# Motion Capture

CS418 Interactive Computer Graphics

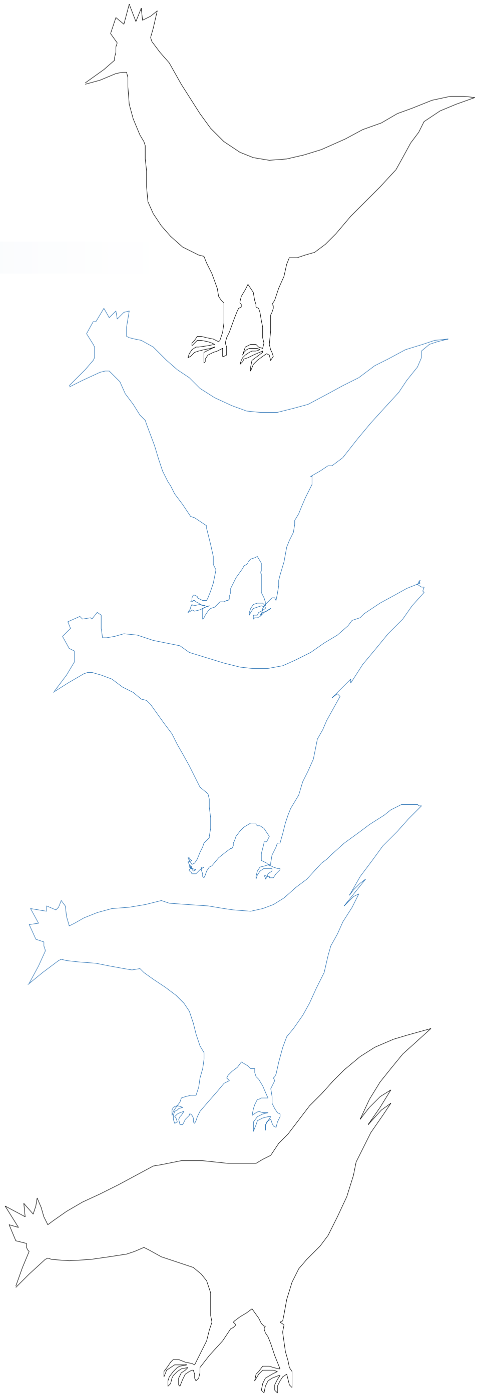
John C. Hart

# Flexible Body Animation

- Need same number and configuration of vertices at key frames for intervening frames to make sense
- Need to have correspondences between two collections of vertices

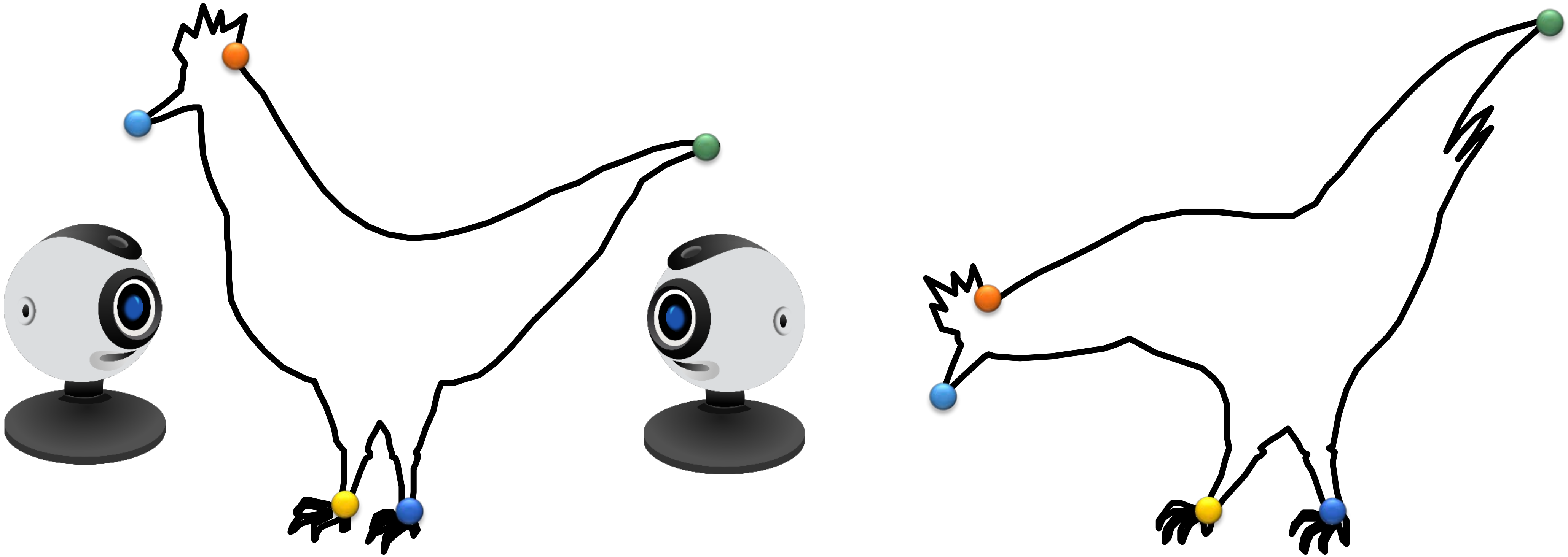
Motion Capture

- Place fiducial markers (e.g. ping pong balls) on a real-world object
- Capture 3-D pose of markers at key frames
- Use motion of markers to deform model



