3D Wed Gallery for Game

Title: 3D Web Gallery for Game

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Chapter 9 **RIGGING**

Learning Outcome

Objectives of this chapter are: -

- Rigging
- Armature
  - Bones
  - Constrains
  - Shape Keys
  - Drivers

RIGGING AND SKINNING

Rigging is a general term used for adding controls to objects, typically for the purpose of animation.

Rigging often involves using one or more of the following features:

Armatures

This allows mesh objects to have flexible joints and is often used for skeletal animation.

Constraints

To control the kinds of motions that make sense and add functionality to the rig.

Object Modifiers

Mesh deformation can be quite involved, there are multiple modifiers that help control this.

Shape Keys

To support different target shapes (such as facial expressions) to be controlled.

Drivers

So, your rig can control many different values at once, as well as making some properties automatically update based on changes elsewhere.

Rigging can be as advanced as your project requires, rigs are effectively defining own user interface for the animator to use, without having to be concerned the underlying mechanisms.

Examples

An armature is often used with a modifier to deform a mesh for character animation.

A camera rig can be used instead of animating the camera object directly to simulate real-world camera rigs (with a boom arm, mounted on a rotating pedestal for example, affects such as camera jitter can be added too).

Armatures

An armature can be thought of as similar to the armature of a real skeleton, and just like a real skeleton an armature can consist of many bones. These bones can be moved around and anything that they are attached to or associated with will move and deform in a similar way.

An "armature" is a type of object used for rigging. A rig is the controls and strings that move a marionette (puppet). Armature object borrows many ideas from real-world skeletons.

How to Add Armature in Blender: -

- Open a default scene, then Delete all objects in the scene.
- Shift + A – Choose Armature or Shortcut "A".

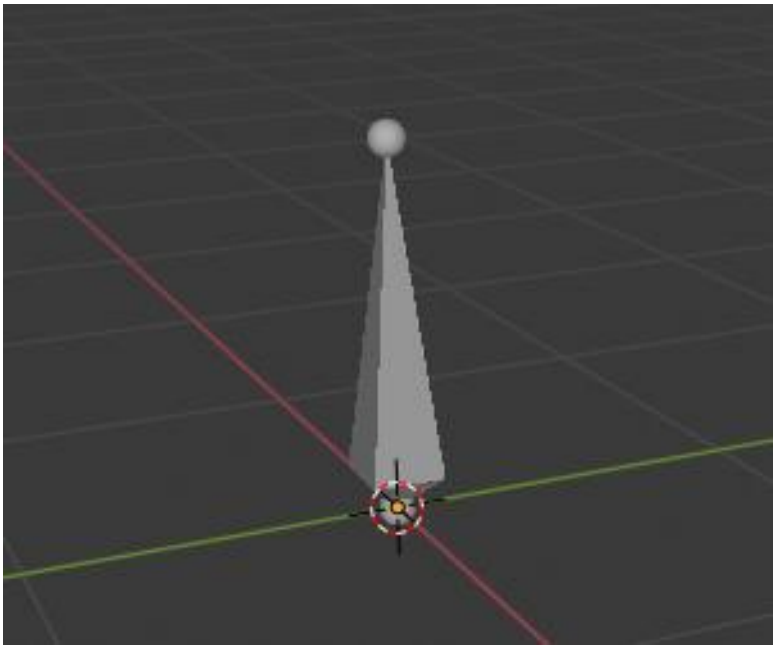


Figure 1 The default armature.

The Armature Object

As you can see, an armature is like any other object type in Blender: -

- It has an origin, a position, a rotation and a scale factor.
- It has an Object Data data-block, that can be edited in Edit Mode.
- It can be linked to other scenes, and the same armature data can be reused on multiple objects.
- All animation you do in Object Mode is only working on the whole object, not the armature's bones (use the Pose Mode to do this).

As armatures are designed to be posed, either for a static or animated scene, they have a specific state, called "rest position". This is the armature's default "shape", the default position/rotation/scale of its bones, as set in Edit Mode.

In **Edit Mode**, you will always see your armature in rest position, whereas in Object Mode and Pose Mode, you usually get the current "pose" of the armature (unless you enable the Rest Position button of the Armature panel).

Bones

Bones are the base elements of armatures. The visualization of bones can be set in the Armatures Viewport Display.

