1 Snippets

1.1 Find all image textures path

```
for img in bpy.data.images:
    print(img.name, ":", img.filepath)
```

1.2 Manipulate selected objects

```
for obj in bpy.context.selected_objects:
    obj.rotation_euler.x += 1.5708  # Rotate 90 degrees (/2) on X-axis
```

2 Shortcuts

2.1 Selection & Navigation

Shortcut	Effect
Ctrl + ‘	Hide/Show gizmos
Tab	Toggle between Object Mode and Edit Mode
A	Select all
Alt + A	Deselect all
L	Select linked geometry (hover over a part and press L)
Ctrl + L	Select all linked geometry (based on selection)
B	Box select
C	Circle select
Shift + G	Select similar (choose criteria like area, shape, or material)
Alt + RMB	Loop select
Shift + RMB	Ring select

2.2 Transformations

Shortcut	Effect
Ctrl + ‘	Hide/Show gizmos
Tab	Toggle between Object Mode and Edit Mode
A	Select all
Alt + A	Deselect all
L	Select linked geometry (hover over a part and press L)
Ctrl + L	Select all linked geometry (based on selection)
B	Box select
C	Circle select
Shift + G	Select similar (choose criteria like area, shape, or material)
Alt + RMB	Loop select
Shift + RMB	Ring select
G	Grab (move)
R	Rotate
S	Scale
X / Y / Z	Constrain movement to an axis (e.g., G + X moves along the X-axis)
Shift + X / Y / Z	Move along the other two axes (exclude one axis)
Ctrl + A	Apply transformations (use in Object Mode)
Ctrl + Tab (or **1, 2, 3** in Blender 2.8+)	Switch between Vertex, Edge, and Face selection
Ctrl + E	Edge menu (Bevel, Mark Seam, etc.)
Ctrl + B	Bevel (works for edges and vertices)
Shift + Ctrl + B	Vertex bevel
F	Fill (creates a face between selected vertices/edges)
Alt + Left Click	Select edge loop
Shift + Alt + Left Click	Select multiple edge loops

Shortcut	Effect
Ctrl + R	Loop cut (scroll mouse wheel to increase cuts)
K	Knife tool (click to cut, Enter to confirm)
Shift + R	Repeat last action
Ctrl + Shift + B	Chamfer/Bevel vertices

2.3 Extrude, Inset & Merge

Shortcut	Effect
E	Extrude
I	Inset faces
M	Merge vertices (choose options like "At Center" or "At Last")
Alt + M	Older version of merge (pre-2.8)

2.4 Proportional Editing & Smoothing

Shortcut	Effect
O	Toggle Proportional Editing
Shift + O	Change proportional falloff type
Ctrl + Shift + B	Bevel vertices
Shift + S	Snap menu (snap selection to grid, cursor, etc.)
U	Unwrap UV (when in UV Editing)
Ctrl + T	Triangulate faces
Alt + J	Convert tris to quads

2.5 Miscellaneous

Shortcut	Effect
H	Hide selection
Alt + H	Unhide all
Shift + H	Hide everything except selection
P	Separate selection into a new object
Ctrl + J	Join selected objects

- Edit mode UV tools: press U
- Edge slide tool: in edit mode, with a vertex selected, press Grab (G) twice
- Triplanap projection: https://www.youtube.com/watch?v=KV_hgeQdCXk
- Baking: https://www.youtube.com/watch?v=sOvRr_D8ZpU

3 Pivot to Cursor

Press **Shift + Right Click** to place the 3D Cursor manually. Or use **Shift + S** → "Cursor to Selected" to place it at the selection.

Instead, to change the pivot point to cursor, do the following:

- In *Object Mode*, go to the top-center of the viewport (next to the selection mode dropdown) where the pivot point options are.
- Click on the Pivot Point dropdown (it's an icon that usually shows a circle with a dot in the center).
- Select 3D Cursor from the list of pivot options.

Alternatively:

- Period key (.) to open the pivot point menu and choose 3D Cursor.
- Perm
- Object - Set Origin

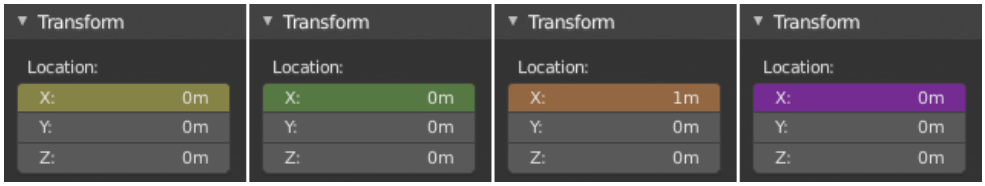
4 Animations: Docs Summary

These notes about animations in Blender are made by summarizing the Blender 4.3 Docs.

