

# Kinematics and Dynamics

## •KINEMATICS:

- Motion parameters such as position , velocity and acceleration are specified without reference to the forces.

## •INVERSE KINEMATICS:

- Initial and final positions of objects at specified times and from that motion parameters .

## •DYNAMICS:

- The forces that produce the velocities and accelerations are specified(physically based modeling).
- It uses laws such as Newton's laws of motion , Euler or Navier-stokes equations.

# Outline

**Principles of Animation**

**Keyframe Animation**

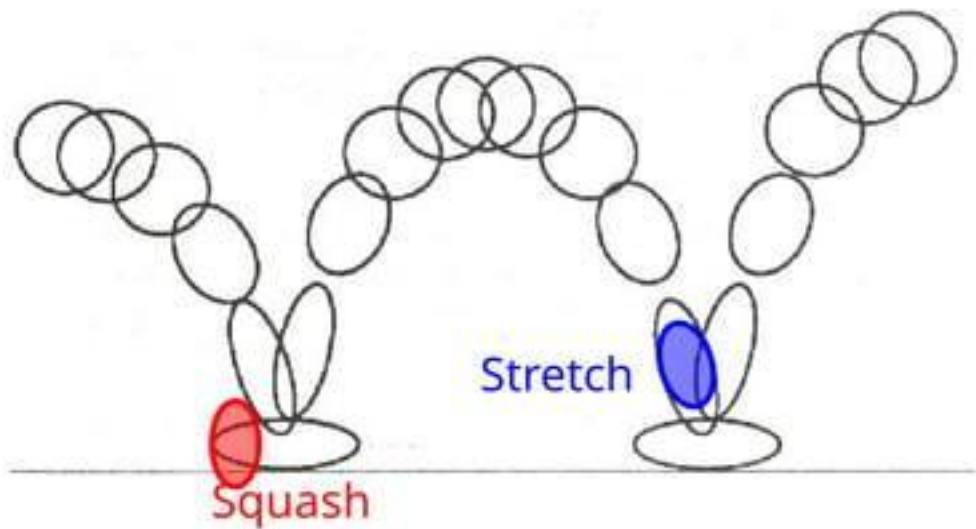
**Articulated Figures**



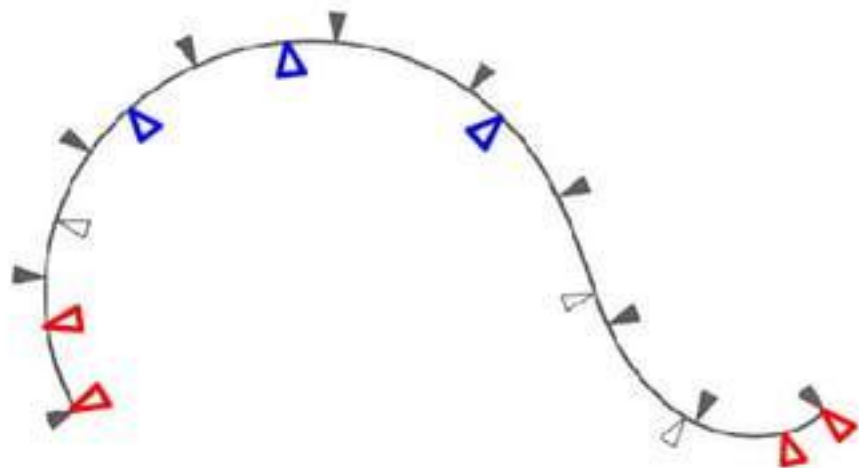
# Principle of Traditional Animation

- Squash and Stretch
- Slow In and Out
- Anticipation
- Exaggeration
- Follow Through and Overlapping Action
- Timing
- Staging
- Straight Ahead Action and Pose-to-Pose Action
- Arcs
- Secondary Action
- Appeal