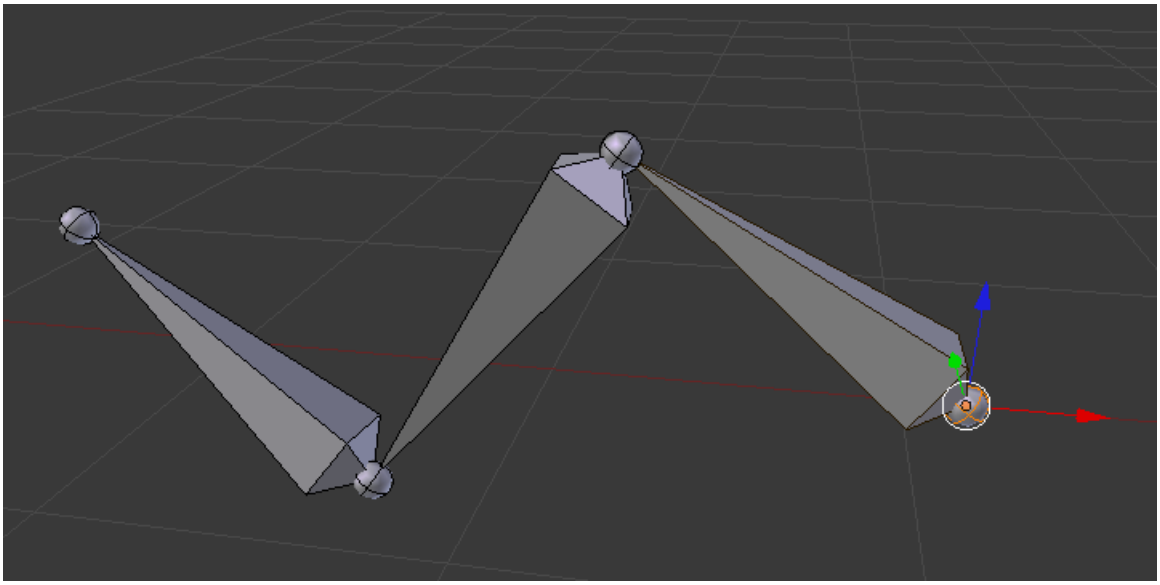


Figure 2 Bone Display

Structure

1. The "start Joint" – Root or head
2. The Body
3. The "End Joint" – Tip or tail

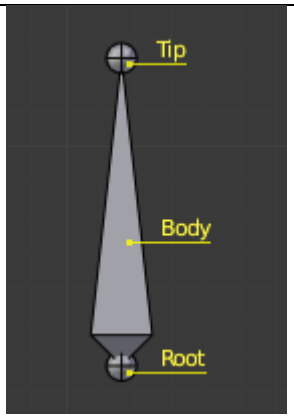


Figure 3 The Element of bone

With the default armature in Edit Mode, you can select the root and the tip, and move them as you do with mesh vertices.

Both root and tip (the "joints") define the bone by their respective position.

They also have a radius property, only useful for the envelope deformation method (see below).

Roll

Activating the Axes checkbox will show local axes for each bone's tip. The Y axis is always aligned along the bone, oriented from root to tip, this is the "roll" axis of the bones.

Bones Influence

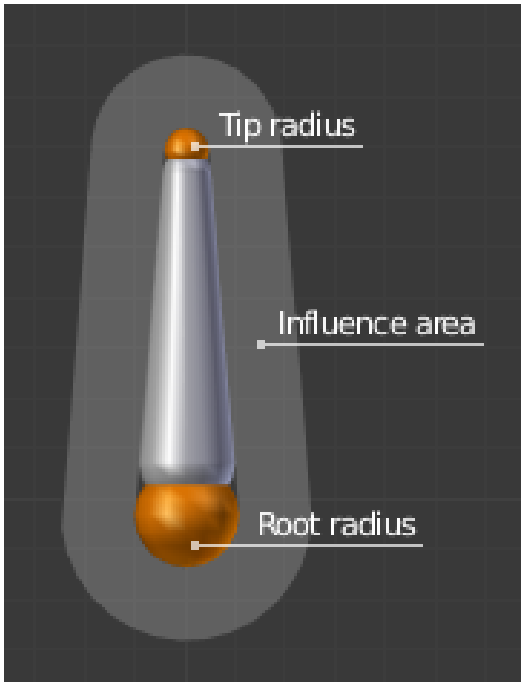


Figure 4 A bone in Envelope visualization, in Edit Mode.

Basically, a bone controls a geometry when vertices "follow" the bone. This is like how the muscles and skin of your finger follow your finger-bone when you move a finger.

To do this, you have to define the strength of influences a bone has on a certain vertex.

The simplest way is to have each bone affecting those parts of the geometry that are within a given range from it. This is called the envelope technique, because each bone can control only the geometry "enveloped" by its own influence area.

If a bone is visualized as Envelope, in Edit Mode and in Pose Mode you can see the area of influence, which depends on:

- The distance property and
- the root's radius and the tip's radius.

