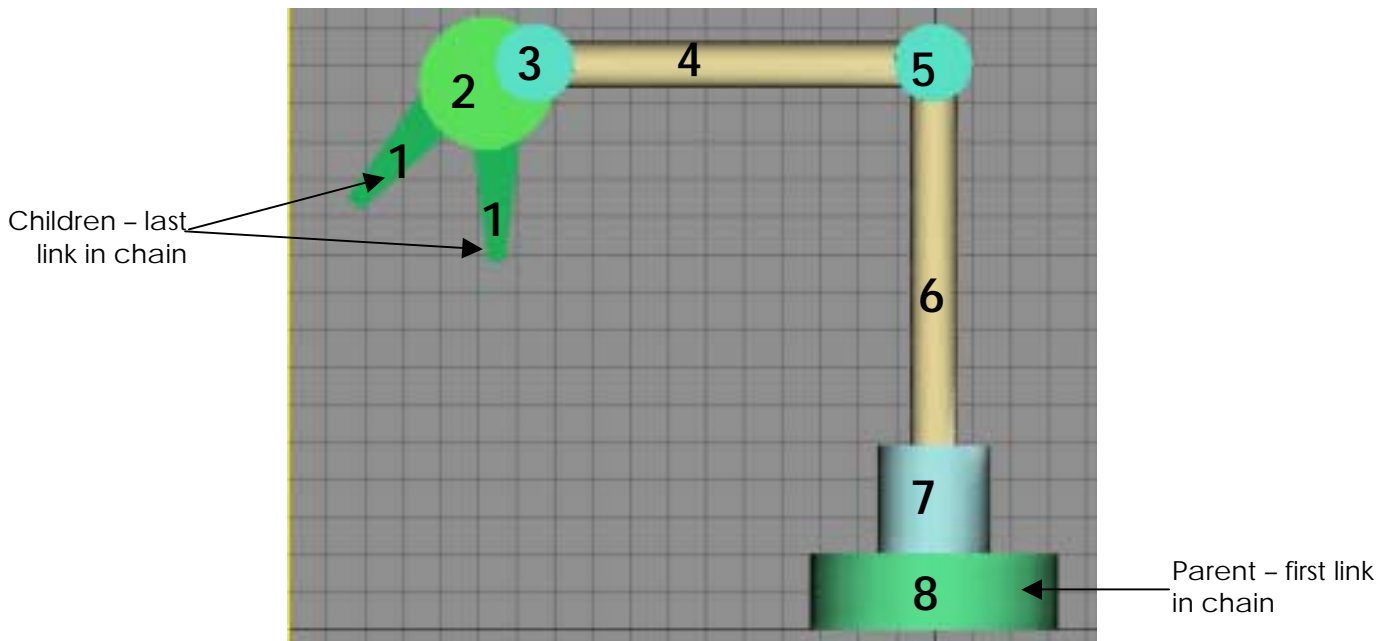


# Forward Kinemation with Segmented Objects (Robot and Ball Animation)

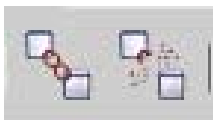
In this exercise you will learn to use forward kinemation in animation; this method is perfect for animating segmented objects. First link the different object segments creating a child/parent relationship; second, change the axis of movement for each animated part; third, animate the arm so it moves.

**Forward Kinemation:** linking segmented objects from child to parent. Transforming the child represents an independent movement and transforming the parent transforms all the children.

**Robot:** below is illustrated in the link order. Parent if the base of the robot arm (moving the base moves the entire armature) and the last child objects are the fingers at the end of the linking (moving the fingers moves only the fingers).



**Link Tool:** Click on child object and drag to parent object to link. Use unlink to break hierarchy created by linking.



*link/unlink*

## 1) Link robot for animation

Select Link tool

Select two fingers labeled #1 in above illustration (*CTRL-click on fingers to select*); drag to round cylinder #2 to link.

