



nurbsSphere1

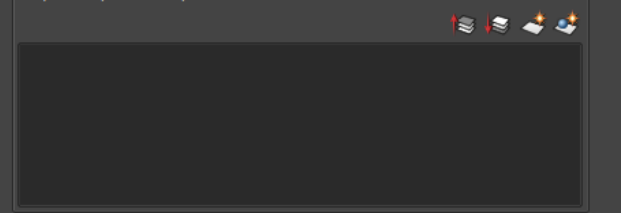
Translate X	-5
Translate Y	10
Translate Z	-2
Rotate X	0
Rotate Y	0
Rotate Z	0
Scale X	1
Scale Y	1
Scale Z	1
Visibility	on

SHAPES

- nurbsSphereShape1
- rigidBody2

INPUTS

- rigidSolver
- time1
- makeNurbSphere1



Attribute Editor

List Selected Focus Attributes Show Help

nurbsSphere1 nurbsSphereShape1 rigidBody2 rigidSolver time

rigidBody: rigidBody2

Focus Presets Show Hide

▼ Rigid Body Attributes

- Active
- Particle Collision
- Allow Disconnection

Mass 1.000

Center Of Mass 0.164 0.000 0.000

Lock Center Of Mass

Static Friction 0.200

Dynamic Friction 0.200

Bounciness 0.600

Damping 0.000

Impulse 0.000 0.000 0.000

Impulse Position 0.000 0.000 0.000

Spin Impulse 0.000 0.000 0.000

Velocity 0.000 -6.778 0.000

Spin 0.000 0.000 0.000

Force 0.000 -9.800 0.000

Torque 0.000 0.000 0.000

Notes: rigidBody2

Select Load Attributes Copy Tab Close

Attribute Editor

List Selected Focus Attributes Show Help

nurbsSphere1 nurbsSphereShape1 rigidBody2 rigidSolver time

rigidBody: rigidBody2

Focus
Presets
Show Hide

▶ Rigid Body Attributes

▼ Initial Settings

Initial Spin	0.000	0.000	0.000
Initial Position	-12.700	25.400	-5.080
Initial Orientation	0.000	0.000	0.000
Initial Velocity	0.000	0.000	0.000

▶ Performance Attributes

▶ Object Display

▶ Node Behavior

▶ Extra Attributes

Notes: rigidBody2

Select Load Attributes Copy Tab Close

Notes

- You cannot use key frame and dynamics simultaneously
- Key set Active and Key Set Passive turn dynamics on/off
- Impulse can be keyed in order to start motion at a given time (e.g. when a bat hits a ball)

Dynamics Constraints

- Help control dynamic behavior
 - Nail
 - An invisible bar connecting something to space
 - E.g. Implement a pendulum.
 - Pin Hinge
 - Causes an object to spin on an axis.
 - Spring
 - Traditional spring behavior
 - Barrier
 - Invisible barrier an object cannot move through.