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Animation for Computer Games
COMP 477/6311

Prof. Tiberiu Popa

Forward Kinematics

Character Animation using Keyframes

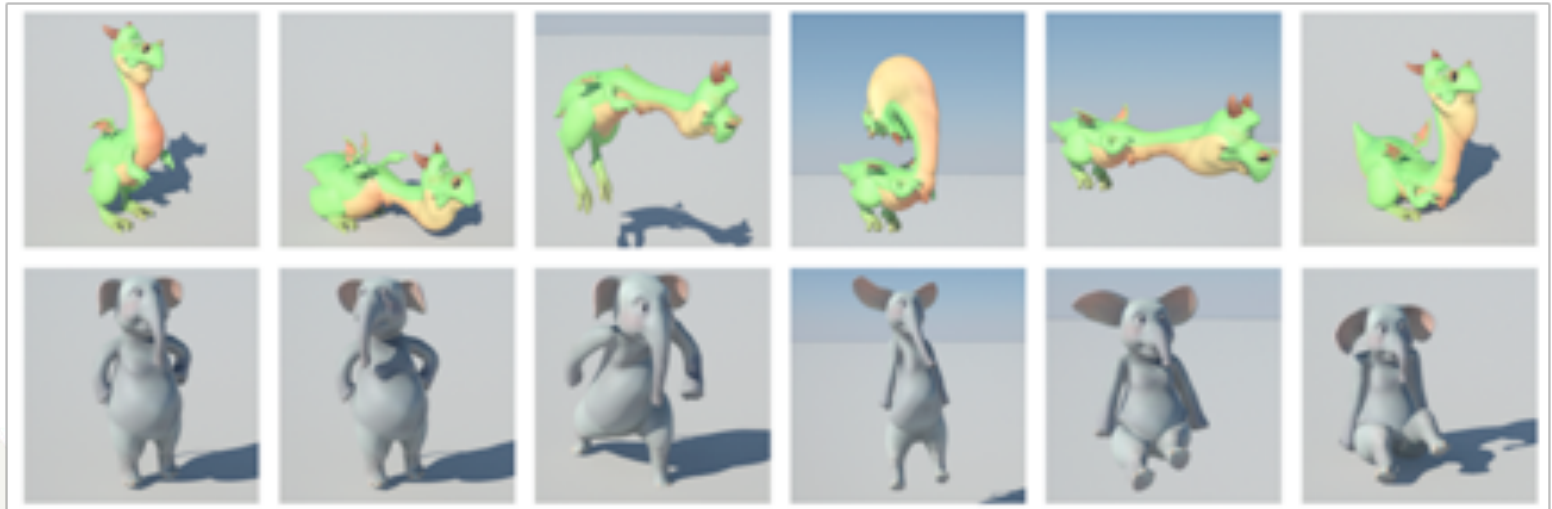1. Pose the character in keyframes

Keyframe 1

Keyframe 2

Keyframe 3

