IK/FK Switch : Rigging

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Introduction

The objective of this tutorial is to Rig a set of arm Joints that can switch (transform) smoothly from IK to FK and back again at any point in your animation, depending on the requirements of the animation.

Learning Outcome

The objective of this tutorial is to introduce you to the following :

1. Create a Joint Chain to Rig an Arm.
2. Create IK handles for the Joint Chain.
3. Create Control Objects.
4. Duplicating Joint Chains.
5. Orient Constraint
6. Point Constraint
7. Parent Constraint
8. Pole Vector Constraint
9. Parenting
10. Add Attributes
11. Set Driven Keys

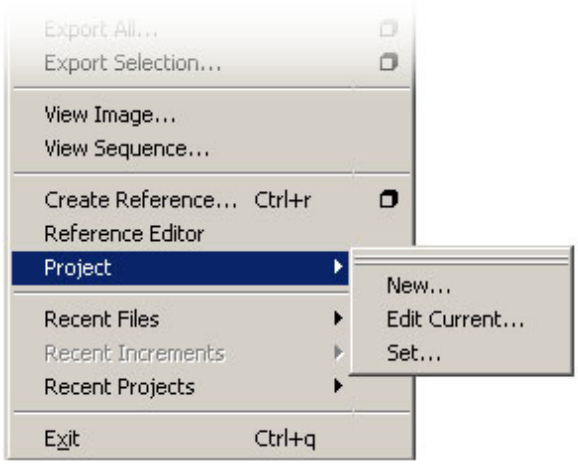
Setting the Project
The Project folder contains all the sub-folders for your project. It allows your scene to source for all the appropriate files and references in an organised manner.

New Project
File > Project > New

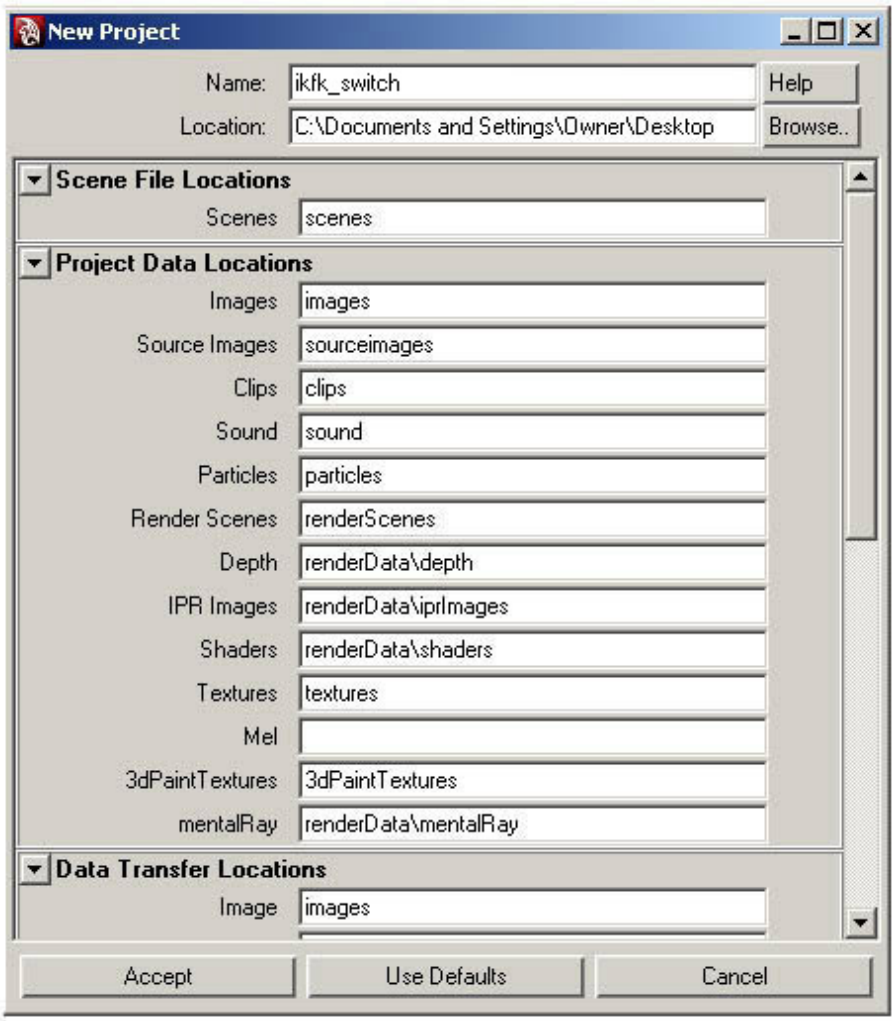
1. Name the Project
2. Location to Save the Project
3. Set Folder Names

Name the Project : lower case character, obvious names with no spaces
Location of Project : The default location is set to Documents Folder, but if you are not working on your own computer it's better to save it to the Desktop. Copy this Project folder to your portable device when you have finished this tutorial.

Do not save your project to a portable drive (thumb drive) or the performance will lag.



Name your project : ikfk_switch. Click the **Use Defaults** button to set the Project Data Locations. Then click **Accept**.


New Project
Name: ikfk_switch
Help
Location: C:\Documents and Settings\Owner\Desktop
Browse..
Scene File Locations
Scenes scenes
Project Data Locations
Images images
Source Images sourceimages
Clips clips
Sound sound
Particles particles
Render Scenes renderScenes
Depth renderData\depth
IPR Images renderData\iprImages
Shaders renderData\shaders
Textures textures
Mel
3dPaintTextures 3dPaintTextures
mentalRay renderData\mentalRay
Data Transfer Locations
Image images
Accept
Use Defaults
Cancel

Introduction

The objective of this tutorial is to create an IK/FK Switch. In this example the IK/FK Switch will be used on a simple arm and allow the arm to be switched between IK and FK mode at any time during the animation.

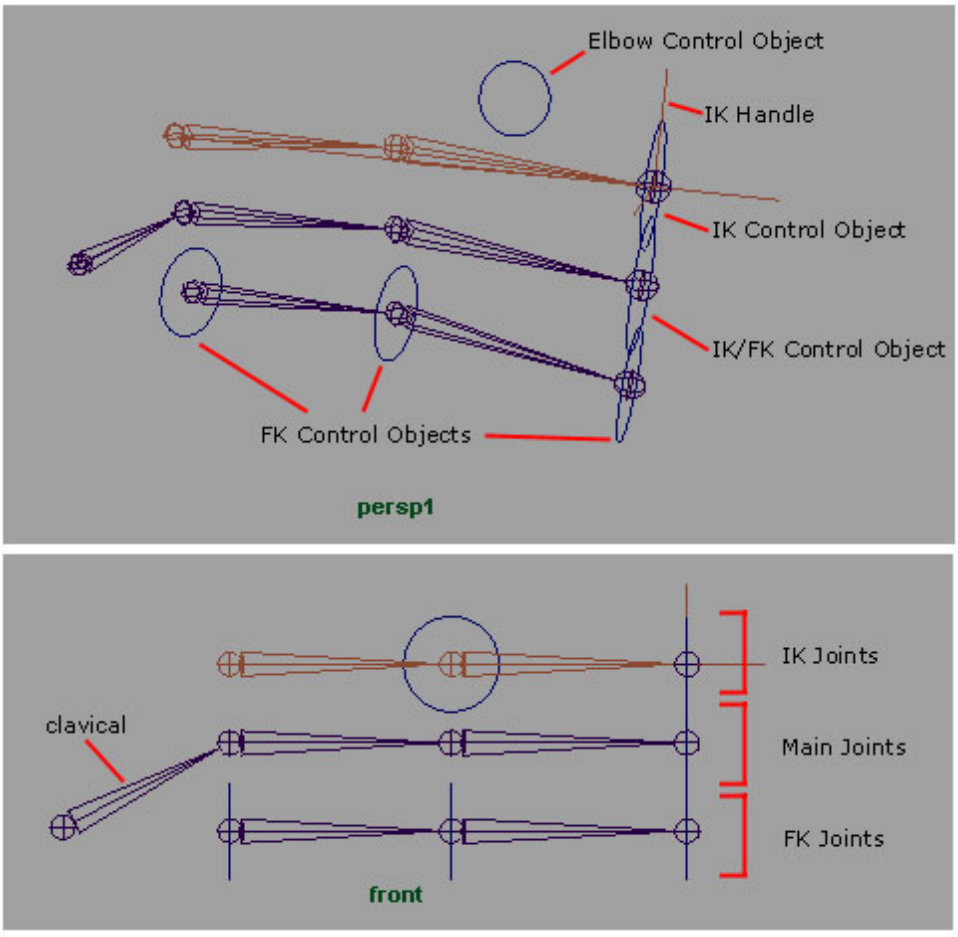
To create and IK/FK Switch, 3 sets of Joints are required in the same location. Take a look at the diagram below. The 3 sets of Joints are separated out to make understanding this tutorial easier.

The actual Skeleton (Main) used to control the model of the character is in the middle. The IK Joint are at the top of the diagram and the FK Joints are at the bottom.

Notice that the IK Joints (top) have a single Control Object (NURBS Circle) at the end of the IK Chain, on the wrist. The IK Control Object is moved (translated) around and the IK Joints will follow. The IK Joints also has a Control Object for the orientation of the elbow.

The FK Joints (bottom) have a Control Object on each Joint as each Joint is rotated into position individually.

The Main Joints remain in their original position, still connected to the Clavicle bone (and the main skeleton). There is a Control Object (NURBS Circle) at the end of the Main Joints with an Attribute (IK_to_FK_switch) to allow you to change the Weight of influence between the IK Joint and FK Joints.



Joints separated out for tutorial purpose only.

