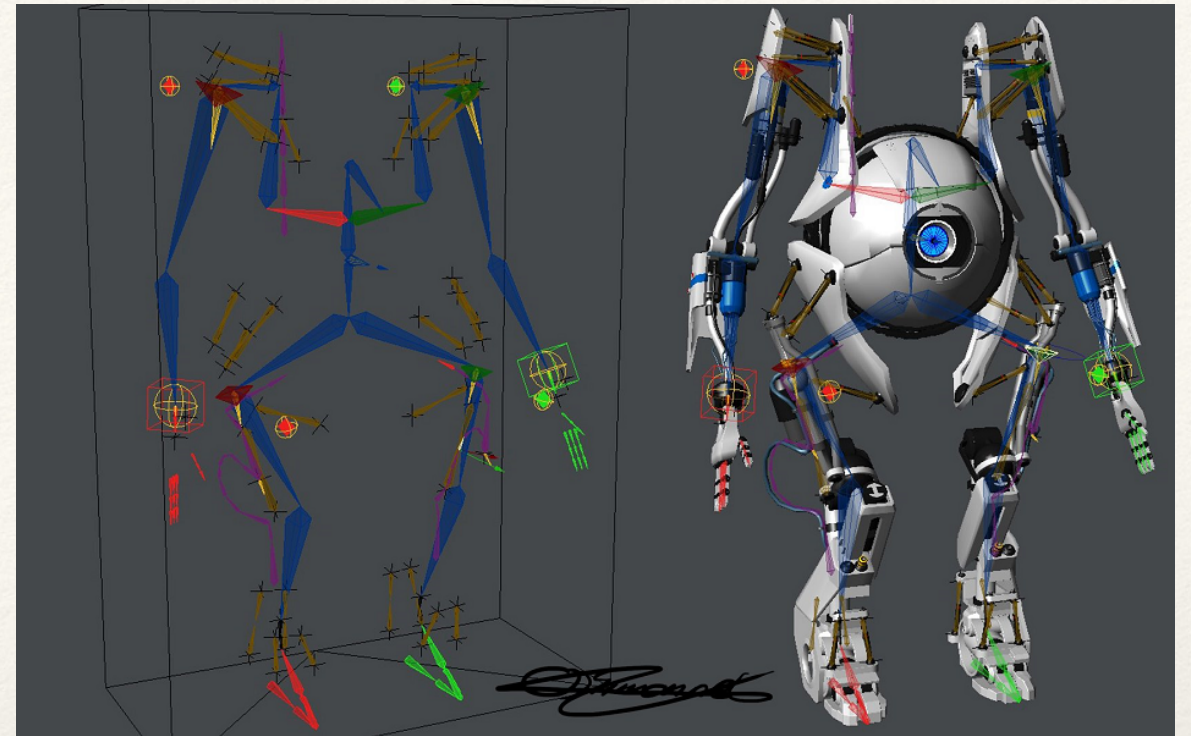*Dr. Sarah Abraham*

University of Texas at Austin

Computer Science Department
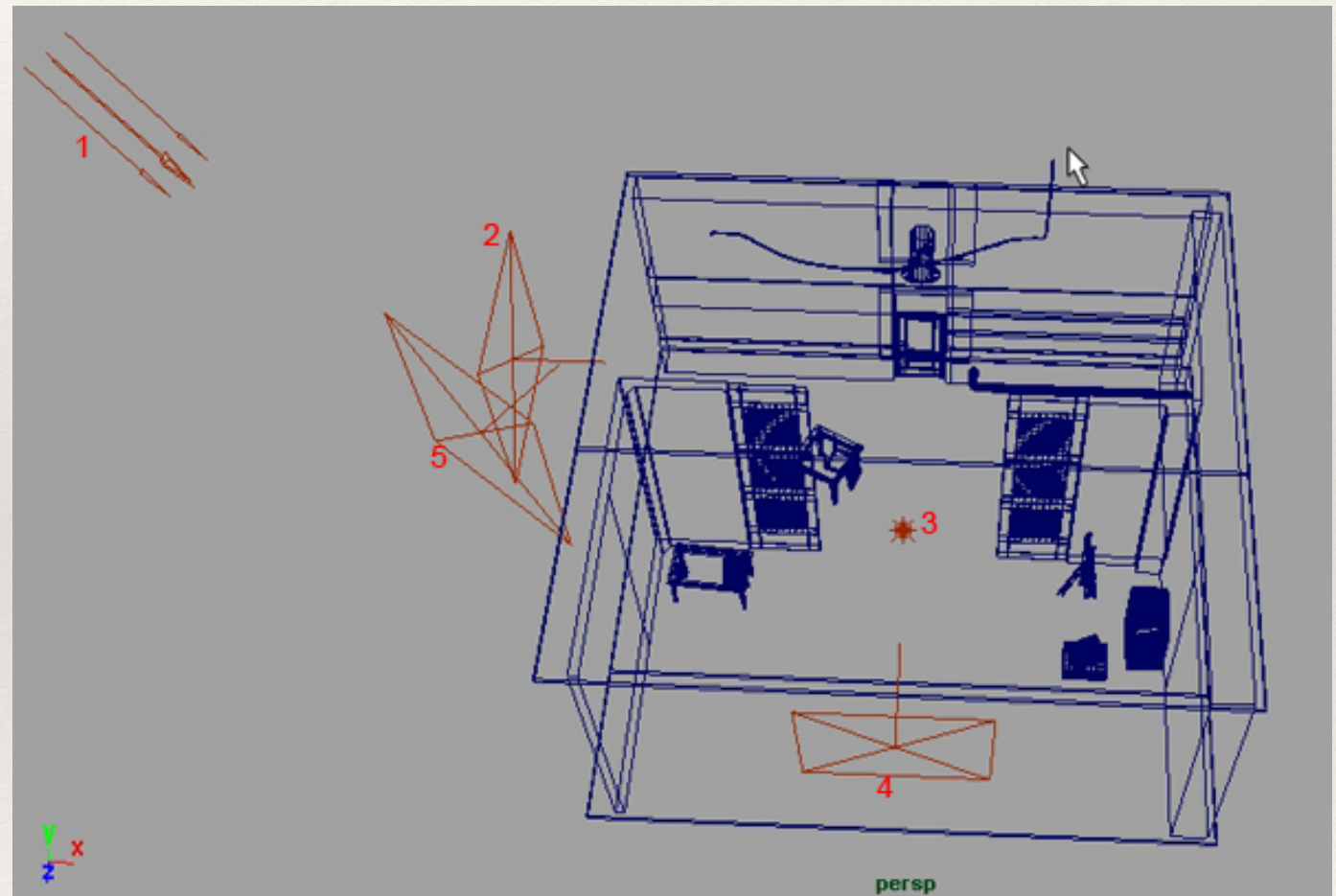
Scene Hierarchies