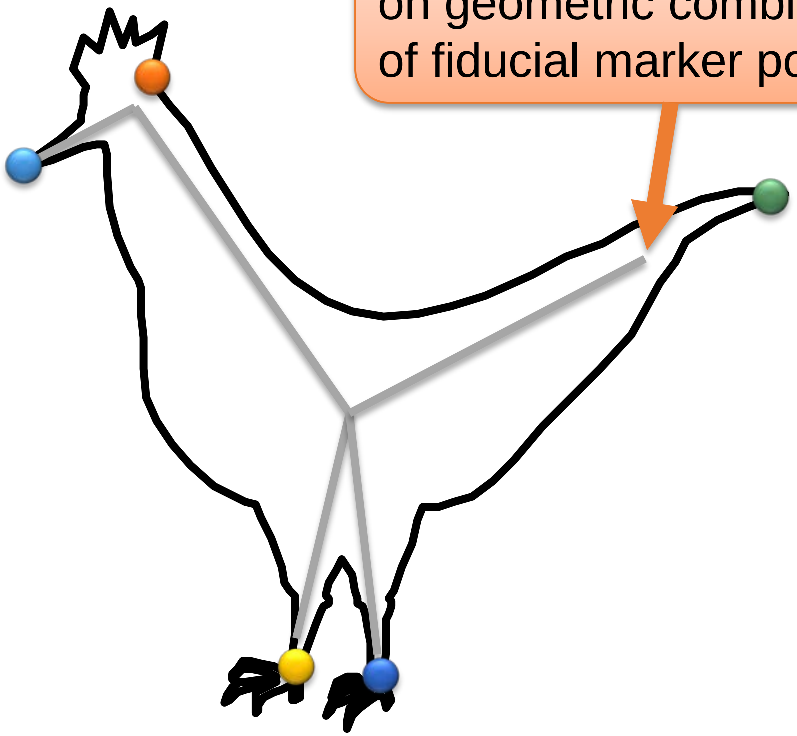
A motivating example from: Sederberg & Greenwood, A Physically-Based Approach to 2-D Shape Blending, Proc. SIGGRAPH 92