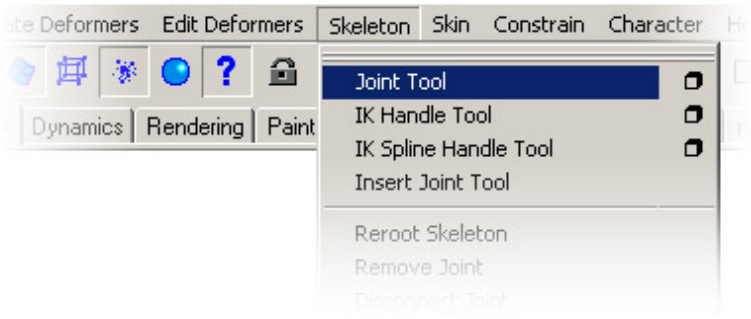
Simply put, you are making an IK arm and an FK arm to add to your Main Skeleton. You can then animate using either the IK or FK arms. The Main Joints will then follow either the IK arm or the FK arm as you define the weightage of influence.

Suppose you need to change from using the FK arm to IK arm (or visa versa) in your animation. If you simply changed the weightage of influence in 1 frame, the Main Joints would instantly jump from FK arm position to the IK arm position. To prevent any possible jump or “popping” in the animation, the IK/FK Switch covered in this tutorial will allow you to animate a seamless transition between the IK and FK positions.

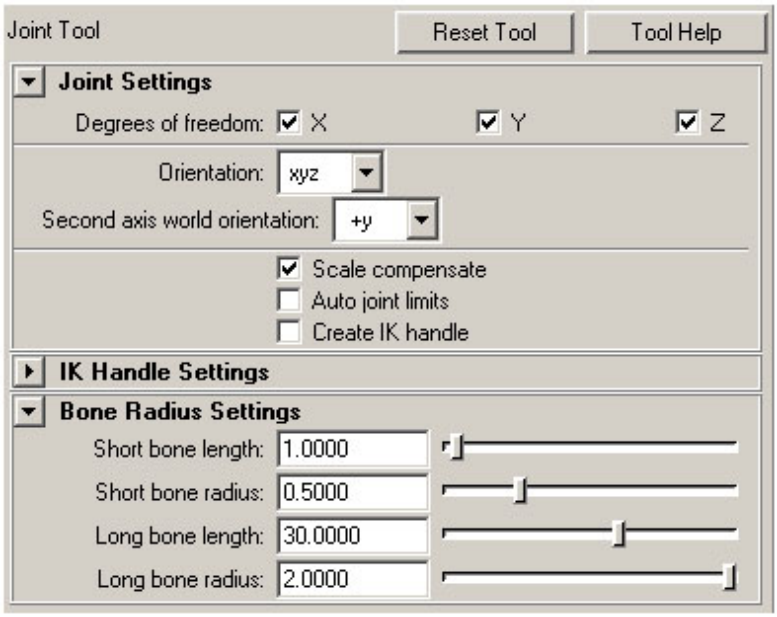
WARNING : If you are referring back to these notes at a later date, it is extremely important to remember that the IK/FK Switch should be applied after Binding the Skin to the Skeleton. If you create the IK/FK Switch before you Bind the Skin, the extra IK and FK Joints and Bones will effect the Skin. …..Be Warned..!!

[1] Building the Skeleton
In the **Top view** create a simple arm Skeleton setup using 4 Joints (3 bones) to create a Clavicle, Shoulder, Elbow and Wrist

Animation Mode > Skeleton > Joint Tool

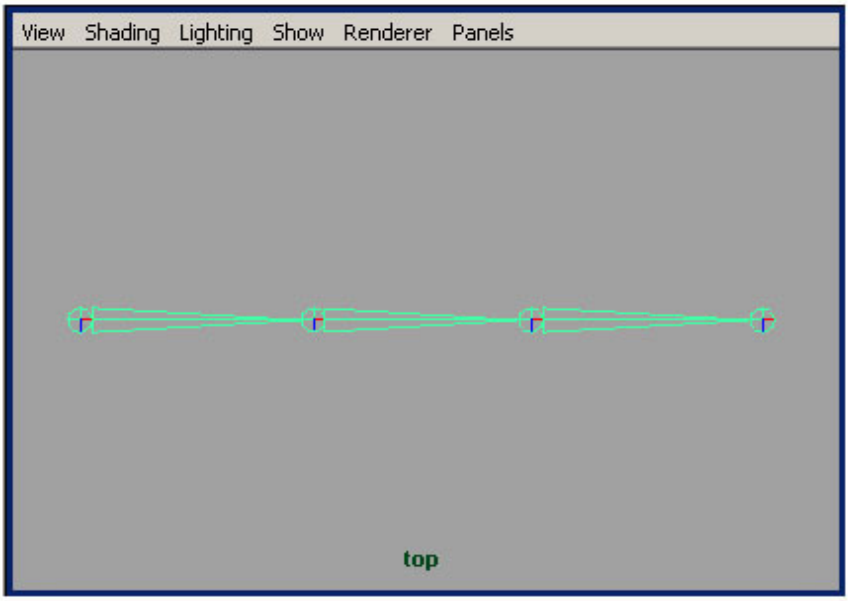


Remember to **RESET** the Joint Tools.



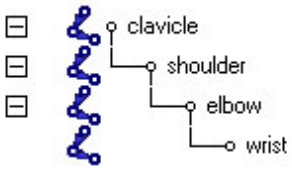
Lay the Joints out from **Left to Right**, even spaced. Press **Enter** when you have finished.

Note : You can lock the position of the Joints Vertically or Horizontally by holding the Shift key down as you click.



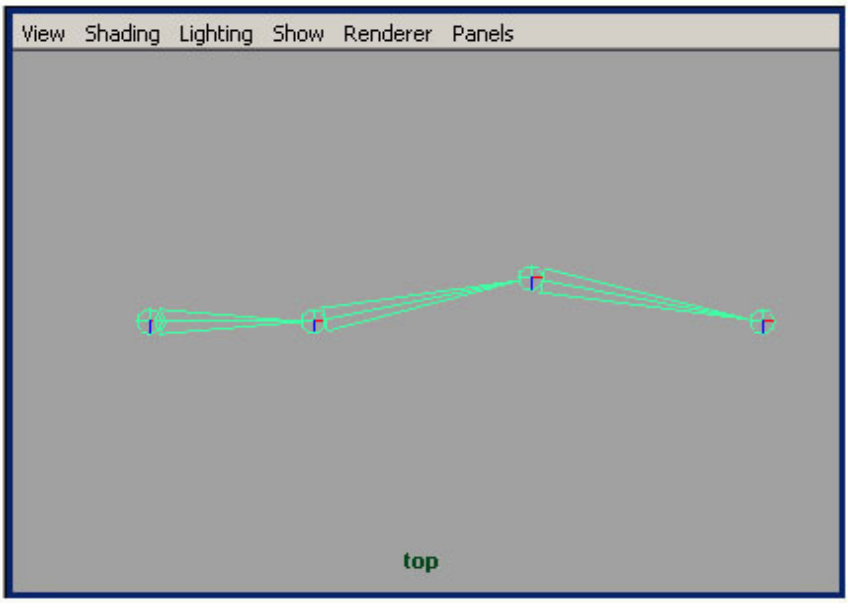
Open the **Outliner** and name the Joints as indicated in the diagram below.

Window > Outliner

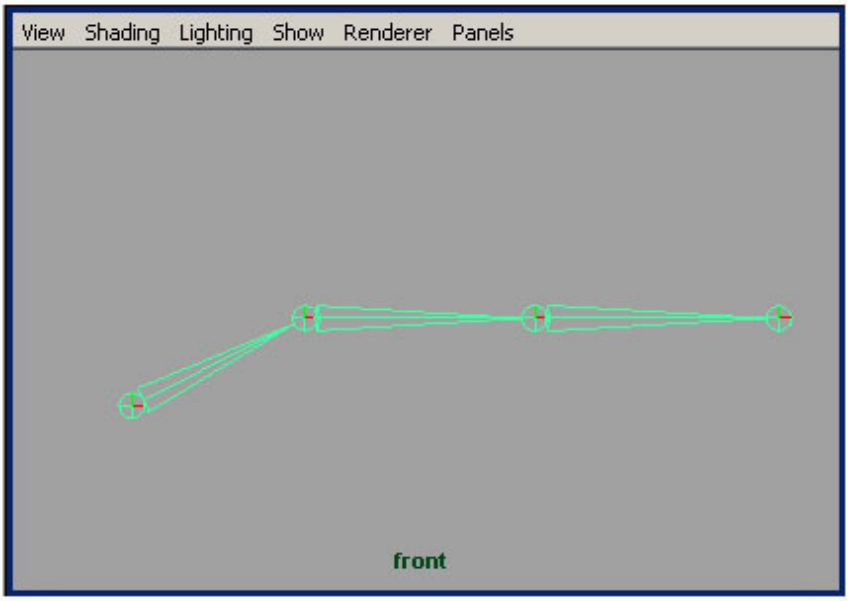


In the **Top view**, adjust the **elbow** Joint by moving it backwards as though the arm is slightly relaxed.

elbow > W Key (translate) > local axis (PC=Insert : MAC=Home)

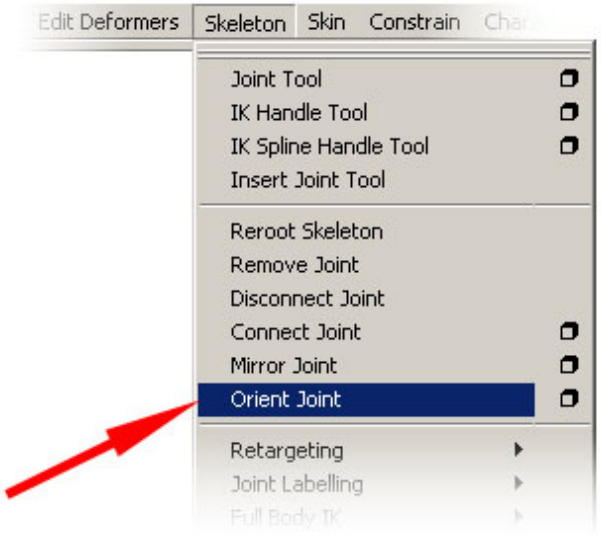


In the **Front view**, adjust the **clavicle** Joint by moving it slightly **lower** than the **shoulder** Joint.