4.1 Introduction

Animation = Transforming an object or changing its shape over time. More generally, any property about a blender object can be animated.
Animation is typically achieved by employing *Keyframes* (more on that later)

Any property in the *Properties Editor* has a *State Color*



Color	Meaning
Gray	Not animated
Yellow	Changed from the current frame
Green	Keyframed on a different frame
Orange	Changed from the keyframed value
Purple	Controlled by a *Driver*

4.1.1 Rigging

Rigging = adding controls handles to animate an object. Blender offers the following feature to rig a model

Rigging Method	Brief
Armatures	A Hierarchy of Joints associated with a mesh. Each joint has a *weight* [0.0, 1.0] for each vertex of the aforementioned mesh (can be painted). Transforming a joint will influence all vertices whose weight for that particular joint is greater than 0. This technique is called *Skeletal Animation* (more later).
Constraints	Control the kind of motion the rig is allowed to perform. They are found under *Properties Editor*, tab "Constraints" (more later).
Object Modifiers	Mesh deformation through modifiers. We are interested in Deformations and Physics (more later).
Shape Keys	Commonly called textitblendshape, meaning having different copies of a mesh (same topology, same UV, same *everything*). Example: different facial expressions that blend over time with *Keyframing* (more later).
Drivers	Mechanisms to control multiple properties at once and make some properties automatically update when others change (more later).

4.2 Keyframes

4.2.1 Relevant Shortcuts

With a property/object Selected:

Shortcut	Effect
I	Insert Keyframe (brings up keyframe menu)
Alt + I	Delete Keyframe
Shift + I	Insert Keyframe for all properties
Ctrl + I	Add keyframe to active keying set
Alt + S	Reset Scale (useful when animating transforms)
Alt + R	Reset Rotation
Alt + G	Reset Location

Inside *Graph Editor* or *Dope Sheet Editor*

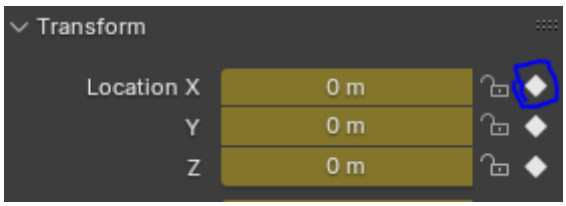
Shortcut	Effect
G	Move keyframe(s)
S	Scale keyframe(s)
R	Rotate keyframe handle (in Graph Editor)
Shift + D	Duplicate keyframe(s)
X or **Delete**	Delete keyframe(s)
E	Extrapolate (Graph Editor)
T	Set Keyframe Interpolation (Linear, Bezier, Constant, etc.)
V	Set Keyframe Handle Type (Vector, Aligned, etc.)
Ctrl + C	Copy Keyframe
Ctrl + V	Paste Keyframe

Playback Shortcuts

Shortcut	Effect
Spacebar	Play/Pause animation
Shift + Left Arrow	Jump to **start frame**
Shift + Right Arrow	Jump to **end frame**
Left Arrow	Move **one frame backward**
Right Arrow	Move **one frame forward**
Up Arrow	Move to **next keyframe**
Down Arrow	Move to **previous keyframe**
Shift + Ctrl + Spacebar	Play animation in **reverse**
Home	Zoom to fit all keyframes in **Graph Editor/Dope Sheet**
Ctrl + Middle Mouse Scroll	Zoom in/out in Timeline/Graph Editor

When you set a keyframe on a simple static mesh, like a cube.
(in the Viewport, object mode, Ctrl + A -> Mesh -> Cube). If

- You press **I**, then all the transform properties are saved in the current frame as a keyframe (see in *Dope Sheet Editor*)
- If you want only a part of the default properties to be saved, then you can set them manually by clicking the *Animate Property* handle to the right of the property in the *Properties Editor*



4.2.2 Introduction

A *Keyframe* is a marker of time which stores the value of the selected property.
The purpose of a keyframe is to save the value of a property in a given instance of ”time” (on a rendered frame. Physical elapsed time depends on the FPS of the animation).