## IDST 147 3D Imaging for Multimedia

- Click on #2 - link to #3
- Click on #3 - link to #4
- Link #4 to #5
- Link #5 to #6
- Link #6 to #7
- Link #7 to #8 (this is the base or parent object)

### 2) Confirm Object Linking.

Open the Schematic View



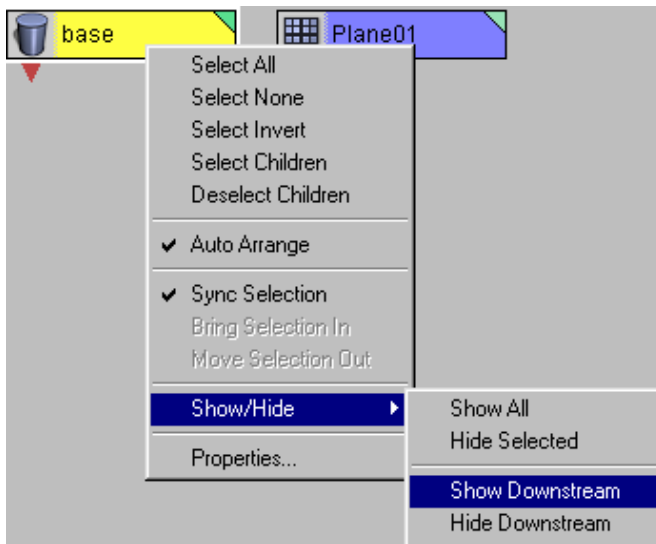
*schematic view*

right-click on 'base' object in schematic view

*(the plane object is the floor and should not be linked to anything)*

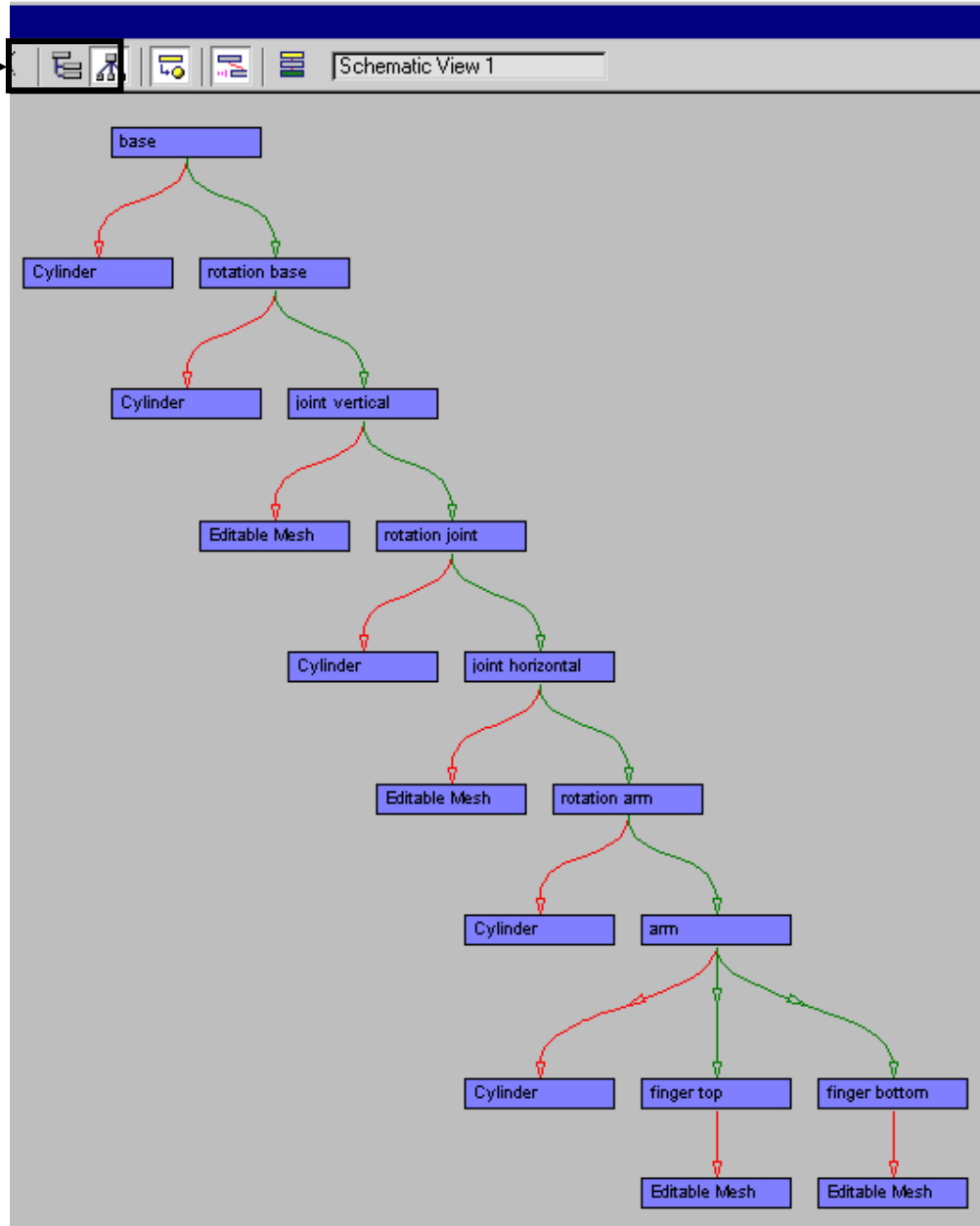
choose menu item: show/hide: show downstream