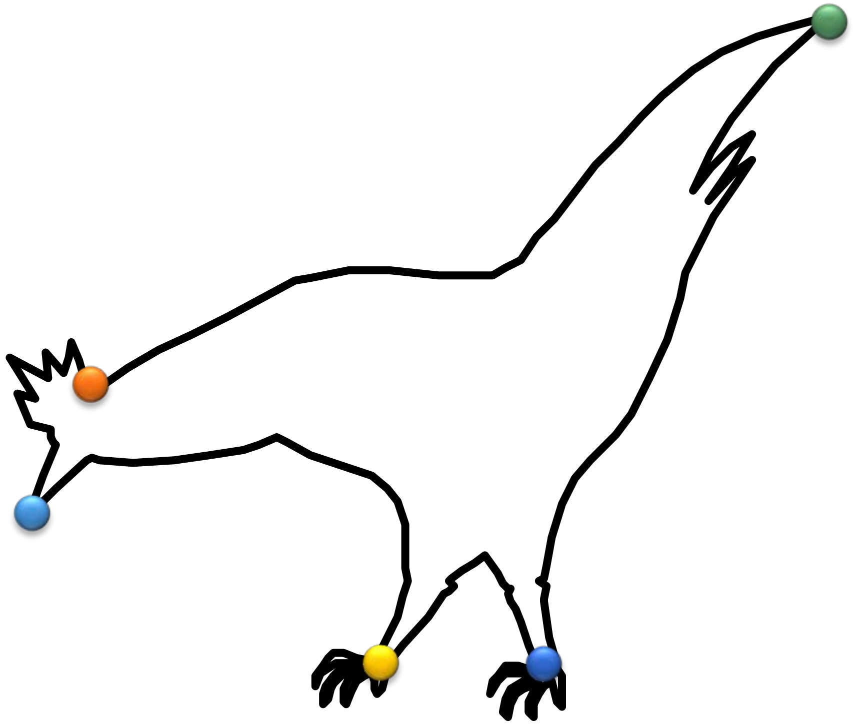
# Place Fiducial Markers



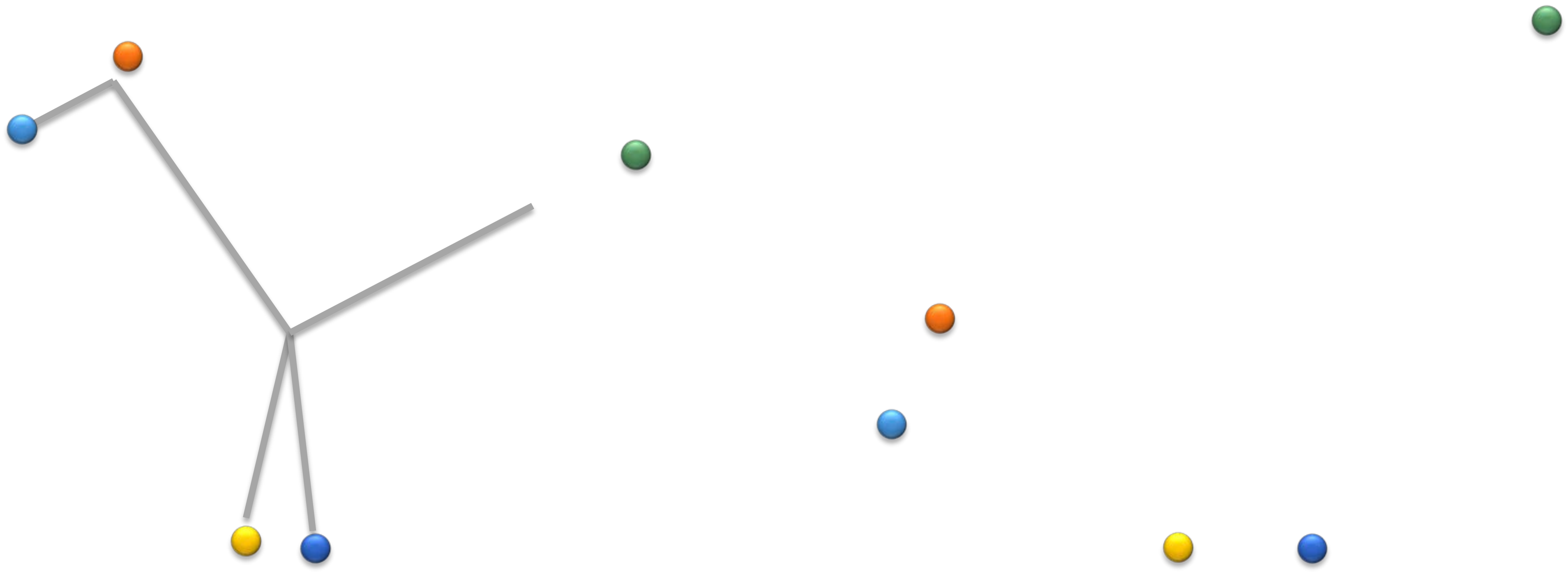
# Create Bone Model

Endpoint positions based on geometric combinations of fiducial marker positions

