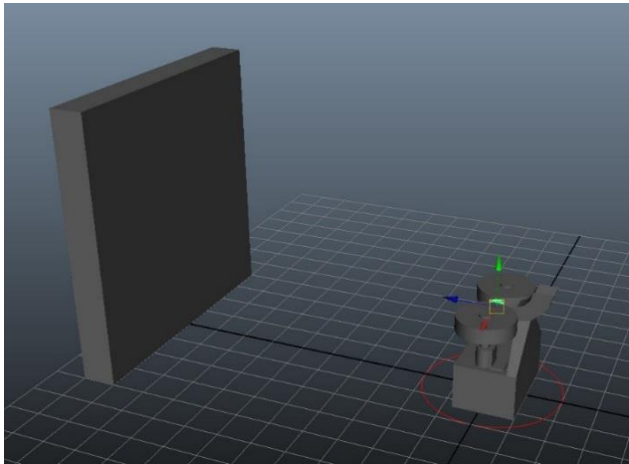


### Animating a Tennis Ball

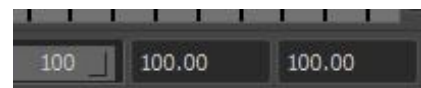
This tutorial will teach you the main principles of animation, specifically how to animate a tennis ball being fired from a cannon and bouncing off a wall to a stop.



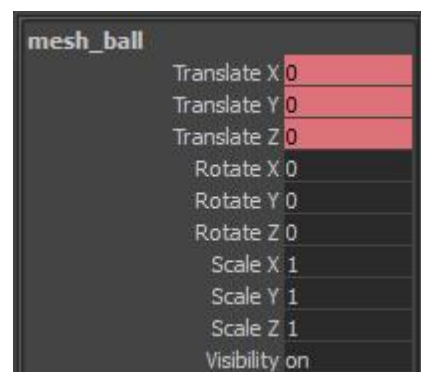
We would recommend you use your own scene for this as all you really need is a poly sphere to represent the tennis ball and a poly cube to represent the wall. If you are feeling extra adventurous you could build a tennis ball launcher like we have built in our scene. Make sure that you freeze your transformations *Modify > Freeze Transformations* and delete any history *Shift-Alt-D* before you start animating.

First let's plan our animation. We want the ball to launch towards the wall at a slight upwards angle and then bounce off the wall, fly over the tennis launcher and bounce on the floor a few times before it comes to a stop. The ball will drop slightly as it is flung, but will lose speed and drop at a steeper angle after each bounce.

Most likely your time slider is set to 48 frames, we are going to increase this to 100 to give us more time to play with.

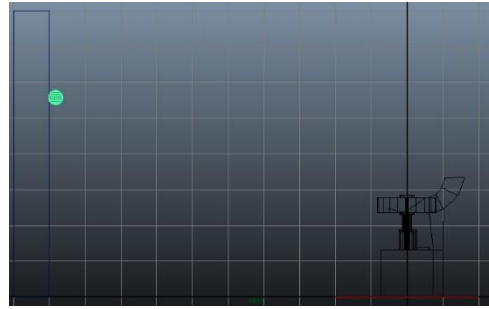


Ensuring we are at the frame one, select the ball and press *Shift-W* to key the translation in its starting position. We only want to create key frames for the attributes that we are animating; this keeps the *time slider* and *graph editor* clean and simple if we want to go in and change things. It also allows us to control other attributes such as rotation and scale without worrying about previous key frames getting in the way.

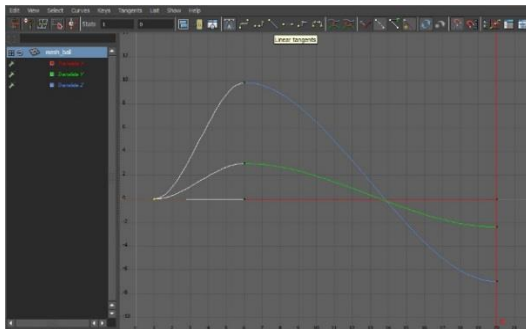
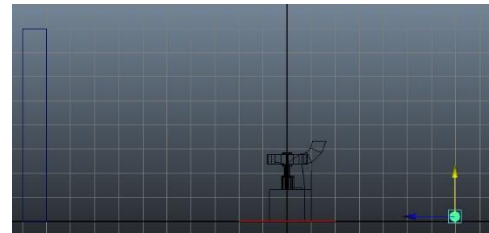


## Week 5: Assignment: Animation

Move the time slider to *frame six* and in the side view move the ball to the wall in the *x axis* and up in the *y axis* by about one fifth of the distance and set another key frame.