An overview of all the existing keyframe in your animation can be seen in the *Playback Editor*. To get the full information about existing keyframes (ie. to which object they refer to and which property they alter/set, use the *Dope Sheet Editor*).

Quick Experiment: Keyframe Visualization

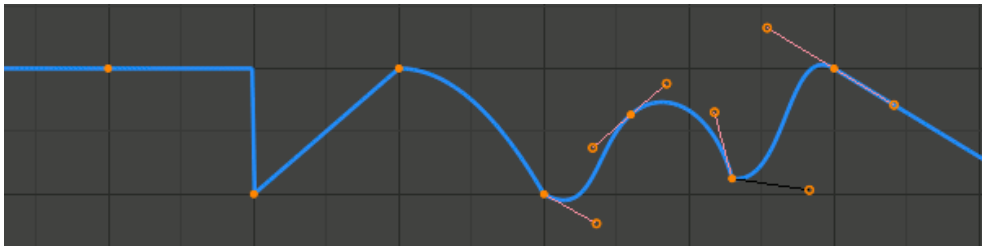
File: `01_Keyframes_Intro-Moving_Cube.blend`

1. Create an empty Blender scene with a cube and check FPS (*Properties Editor* → Output → Frame Rate).
2. Select its position from the *Properties Editor* and set a keyframe (**I** to keyframe the transform).
3. Move to another keyframe inside *Dope Sheet Editor* or *Playback Editor*.
4. Freely transform your cube and then set a keyframe.
   Note: It's imperative that you first move to another place in the timeline and then manipulate your object, otherwise it won't work!
5. Go back to the start of the timeline (**Shift + Left Arrow**) and play the animation (**Spacebar**).

Keep this example for the next section on Interpolation.

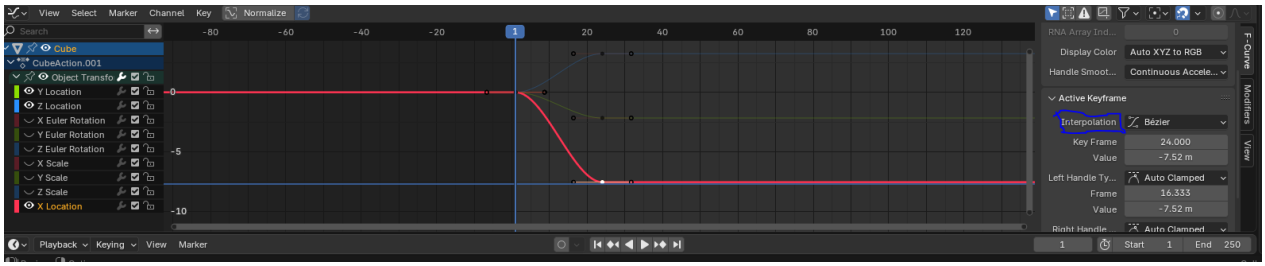
Interpolation

When you set two keyframes on the same property, its value changes over the span of frames inbetween the two keyframes with *Interpolated Values*, ie values computed using a matematical formula. In particular, such formula is defined by an *F-Curve*, manipulated in the *Graph Editor*.



There is 1 curve for each animated property in the *Dope Sheet Editor*. The main setting is the *Interpolation* Type, which appears in the *Graph Editor* inside the *F-Curve* Tab. **Interpolation Modes:**[1]

- Bezier Curve
- Linear
- Constant



While what happens during the transition between a keyframe and the next one is defined by the *Interpolation* Mode, What happens outside the "Keyframed Range" (before the first keyframe and after the last keyframe) is defined by the *Extrapolation Mode*.

Extrapolation Mode is found under "*Graph Editor*/Channel/Extrapolation Mode" or with shortcut **Shift + E** (*Graph Editor* Selected) The following are the available **Extrapolation Modes:**[2]

- Constant: Continue in a straight horizontal line
- Linear: Continue in a straight line keeping the slope
- Make Cyclic: Repeat the curve
- Clear Cyclic: Removes Cycles Modifier

The settings to manipulate Curve Handles (placed on the F-Curve on the keyframe positions) depend on the Interpolation Type. A common setting among them all is the *Auto Handle Smoothing*, which can be either *None* or *Continuous Acceleration*.

When not *None*, edits to a handle are propagated in the near handles (similiar to proportional editing) to keep the F-Curve as smooth as possible.