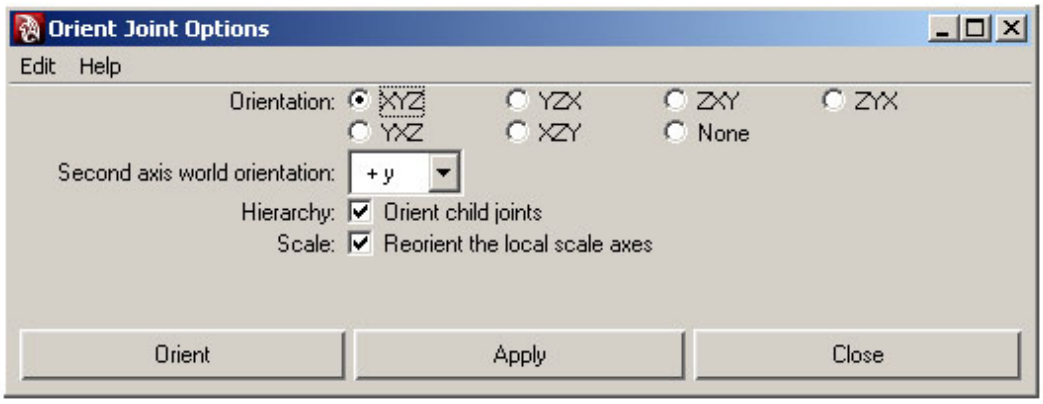
After you have adjusted the position of the Joints it is necessary to make sure all the necessary axis are re-align and pointing in the correct direction before you start rigging.

Animation > Skeleton > Orient Joint > Options



Reset the options and ensure the **Orientation** option is set to **XYZ**.

Note : The **Orientation** option allows you to select various combinations of XYZ. In each combination the first letter is the axis which will be aimed down the Joints Chain from one Joint to another. The second letter defines the “up” direction, and the third axis is simply the remaining axis – normally the axis around which you rotate the Joint.



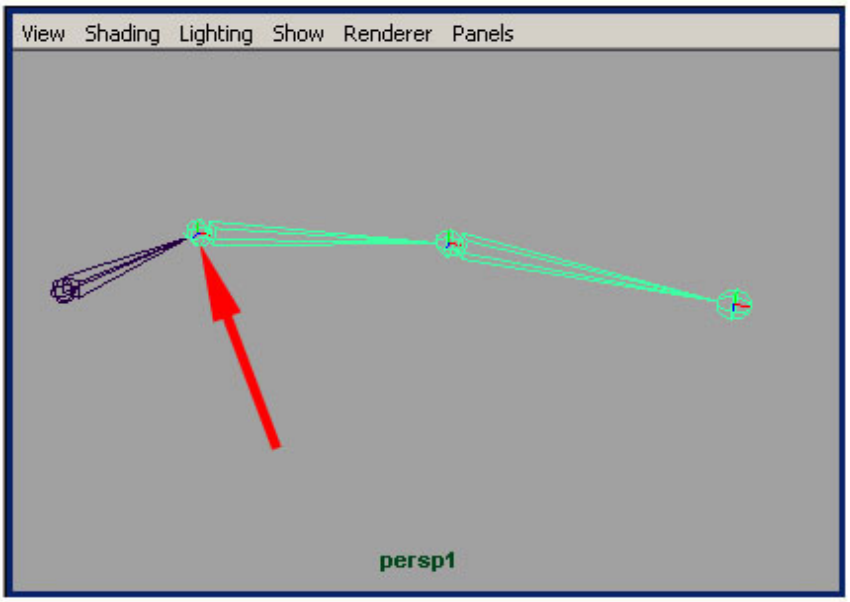
That's it – The Main set of Joints are now complete. The objective now is to **Duplicate** the Joint Chain from the **Shoulder to the Wrist** and then **Disconnect** the new Joint Chains from the Clavicle. This needs to done twice so that you have the original Joints plus 2 duplicates – 1 for the FK arm and 1 for the IK arm.

Note : Read the explanation above again to get a clear understanding of the intended outcome and why you are completing the following steps before you start.

[2] Creating the FK and IK Joints Chain

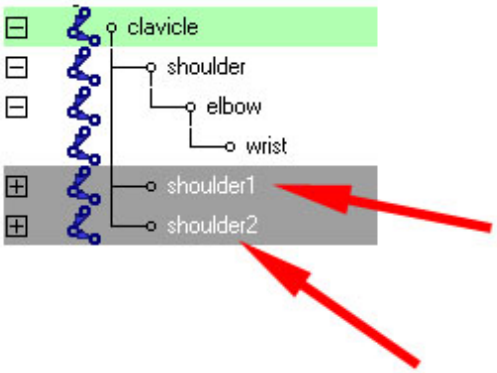
Select the **shoulder** Joint and **Duplicate** it twice.

Edit > Duplicate (Ctrl + D)



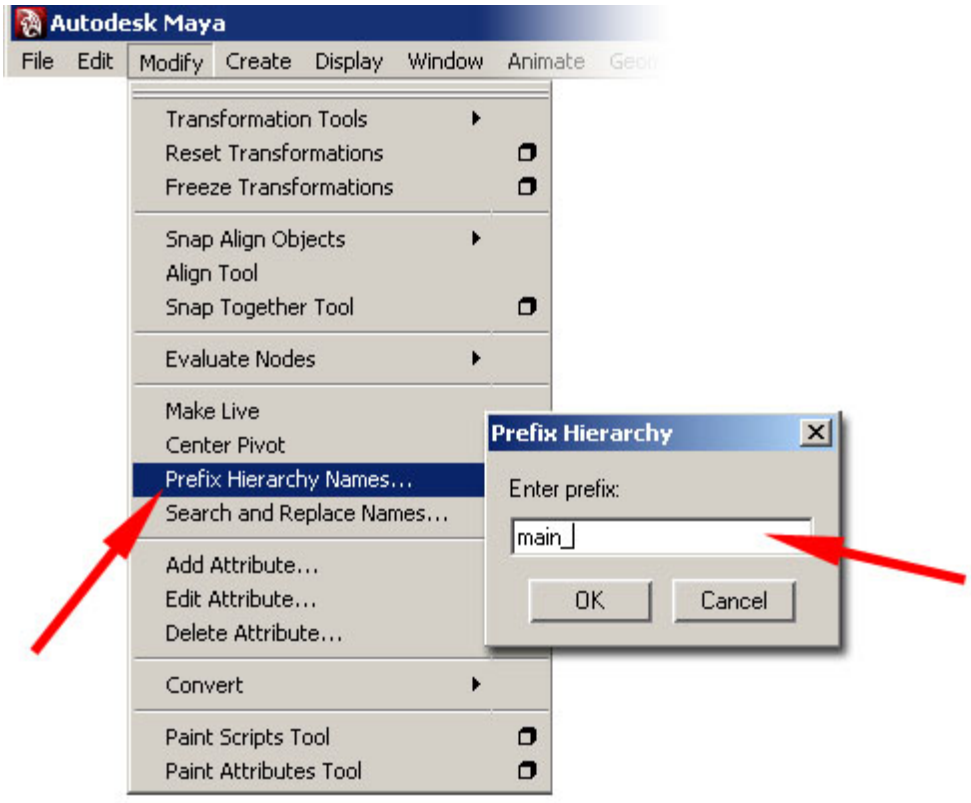
Note : It's probably a good idea to **RESET** the **Duplicate Tool** before Duplicating – just to be safe.

Take a look in the **Outliner**. You should have a single Clavicle Joint and 3 shoulders joined to it.



Re-name all the joints by using the **Prefix Hierarchy** Tool**. Select** a **shoulder** in the **Outliner**, open the **Prefix Hierarchy** tool and enter the prefix. This will append (add) the prefix to the beginning of the names of all the Joints beyond the shoulder currently selected.

Modify > Prefix Hierarchy Names… > enter the prefix & an underscore (_)

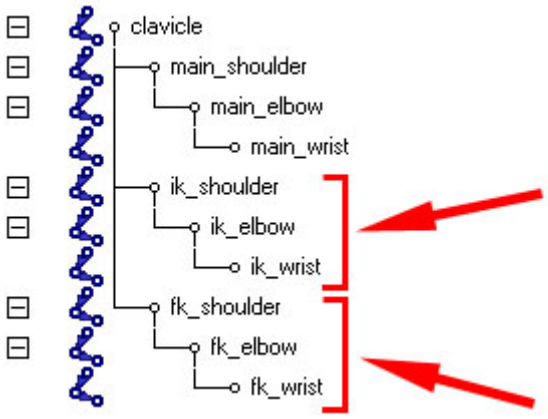


Name the 3 sets of arms joints as follows…

FK = fk_shoulder > fk_elbow > fk_wrist
Main = main_shoulder > main_elbow > main_wrist
IK = ik_shoulder > ik_elbow > ik_wrist

Note : You may need to remove the numerical suffixes from the shoulder Joints.

Extend [+] the **Outliner** view and check the labelling against the diagram below.