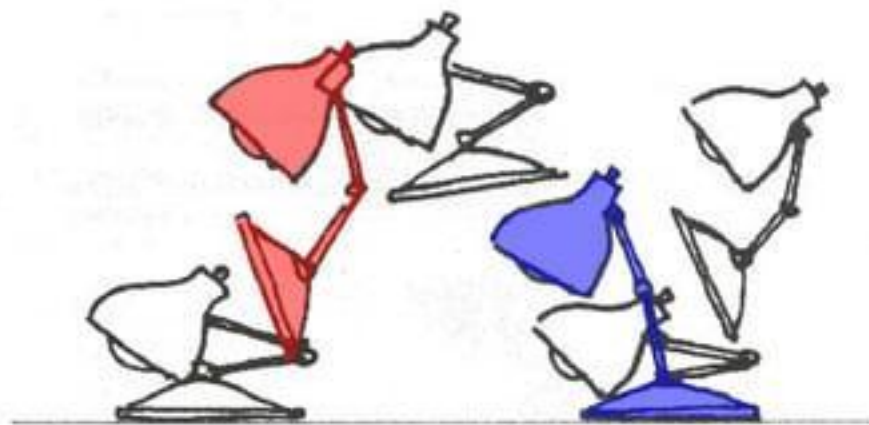
# Squash and Stretch



## Slow In and Out



# Anticipation



# Computer Animation

## Animation Pipeline

- 3D modeling
- Motion specification
- Motion simulation
- Shading, lighting, & rendering
- Postprocessing



# Outline

Principles of Animation

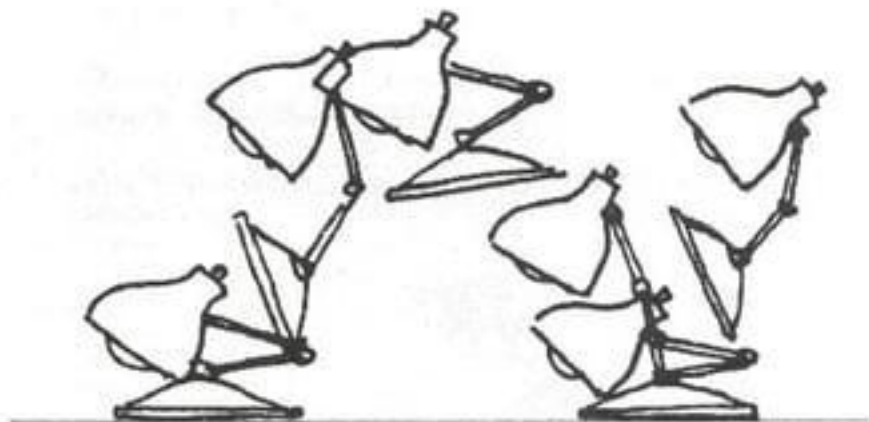
**Keyframe Animation**

Articulated Figures



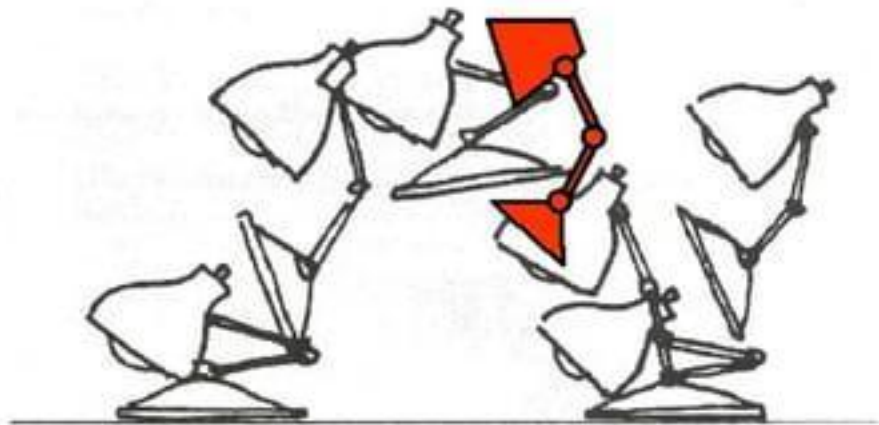
# Keyframe Animation

Define Character Poses at Specific Time Steps Called  
“Keyframes”