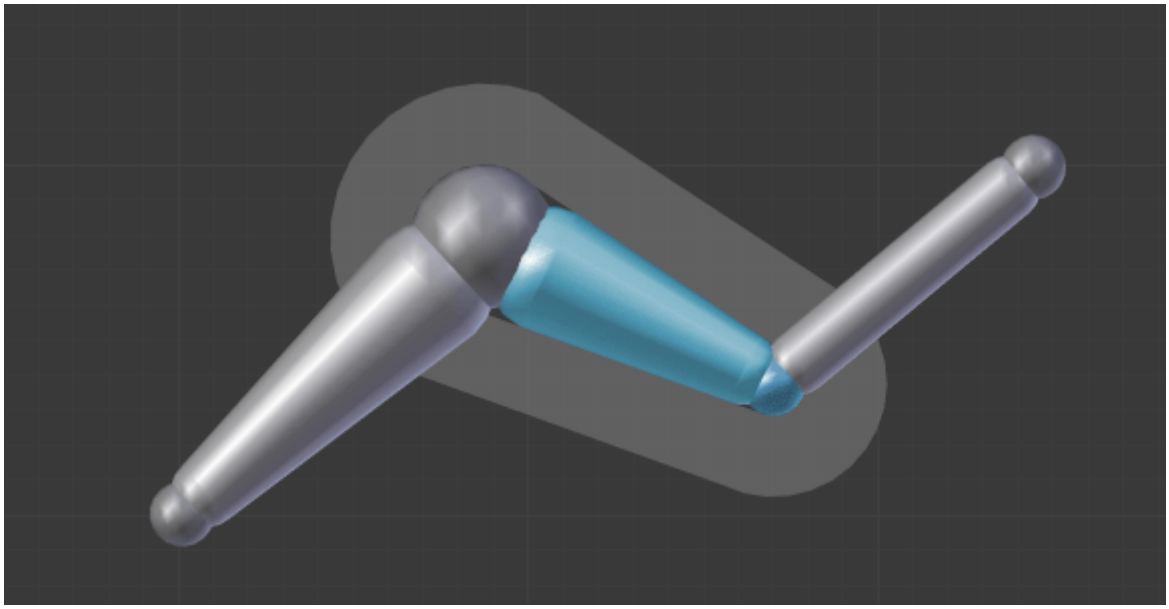


Figure 5 Our armature in Envelope visualization, in Pose Mode.

Bones in an Armature can be generally classified into two different types:

- Deforming Bones
- Control Bones

Deforming Bones

Are bones which when transformed will result in vertices associated with them also transforming in a similar way. Deforming Bones are directly involved in altering the positions of vertices associated with their bones.

Control Bones

Are Bones which act in a similar way to switches, in that, they control how other bones or objects react when they are transformed. A Control Bone could for example act as a sliding switch control when the bone is in one position to the left, it could indicate to other bones that they react in a particular way when transformed, and when the Control Bone is positioned to the right, transforming other bones or objects could do something completely different. Control Bones are not directly used to alter the positions of vertices; in fact, Control Bones often have no vertices directly associated with themselves.

Constrains

Constraints are a way to control an object's properties (e.g., its location, rotation, scale), using either plain static values (like the "limit" ones), or another object, called "target" (like e.g., the "copy" ones).

Even though constraints are useful in static projects, their main usage is obviously in animation.

- You can control an object's animation through the targets used by its constraints (this is a form of indirect animation). Indeed, these targets can then control the

constraint's owner's properties, and hence, animating the targets will indirectly animate the owner.

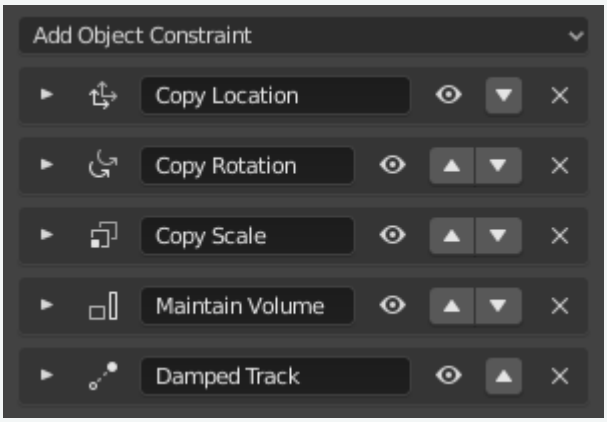
- You can animate constraints' settings. e.g., the Influence or when using an armature's bone as target, animate where along this bone (between root and tip) lays the real target point.

They can make the eyes of a tennis player track a tennis ball bouncing across the court, allow the wheels on a bus to all rotate together, help a dinosaur's legs bend at the knee automatically, and make it easy for a hand to grip the hilt of a sword and the sword to swing with the hand.

Constraints, in Blender, work with Objects and Bones. Read about using constraints in rigging in the Armature chapter.

Object

Bone



The Constraint Stack is evaluated from top to bottom.

Constraints work in combination with each other to form a Constraint Stack.

Tips

Constraints are a fantastic way to add sophistication and complexity to a rig.

But be careful not to rush in too quickly, piling up constraint upon constraint until you lose all sense of how they interact with each other.

Start simply. Get to know a single constraint inside and out. Copy Location Constraint is a good first constraint to explore it also has an animation example. Take the time to understand every fundamental concept behind it, and the other constraints will make far more sense.

Object Modifiers

Modifiers are automatic operations that affect an object's geometry in a non-destructive way. With modifiers, you can perform many effects automatically that would otherwise be too tedious to do manually (such as subdivision surfaces) and without affecting the base geometry of your object.

Note

For more information on Modifiers Refer to modifiers Chapter

Shape keys

Shape keys are used to deform objects into new shapes for animation. In other terminology, shape keys may be called "morph targets" or "blend shapes".

The most popular use cases for shape keys are in character facial animation and in tweaking and refining a skeletal rig. They are particularly useful for modelling organic soft parts and muscles where there is a need for more control over the resulting shape than what can be achieved with combination of rotation and scale.

Shape keys can be applied on object types with vertices like mesh, curve, surface and lattice.