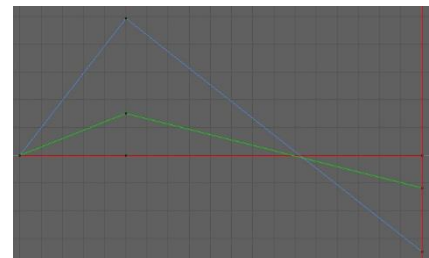


Now move the time slider further on to frame 20 and move the ball back behind the launcher and on the ground. If you play back the animation now, you will see that it is missing something – the ‘bounce’ off the wall is too soft and the ball leaves the wall in the wrong direction – it should bounce upwards first and then drop.

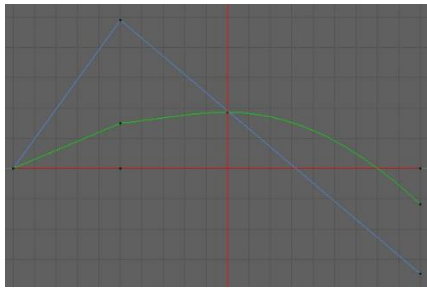


Open your graph editor *Window > Animation Editors > Graph Editor* and press *F* to frame the key frames. Select the first key frame, at the moment it has *Flat tangents* which means the ball will ease into the animation – because we are firing the ball straight from a cannon we want to change the tangents to

*linear tangents*. This will give us an instant trajectory. In similar vein we want to change our other keys to linear because they are currently all impact points where the ball will bounce.

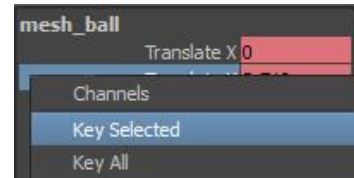


## Week 5: Assignment: Animation

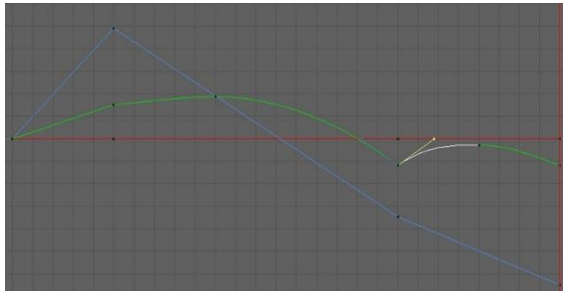


The bounce speed is more accurate, but we still need to make the ball continue upwards a little after the bounce. Move to *frame 11* and move the ball up in the *Y Axis*. *Right-click hold* the *Translate Y* attribute and select *Key Selected*.

Keying the attribute individually ensures that the

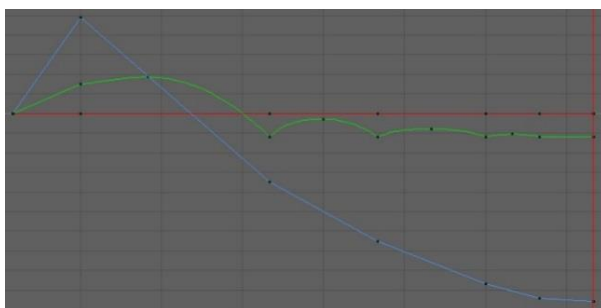
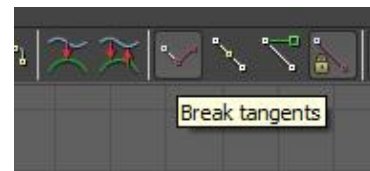


other translate values are not inhibited.