Elements of Graphics
CS324e

What is a Scene?

❖ A space we want to depict (render) on our screen

❖ Can be 3D or 2D

❖ What can a scene include?

  ❖ Objects
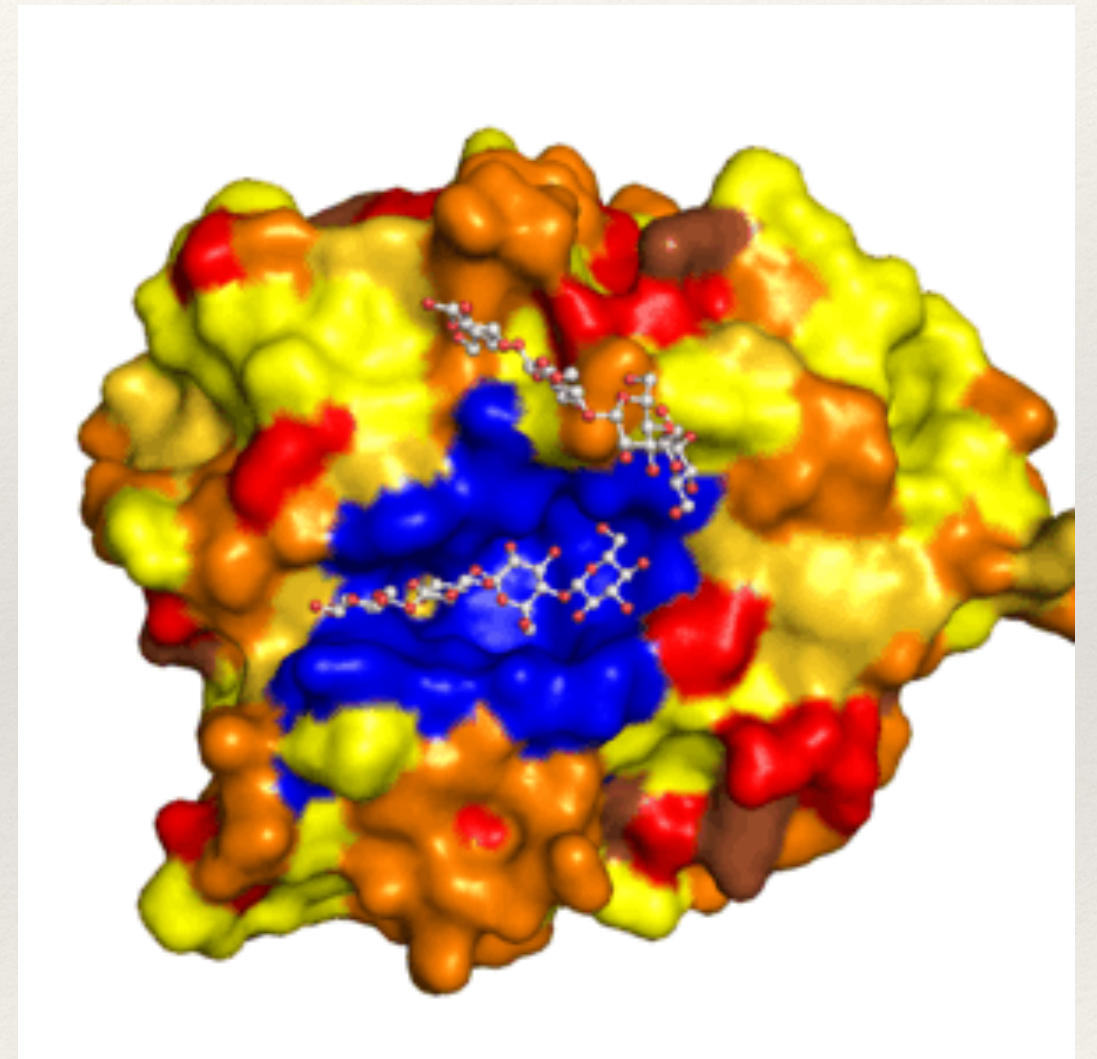
  ❖ Lights

  ❖ Camera

Scenes in Games and Movies

- Much like a movie set:

- Agents (actors)

  - Scripted

  - Player-controlled

- Props for interactions

- Lights for shading

- Camera for rendering

Maya scene (Parik Gulati)

Scenes for Visualization
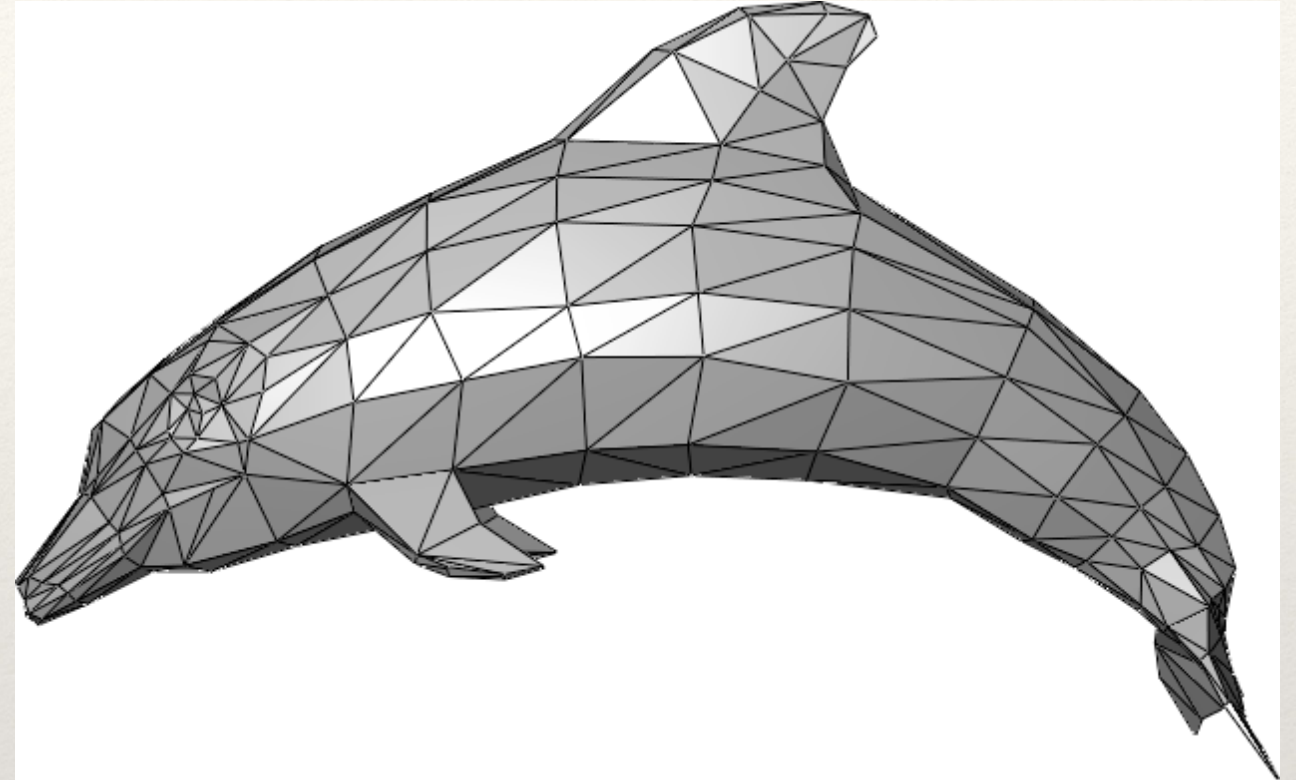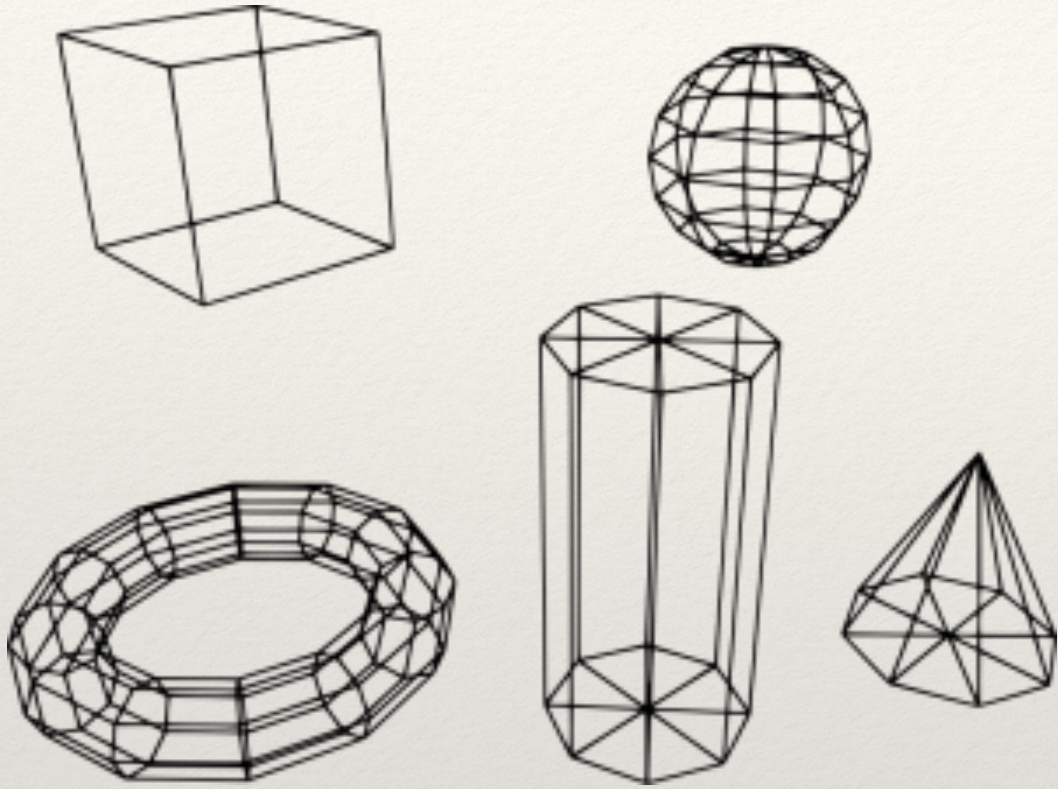
❖ Still involve agents, props, lights and cameras