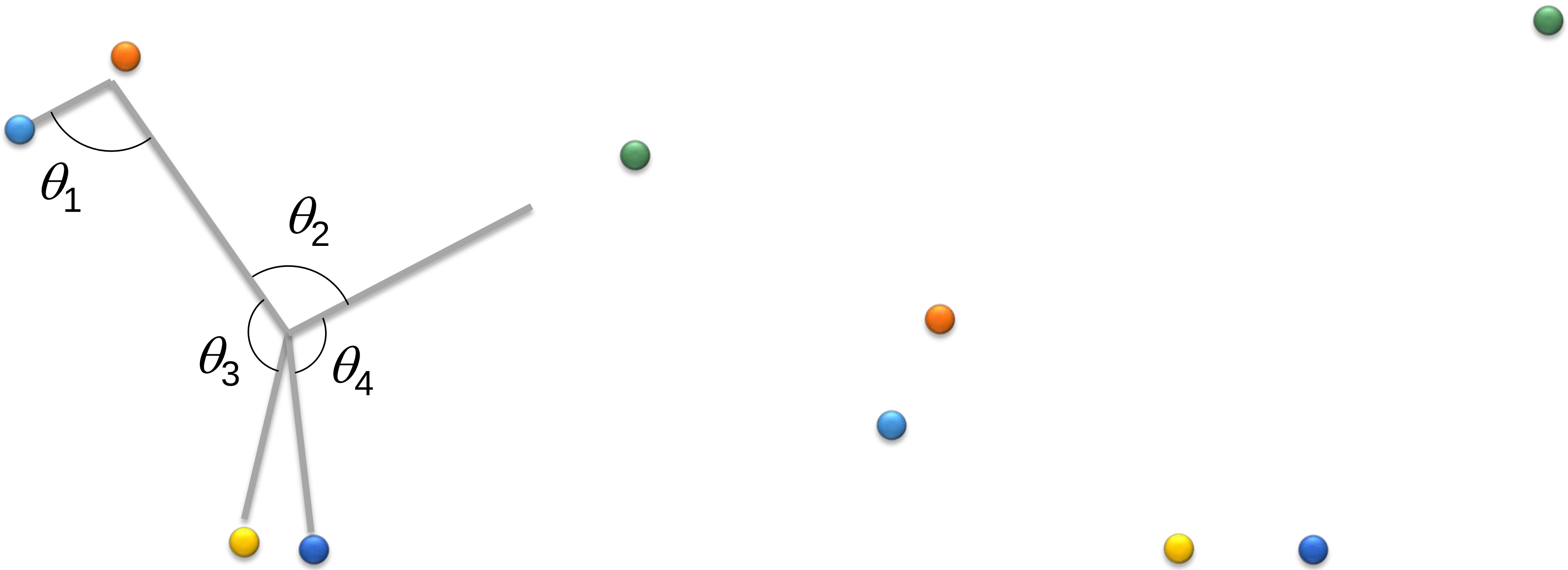




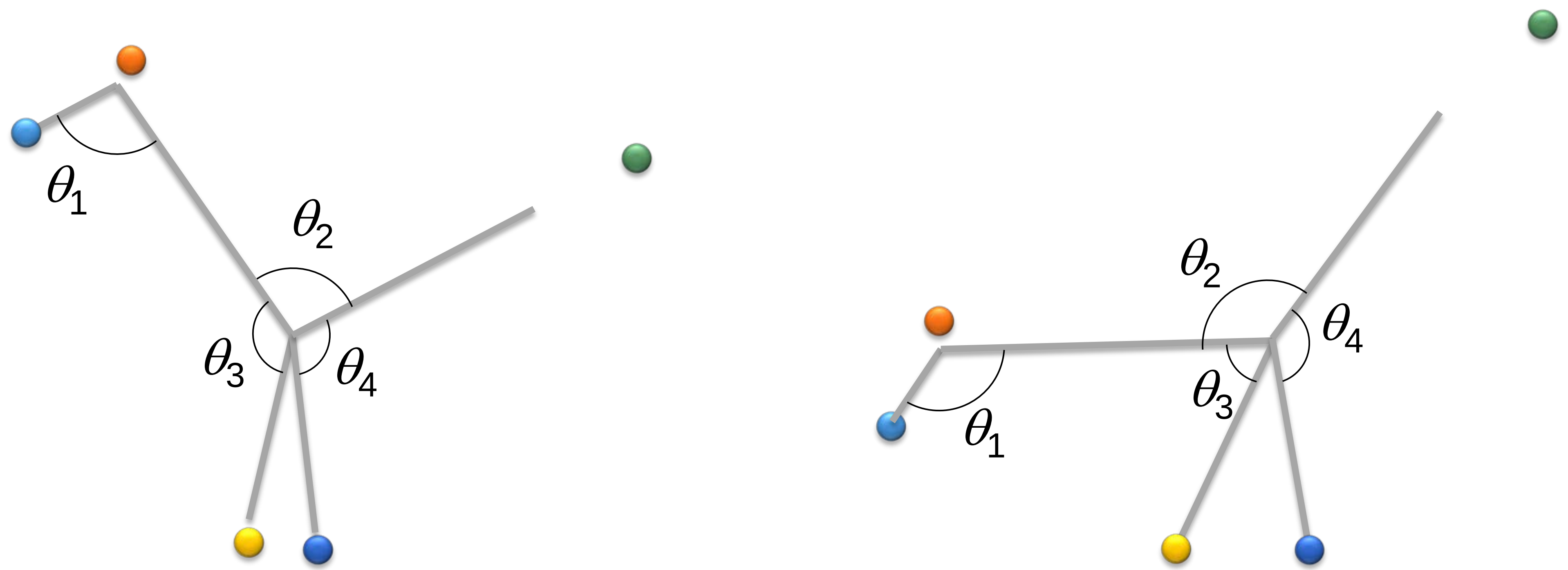
# Create Bone Model



# Measure Joint Angles

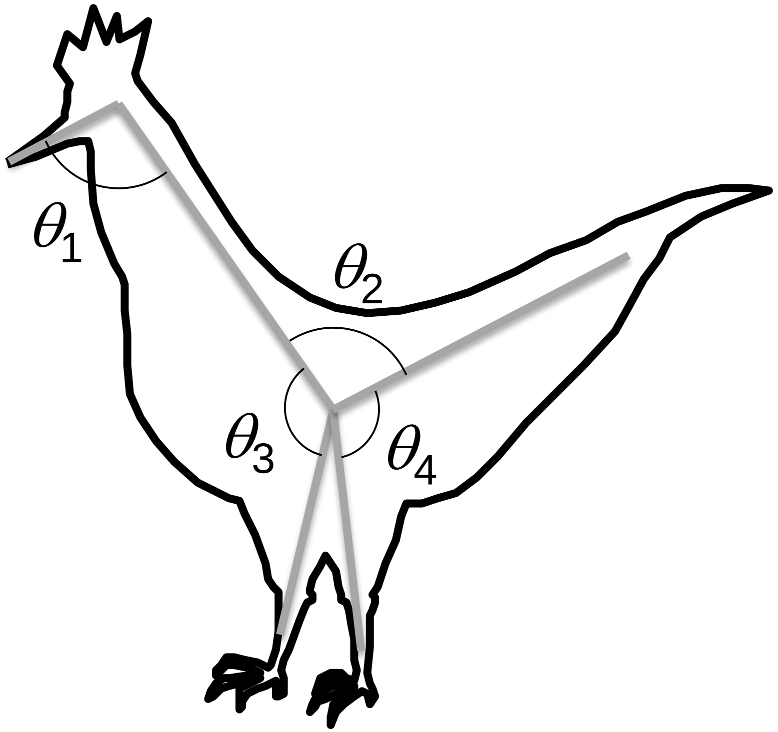