Now we want to use this method of animation to make the bounce again on the floor. When you have set your keys and are in the graph editor, one extra tool we will need to use is the *Break Tangents* button. This allows us to move the in and out tangents

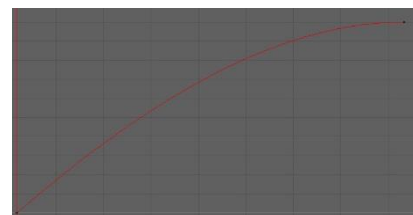
independently. To change our tangents (the yellow lines coming from the point) make sure you are in move mode (*W* key) select the line and *middle-click drag* to change its direction.



Using the same techniques, add another couple of bounces, reducing the length and height each time. Your graph editor should resemble something similar to the one on the left.

Before we finish, we are going to add some back spin to the ball. At *frame one* key the ball's *Rotate X* attribute at *zero* and then on our last frame set the value to something like *1000*. The initial key should be made linear to resemble the curve on the right.

Play with the in and out curves to get the correct bounce speed, and you should be left with a simple ball being fired into a wall and bouncing back.



### Creating a Walk Cycle

A walk cycle is one of the most important and often most overlooked part of animation. The walk cycle is vital to making your character believable – in the same way that you can discern your friends from their body language alone, it is the subtleties in the weight and balance distribution that makes a good walk cycle.

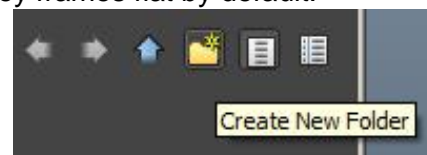
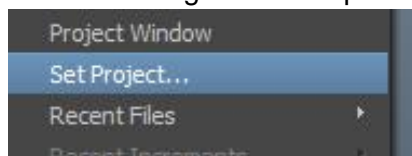
#### Character Rigs

For the most part we have always recommended that you use your own models, your own rigs and apply our techniques to your own scene. If you already have a suitable rigged character that is animation ready then load it up, but if you are more interested in getting stuck into animation that modelling and rigging then we recommend that you use one of many freely available rigs. We recommend the popular '*Andy Rig*' created by **John Doublestein**. Designed specifically for students it has all the control systems we could want including IK/FK switches and squash stretch.

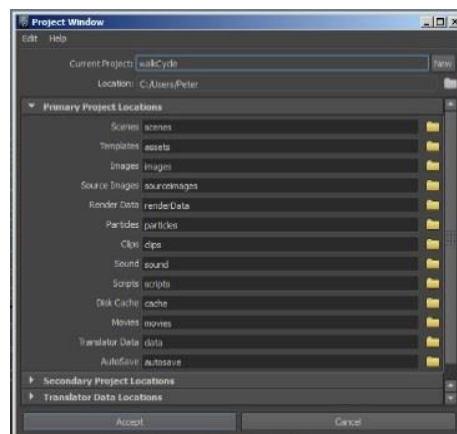
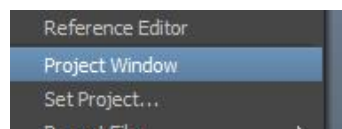
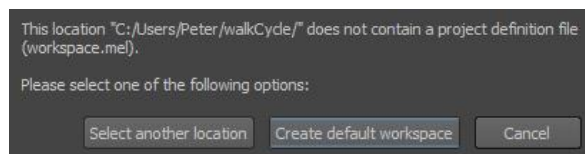
#### Animating the Walk Cycle

First we need to double check our animation preferences. Open up your *Window > Settings Preferences > Preferences* window and under the *Settings* tab make sure that our Time is set to *25 fps* (standard UK PAL). Under the *Animation* tab set both the *Default In tangent* and *Default out tangent* to *plateau*. This will give our keep our key frames flat by default.

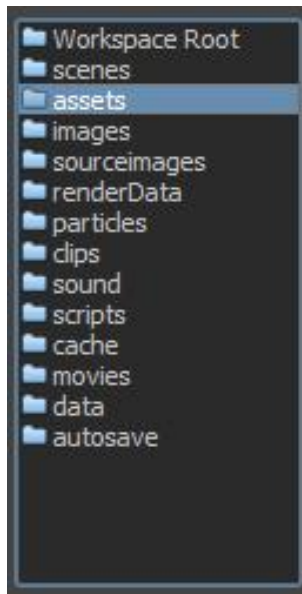
Now let's set up our project. Under the *File* menu click *Set Project*



and then create a new folder with your project name, let's call it *walkCycle*. If a dialogue pops up, select *Create default workspace*. Now to finalise our project and create our subfolders, simply click on *Project Window* in the *File* menu and then *Accept* the default folder names.