*this reveals the children and linkage between objects*



If everything is linked correctly close the schematic view to next set up link axes.

These buttons  
are toggled to  
see the links

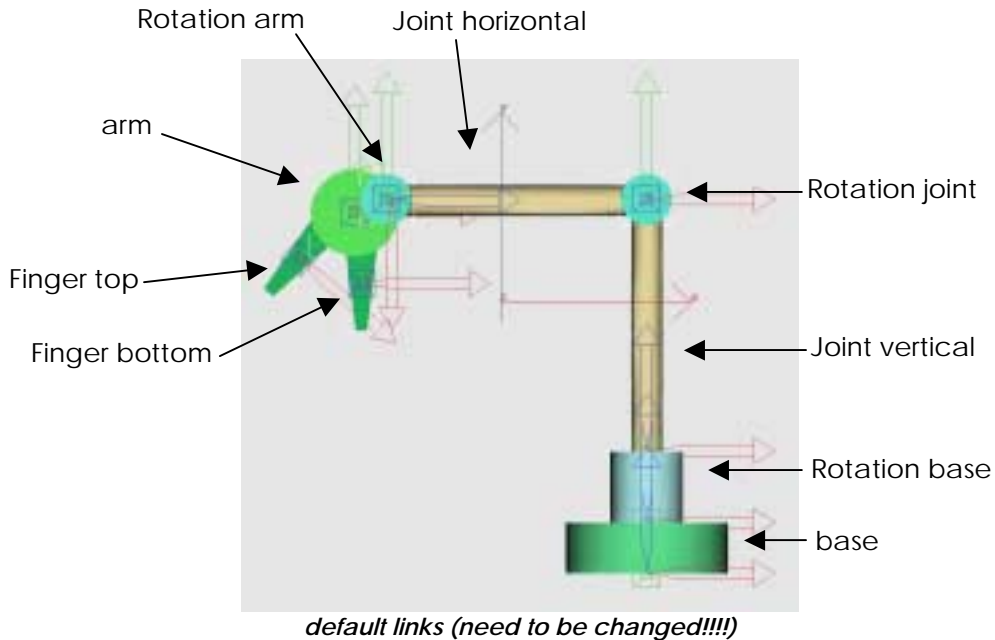


*green arrows represent linkage (parent is at top of chart – children are at bottom)*

if you accidentally linked the wrong objects you can fix them in this view using the unlink/ link tools to revise. Select the child object you want to relink and click-drag with the link tool in the schematic view. All children under that child will also be relinked to the new parent.

### 3) Set axis positions for rotation and movement constraint of robot arm

In order for the animation to be easy to execute the axis for each object must be adjusted so rotation happens on joints, not the center of the object.



**Base:** no need to change

**Rotation Base:** centered to object; otherwise no change

**Joint vertical:** centered to object / base of object; otherwise no change

**Rotation joint:** centered to object

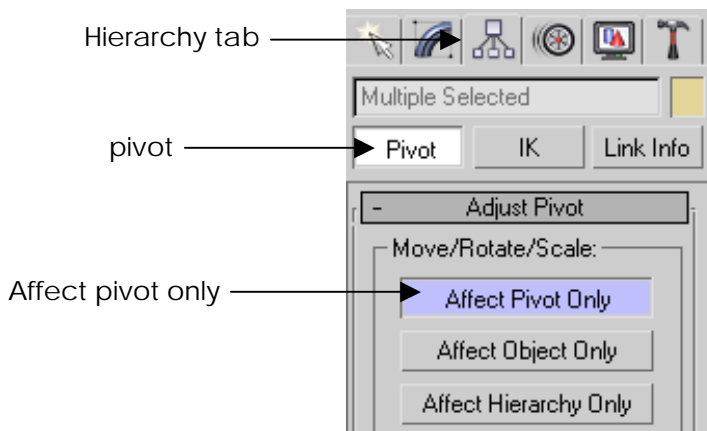
**Joint horizontal:** axis on right side of object (closest to rotation joint)