Quick Experiment: Interpolation and Extrapolation: "Cyclic Overshoot"

File: `02_Keyframes_Interpolation-Moving_Cube_Custom_Interpolation.blend`

1. Open the cube example you produced from the previous experiment
2. Open the *Graph Editor* and select a "Location" Curve (the one with the bigger displacement in the Vertical axis)

[1] All the settings inside the *F-Curve* Tab affect the keyframes selected
[2] Extrapolation Mode affects all *F-Curves* selected

Figure 1: **To the left**, keyframe types. **To the right**, bezier interpolation handles type

3. Play around with the 2 Handles freely. Example: Use the last one as "Bezier" Interpolation and create an "overshoot"
4. Change the *Extrapolation mode* to Linear and then to Make Cyclic
5. Check in the "*Graph Editor*/Modifiers" (Tab) that The Cycles Modifier has been added to the *F-Curve*
6. Go back to the start of the timeline (**Shift+Left Arrow**) and play the animation (**Spacebar**)

Keep this example for the next section on Interpolation.

Keyframe Types

Blender has different keyframe types. Such type is determined by the keyframe's source (eg set manually or automatically generated), as well as the effect they achieve.
To change a keyframe type

1. In the *Dope Sheet Editor*, select the keyframes you want to change
2. Click the **Menu Key** (to the left of the right CTRL key) to display the popup context menu, therefore click "KeyFrame Type" and select your keyframe type

Note: **This has no functional purpose**, it is merely a visual tool to help us navigate into complicated animations.
Another visual tool the *Dope Sheet Editor* and *Graph Editor* give us are *Marker*s, which can assign a name to a keyframe. To create a marker:[3]

1. select the keyframe you want to label
2. press **M**
3. then select the marker and, from the top menu of the editor, click "Marker/Rename Marker"

Here's the list of the available Keyframe types, their visual appearence, and their meaning

Keyframe Type	Appearence (Not Selected / Selecteed)	Meaning
Keyframe	white / yellow diamond	Normal keyframe.
Breakdown	small cyan diamond	Breakdown state. e.g. for transitions between key poses.
Moving Hold	dark gray / orange diamond	A keyframe that adds a small amount of motion around a holding pose. In the Dope Sheet it will also display a bar between them.
Extreme	big pink diamond	An "extreme" state, or some other purpose as needed.
Jitter	tiny green diamond	A filler or baked keyframe for keying on ones, or some other purpose as needed.
Generated	dark diamond	A key generated by some tool, for example Copy Global Transform: Fix to Camera. This keyframe type indicates to Blender and add-ons that it is safe to remove and re-generate them, so be careful when manually marking your hand-made animation with this type.

Interpolation Mode Handles

Similiarly to *Keyframe Types*, the *Dope Sheet Editor* shows Keyframe interpolation handles with *Bezier* mode differently based on the handle type given in the F-Curve tab, giving us some visual feedback without having to open the *Graph Editor*

- *Circle*: Auto Clamped (default)
- *Circle with Dot*: Automatic
- *Square*: Vector
- *Clipped Diamond*: Aligned
- *Diamond*: Free

This holds only if the left handle and right handle have the same type, otherwise, it's always displayed as a Diamond.

[3] the file `02_Keyframes_Interpolation-Moving_Cube_Custom_Interpolation.blend` contains an Extreme keyframe and a marker

4.2.3 Keying Sets

Reference Video: https://www.youtube.com/watch?v=5g7EbDtlKGM
Whenever you press **I** to create a keyframe, the newly created keyframw will automatically Store and therefore animate the whole *Object Transform*, and animated properties appear grouped under the "Object Transform" group, or better, under the *Keying Set* "CubeAction", .

If we want to animate only certain properties of our objects, we would need to spend time finding them in the appropriate tab inside the *Properties Editor*, right click and "Insert Keyframe".

We can speed up the Keyframe creation process by specifying which properties we want to animate, and we can do that by creating a *Keying Set*, found inside the *Properties Editor*, under "Scene/Keying Sets"[4].