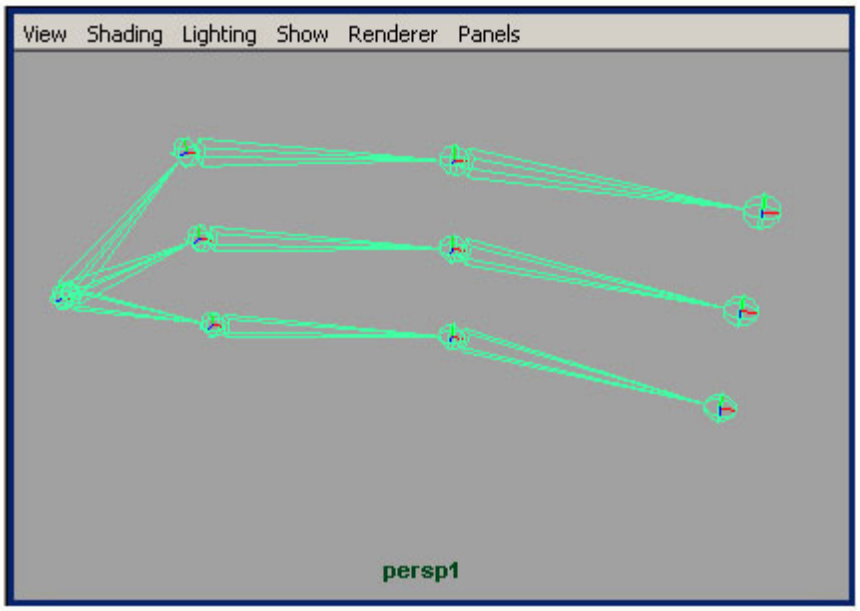
[3] Separating and Disconnecting the IK Joint and FK Joint
Visually separate the main, ik and fk Joints by selecting the ik_shoulder and fk_shoulder Joints up and down respectively.

ik_shoulder > W Key (translate) > local axis (PC=Insert : MAC=Home)

Move (Translate) **ik_shoulder up.**

fk_shoulder > W Key (translate) > local axis (should already be active)

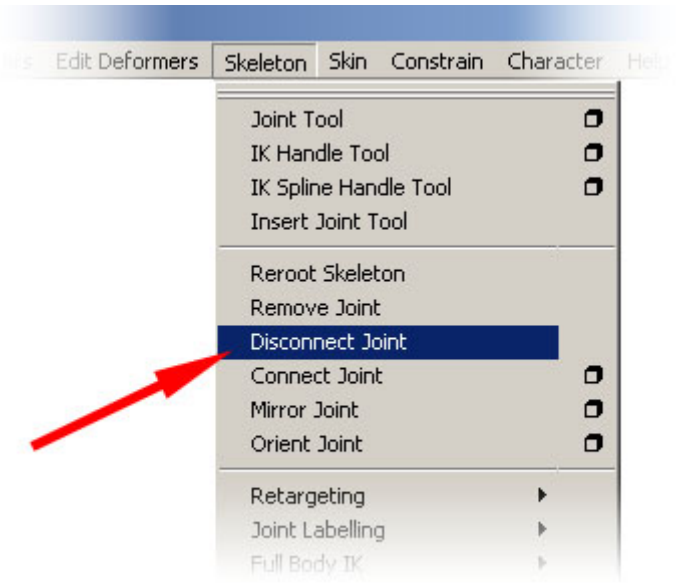
Move **fk_shoulder down.**



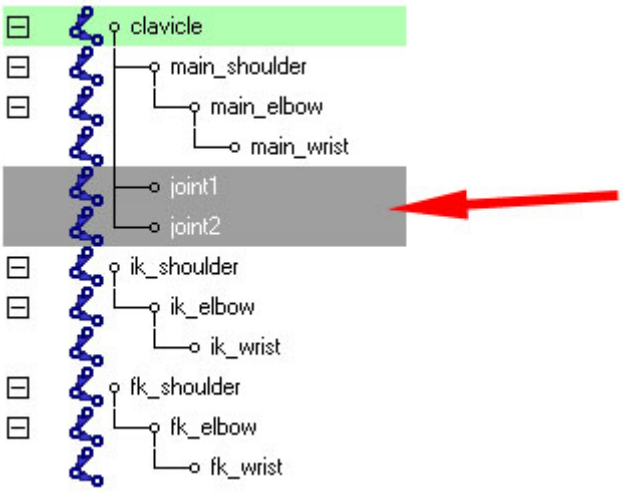
As you can see, the ik_shoulder Joint and fk_shoulder Joint are still connected to Clavicle Joint.

Remove the connections (bones) to the ik_shoulder Joint and fk_shoulder Joint by selecting each Joint and **Disconnecting Joint**.

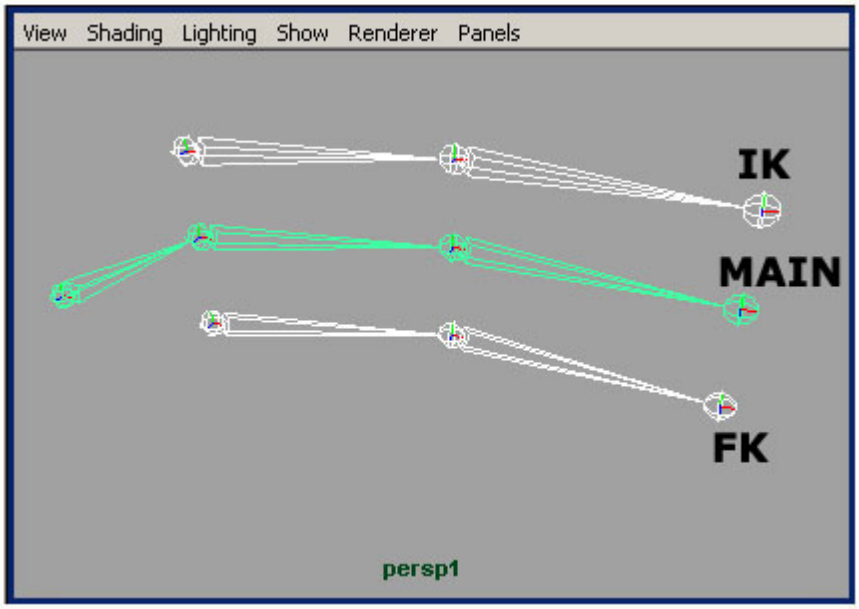
Animation > Skeleton > Disconnect Joint

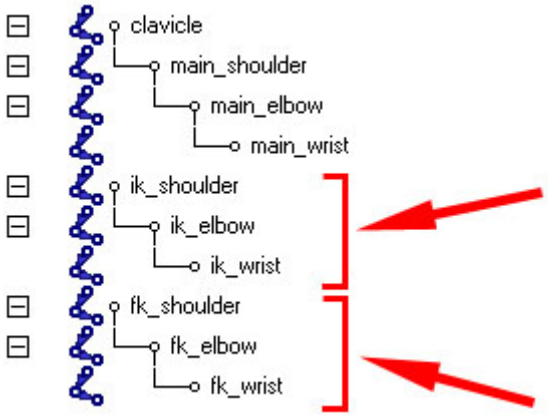


When you Disconnect a Joint a new Joint is placed in the same place to preserve the bone. Select **2 new Joints** in the **Outliner** and **Delete** them.



At this point you should have the original set of main Joint PLUS a set of arm joints for IK (above) and a set of joints of FK (below). See the diagram below.

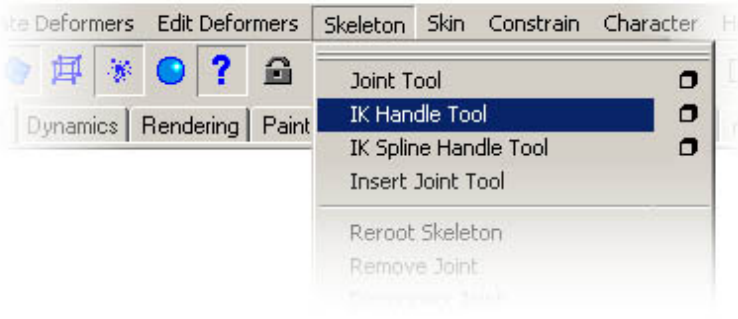




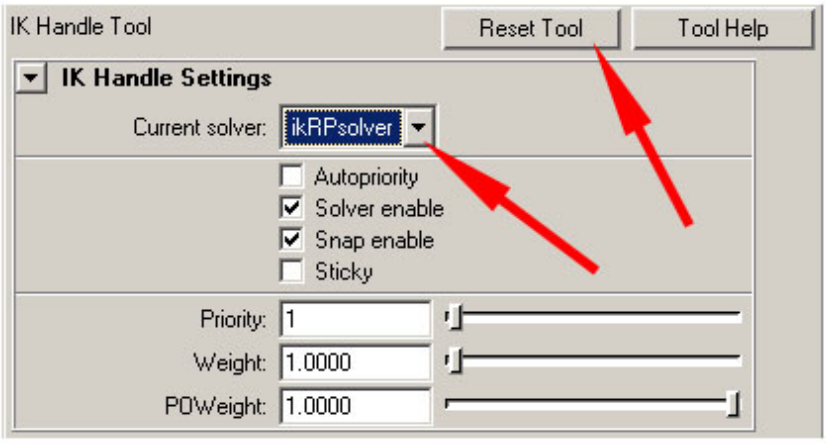
[4] Add the IK Handle

The next thing you need to do is add the IK Handle to the IK Joints.

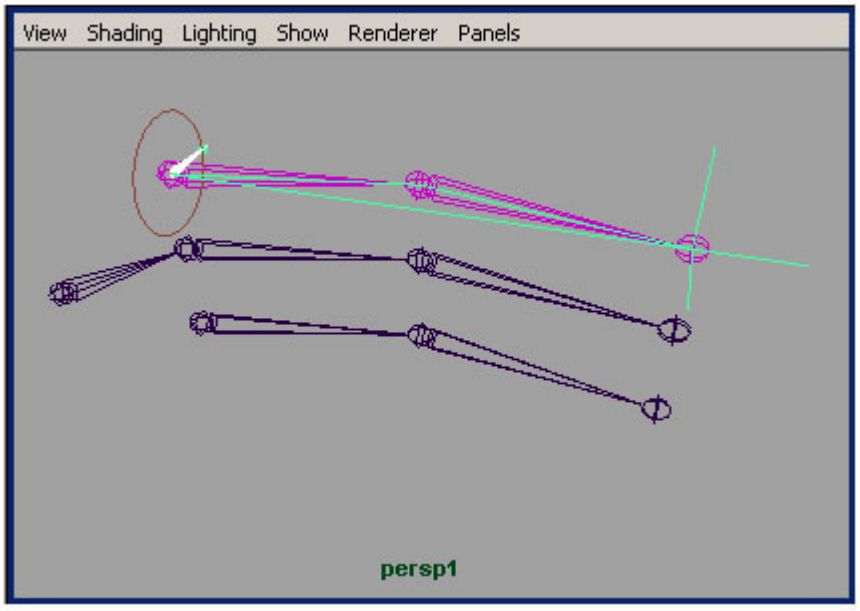
Animation > Skeleton > IK Handle Tool > Options



Reset the IK Handle Tools. Set the **Current Solver** to a **Rotation Plane Solver**.