# Keyframe Animation

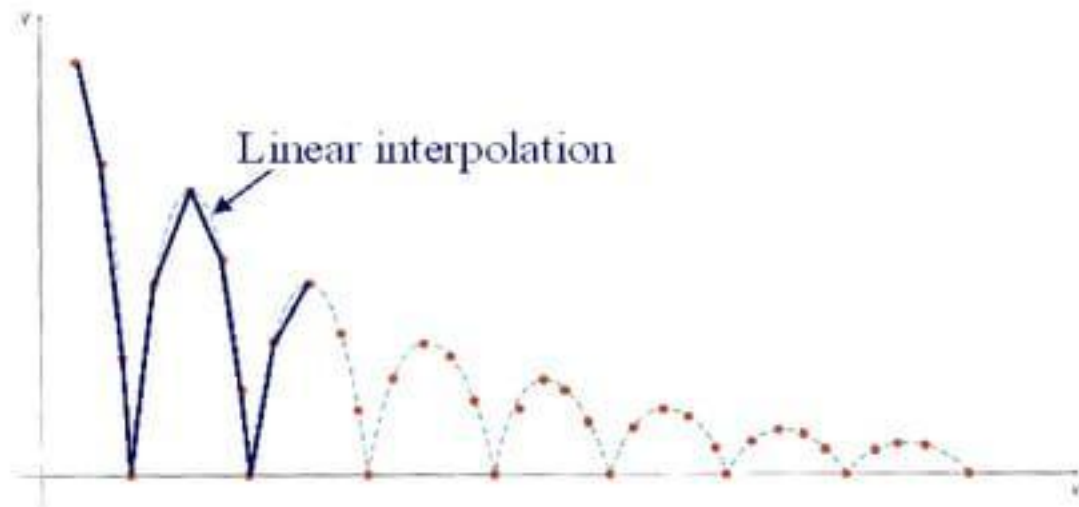
Interpolate Variables Describing Keyframes to Determine Poses for Character in between