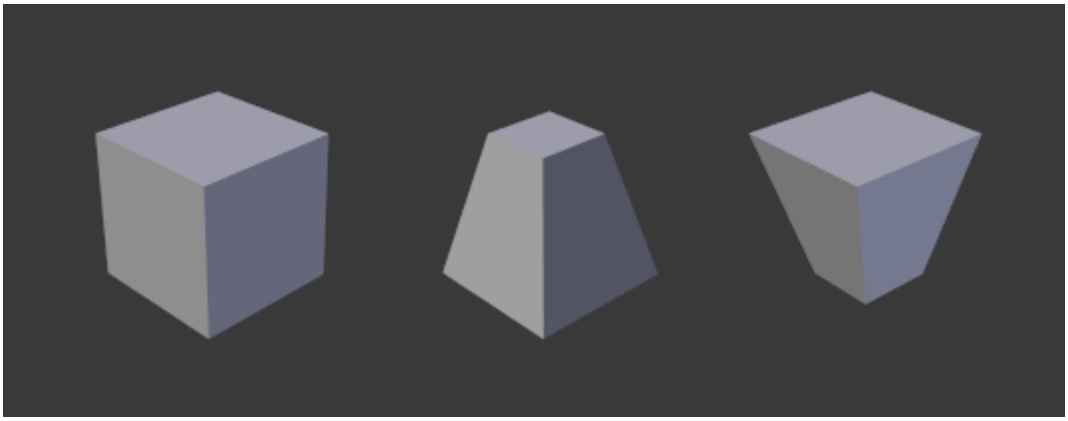


Figure 6 Example of a mesh with different shape keys applied.

Workflow

Shape keys are authored in the Shape Keys panel which is accessed in the Object Data tab of the Properties (e.g., the Mesh tab for mesh objects).

A shape key is modified by first selecting a shape key in the panel, and then moving the object's vertices to a new position in the 3D Viewport.

The panel has controls for affecting the current Value (influence, weight) of a shape. It is possible to see a shape in isolation or how it combines with others.

Adding and Removing Vertices

It is not possible to add or remove vertices in a shape key. The number of vertices and how they connect is specified by the mesh, curve, surface or lattice. A shape key merely records a position for each vertex and therefore shapes always contain all the object's vertices.

When adding a vertex, all shape keys will record it with the position in which it is created. Workflow-wise, adding and deleting vertices after creating shape keys is possible, but it is best to leave the creation of shape keys for when the mesh is finished or its topology is stable.

Adding Shape Keys

When adding a new shape key with the + button next to the list, the new shape will be a copy of the Basis shape, independently of the current result visible in the 3D Viewport.

When adding a new shape key from Specials ▸ New Shape from Mix, the shape will start off with the vertex configuration that is visible at that moment.

When doing facial animation with relative shape keys, it can be useful to first create a shape key with a complex extreme pose (e.g., anger or surprise), and then break this complex shape into components by applying a temporary vertex group to the complex shape and creating a copy with New Shape from Mix. This technique helps reducing conflicts between different shape keys that would otherwise produce a double effect.

Relative or Absolute Shape Keys

A mesh (curve, surface or lattice) has a stack of shape keys. The stack may be of Relative or Absolute type.

Relative

Mainly used for muscles, limb joints, and facial animation.

Each shape is defined relative to the Basis or to another specified shape key.

The resulting effect visible in the 3D Viewport, also called Mix, is the cumulative effect of each shape with its current value. Starting with the Basis shape, the result is obtained by adding each shape's weighted relative offset to its reference key.

Value

Represents the weight of the blend between a shape key and its reference key.

A value of 0.0 denotes 100% influence of the reference key and 1.0 of the shape keys. Blender can extrapolate the blend between the two shapes above 1.0 and below 0.0.

Basis

Basis is the name given to the first (top-most) key in the stack.

The Basis shape represents the state of the object's vertices in their original position. It has no weight value and it is not keyable. This is the default Reference Key when creating other shapes.

Absolute

Mainly used to deform the objects into different shapes over time.

Each shape defines how the object's shape will be at Evaluation Time specified in its Value.

The resulting shape, or Mix, is the interpolation of the previous and next shape given the current Evaluation Time.

Value

Represents the Evaluation Time at which that shape key will be active.

Basis

Basis is the name given to the first (topmost) key in the stack. The Basis shape represents the state of the object's vertices in their original position.

Shape Keys Panel

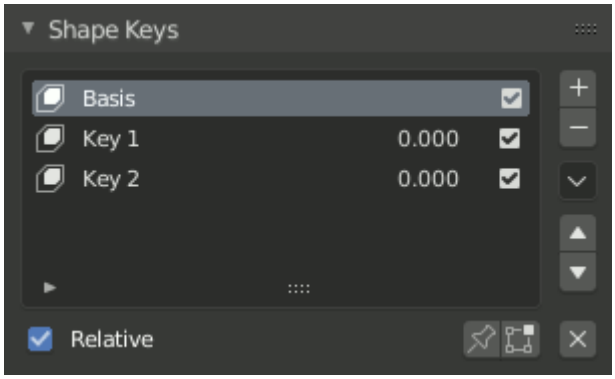


Figure 7 Shape Keys panel.

The Shape Keys panel is used for authoring shape keys.

Settings

Active Shape Key Index

Value (number)

In Relative mode: Value is the current influence of the shape key used for blending between the shape (value=1.0) and its reference key (value=0.0). The reference key is usually the Basis shape. The weight of the blend can be extrapolated above 1.0 and below 0.0.

In Absolute mode: Value is the Evaluation Time at which the shape will have maximum influence.