Create an **IK Handle** from the **ik_shoulder** to the **ik_wrist**.



[5] Constraining main Joints(middle) to IK(above) and FK(below) Joints
The object here is to get the main Joints to follow the **orientation** of the IK Joints and FK Joints.

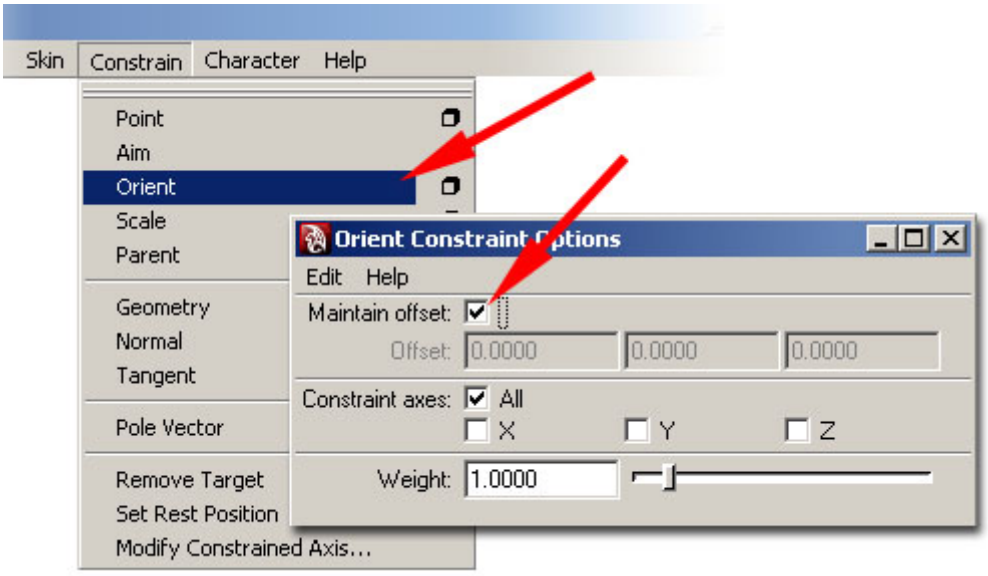
To apply an Orient Constrain, first select FK Joint, then IK Joint and finally the Main Joint (select the Commanders first and the Soldier last).

Follow the steps below to apply and Orient Constraint to the main_shoulder, main_elbow and main_wrist Joints.

> Select **fk_shoulder** > **ik_shoulde**r > **main_shoulder** > Constraints > Orient (Maintain Offset ON).

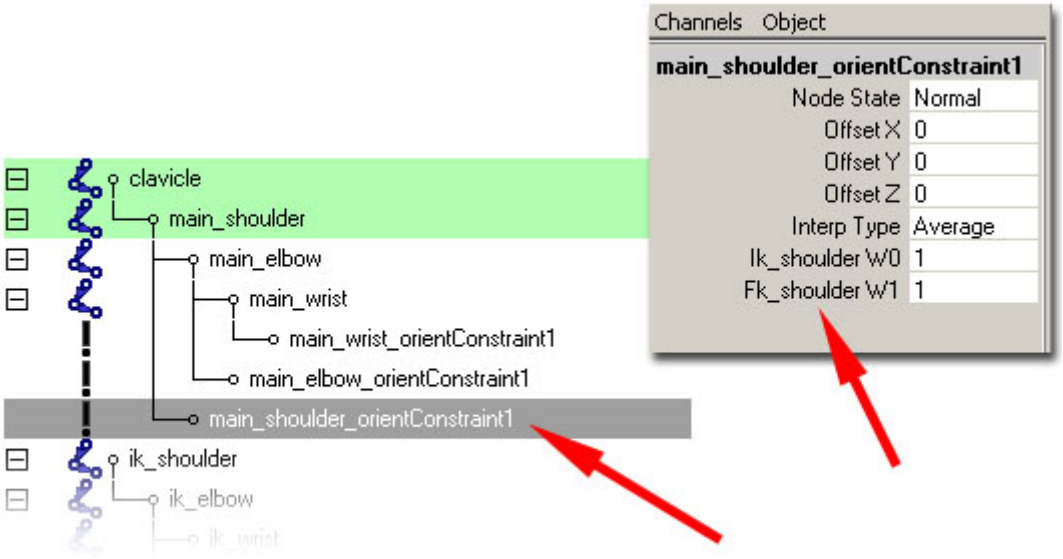
Select **fk_elbow** > **ik_elbow** > **main_elbow** > Constraints > Orient (Maintain Offset ON)

Select **fk_wrist** > **ik_wrist** > **main_wrist** > Constraints > Orient (Maintain Offset ON)



At this stage the orientation of the **main** Joints is controlled 50% by the **FK** Joints and 50% **IK** Joints

Note : Open the **Outliner** to **check** if the **Orient Constraints** have been applied correctly. Select main_shoulder joint. Notice main_shoulder now has an Orient Constrain Node (**!** main_shoulder_orientConstraint1). Select the Constraint Node and have a look at the Channel box - It should have 2 weight input Attributes – ik_shoulder W0 and fk_shoulder W1.



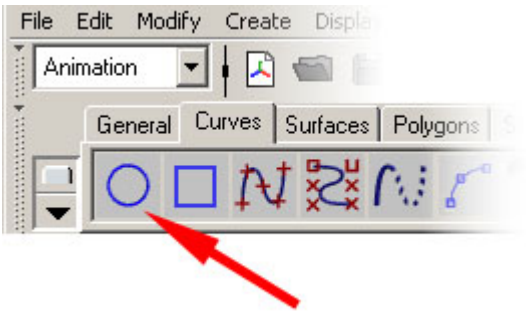
Check that main_elbow and main_wrist also have Orient Constraint Node have 2 weight input Attributes (As shown above).

The values are both set to **1** meaning the Orientation of main_shoulder is **equally** weighted between the ik_shoulder Joint and fk_shoulder Joint.

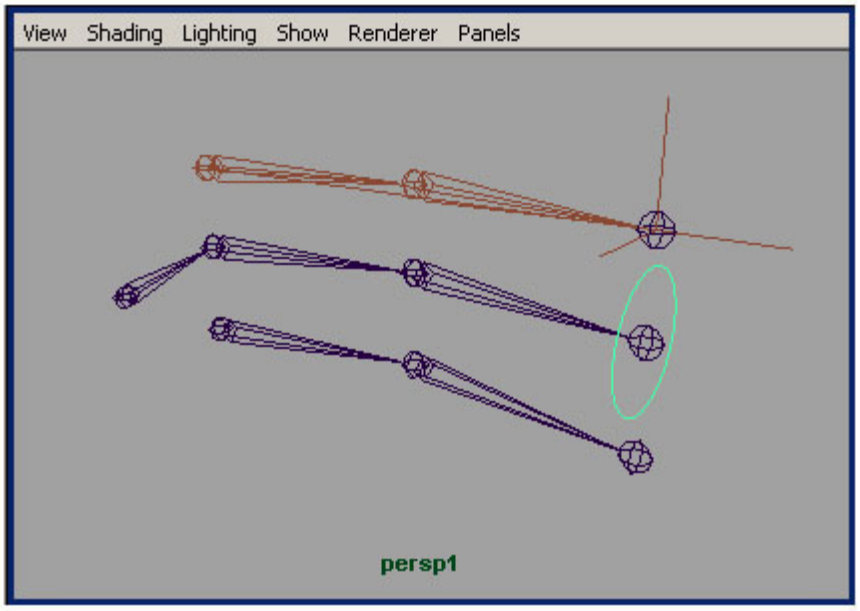
The objective is to create a switch that will allow you to smoothly transform from IK to FK and back again at any point in your animation.

[6] Create an Switch Controller (IKFK_controller)
Create a **NURBS Circle** to use as a Control Object. Positioned the Control Object on main_wrist. Renamed the Control Object **IKFK_controller**. Add an Attribute to IKFK_controller called **IK_to_FK** (minimum value 0 – maximum value 10). The IK_to_FK Attribute will allow you to switch the weightage of the main Joints between IK and FK Joints.

Shelf > Curves > Circle

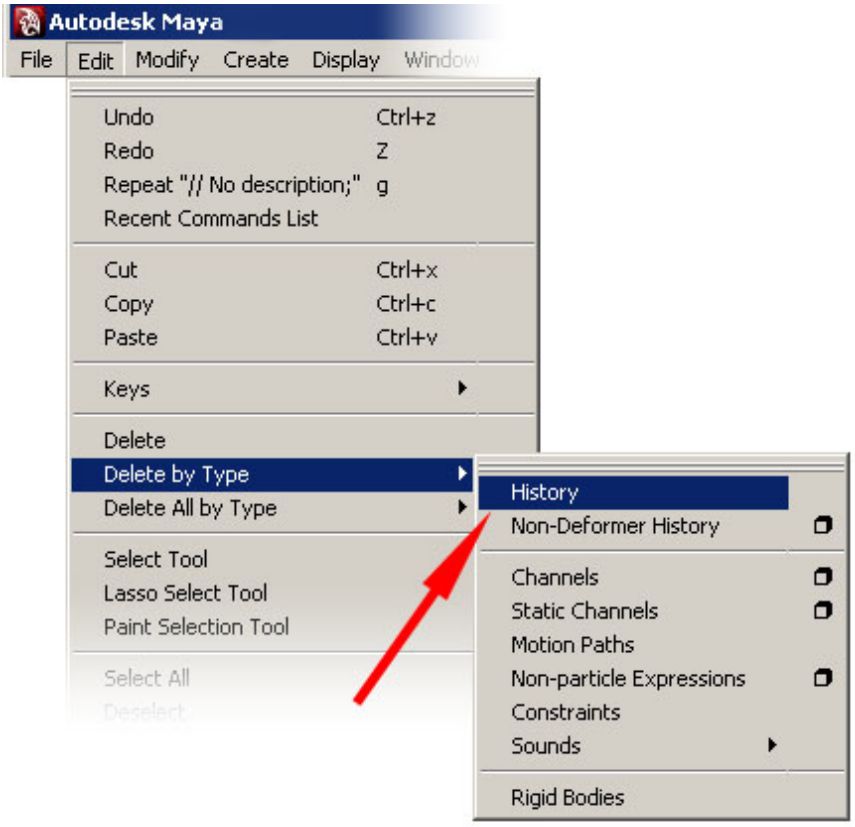


Move (Translate) the NURBS Circle and snap it to the main_wrist Joint. Rotate the NURBS Circle 90°

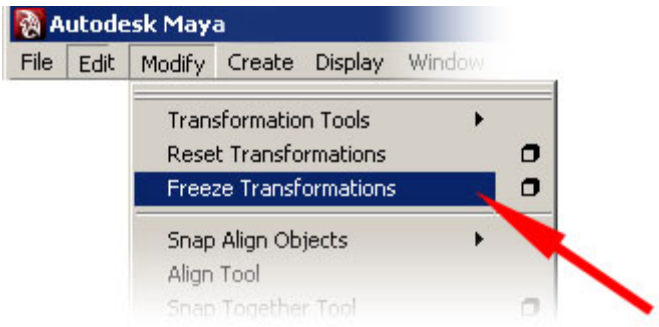


Note : Move + V key to snap to main_wrist Joint. Circle appears at the centre of the axis, click in the circle and drag it to main_wrist joint.