Character Animation using Keyframe Animation

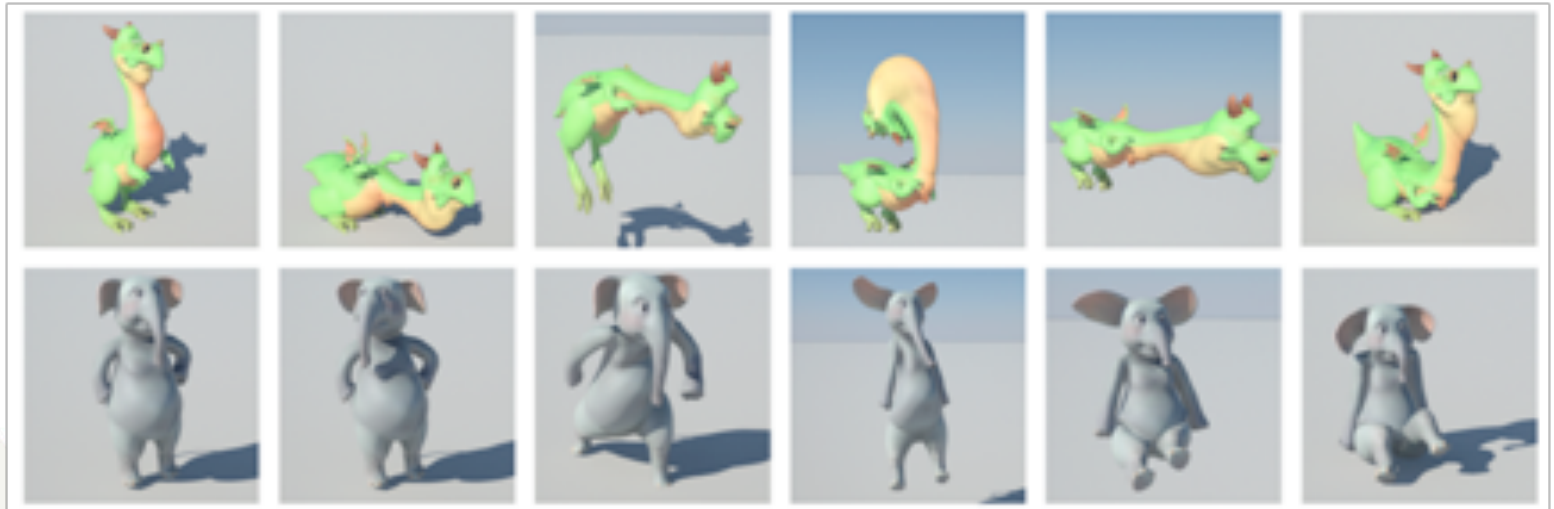2. Interpolate in between keyframes

Character Animation

- How to pose geometry?
- Geometry → min 10,000 vertices, sometimes 100,000 or more
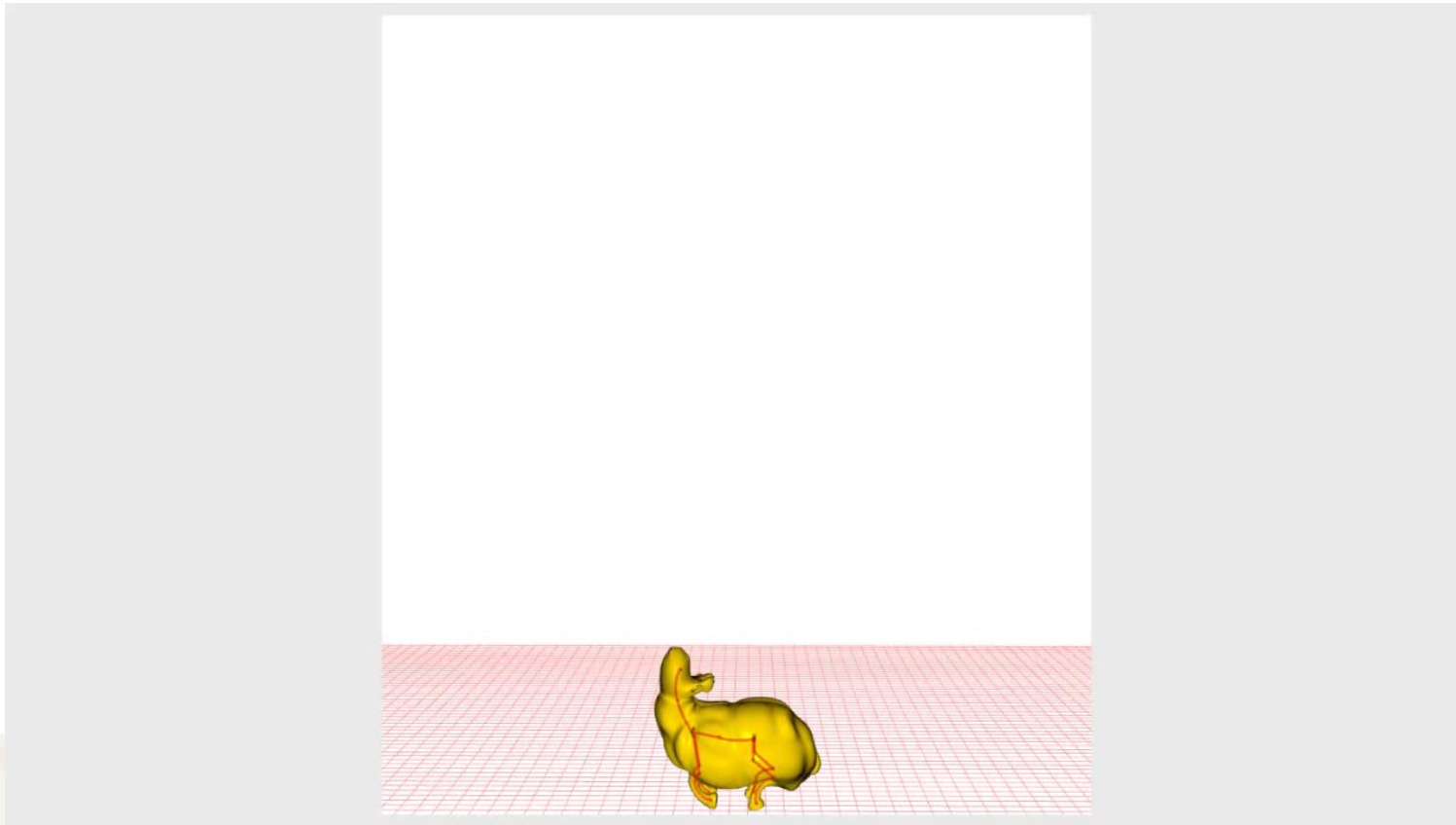- Have to move every vertex!!!