Mute (check mark)

If unchecked, the shape key will not be taken into consideration when mixing the shape key stack into the result visible in the 3D Viewport.

Specials

New Shape from Mix

Add a new shape key with the current deformed shape of the object. This differs from the + button of the list, as that one always copies the Basis shape independently of the current mix.

Mirror Shape Key

If your mesh is symmetrical, in *Object Mode*, you can mirror the shape keys on the X axis. This will not work unless the mesh vertices are perfectly symmetrical. Use the `Mesh ▸ Symmetrize` tool in *Edit Mode*.

Mirror Shape Key (Topology)

Same as Mirror Shape Key though it detects the mirrored vertices based on the topology of the mesh. The mesh vertices do not have to be perfectly symmetrical for this action to work.

Join as Shapes (Transfer Mix)

Transfer the current resulting shape from a different object.

Select the object to copy, then the object to copy into. Use this action and a new shape key will be added to the active object with the current mix of the first object.

Transfer Shape Key

Transfer the active shape key from a different object regardless of its current influence.

Select the object to copy, then the object to copy into. Use this action and a new shape key will be added to the active object with the active shape of the first object.

Relative

Set the shape keys to Relative or Absolute. See Relative or Absolute Shape Keys.

Shape Key Lock (pin icon)

Show the active shape in the 3D Viewport without blending. Shape Key Lock gets automatically enabled while the object is in Edit Mode.

Shape Key Edit Mode (edit mode icon)

If enabled, when entering *Edit Mode,* the active shape key will not take maximum influence as is default. Instead, the current blend of shape keys will be visible and can be edited from that state.

Relative Shape Keys

With absolute shape keys, the value shown for each shape in the list represents the current weight or influence of that shape in the current Mix.

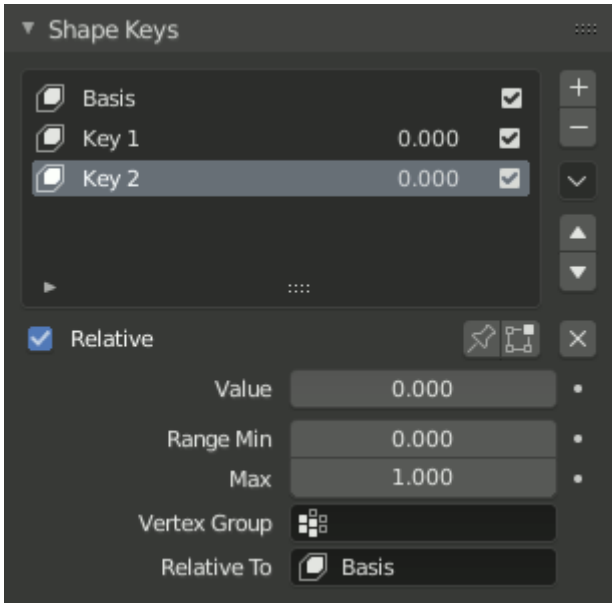


Figure 8 Relative Shape Keys options.

Clear Shape Keys X

Set all influence values, or weights, to zero. Useful to quickly guarantee that the result shown in the 3D Viewport is not affected by shapes.

Value

The weight of the blend between the shape key and its reference key (usually the Basis shape).

A value of 0.0 denotes 100% influence of the reference key and 1.0 of the shape keys.

Range

Minimum and maximum range for the influence value of the active shape key. Blender can extrapolate results when the *Value* goes lower than 0.0 or above 1.0.

Vertex Group

Limit the active shape key deformation to a vertex group. Useful to break down a complex shape into components by assigning temporary vertex groups to the complex shape and copying the result into new simpler shapes.

Relative To

Select the shape key to deform from. This is called the Reference Key for that shape.

Absolute Shape Keys

With absolute shape keys, the value shown for each shape in the list represents the Evaluation Time at which that shape key will be active.

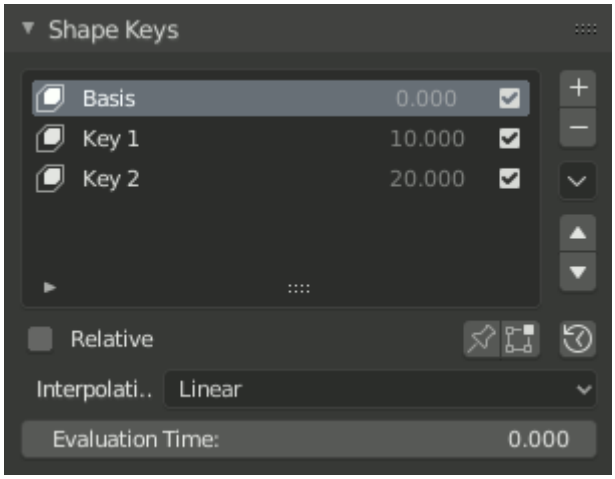


Figure 9 Absolute Shape Keys options.

Re-Time Shape Keys (clock icon)

Absolute shape keys are timed, by order in the list, at a constant interval. This button resets the timing for the keys. Useful if keys were removed or re-ordered.

Interpolation

Controls the interpolation between shape keys.