Delete the History



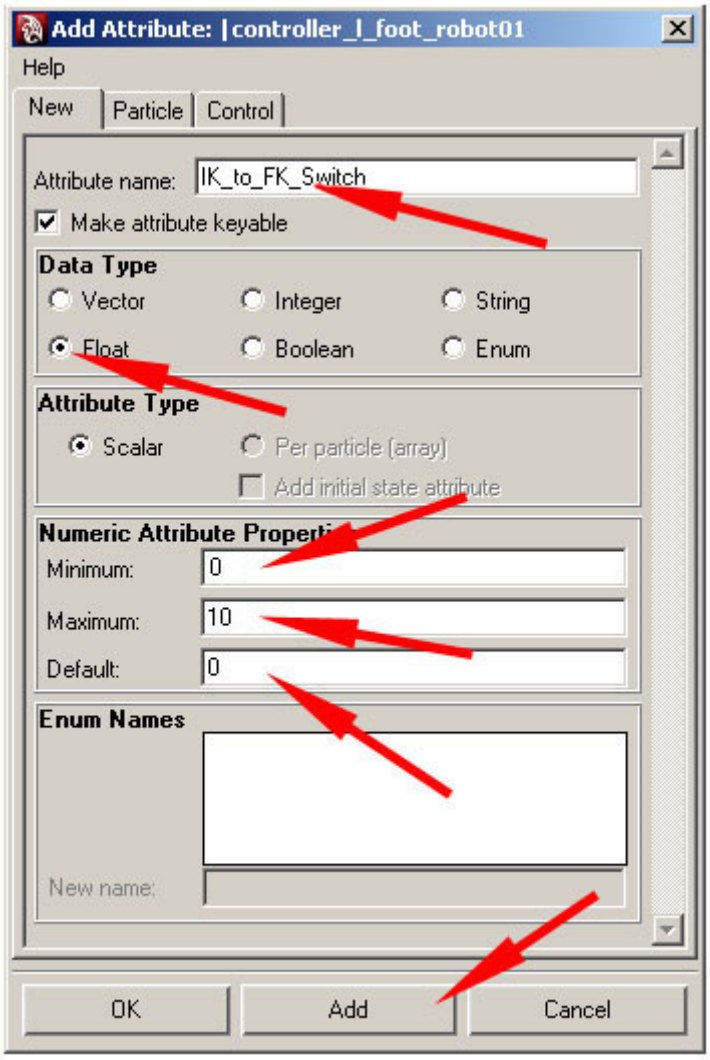
Freeze the Transformations



Name the NURBS Circle > **IKFK_Controller**

Select **IKFK_Controller**. Open the **Channel Box** and **RMB** on the list of Attributes. Select **Add Attribute**.

Enter the values as indicated in the diagram below.



Note : Minimum 0 means the IK is fully enabled (FK is disabled). Maximum 10 mean FK is fully enabled (IK is disabled).

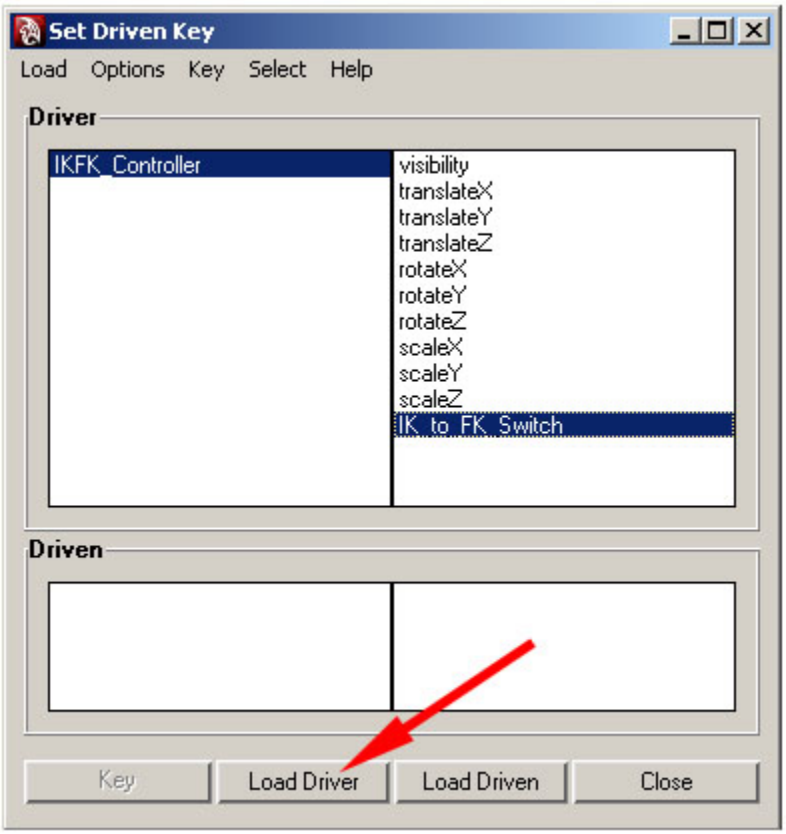
[7] Set Driven Key

The objective now is to define and set key values for the IK_to_FK_Switch Attribute and match them with values for the Orientate Constraint values.

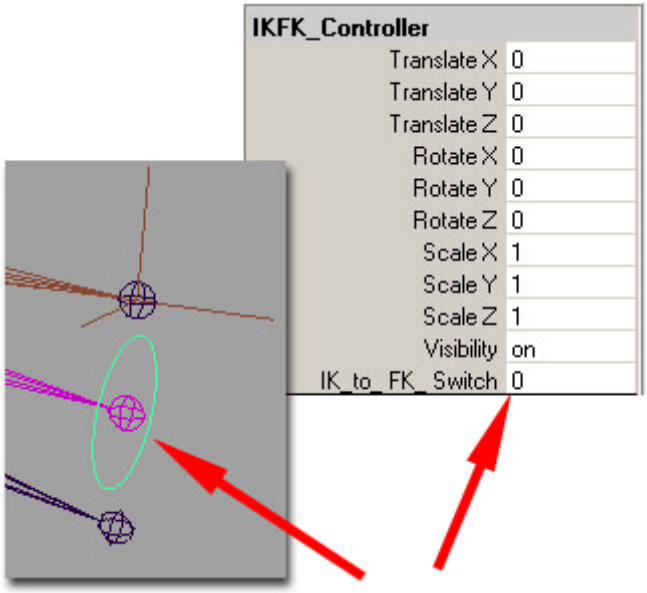
Open the Set Driven Key dialogue box...

Animation > Animate > Set Driven Key > Set

The IKFK_Controller has the newly define IK_to_FK_Switch Attribute. **Load** the **IKFK_Controller** as the **Driver** and select the **IK_to_FK_Switch** Attribute.

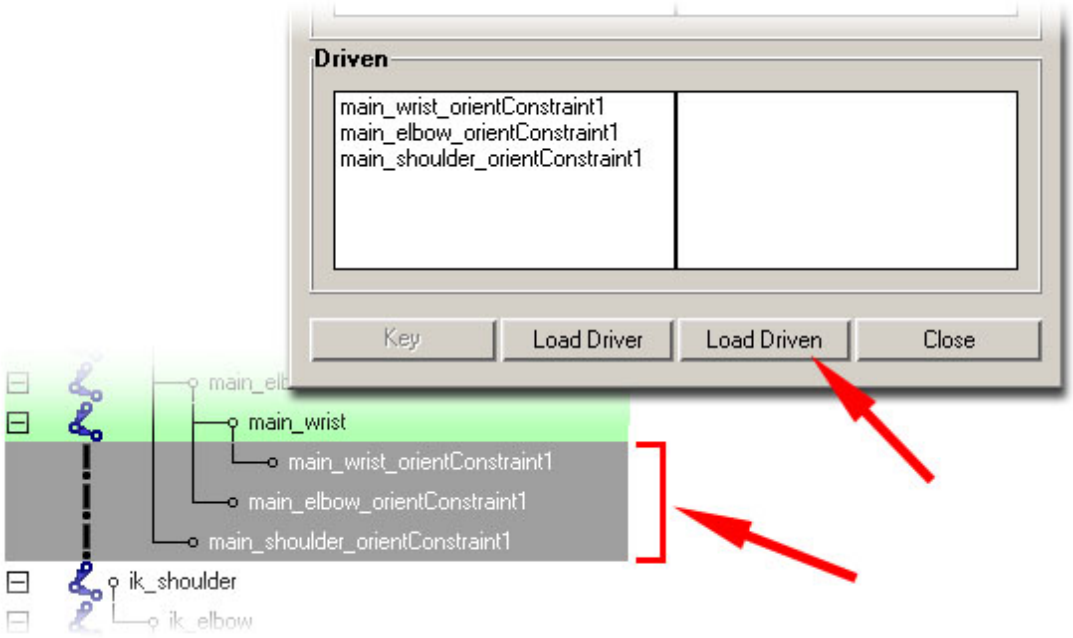


Access the **Channel Box** and set the **IK_to_FK_Switch** value to **0**.