❖ Same overall structure

Protein rotation
(structuralbioinformatician.wordpress.com)

How Do We Define Shape?

* Vertices form edges

* Edges form faces

* Faces form meshes

Vertices

- A vertex is a point that provides geometric information

  ```
  point(x, y);
  ```

- Multiple vertices can define a polygon or shape

  ```
  quad(0, 0, 10, 0, 20, 10, 5, 10);
  ```

- Polygons and vertices represent an object in *world space* rather than just *screen space*

Polygons

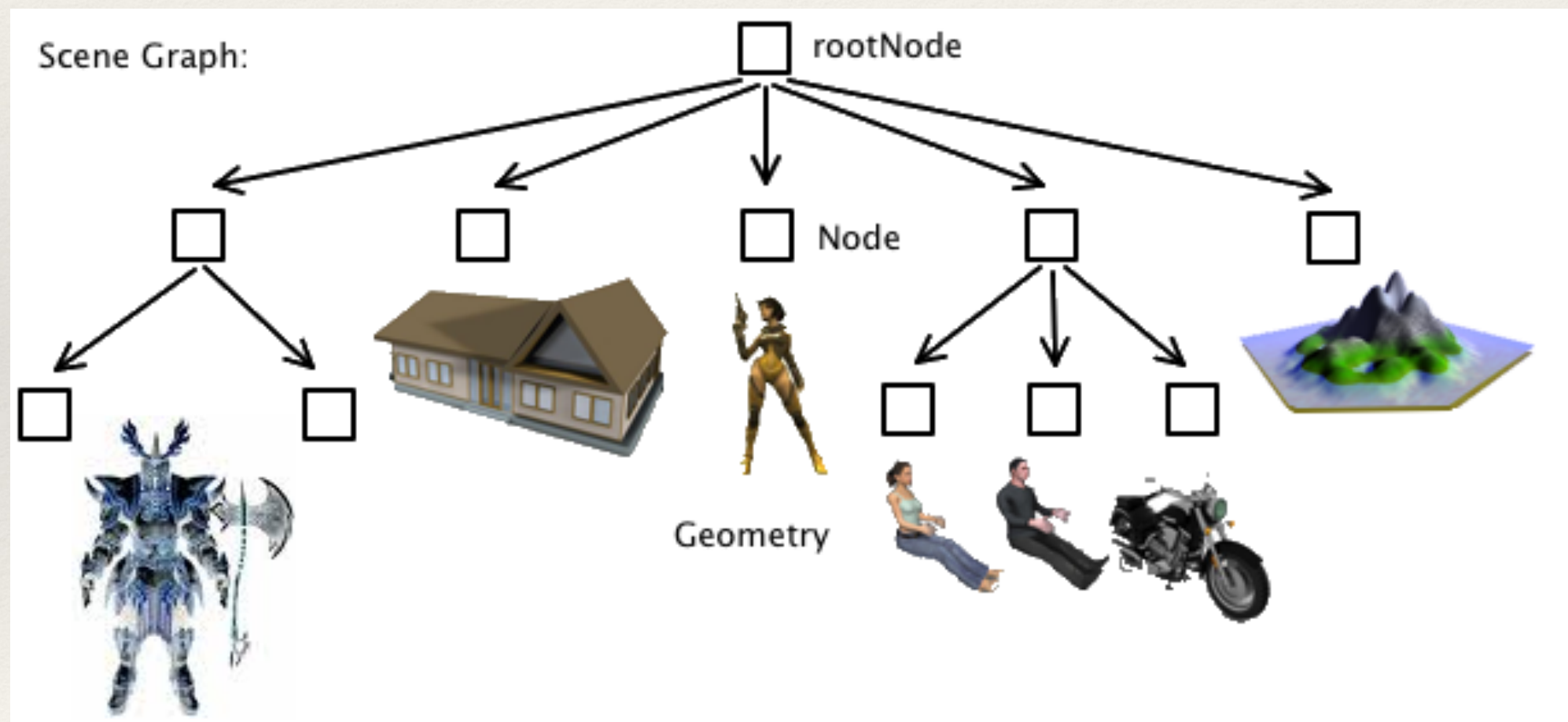❖ Common representation for objects in graphics