Once you create a keying set, you can add properties to it by

1. Right Clicking the property (eg. from the *Properties Editor*, Object Tab)
2. Click "Add Single to Keying Set" to add the property to the active keying set

Once you added it, go back to the Scene/Keying Sets/Active Keying Set panel and make sure that

- The *Target ID Block*, ie to which object the keyframe should be applied has no object selected. This means that, regardless of which object you have selected, the keyframe will be created from the object you specify here
- You can modify the *Index* of the property, ie the order in which they appear inside the *Dope Sheet Editor*
- You can modify how the animated properties are organized into a folder hierarchy by changing the *F-Curve Grouping* (details in video)

Furthermore, if you want to export and import keying sets from a blender scene to another, you can click the *Export to File* button to generate a Python script, which, executed on a new scene, will create the keying set you exported.

[5] Usage Limited on a specific scenario, for example

- You have a predefined set of objects you want to animate. Therefore, you can create a Keying set which encompasses all the properties across all the different objects you need
- You can select a frame, modify the properties of *all the objects* to their desired value, and then press **I** once (instead of setting all the properties from the context menu or pressing **I** for each object)

Instead of going to the *Properties Editor*, "Scene/Keying Sets", you can set the Active Keying set also from the *Timeline Editor*, the Keying dropdown menu.

4.3 Actions

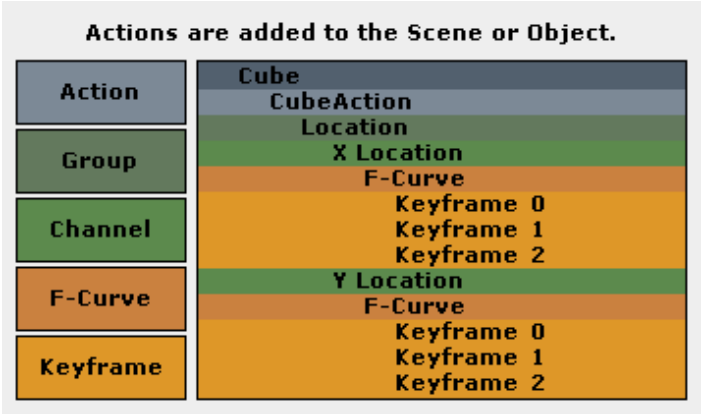
Video Reference:

- Part1: https://www.youtube.com/watch?v=x28RWgsIu8Y[6]
- Part2: https://www.youtube.com/watch?v=LXMiHvwIgDs

Blender saves everything as a *Data Block*, and animations are no exceptions. In fact, whenever we create a new keyframe, blender actually creates for us a new *Action*, with a default name equal to "(Object Name)Action". To visualize all Actions in your scene[7]

- In the *Outliner Editor*, open the *Data API* Display Mode, and click under the item "Actions"

The structure of the Action Data block is the following



Succinctly, **Actions are reusable animation segments**.
Actions can be managed from 2 places

[4] Once you create a keying set, the default one won't be active anymore, and you need to add at least one property to the active (selected/highlighted)

[5] Maybe modifying that script you can also use the `bpy.context.active_object` instead of fixing the keying set property object?

[6] This rig is also available for download!

[7] Useful if you want to remove some unused data which is still present in the .blend file

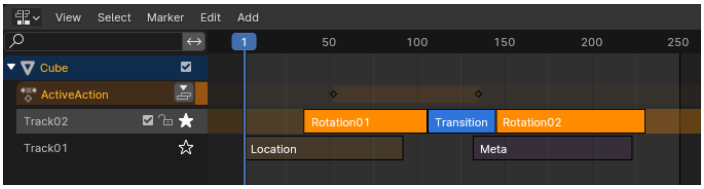


Figure 2: Example of *NLA Editor* Tracks

- *Dope Sheet Editor*, with Display Mode *Action Editor* (and not the default *Dope Sheet*, which gives an overview of the current action)
- *NLA Editor* sidebar (See later *Non Linear Animations*)

This allow us to

- Apply the same Action to different objects (as shown in the second video, in which the animation is first applied to a stand in, then applied to the final model)
- Store different animations applied to the same object (example running, walking, throwing a punch, ...), all starting from zero. Of course, we then need to **Combine** them together
  (Example: We want our character to run to a given position, and then throw a punch) (used with NLA)

In the *Dope Sheet Editor/Action Editor*, the Action Sidebar shows 2 checkboxes

- *Manual Frame Range*: Instead of using the range specified by the *Timeline Editor*, uses a manually specified frame range (used with NLA)
- *Cyclic Animation* The animation is Cyclic over the specified range (used with the previous checkbox)

Non Linear Animations

- Video Reference: https://www.youtube.com/watch?v=Hz1TwvSNsrA (**Really Important**)