You now need to set the weightage values for main_shoulder, main_elbow and main_wrist. When the IK_to_FK_Switch is set to 0, the weightage should be 100% towards the FK Joints and 0% towards the IK Joints.

Open the **Outliner** and Expand [+] main_shoulder. Select all 3 orientConstraints and click **Load Driven.**

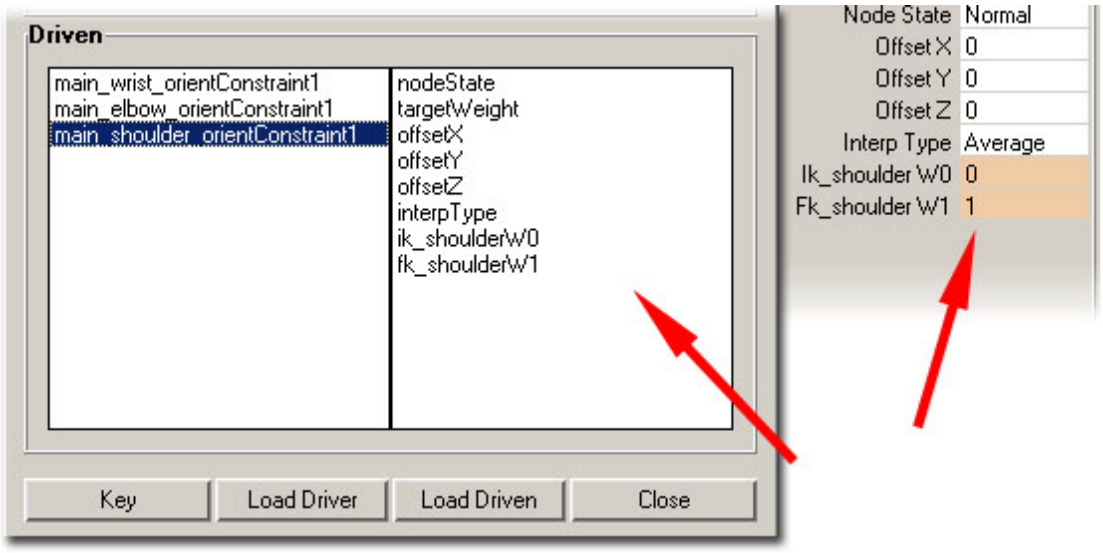


The objective now is to set all 3 Orient Constraints values to 0 for IK and 1 for FK.

Select **main_shoulder_orientConstraint1** in the **Driven** window. Then select ik_shoulderW0 and fk_ shoulderW1.

In the Channel Box, change the values of ik_shoulderW0 and fk_shoulderW1.

ik_shoulderW0 = 0
fk_shoulderW1 = 1



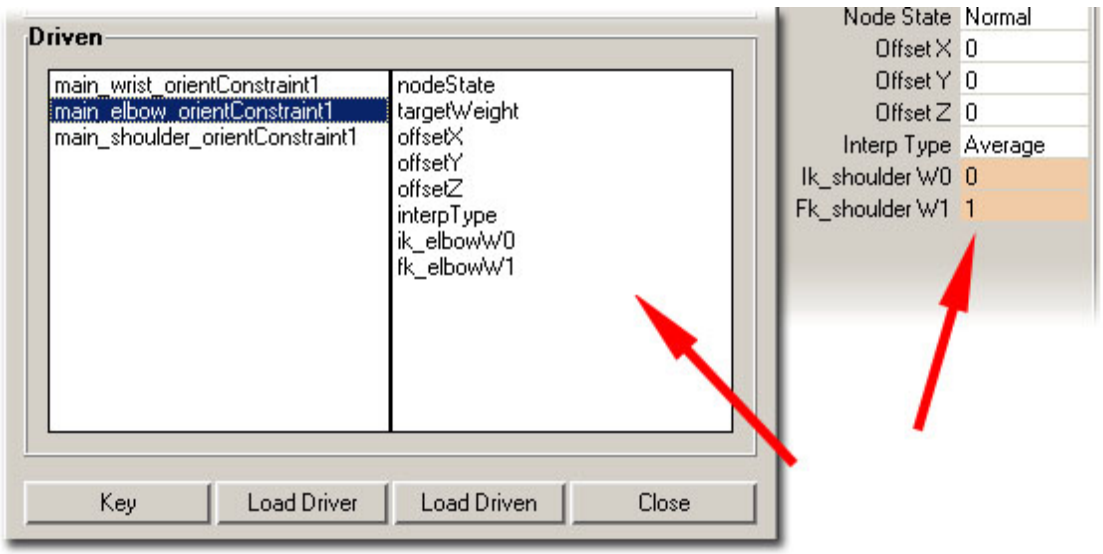
Click **Key** to set the values.

Follow the steps below to **repeat** these steps above and set the **Orient Constraint** for **Elbow** and **Wrist** also in favour of fk_shoulderW1

Select **main_elbow_orientConstraint1** in the **Driven** window. Then select **ik_elbowW0** and **fk_shoulderW1** from the list of Attributes.

In the **Channel Box**, change the values of ik_elbowW0 and fk_elbowW1.

ik_elbowW0 = 0
fk_elbowW1 = 1

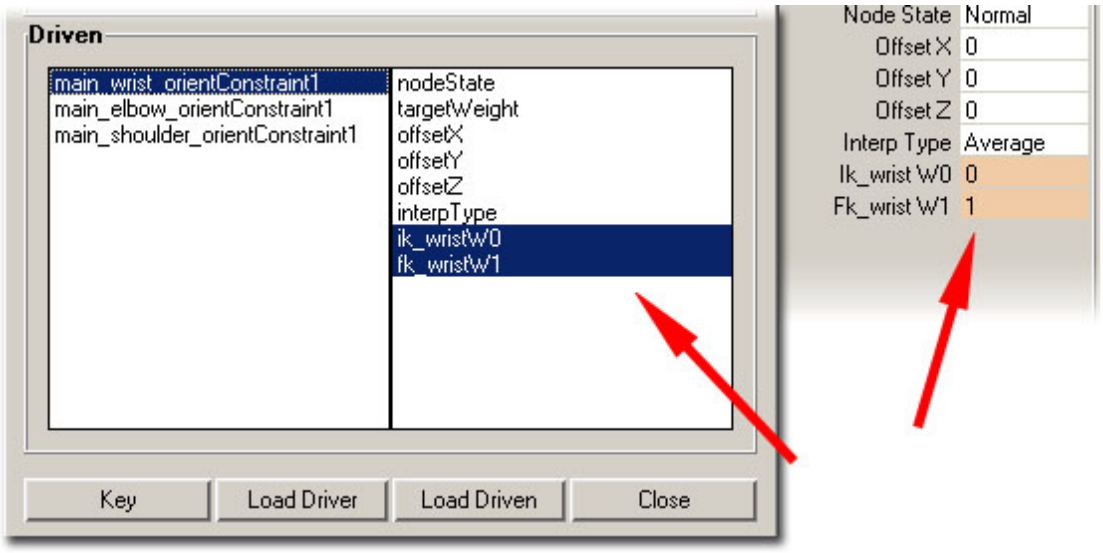


Click **Key** to set the values.

Select **main_wrist_orientConstraint1** in the **Driven** window. Then select **ik_wristW0** and **fk_wristW1** from the list of Attributes.

In the **Channel Box**, change the values of ik_wristW0 and fk_wristW1.

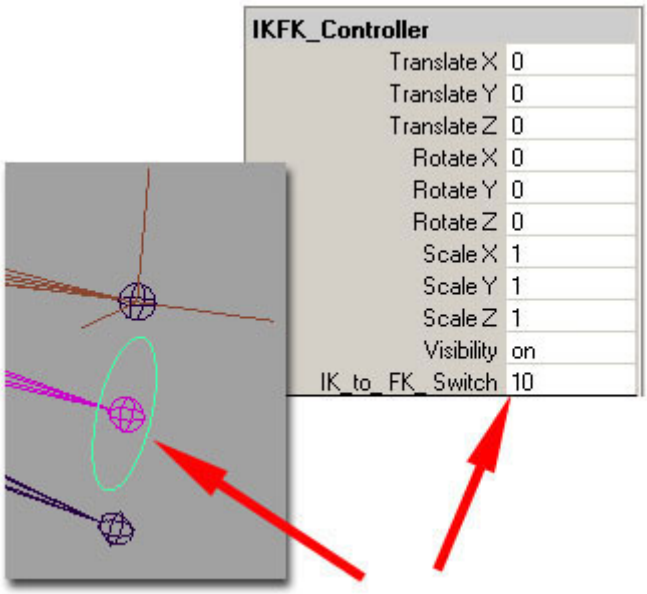
ik_wristW0 = 0
fk_wristW1 = 1



Click **Key** to set the values.

The objective now is to set the **IK_to_Switch** value to **10** and the Orient Constraint for main_shoulder, main_elbow and main_wrist to favour IK Joint Chain.

Select the **IKFK_Controller** and in the channel box set the **IK_to_FK_Switch** value to **10**.