Linear, Cardinal, Catmull-Rom, B-Spline

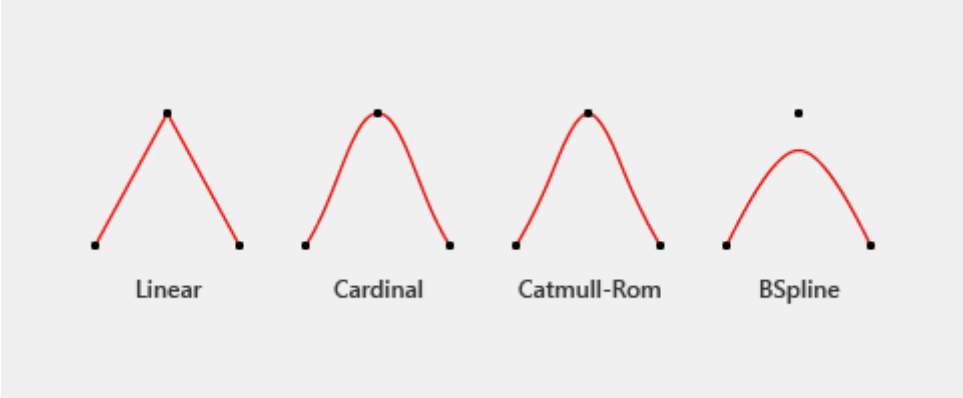


Figure 10 Different types of interpolation.

The red line represents interpolated values between keys (black dots).

Evaluation Time

Controls the shape key influence. Scrub to see the effect of the current configuration. Typically, this property is keyed for animation or rigged with a driver.

Workflow

Relative Shape Keys

1. In Object Mode, add a new shape key via the Shape Key panel with the + button.
2. "Basis" is the rest shape. "Key 1", "Key 2", etc. will be the new shapes.
3. Switch to Edit Mode, select "Key 1" in the Shape Key panel.
4. Deform mesh as you want (do not remove or add vertices).

5. Select "Key 2", the mesh will be changed to the rest shape.
6. Transform "Key 2" and keep going for other shape keys.
7. Switch back to Object Mode.
8. Set the Value for "Key 1", "Key 2", etc. to see the transformation between the shape keys.

In the figure below, from left to right shows: "Basis", "Key 1", "Key 2" and mix ("Key 1" 1.0 and "Key 2" 0.8) shape keys in Object Mode.

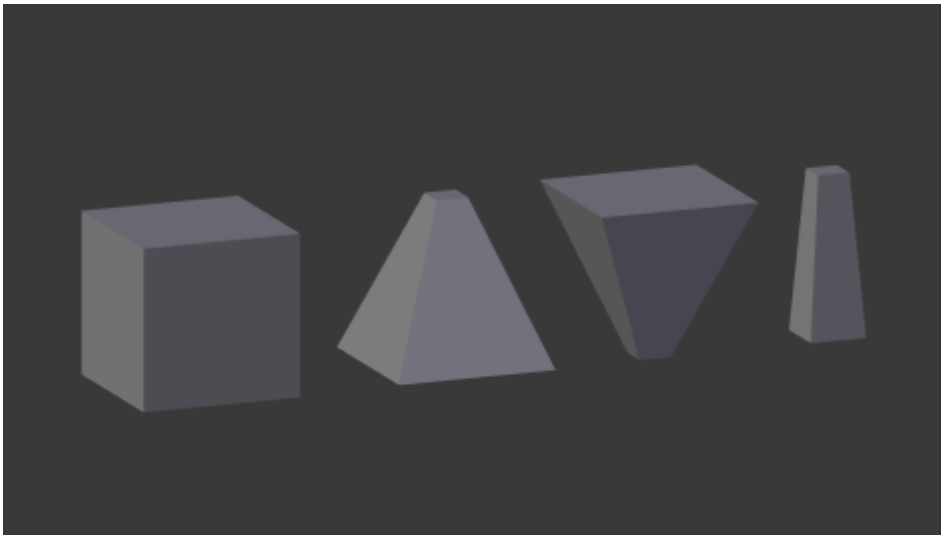


Figure 11 Relative shape keys example.

Absolute Shape Keys

1. Add sequence of shape keys as described above for relative shape keys.
2. Uncheck the Relative checkbox.
3. Click the Reset Timing button.
4. Switch to Object Mode.
5. Drag Evaluation Time to see how the shapes succeed one to the next.

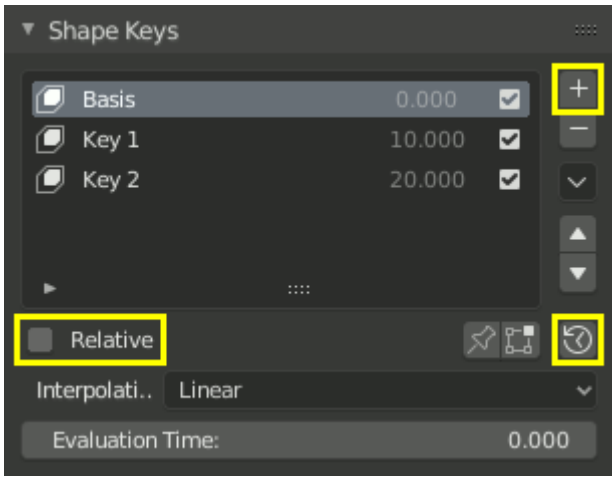


Figure 12 Absolute shape keys workflow.