- Blender Ref: https://docs.blender.org/manual/en/4.3/editors/nla/introduction.html

To combine different actions, we need to use the *NLA Editor*. Brief description of the content of this editor

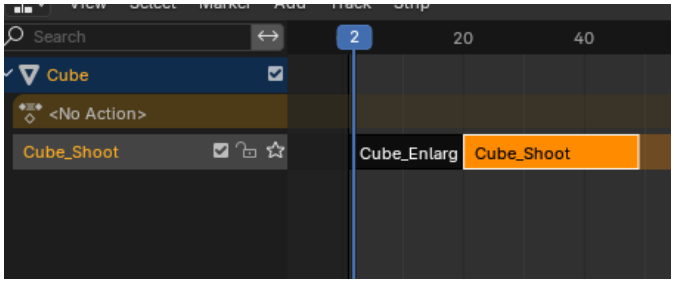
- Left Panel containing a down down menu for each object containing at least 1 action. Each dropdown menu is a **Stack of Actions**
- The Main Region displays a Stack of *Track*, in which each Track is made up of *Strips*. The top of the stack, highlighted in orange, which contains no strips, is the object's *Active Action*
- Right Panel, non empty only for the active object's action, having options *Extrapolation* (already seen), *Blending*, *Influence*. Brief:
  - *Blending*[8] how to combine this action's property values with the ones from the track below (similiar to layer modes in Photoshop). Formulas used by each mode in the footnote link
  - *Influence* how much the actions contributes to the NLA Stack

Quick Experiment: Actions and Non Linear Animation: "Enlarge and Shoot"

File: `03_Actions_NLA-Cube_Path.blend`

1. Create a Cube, and in the *Dope Sheet Editor/Action Editor* create a new Action, call it "Cube_Enlarge"
2. Open the *NLA Editor* alongside *Dope Sheet Editor/Action Editor*, and *Push Down* (either from NLA Editor of from Dope Sheet) the current action.
   As you can see, this will create a new *Track* containing a single *Strip* which contains the action we just pushed.
   - Now the object has no active action, and in fact the dope sheet is empty...
   - ... But if you press **Shift + Left Arrow** and **Spacebar** (go to beginning of timeline and play), the animation still plays out, because the final animation is the **composition of the whole NLA Stack**
   - On the newly created *Track*, try to grab the *Strip* and move it along the Track's timeline. A strip can be placed wherever we want in the frame range
   - To the left of each *Track* there is a visibility checkbox. If deactivated, the *Track*'s animation won't be played out
3. Create another action to move the cube, with an "explosive" F-Curve, ie most of the displacement is done earlier in the F-Curve (therefore you need to open it in the *Graph Editor*)
   (it is reccomended to turn off all NLA Tracks while working on another action in the *Dope Sheet*)
4. Push down the newly created Action in the NLA Stack. This will create a new NLA Track. We don't want that, so click and drag the *Strip* in the new *Track* onto the existing track, delete the now empty track, and place the Shoot Action after the Enlarge action. The result should be something like this:

[8] Link: https://docs.blender.org/manual/en/4.3/editors/nla/sidebar.html?utm_source=blender-4.3.2#bpy-types-animdata-action-blend-type



5. Note: **Having more strips that modify different properties will reset all the work done by the previous strip, even if Extrapolation is set to Hold in the right side panel, strip menu**
   As you can see playing out the animation, after the Enlarge Action is done, the cube snaps back to its original scale and starts traslating. Fix:
   - Have *Strips* which modify different properties in different *Track*s. Therefore, from the topbar of the Editor, with a track selected, Click Track/Add and move one of the two strips in the newly created Track[a]

[a]Remember to rename the tracks in a "serious" project

Important Note: **Unassigned Actions are LOST when you quit blender if they are not used by anybody, therefore you need to protect them with a fake user**.
As a remainder on how to add a fake user, you can do it in different ways, one of them is by clicking the "Shield" icon from the *Outliner Editor*/Blender File Display mode, under Actions.

For more detail, eg how to *Repeat* (Under NLA Editor/Strip/Action Clip/Repeat) a Strip, check out the Reference video.

4.4 Armatures

4.5 Lattice

4.6 Constraints

4.7 Drivers

4.8 Shape Keys

4.9 Motion Paths

5 Animations Through Physics

6 Compositing Essentials

7 Video Editing Essentials