**Rotation arm:** centered to object; otherwise no change

**Arm:** moved to top right area of object in line with rotation arm

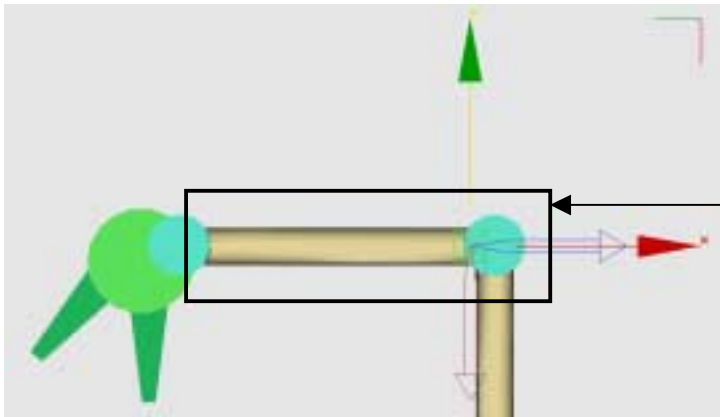
**Finger top:** moved to top right of finger in line with arm

**Finger bottom:** moved to top right of finger behind inside edge of arm



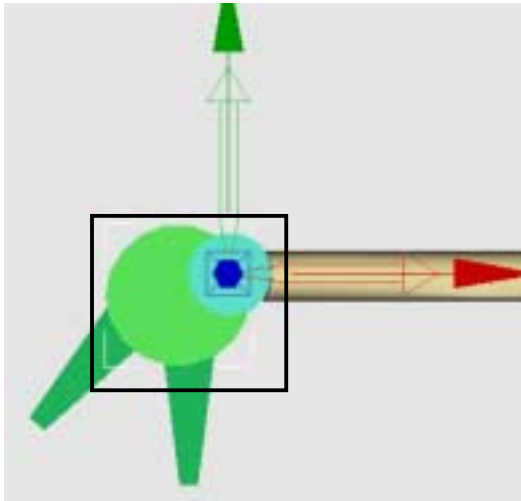
# IDST 147 3D Imaging for Multimedia

To change axis center: Select hierarchy tab  
choose pivot  
**highlight:** affect pivot only

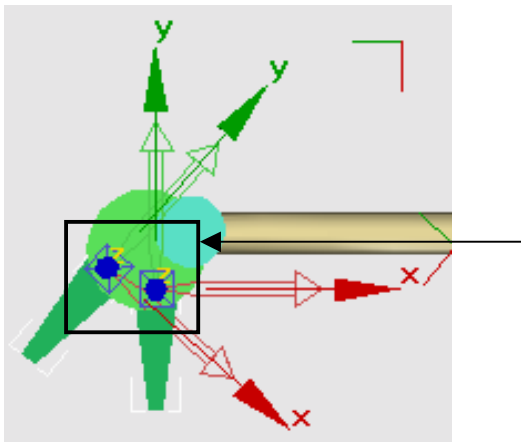


Select move tool  
and move axis

*with joint horizontal selected – choose move tool and reposition axis*



*select arm and reposition axis to center of rotation arm*



*select each finger separately and move axis to edge of arm*

When axes are rigged, toggle **off Affect Pivot Only** Button in Hierarchy Tab.