By adding a driver or setting keyframes to Evaluation Time you can create an animation.

Drivers

Drivers are a way to control values of properties by means of a function, or a mathematical expression.

Workflow & Examples

Simple Drivers can be configured from the pop-over that appears when adding a new Driver. When adding multiple Drivers or for more advanced configurations, it is useful to have open the Drivers Editor.

Transform Driver

Control a property with an object's transform. In this example, the Y rotation of Object 2 will be driven by the X position of Object 1. Starting from a simple setup with two objects:

1. Add a Driver to the Rotation Y property of the second object via the context menu or with Ctrl-D.

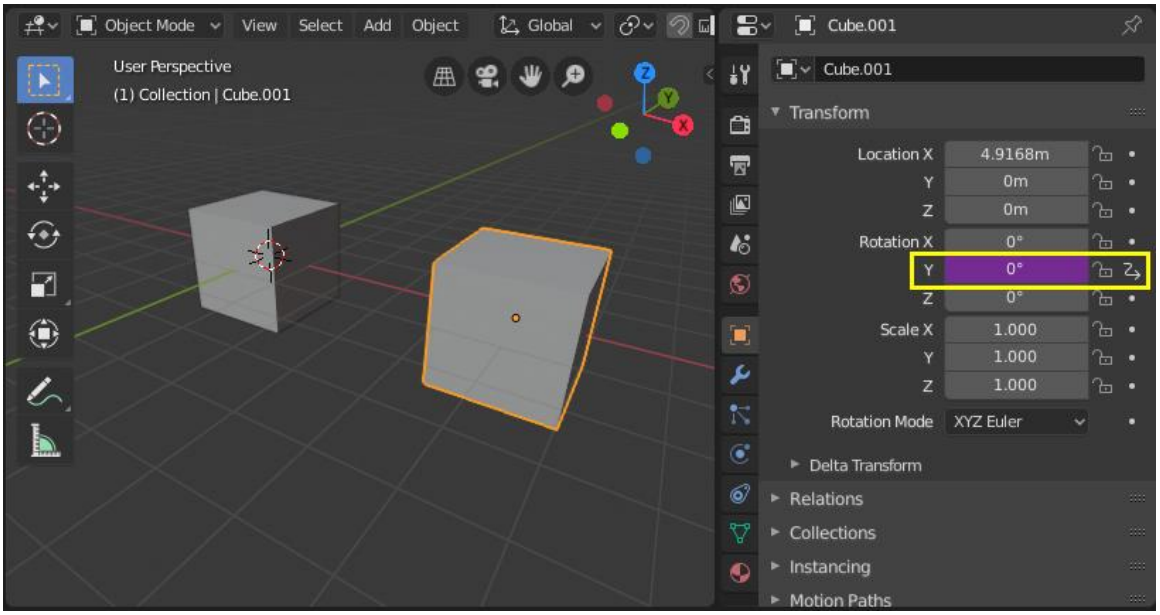


Figure 13 Driver panel

2. Open the Drivers Editor and select the Y Euler Rotation property in the channel's region.
3. Open the Sidebar region and select the Drivers tab.
4. Configure the driver to be the Averaged Value of a Transform Channel of the first object.

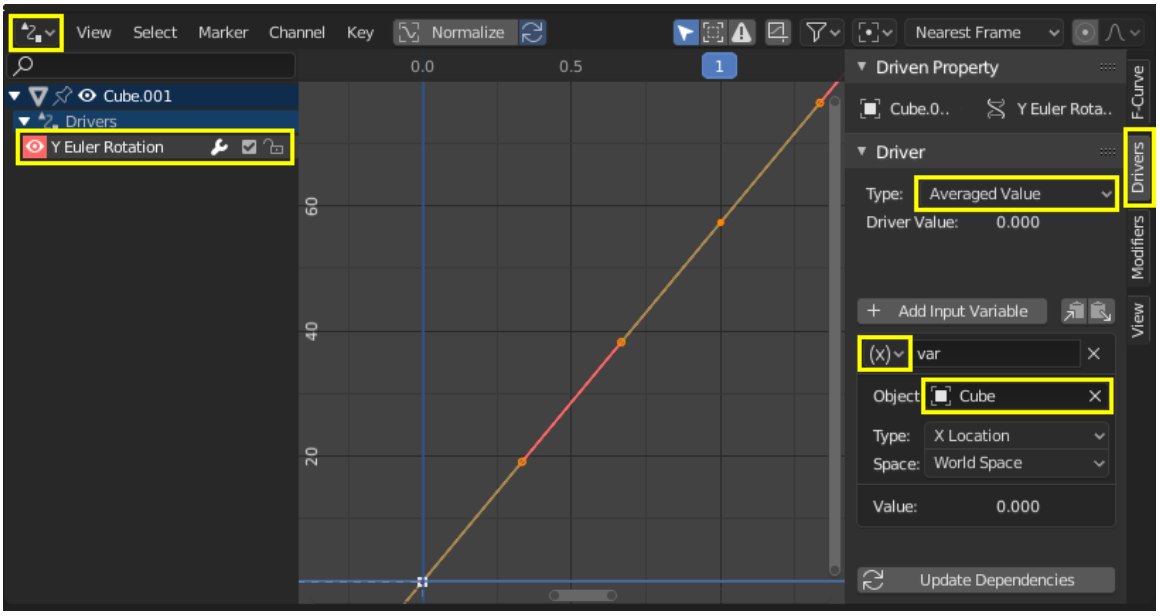


Figure 14 Graph editor panel

5. Experiment with moving the first object and notice how it affects the Y rotation of the second object.

Scripted Expression - Orbit a Point

Orbit an object's position around a point with a custom Scripted Expression. The object's position will change when scrubbing the timeline. Using trigonometry, circular motion can be defined in 2D using the sine and cosine functions. (See Unit Circle.) In this example, the current frame is used as the variable that induces the motion. Frame is a Simple Expression that corresponds tobpy context scene frame current.