Character Animation

- Define a rig → simple and low dimensional control

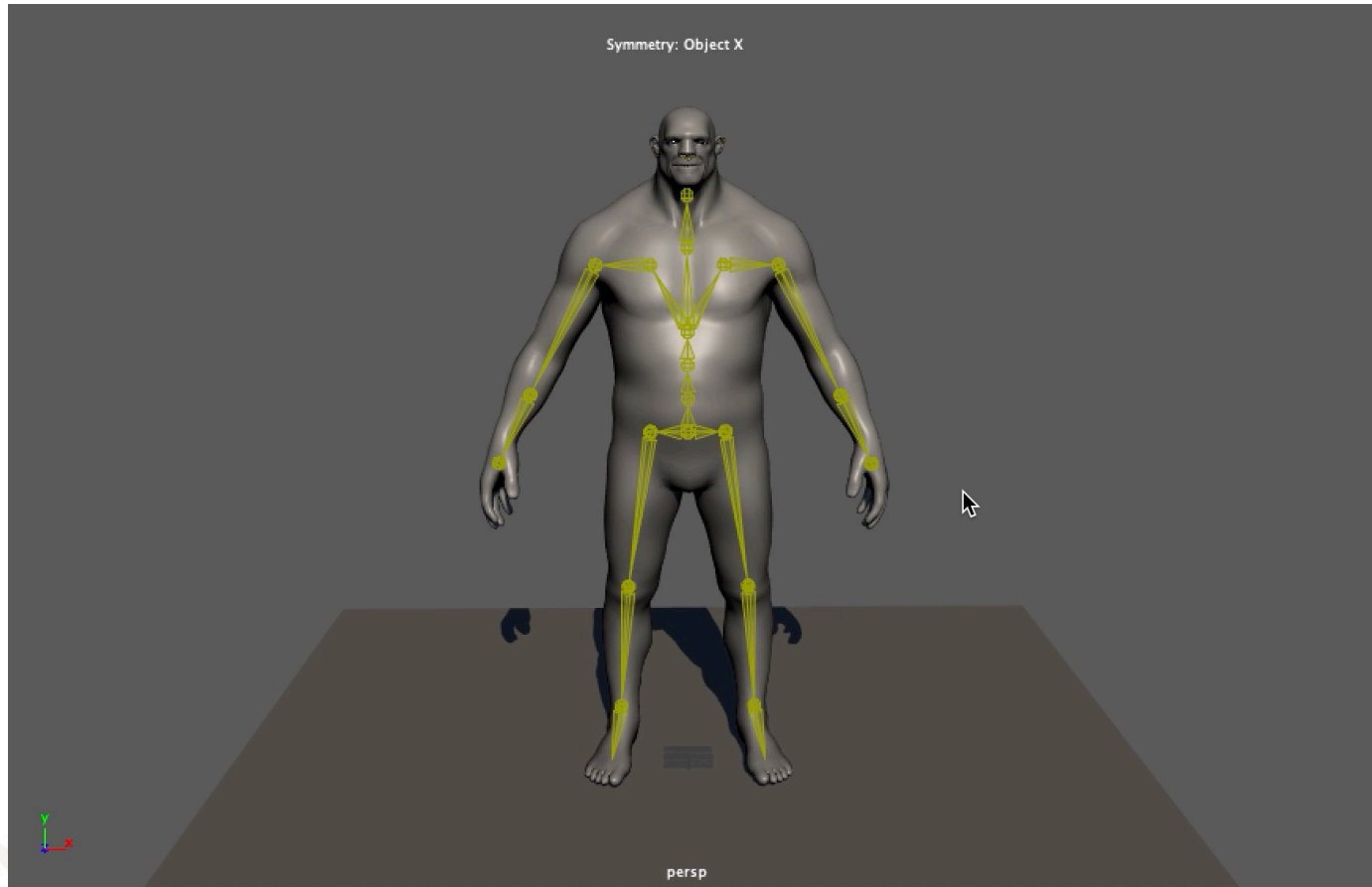# Character Animation

- Define a rig → simple and low dimensional control
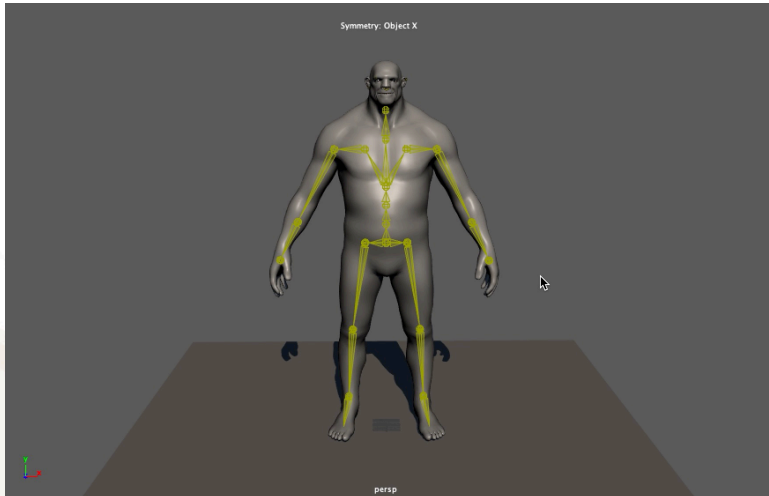
Character Animation

Character Animation

- Hierarchical skeleton