#### 4) Lock Translation for the following objects

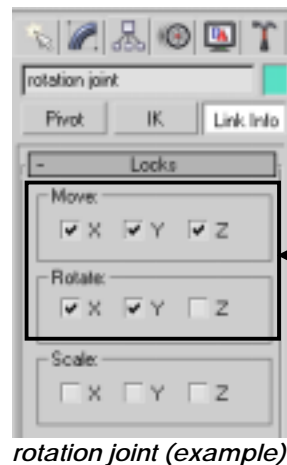
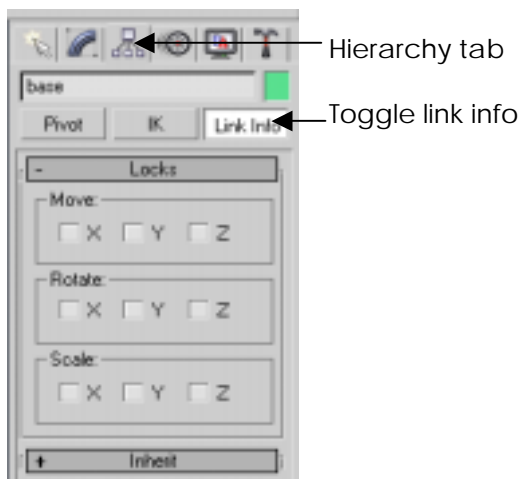
lock the following axis for each object so they rotate in one direction only:



To view pivot axis in viewport - change the reference coordinate system to local

#### 5) Check boxes to LOCK axis:

- Base:** rotate: x, y, z  
does not rotate but can be moved
- Rotation Base:** rotate: x, y, z; move: x, y, z  
Does not move or rotate
- Joint vertical:** rotate: x, y; move: x, y, z  
does not move but can rotate on z local axis
- Rotation joint:** rotate: x, y; move: x, y, z  
does not move but can rotate on the z axis
- Joint horizontal:** rotate: x, z; move: x, y, z  
does not move but can rotate on the y axis
- Rotation arm:** rotate: x, y; move: x, y, z  
does not move but can rotate on the z axis
- Arm:** rotate: x, y; move: x, y, z  
does not move but can rotate on the z axis
- Finger top:** rotate: x, y; move: x, y, z  
does not move but can rotate on the z axis
- Finger bottom:** rotate: x, y; move: x, y, z  
does not move but can rotate on the z axis



This is an example of how the move locks and rotate locks look (check means locked)

#### 6) Now the arm only rotates on the local axis not locked in the link info box

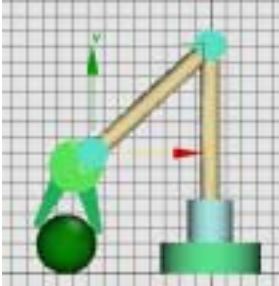
Select the rotate tool and rotate the arm. Notice the arm will only rotate on the local axis you have selected.

**7) Create a sphere (ball) in which the arm will pick up**

Create a sphere that fits between the fingers of the robot arm and move to position on the ground so it can easily be picked up by robot fingers

**8) Animate the arm rotating and moving over the ball until touching it**

I rotated rotation joint first then rotation arm second and finessed keys in the track view to make it look more realistic. Mine occurs In 15 frames. **Do not animate the Ball!!!!!!**



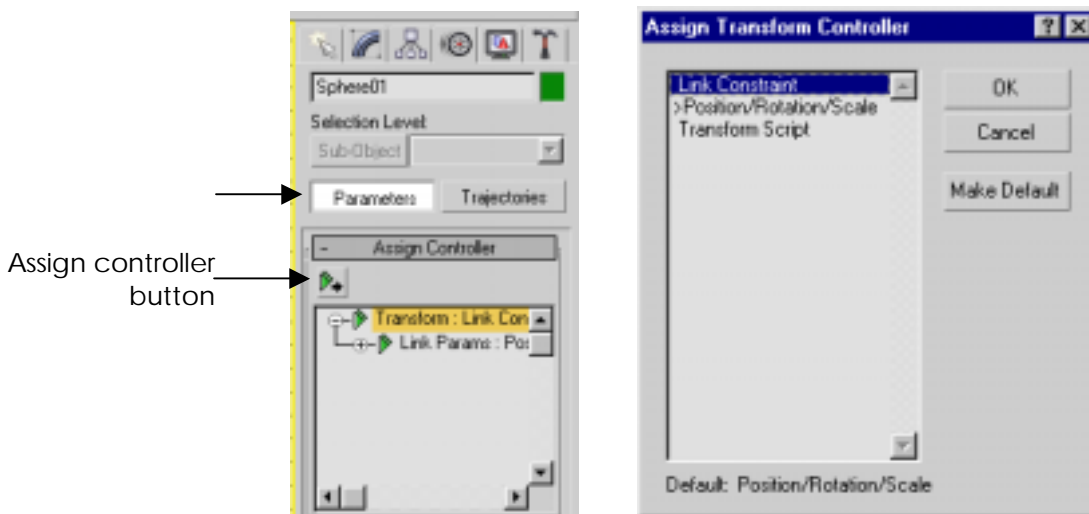
**9) Link ball to finger in last frame of the animation using a Link Constraint so when the arm moves up the ball will follow automatically**