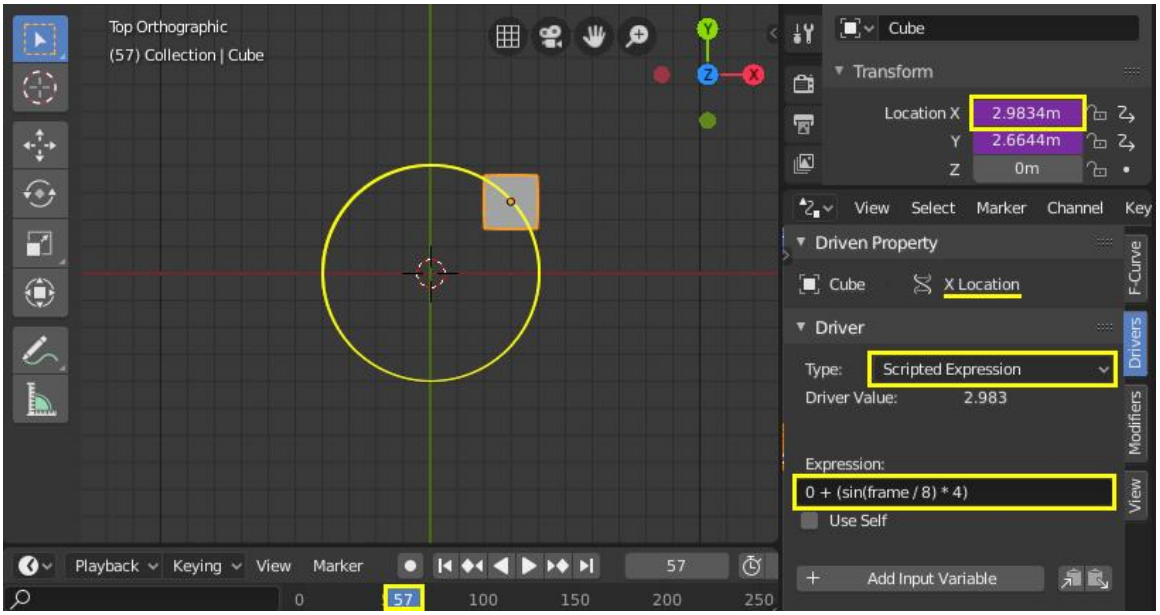
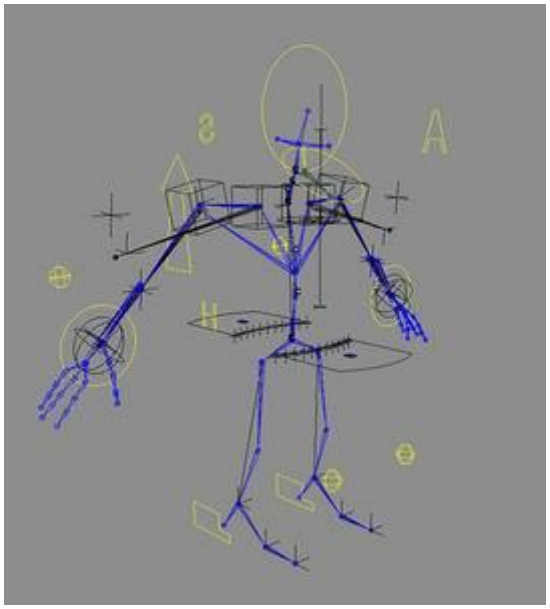


Figure 15 Animated

6. Add a driver to the X Location property.
7. Set the Driver Type to Scripted Expression.

8. Add the expression 0 + (sin (frame / 8) * 4), where:
9. frame/8: is the current frame of the animation, divided by 8 to slow the orbit down.
10. (sin ( )*4) : multiplies the result of sin(frame/8) by 4 for a bigger circle.
11. 0 + : is used to control the offset to the orbit center point.
12. Add a driver to the Y Location property with the expression 0 + (cos(frame / 8) * 4).
13. Scrub the timeline to see the effect. Experiment with the variables to control the size and center of the orbit.

We've gotta put in those skeletons into a 3D character before he can move!



Setting up a character to walk and talk is the last stage before the process of character animation can begin. This stage is called 'rigging and skinning' and is the underlying system that drives the movement of a character to bring it to life.

Rigging is the process to set up a controllable skeleton for the character that is intended for animation. Depending on the subject matter, every rig is unique and so is the corresponding set of controls.

Skinning is the process of attaching the 3D model (skin) to the rigged skeleton so that the 3D model can be manipulated by the controls of the rig.