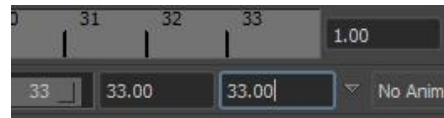


## Week 5: Assignment: Animation

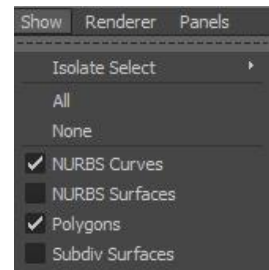


Copy your character rig into the assets folder, then back Maya click *Create Reference* from your File menu. Click on Assets from the left hand menu and select the rig your wish to animate with.

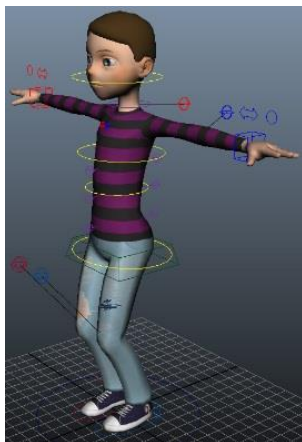
While we are still setting the scene up, change the playback range to 33. This is going to be the length of our walk cycle.



In your viewport *Show* menu, select *None* to hide all objects and then tick *NURBS Curves*, *NURBS Surfaces* and *Polygons* to make them visible. This will keep any joints and other visible objects hidden while we are animating.



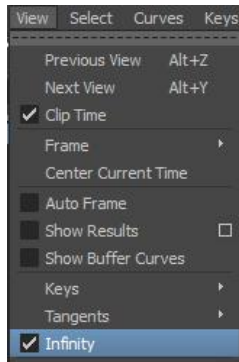
Select all of your controls (if you are working with your own rig then make sure that only controls are selected, not your mesh or any other nodes that could break if keys are applied). We can also turn on our *Auto Keyframe toggle* on in the bottom right.



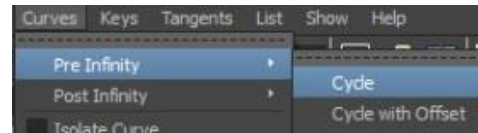
We have four key points during our walk cycle, causing our characters centre of gravity to create a wave pattern. Frames 5, and 21 are when the hips will be at their lowest, frames nine and 25 the highest. Let's plug some values in to give us this bob to work with. Make sure you are at frame one and key the hips *Translate Y* at zero, then key the value on frames 17 and 33. Move to frame five and bring the hips down, auto key should have created a new key for us. To set this same value you for frame 21, middle click on frame 21. You will see that the animation does not update, but if we key the *Translate Y* attribute it will create a new key with the previous value. This technique is also great for keying hold poses. Now on frames nine and 13 and then 23 and 29 key the hips in a more elevated position to give us a nice smooth bobbing effect.

## Week 5: Assignment: Animation

---

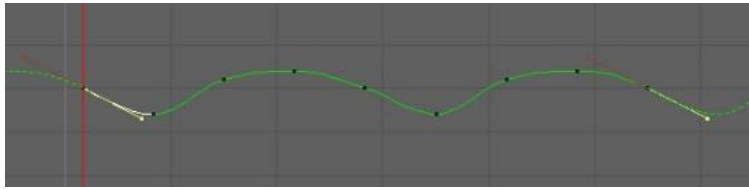


Open up your *Graph Editor* and press 'F' to frame up your translate curve. In the Curves menu select



*Pre-Infinity > Cycle* and *Post-Infinity > Cycle*. This will force the curves into a loop and to show us this loop we can enable the Infinity box in the view menu.