# Inbetweening

## Linear Interpolation

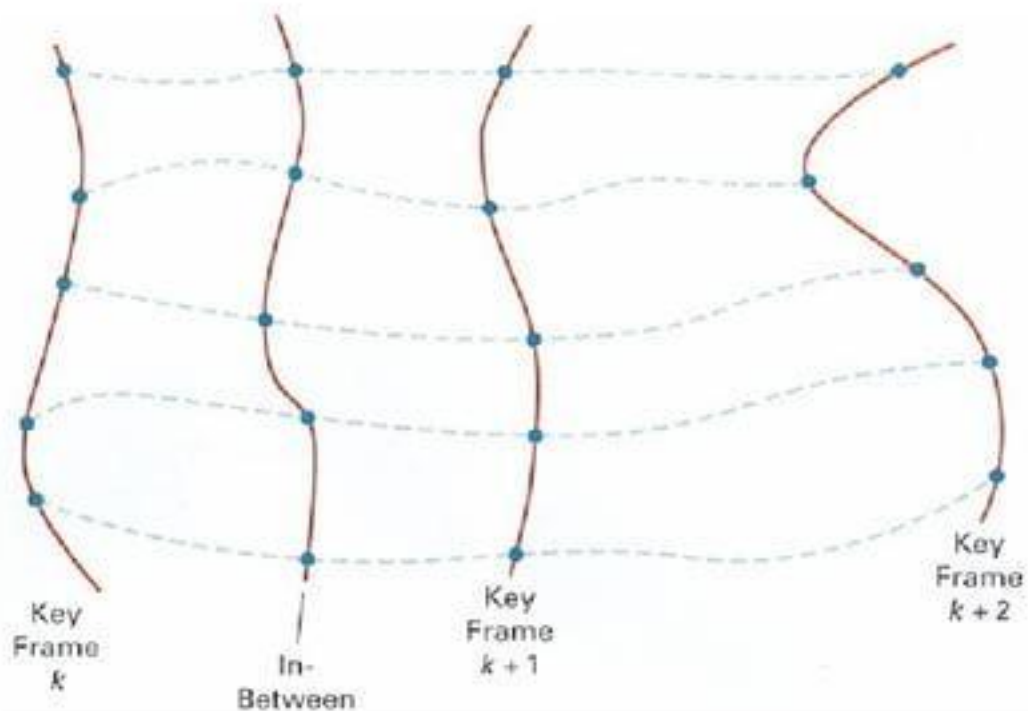
- Usually not enough continuity



# Inbetweening

## Spline Interpolation

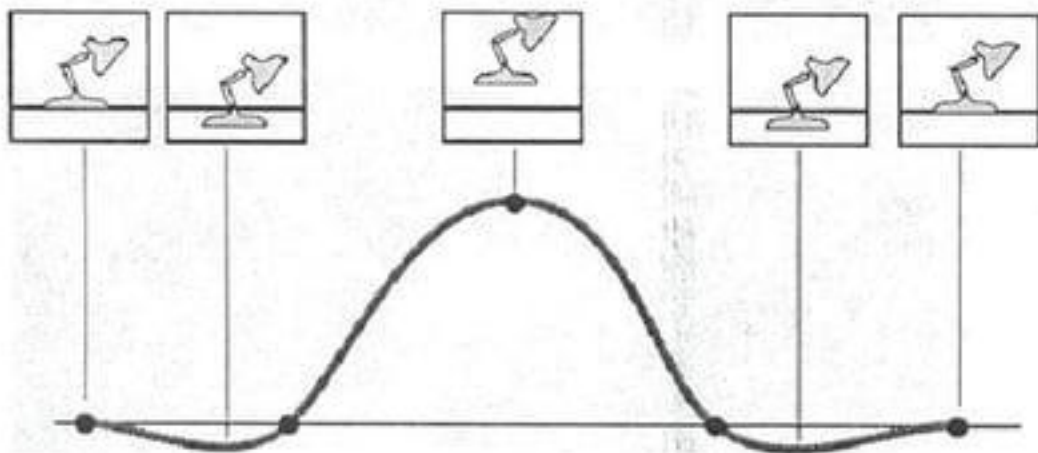
Maybe good enough



# Inbetweening

## Spline Interpolation

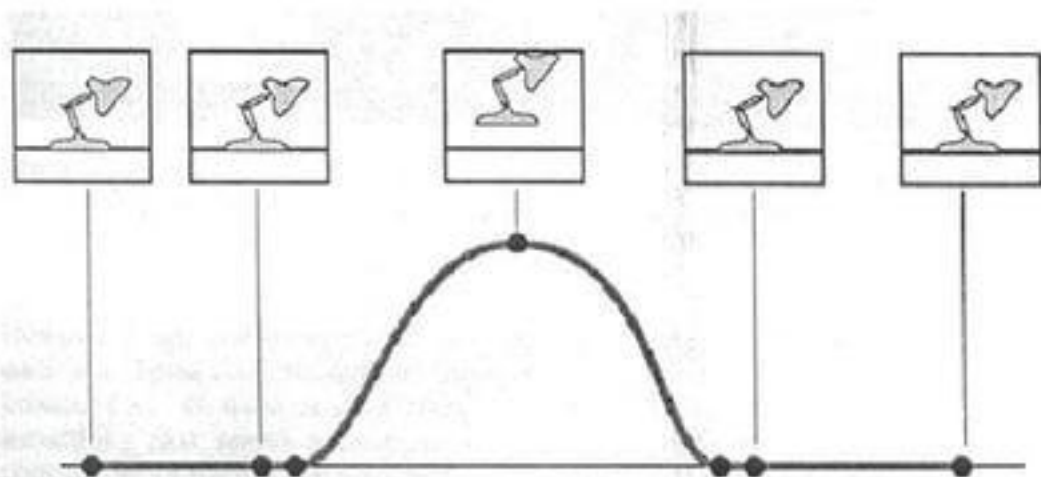
- Maybe good enough
  - May not follow physical laws