Consider…
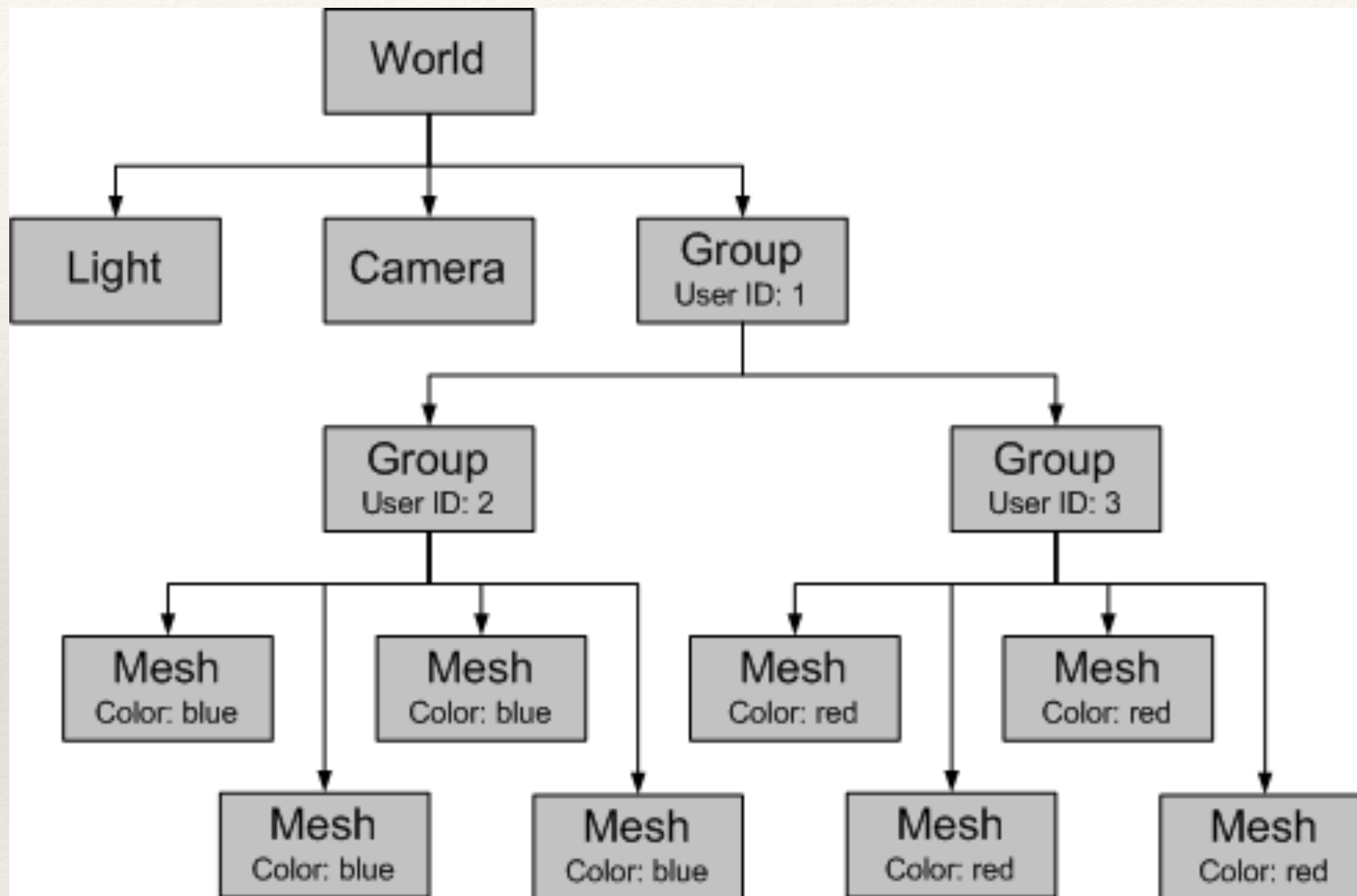
❖ What are some of the ways things in a scene relate to each other?

  ❖ How do polygons relate to each other?

  ❖ How to objects relate to each other?

Scene Graphs

❖ Graph (tree) hierarchy representing the relationship between objects in a scene


Scene graph example
(JMonkeyEngine)

Another scene graph example
(http://hadva.blogspot.com/)

Other Hierarchies

❖ Scene graphs can represent (and facilitate) object interactions at varying levels of granularity:

  ❖ Object animations

  ❖ Polygon transformations

  ❖ Vertex transformations

❖ We'll get to low-level transformations later, but let's start with animation!