the link constraint is the only way the linkage between 2 objects can be exchanged or passed to another object or removed (for example: the ball has its own motion but can also be controlled by the robot arm; in certain instances you don't want the arm to affect the position of the ball so pass the link from arm to dummy object)

Select the ball object

Select Motion Tab

Toggle Parameters and choose *Assign Controller: Link Constraint*



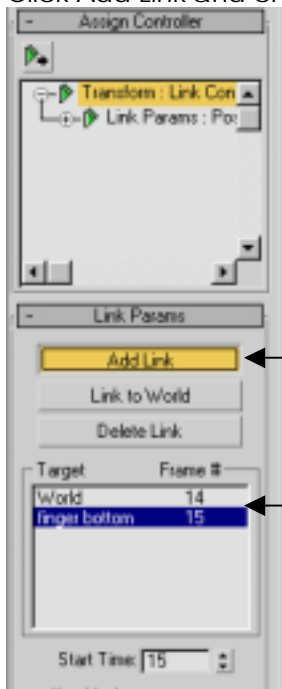
**Link to World**

Click *link to world* then change frame to -14 (*this is the frame prior to the pickup*)

**Link to finger (either one)**

## IDST 147 3D Imaging for Multimedia

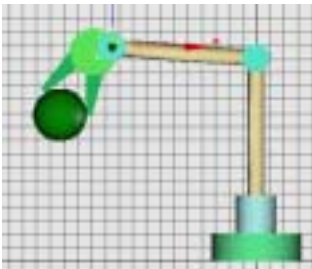
Click Add Link and change to frame 15 (*this is when the fingers 'grab' the ball*)



Toggle link to world first - make sure frame numbers match. toggle **add link** - click on finger in viewport to select - change frame number if necessary.

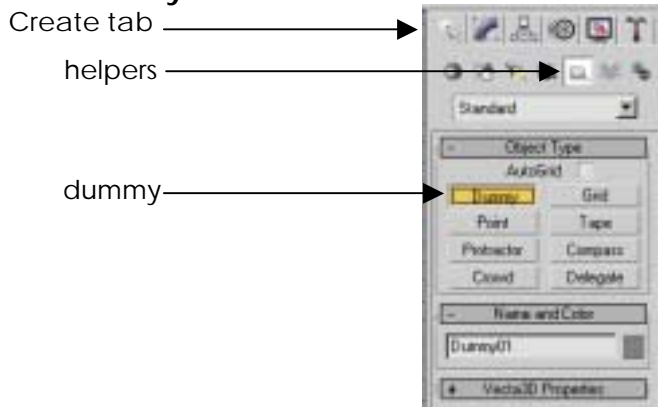
Untoggle add link

10) Animate the arm moving back up again similar to below



the end frame for this animation is frame 48

11) Create a dummy so that the ball can be linked to it and moved

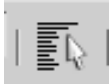


Place the dummy inside the ball

Move playback head to position where ball should fall from robot fingers.  
(you can animate the robot hands before or after this step) my animation of the fingers releasing the ball occurs between frame 48-50

approximately frame 50

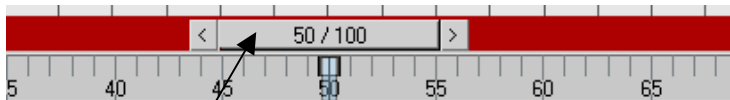
Select ball and click "add link" in link parameters box  
You might need to select using the select by name option



*select by link - choose dummy*

12) Create a key for the dummy object - this dummy moves the ball making it look as if it is bouncing

Select dummy at frame where link is created and create key for position, rotation, scale by right-clicking on the playback head.