- Joints and bones
  - Parent transformations are inherited by children
  - Geometry is "attached" to the skeleton
    When bone moves → skin follows (skinning)
Transformation
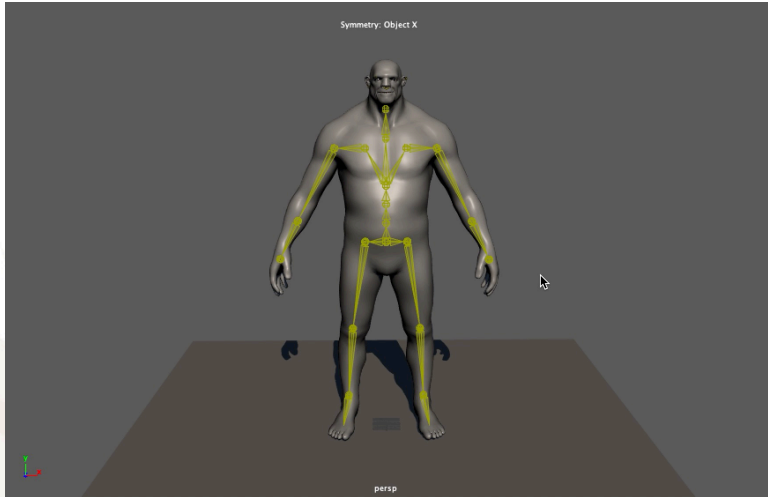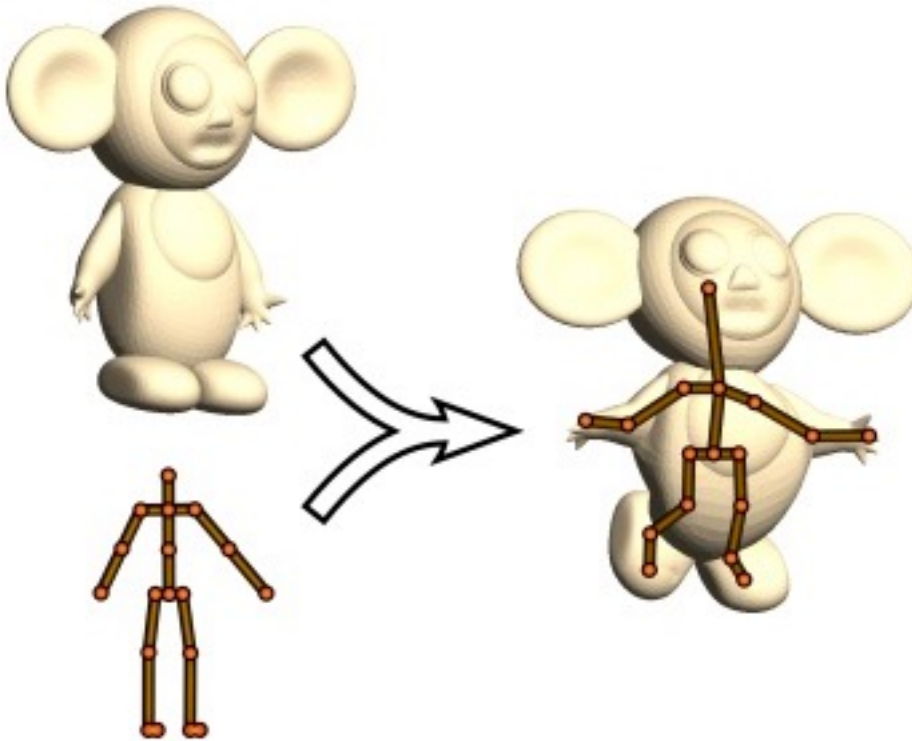   Generally local rotations!!!