3D Modeling and Animation

❖ Consider Atlas from Portal 2…
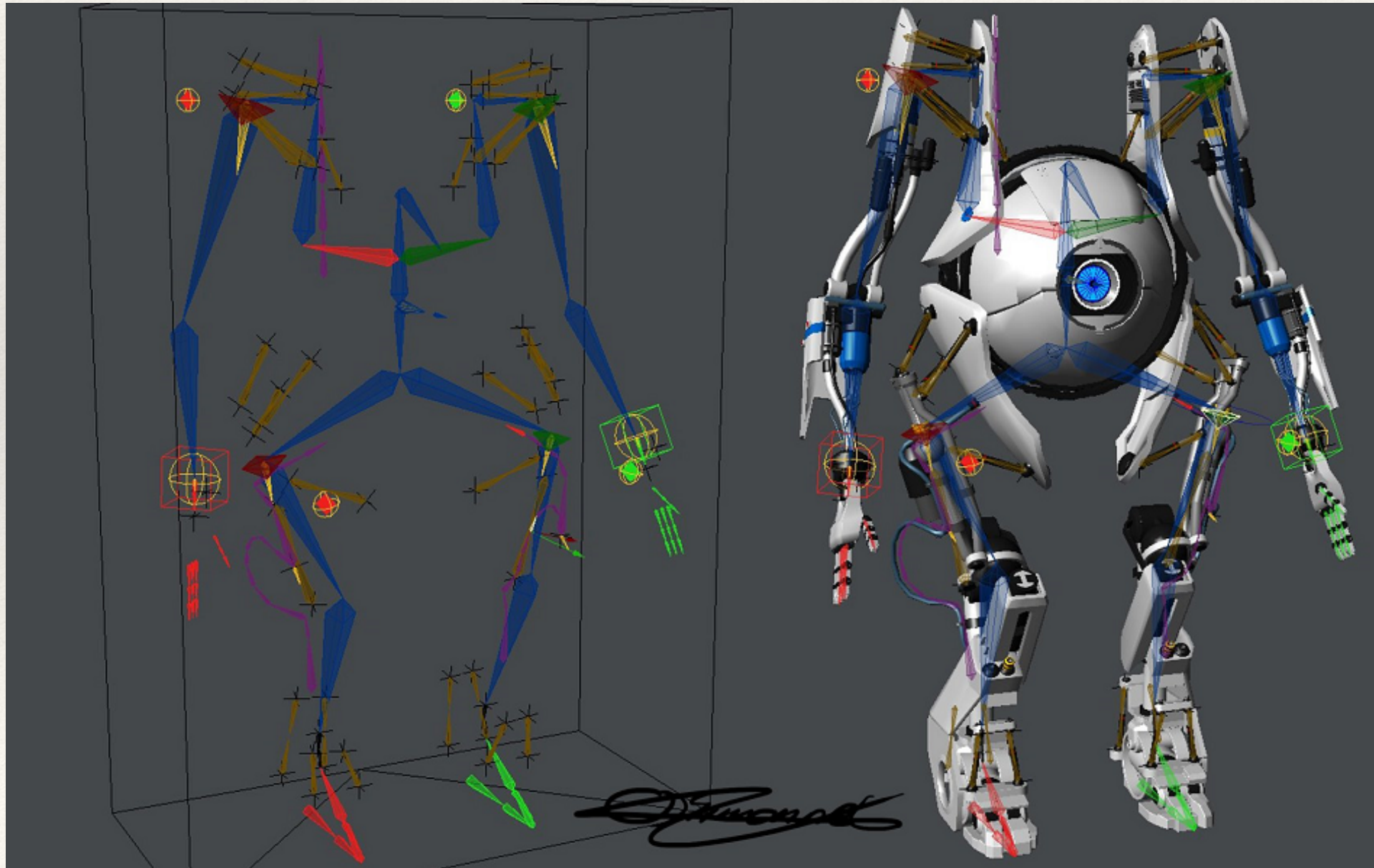
- His joint movements are in some way relative to each other

- Bending the elbow changes the wrist position…

- Turning the wrist changes the finger orientation…
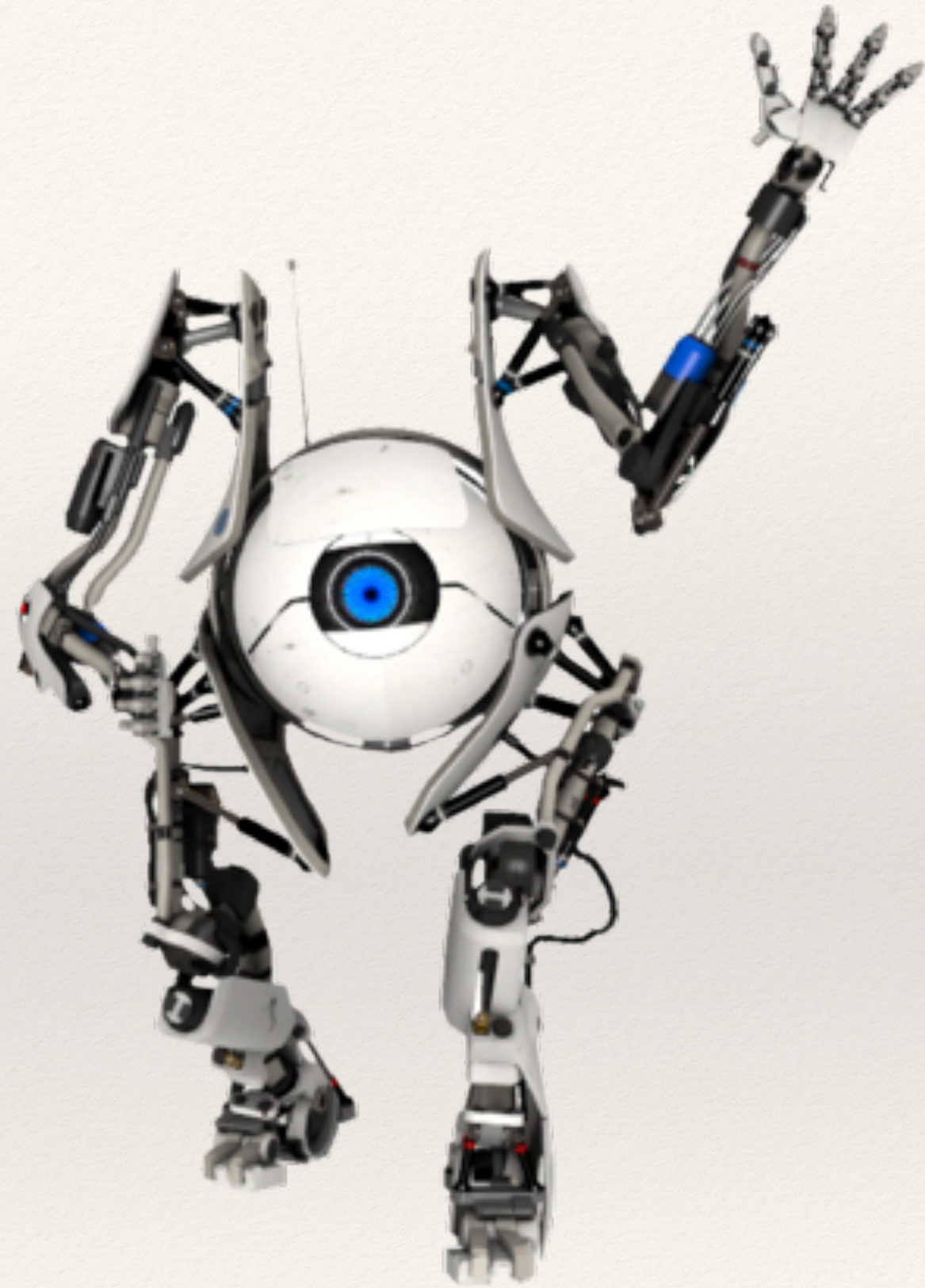
Hierarchical Modeling