Right-click here to create key for position, rotation, scale

Move playback head over to frame somewhere in the future (I moved it temporarily to frame 73)

Move dummy to ground (*the ball will follow: it is linked*)

Move to new future frame (I chose frame 100 this time)

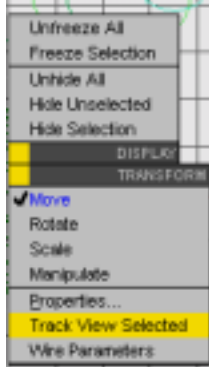
Move dummy up so it looks like a bounce

## IDST 147 3D Imaging for Multimedia

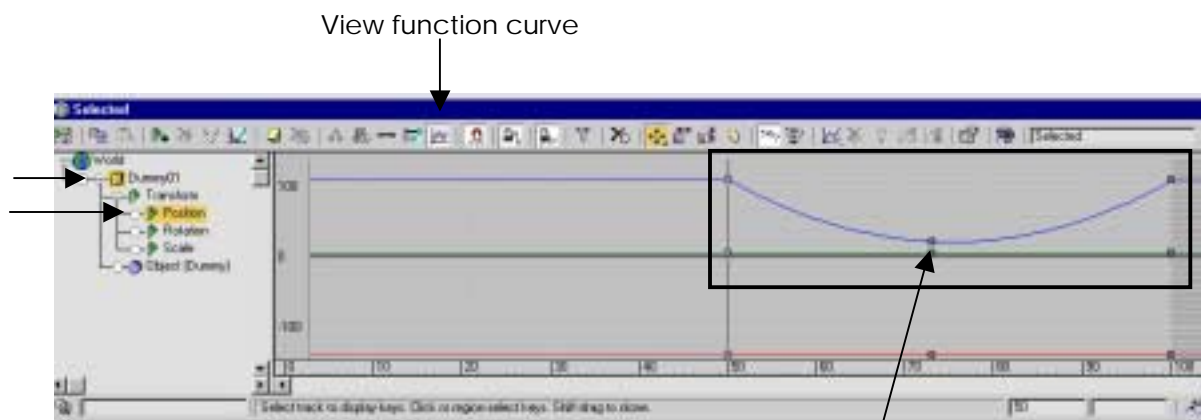
Open track view and change the curve for the dummy object so it resembles more the arc of a bouncing ball

Select dummy and right-click on it

Choose in menu: Track View Selected



Select the dummy object position in the track view and change to view function curves



r = x  
g = y  
b = z

keyframe

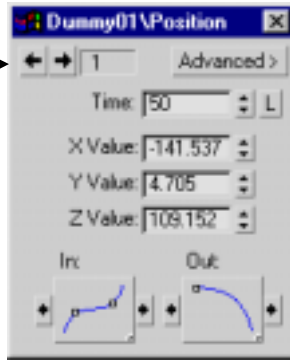
the dummy changes position on the z but this can be boring because motion is constant

**Change motion**

Right click on keyframe in motion track

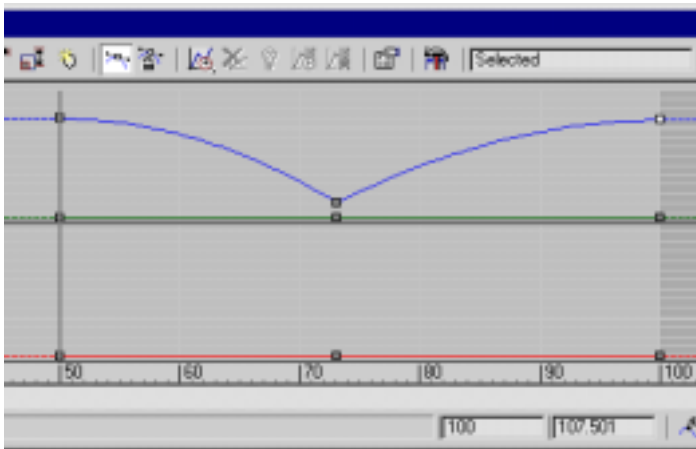
## IDST 147 3D Imaging for Multimedia

Go to next key  
previous key



key info (1<sup>st</sup> key) - change out position

repeat for other keys in dummy object



3 keys to set for dummy object affecting ball – this looks correct

*(more information regarding curves is in your book or in the on-line help)*