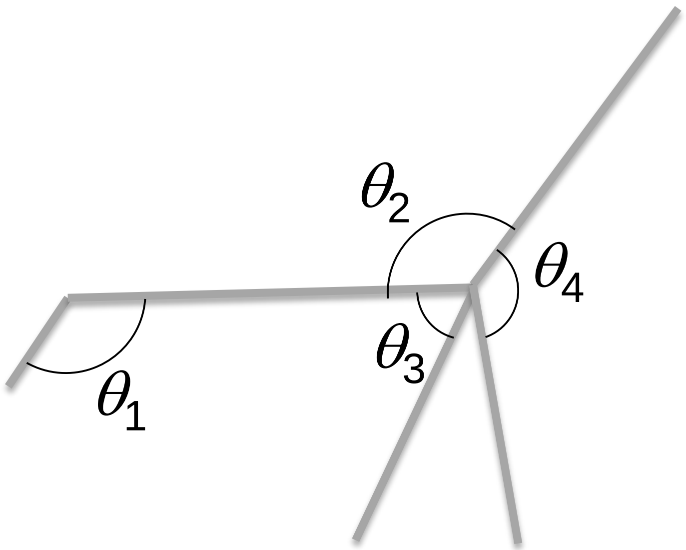
# Fit New Pose



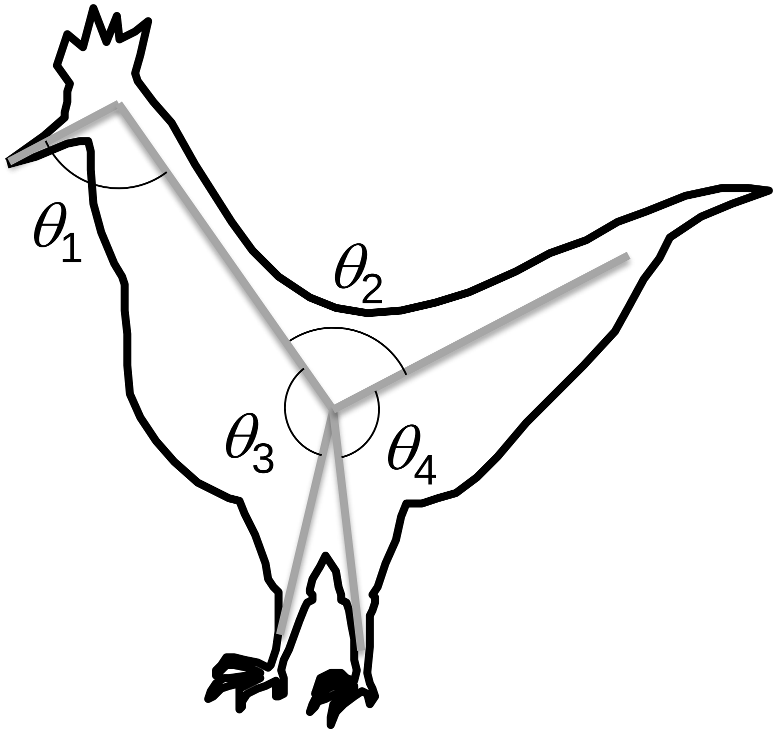
# Joint Angles = Pose

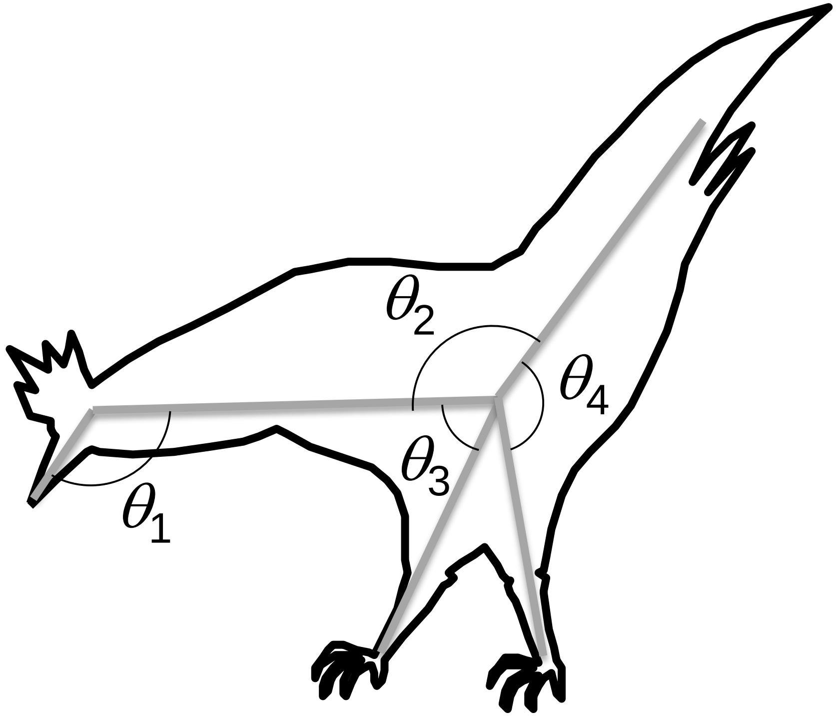