Character Animation

Skeleton not the only rigging possible, but a classic widely used in games today

1. Construct and attach the skeleton to skin
2. Pose the skeleton
3. Deform the character
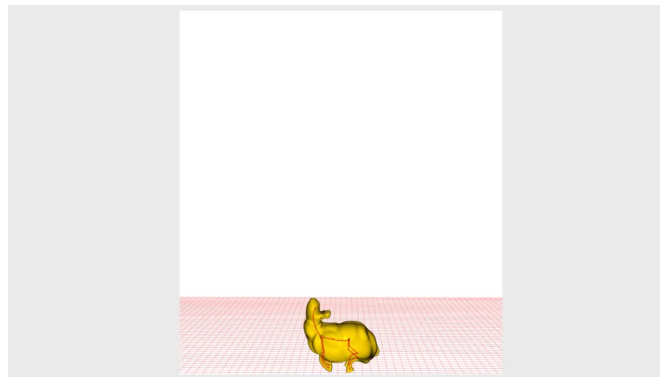4. Interpolate transformations (i.e. rotations)
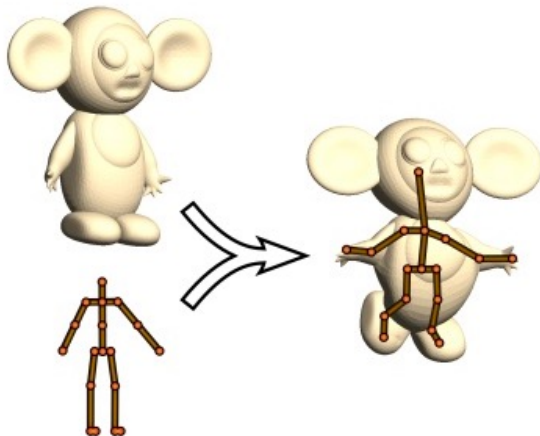
Character Animation

1. Construct and attach the skeleton to skin

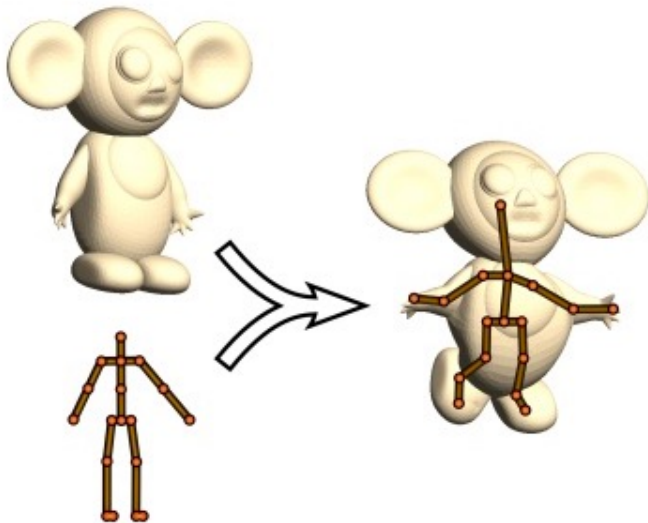# Character Animation

1. Construct and attach the skeleton to the skin

    1. Animator decides skeleton structure (i.e. how many joints, bones, etc.)

        - Depending on the type of character (i.e level of detail required)