## Week 5: Assignment: Animation

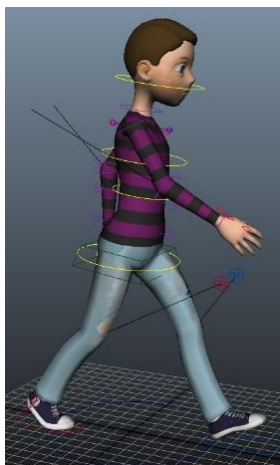


This will give us a dotted line either side of our key frames to show us how the value will continue. At the moment our loop

has this 'step' or kink at the beginning. Select the first key frame and then shift select the last and press 'flat tangents' to make sure they are the same. Now select and shift select the tangents for the key frames and in ensuring you are in move mode (W) move the tangents down so that the curve is smooth.

Go back to frame one and move the feet into position (starting with your left foot leading) watching for any hyper-extension. We never want any of our limbs to be completely locked out because this will cause 'popping' to occur during our animation. We want to bring the rest of our character into a rough start pose. Rotate the body forwards a little and also rotate our hips to follow along with our legs. Your feet may be different if you are using your own character, but we are going to use our *Foot Roll* attribute on our foot controls to bring the toes up and heel forwards for our respective feet. We also want to ensure that auto stretch is turned off.

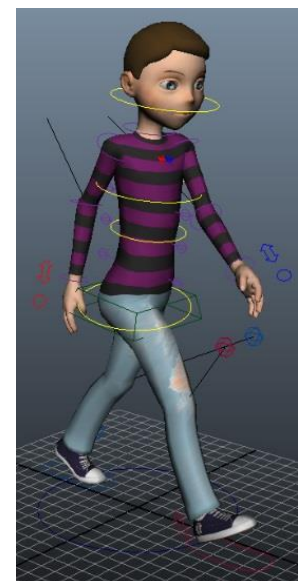
Translate X	0
Translate Y	-0
Translate Z	-4.252
Rotate X	0
Rotate Y	0
Rotate Z	0
Auto Stretch	off
Stretch	0
Lock Mid	0
Pivots	off
Heel Pivot	0
Ball Pivot	0
Toe Pivot	0
Roll	off
Foot Roll	0



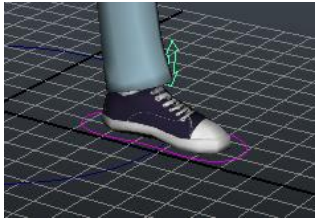
In our upper body, we want to bring our arms down and out (do not rotate them forward too far) and rotate our upper-body / chest control and shoulders out to follow our arms. For a female character it is often nice to rotate the arms out away from the body slightly, whereas with a male character we want to turn them in a little. I have also taken this opportunity to relax his fingers. With the first frame basic pose complete, select all of our controls and press *S* to key them in place. We also want to key everything at frame 33.

Now we need to build our right foot forward pose on frame 17. Starting with the feet copy the left foot values at frame one for your *Translate* and *Foot Roll* attributes and at frame 17 paste them onto our right foot values, then repeat the process for our other foot. Do the same process for our arms. The hips, chest and shoulders are easier – we simply want to put the negative (or positive) version of the current *Rotate Y* value to flip it.

Ok, so if we play back our cycle it is already starting to resemble a nice walk.

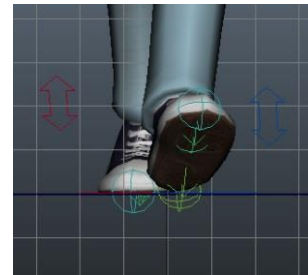


## Week 5: Assignment: Animation



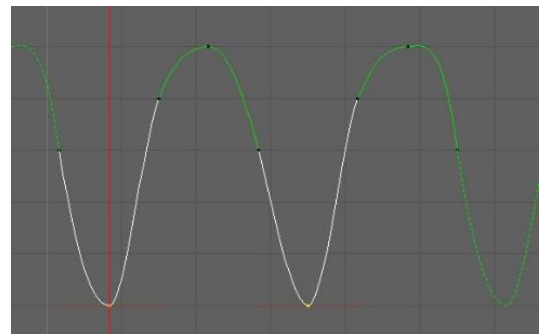
The feet are the most noticeable problems. By frame five (and 21) his foot should be completely planted, so let's go in and fix this by zeroing out the Ball Roll attribute on these keys.