# Inbetweening

## Spline Interpolation

- Maybe good enough
  - May not follow physical laws



# Inbetweening

**Inverse Kinematics or Dynamics**



# Outline

Principles of Animation

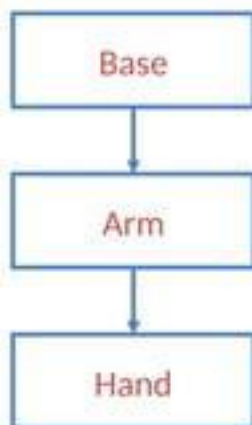
Keyframe Animation

**Articulated Figures**

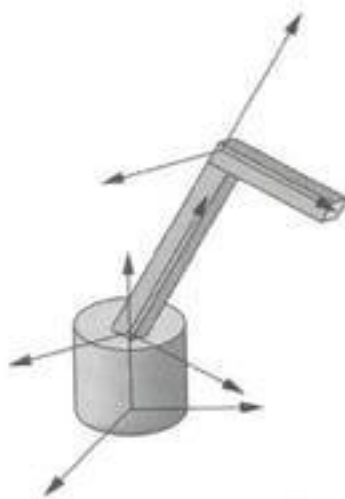


# Articulated Figures

**Character Poses Described by Set of Rigid Bodies  
Connected by “Joints”**

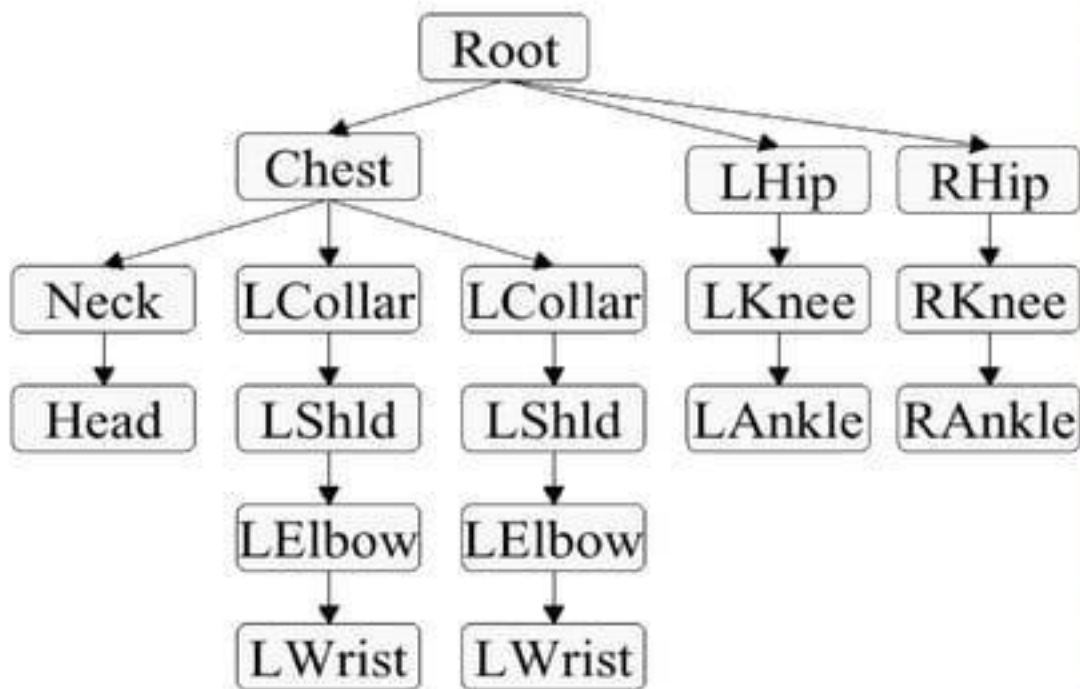


Scene Graph



# Articulated Figures

Well-Suited for Humanoid Characters



# Articulated Figures

**Joints Provide Handles for Moving Articulated Figure**