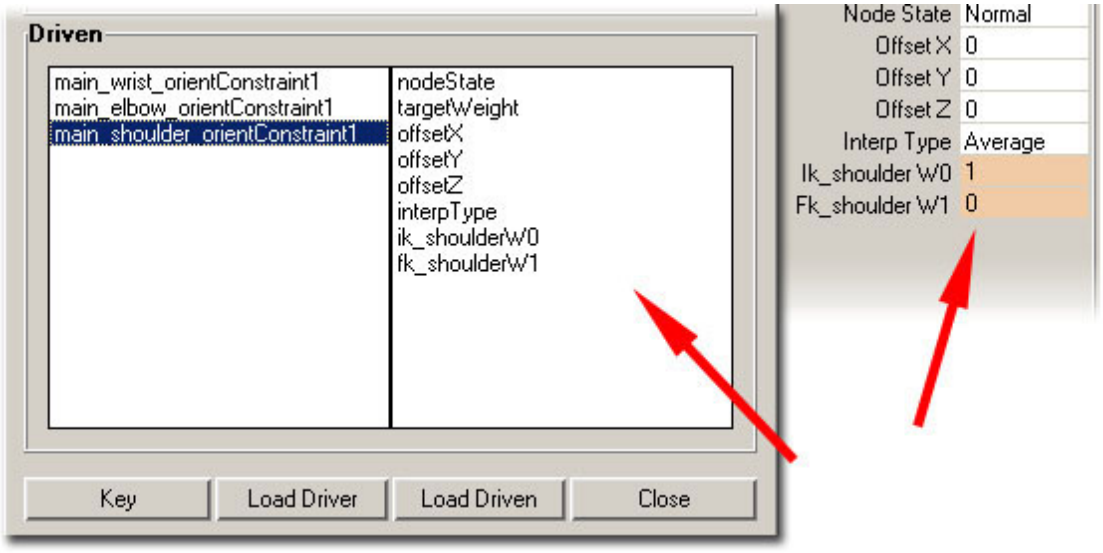


Now set all 3 Orient Constraints to 1 for IK and 0 for FK.

Select **main_shoulder_orientConstraint1** in the **Driven** window. Then select **ik_shoulderW0** and **fk_shoulderW1** from the list of Attributes.

In the **Channel Box**, set the values of ik_shoulderW0 and fk_shoulderW1.

ik_shoulderW0 = 1
fk_shoulderW1 = 0

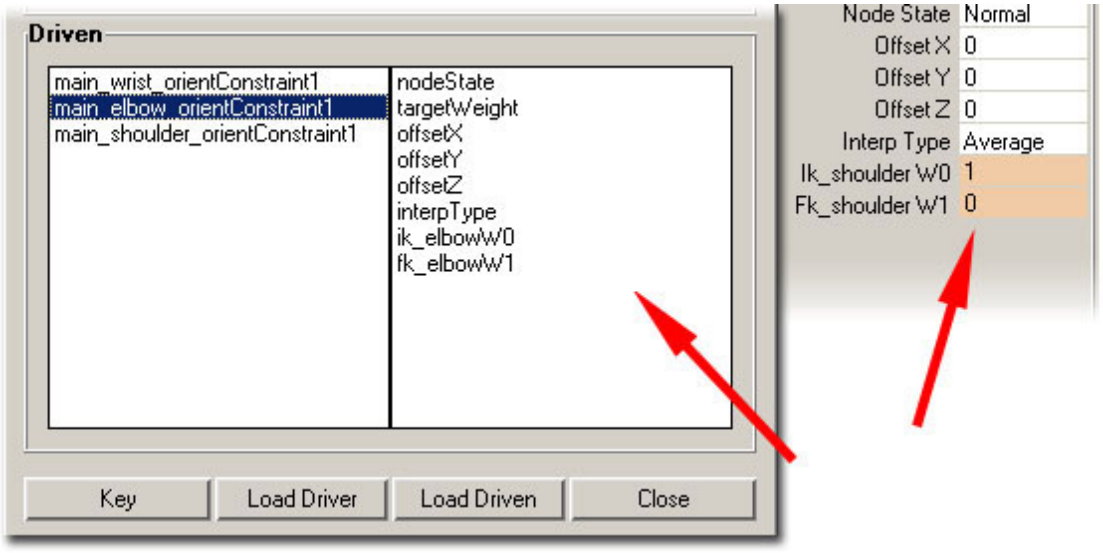


Click **Key** to set the values.

Select **main_elbow_orientConstraint1** in the **Driven** window. Then select ik_elbowW0 and fk_shoulderW1 from the list of Attributes.

In the Channel Box, change the values of ik_elbowW0 and fk_elbowW1.

ik_elbowW0 = 1
fk_elbowW1 = 0

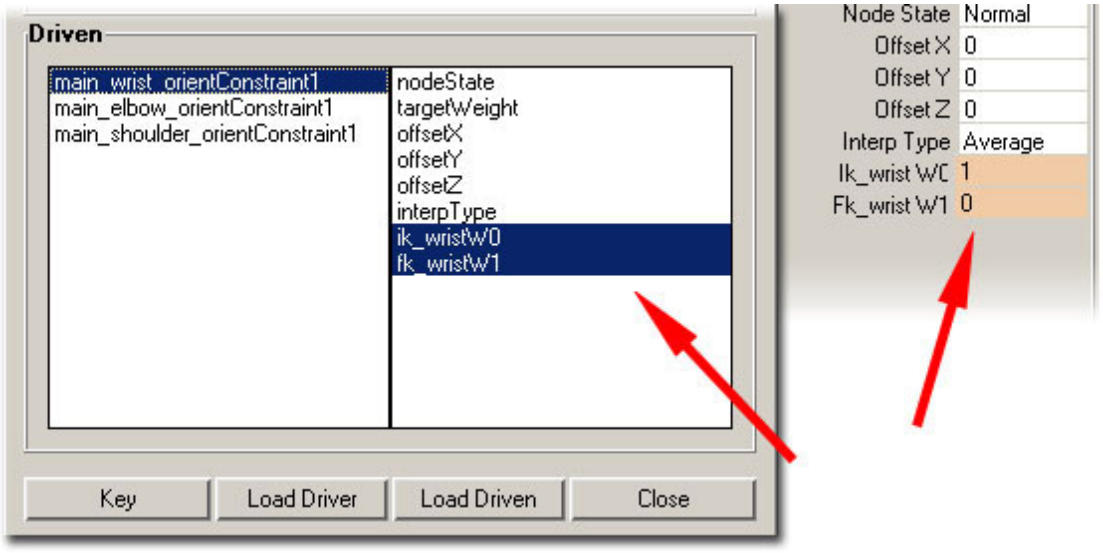


Click **Key** to set the values.

Select **main_wrist_orientConstraint1** in the **Driven** window. Then select ik_wristW0 and fk_wristW1 from the list of Attributes.

In the Channel Box, change the values of ik_wristW0 and fk_wristW1.

ik_wristW0 = 1
fk_wristW1 =0



Click **Key** to set the values.

Note : You will no longer animate any of the Joints in the **main** Joints Chain. Instead you will decide if you need IK or FK functionality to animate. You will then select the **IKFK_Controller** object (NURBS circle) and set the **IK_to_FK_switch** value to either **0** (IK) or **10** (FK).

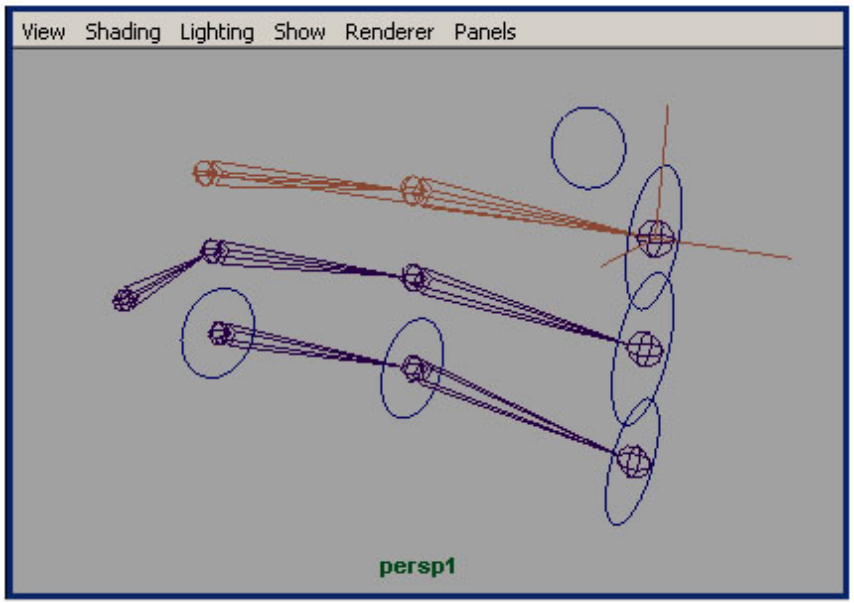
Having the values 0 to 10 for the IK_to_FK_switch allows you to gradually switch from the IK Joints to the FK Joints without jumping or “popping”.

In the **Outliner**, select the **ik_shoulder** and notice that main_shoulder is now **Pink**. This indicates that **main_shoulder** is **Constrained** in some way to **ik_shoulder**.

Now select **fk_shoulder** and notice that **main_shoulder** is still **Pink**. This indicates that **main_shoulder** is **Constrained** in some way to **fk_shoulde**r.

[8] Create controllers for FK and IK

Using a NURBS Circle, create 5 control objects and shown the diagram below.



Name them as follows…

1. ik_arm_control
2. ik_elbow_pole_control (this control object is used to control the elbow position, so it is placed behind the elbow)
3. fk_shoulder_control
4. fk_elbow_control
5. fk_wrist_control

Delete the **History** and **Freeze Transformations**.

IK Arm Rigging

1. Select **ik_arm_control** and then select the **IK Handle** (arm_ik). Apply a **Point Constraint**.
2. Select **ik_arm_control** and then select **ik_wrist**. Apply an **Orient Constraint**.
3. Select **ik_elbow_pole_control** and then select the **IK Handle** (arm_ik). Apply a **Pole Vector Constraint**.

FK Arm Rigging

1. Select **fk_shoulder_control** and then select the **fk_shoulder**. Apply a **Parent Constraint**.
2. Select **fk_elbow_control** and then select the **fk_elboe**. Apply a **Parent Constraint**.
3. Select **fk_wrist_control** and then select the **fk_wrist**. Apply a **Parent Constraint**.
4. Parent (P Key) **fk_wrist_control** to **fk_elbow_control** to **fk_shoulder_control** to **clavicle**

Main Arm Rigging

1. Select **main_wrist** and then select the **IKFK_Controller**. Apply a **Parent Constraint**.