Switch to the front view. We can see that his weight is way off, so let's centre our feet a little. At frames one, 17 and 33 we want to bring both feet closer to (but not on) the centre line, at frame 25 we want to move our left feet out to the side and at frame nine we want to move our right foot out to the side. While we have our feet selected, I have also used the *Toe Pivot* attribute to point our feet out a little.



The main thing missing now is our feet actually lifting off the floor. Select your feet and make sure that your *Translate Y* and *Rotate X* attributes are keyed at zero. Now at frames nine and 21 for your right and left feet respectively, rotate the foot down and lift the foot up. This should create a nice arc for your feet to travel in.

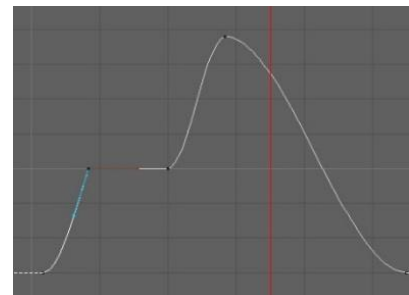
We need to add some weight to our animation, at the moment it is looking a little too floaty. With your hips selected open up your graph editor, select your *Translate Y* curve and press the *F* key to frame it. To increase the illusion of weight, select your bottom keys (frames five and 21) and



click on *Break Tangents* to allow us to move the in and out tangents separately.



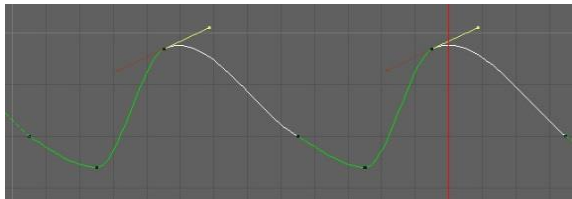
We want to increase the angle in and out of these points to make a point. Notice the weightier bounce when we play back our animation. We want to use a similar technique to give the feet more weight as they hit the ground. The left foot should resemble something like on the right, with a sharp in tangent at frame five. Our right foot will be similar, with the sharp tangent at frame 21.



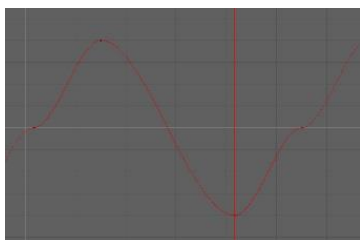


## Week 5: Assignment: Animation

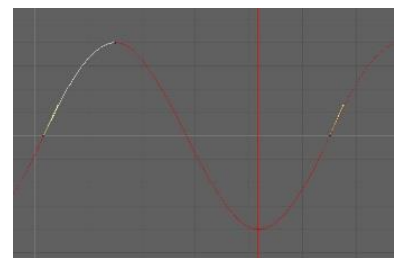
Now when we play back our loop, we can see that the weighting is much more realistic; our footsteps much snappier. To finalise our feet, let's check our leg extension on the plant and lift, making sure that we don't have any over extension (popping). On frame nine, let's move our body up to straighten the leg. To mirror this on frame 25, middle click frame 25 and key the *Translate Y* attribute.



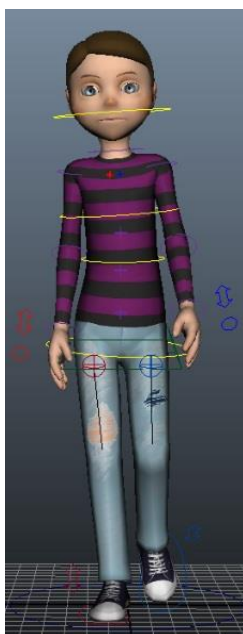
In your graph editor, grab the two top points and move the tangents to give the curve more of a hold on the higher position and lead into the next frame better.



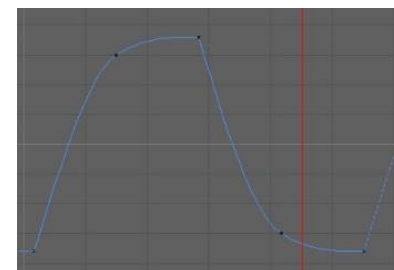
This is still looking much nicer, a much more dynamic walk. Moving on to our balance and weight distribution, move our body left on frame nine and right on frame 25 to match up with where our characters weight is being distributed. If we check our graph editor, we will find that we have a step again on the first and last frame, so let's select both of these points, flatten the tangents and then move both tangents up together.