        - For humanoid characters there are a few standard presets - see Maya

Character Animation

1. Construct and attach the skeleton to the skin
   1. Animator decides skeleton structure
   2. Positioning of the bones inside the geometry (semi automatic – medial axis)
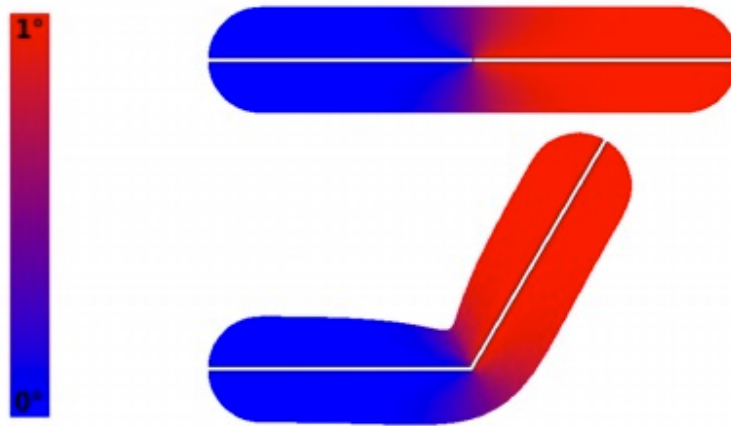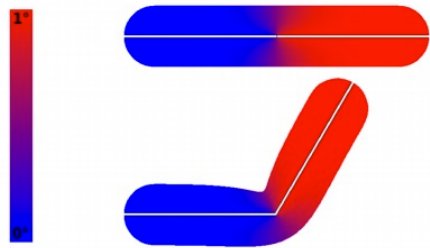
Character Animation

1. Construct and attach the skeleton to the skin
   1. Animator decides skeleton structure
   2. Positioning of the bones inside the geometry
   3. "Attaching" the bone to the geometry (i.e. skinning)

Character Animation

1. Construct and attach the skeleton to the skin

   3. "Attaching" the bone to the geometry (i.e. skinning)

   - Uses a skinning weight matrix w of size BxN
     - N – number of vertices
     - B – number of bones
     - w(i,j) = influence of bone i onto vertex j
   - Sometimes written as: $w_i(j)$

Character Animation

- The problem:
  - Finding weights for each vertex/bone: $w_i(j)$
- Semi-automatic solutions:
  - An initial weight matrix computed automatically
  - Artist edits the weights to avoid artifacts

Character Animation

Skeleton not the only rigging possible, but a classic widely used in games today

1. Construct and attach the skeleton to skin
2. Pose the skeleton (live Maya demo)
3. Transform the character
4. Interpolate transformations (i.e. rotations)
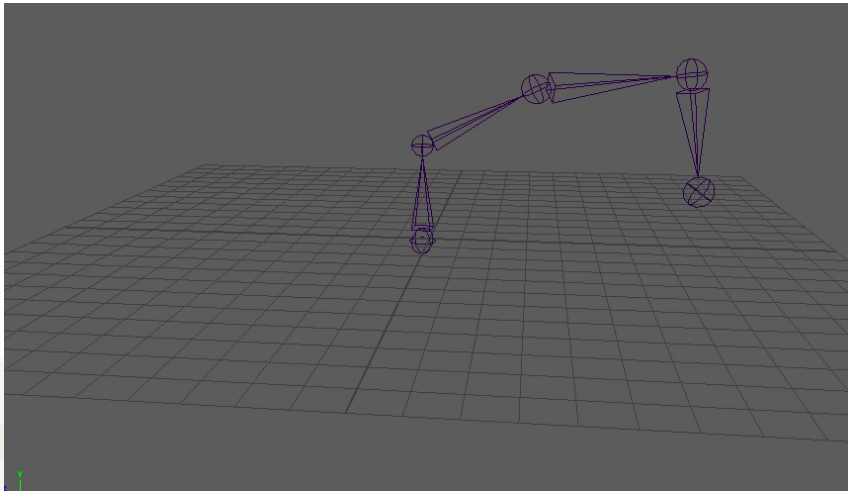
Character Animation

Skeleton not the only rigging possible, but a classic widely used in games today

1. Construct and attach the skeleton to skin
2. Pose the skeleton
3. Transform the character
4. Interpolate transformations (i.e. rotations)

$$\mathbf{p}' = \sum_{i \in B} w_i(\mathbf{p}) T_i \mathbf{p}$$

place skeleton in shape   compute/paint weights   deform bones

$w_i(\mathbf{p})$ T_i