# Model Shape from Bones



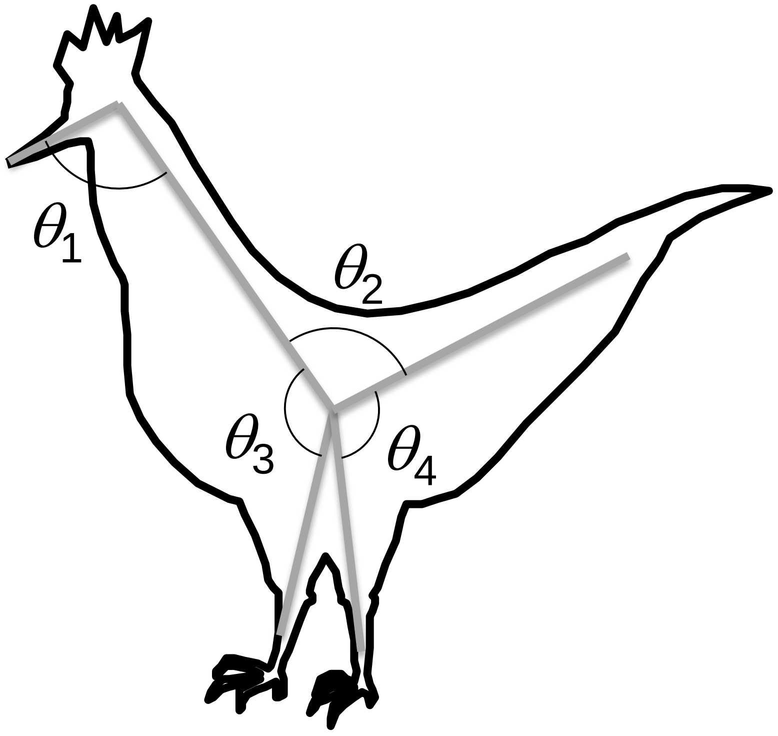



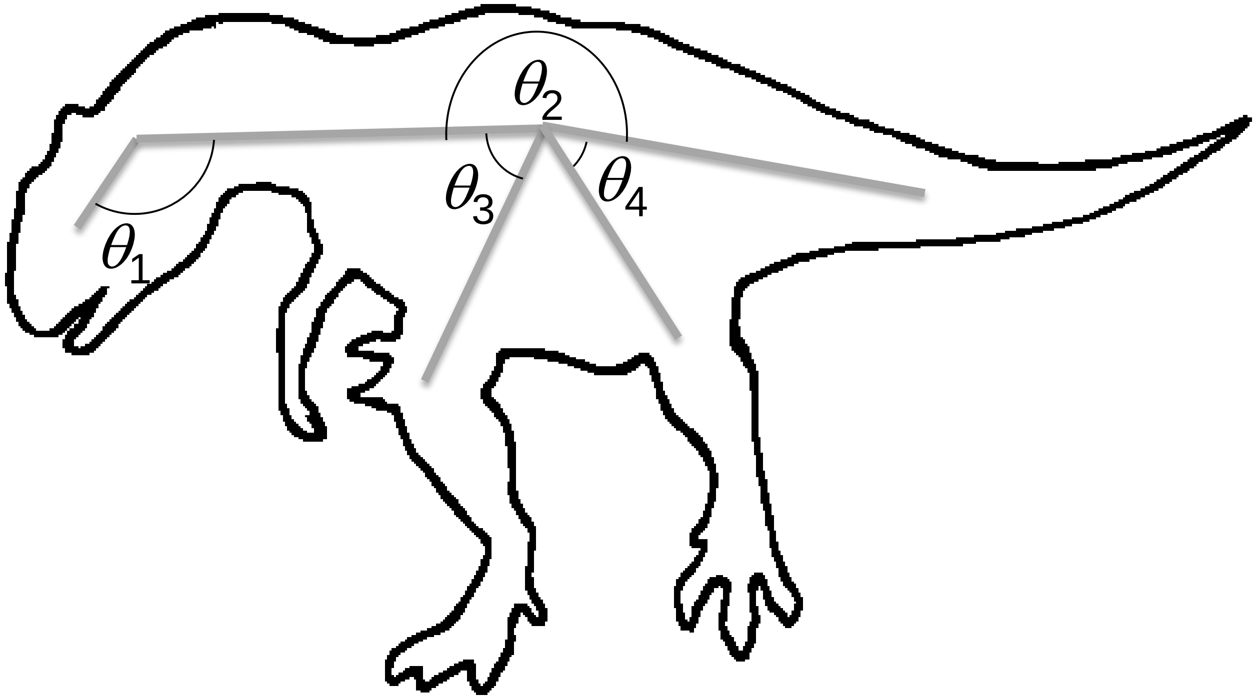
# Model Shape from Bones



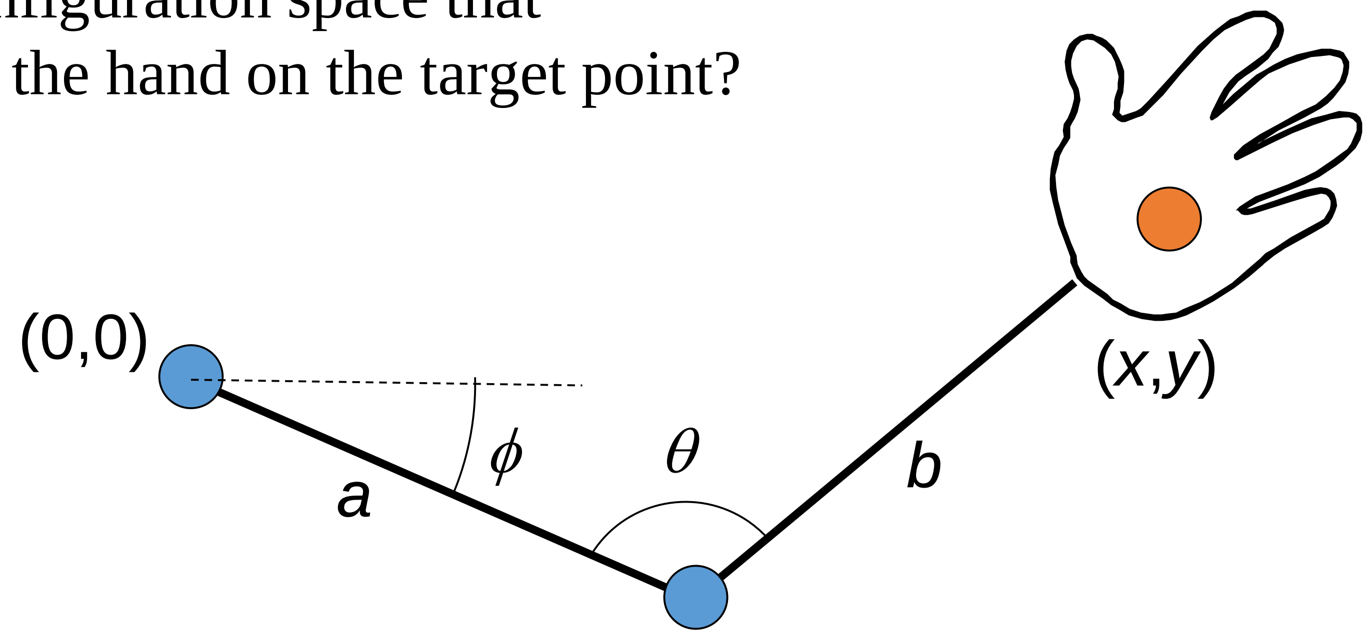
# Motion Retargeting



# Simple Inverse Kinematics

Given target point ($x$,$y$) in position space,
what are the parameters ($\theta$,$\phi$)
in configuration space that
place the hand on the target point?