This will give us a nice side to side movement which we can enhance by rotating his hips in line with the movement. It is also nice to add weight to this rotation, to really emphasise the feet planting on the ground. Were nearly there but I'm still not



quite happy with my foot planting – there is too long a delay between the heel hitting the ground and the toes. Go into your graph editor and bring the Foot Roll one frame sooner depending on your animation.



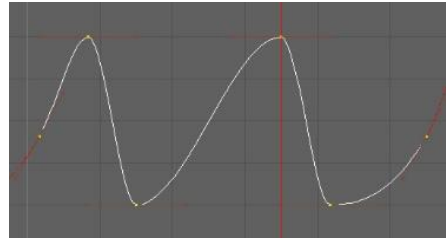
Now we can leave the bottom half for the moment and concentrate on the upper body.

Select your chest control and rotate it side to side on frames nine and 25 in the opposite direction of the hips. In the graph editor be sure to smooth the in and out tangents to remove the step from our loop. Playing the animation back you will see that instantly we have much more attitude going on in the walk cycle, especially from a more front facing angle.

## Week 5: Assignment: Animation

---

The front to back rotation is ever so slightly more complicated because it is reacting to the hips so it will be slightly delayed. Key the chest forward at frame five and 21 and straighter at frame nine and 25. Now after we have fixed the curve in the graph editor, we want to select all the curve points and *Shift-Middle-Click* to the right to move all the frames right by one frames.



Use this same technique to animate our head nodding, but move the head *Rotate X* keys forwards by two frames.

Our arms still look a little robotic. For our hands, repeat the steps for the chest and head but move the rotation keys way forward so that the start key is on frame ten. This will make our hands drag behind the arms to give us more fluid animation. You could also move our elbow key frames on by one or two frames.

Check all of your key frames in the graph editor, especially for kinks or steps in the curves and also for areas where you wish to add weight. Also keep an eye on your legs for popping. Finally hide your curves and preview your animation using a *Playblast* by right clicking on the



timeline and selecting *Playblast*. Although playback in Maya is a good start, sometimes the system can be choppy – a *Playblast* is much more realistic to your final outcome.

This concludes our walk cycle tutorial. You should now be well equipped to transfer these techniques onto your own characters and use the same techniques to create run, jump and other cycles within your animation.

### Animating a Arthropod (Scorpion)

Animating a scorpion is no simple task, even the fundamentals of a walk cycle takes some thinking about when you are dealing with eight legs. The key thing to remember is that research is your best friend so the first step is to work out how an arthropod walks. Watching spiders and scorpions, we can see that generally the legs work in pairs, in a logical pattern – so using that knowledge we can draw up a spreadsheet with frame numbers and write a plan for which frame each foot lands on and lifts during the cycle.

This takes planning and patience, but you will end up with something that looks a little like this:

Frames	1	3	5	7	9	11	13	15	17	19	21
R1	D	D	D	D	D	D	U	U	U	U	U
R2	U	U	U	U	U	U	D	D	D	D	D
R3	U	U	U	U	D	D	D	D	D	D	U
R4	D	D	D	D	D	U	U	U	U	U	U
L1	D	U	U	U	U	U	U	D	D	D	D
L2	U	D	D	D	D	D	D	U	U	U	U
L3	D	D	D	D	U	U	U	U	U	U	D
L4	U	U	U	U	U	D	D	D	D	D	D

Following these directions, you can start to make the laborious process of keying the feet. First animate your body control to get the correct timing and placement for your feet, then animate the feet to follow. You will find that as you go on, you will be able to animate quicker and quicker.

As with any walk cycle, be sure to add weight to your feet and body movements by manipulating (and breaking) your tangent weights. This will go a long way to make your scorpion look more dynamic.

Bear in mind that this should be used as a guide, obviously if the scorpion is in an action sequence then his movement will be different, and there are other times you might need to take some creative licence with the plan.