❖ Hierarchical structure avoids moving each "piece" (i.e. vertex) of the object individually

❖ This structure is based on the object's design — not haphazard or random

What is a hierarchical model that captures the Pixar lamp?

From Modeling to Animation

❖ Modeling (set shape and form)

❖ Rigging (set underlying bone structure)

❖ Skinning (mapping the shape to bone)

❖ Animating (position the bones to move the shape)
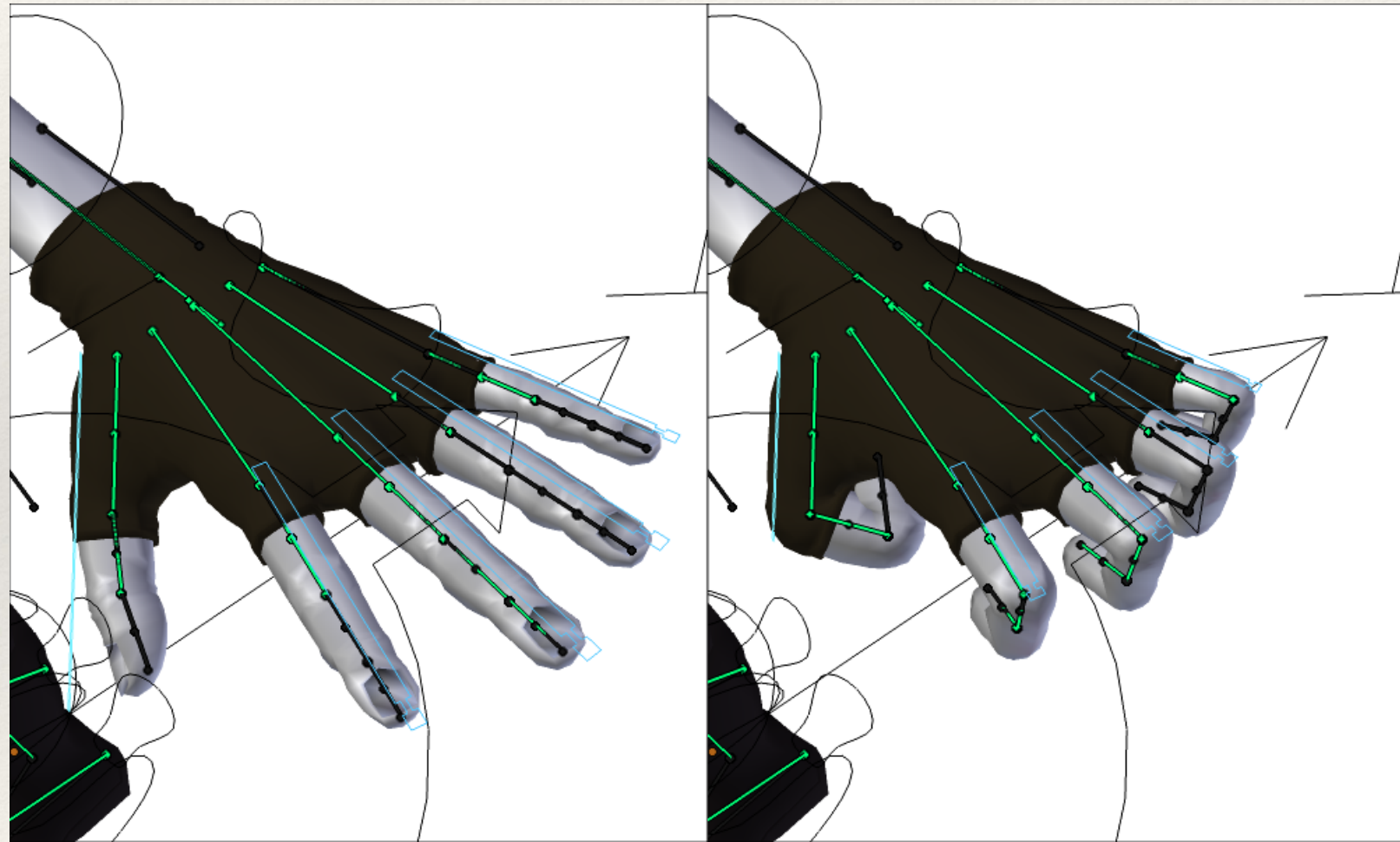
Combining OOP with Scene Graphs?