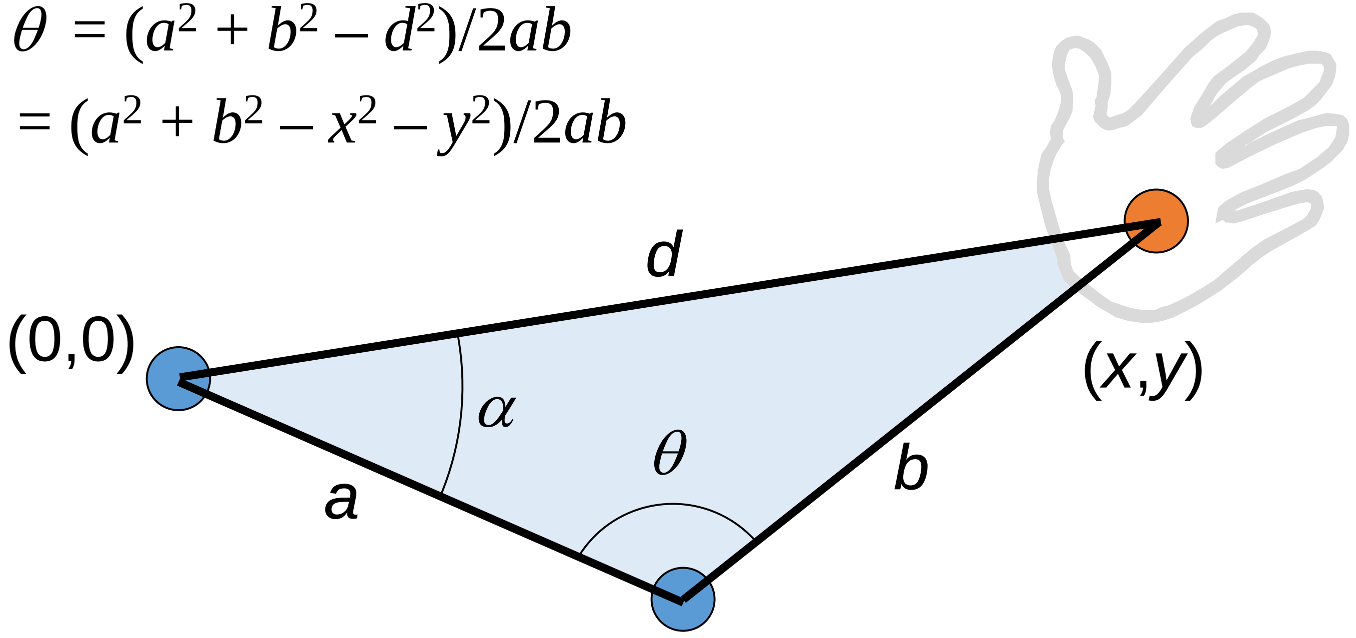
# Simple Inverse Kinematics

Use Law of Cosines to find $\theta$

$$d^2 = a^2 + b^2 - 2ab \cos \theta$$

$$\cos \theta = (a^2 + b^2 - d^2)/2ab$$

$$\cos \theta = (a^2 + b^2 - x^2 - y^2)/2ab$$

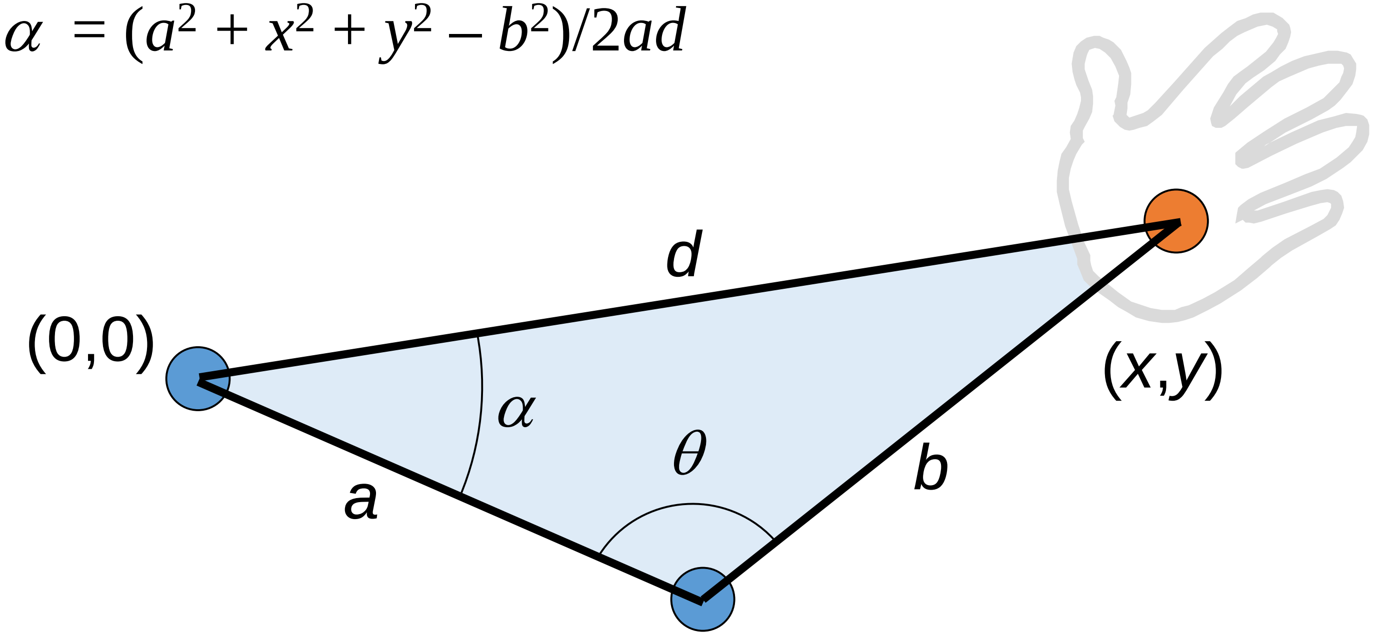


# Simple Inverse Kinematics

Use Law of Cosines to find $\alpha$

$$\cos \alpha = (a^2 + d^2 - b^2)/2ad$$

$$\cos \alpha = (a^2 + x^2 + y^2 - b^2)/2ad$$

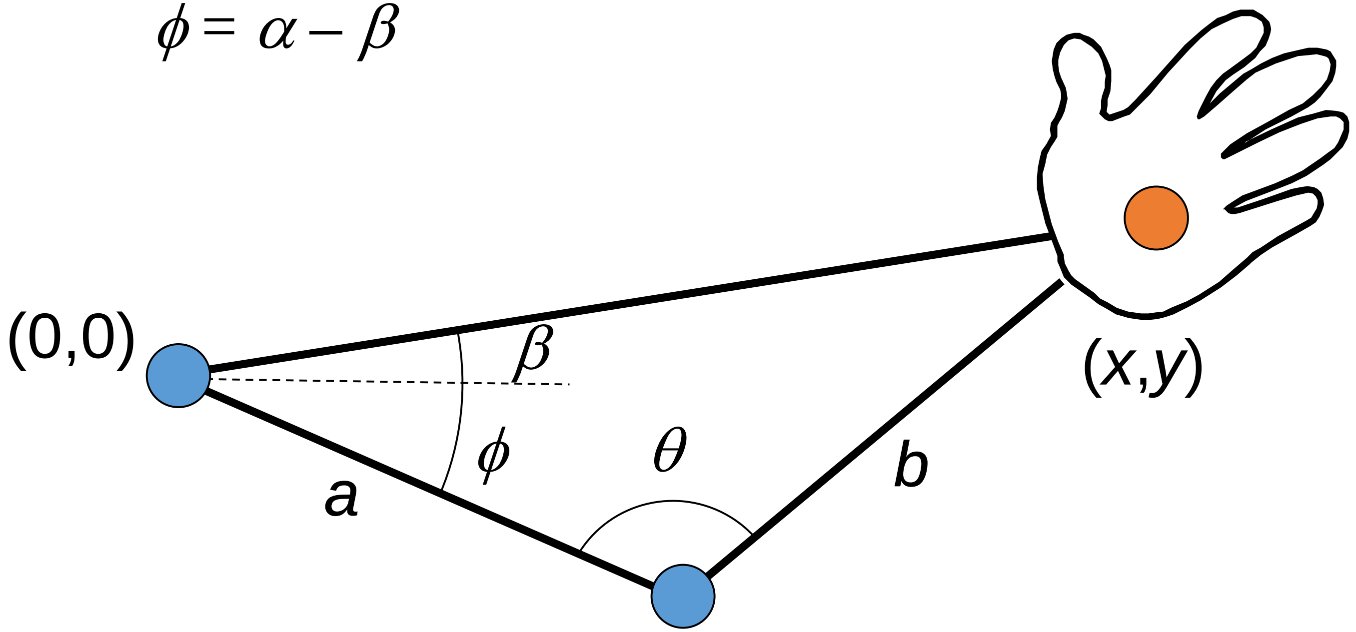


# Simple Inverse Kinematics

Use arctangent to find $\beta$ then $\phi$

$$\beta = \text{atan2}(y,x)$$

$$\phi = \alpha - \beta$$



# Simple Inverse Kinematics

- Only works for single joint
- Always planar because only three points
- Works great for elbows, knees, etc.