❖ Composing scene hierarchies is **not** a type of object-oriented programming

   ❖ **Scene hierarchies is not OOP concept of inheritance!**

❖ But they can be used in the same class

   ❖ Instance has animation hierarchy to determine how it moves and looks

   ❖ Instance has properties and methods to **change** how it moves and looks

Flower Example

- How is the flower as a whole moving?

- How are the petals moving **relative** to the flower?

- What is the scene hierarchy of all flowers?

- What fields and methods would a Flower class have?
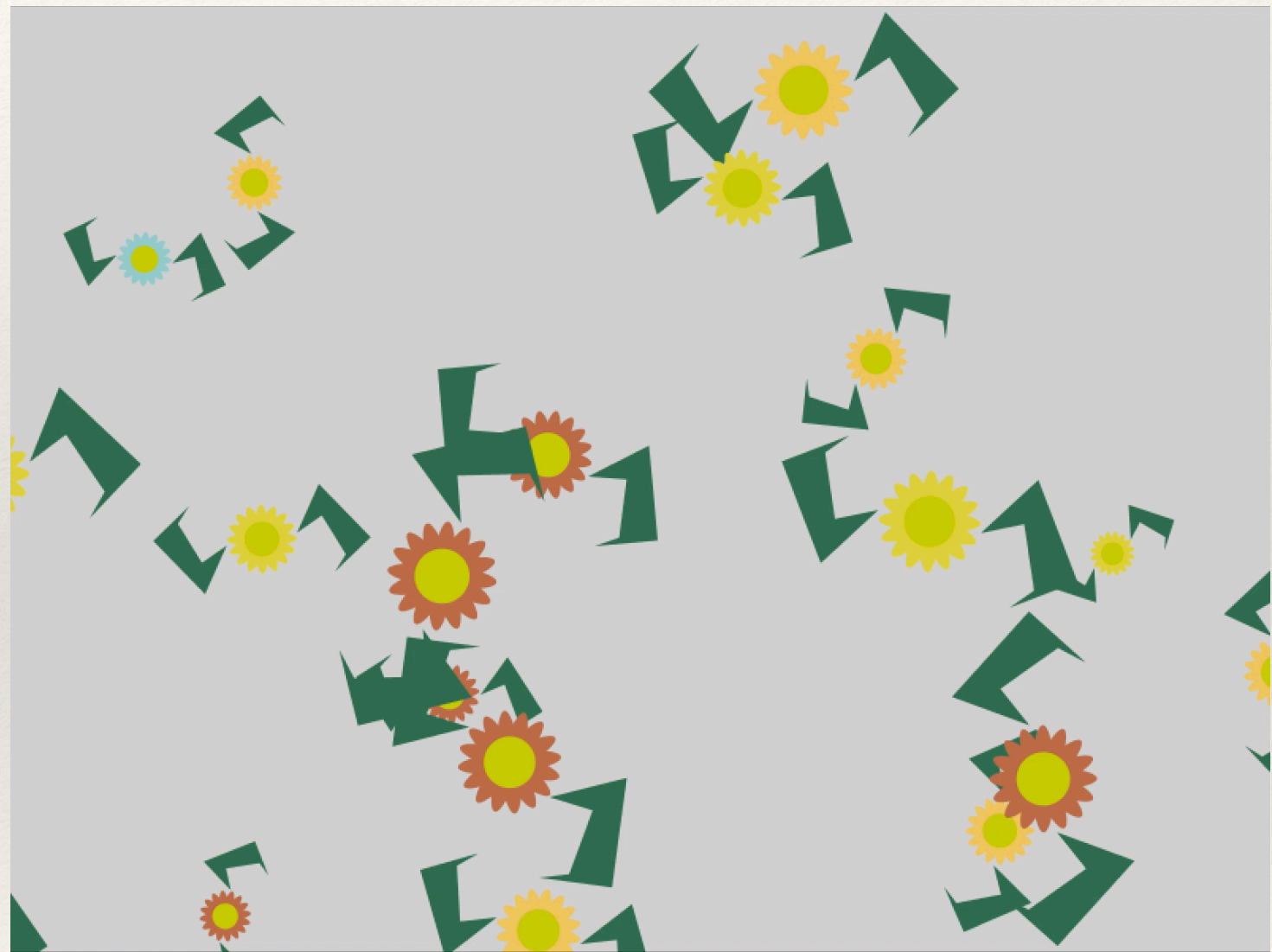
Hands-on: Creating Scene Hierarchies

❖ Today's activities:

1. Consider your team's animations for Assignment 4

2. Draw out the **scene hierarchy** of the individual animations and demonstrate how each of these scene graphs will have **two levels of animation** (e.g. the main animation and a sub animation that moves relative to it)

Submit as a group but include all of the individual animations in this s