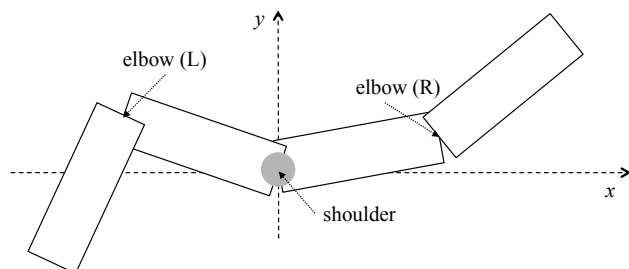


Hierarchical Models

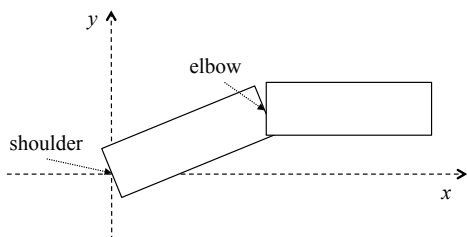
1. **Robot with two arms:** Draw the hierarchical tree for the model below, with two arms attached at a “shoulder”. Where should push and pop be placed on the tree?



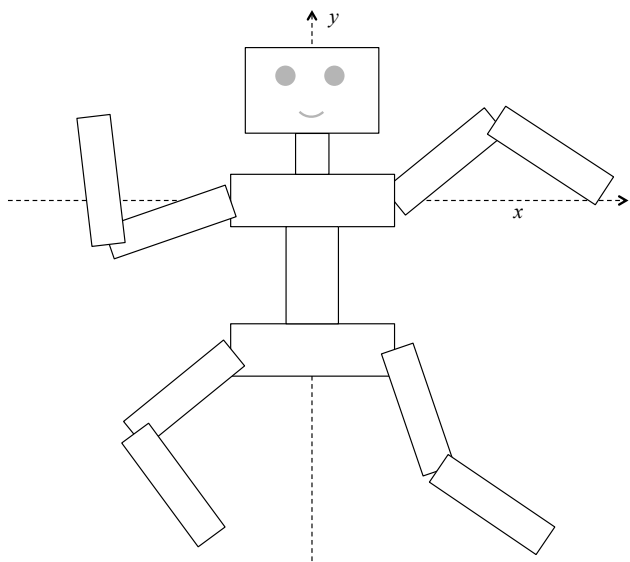
2. **Robotic arm, Lab 11:** Draw the hierarchical tree for this lab, based on the code below. Use one node for each transformation and each object.

```
gluLookAt(1,2,8, 0,0,0, 0,1,0)
glPushMatrix()
  glRotate(shoulderAngle, 0, 0, 1)
  glTranslatef(1, 0, 0)
  glPushMatrix()
    glScale(2, 0.4, 1)
    glutWireCube(1.0)
  glPopMatrix()

  glTranslate(1, 0, 0)
  glRotatef(elbowAngle, 0, 0, 1)
  glTranslate(1, 0, 0)
  glPushMatrix()
    glScale(2, 0.4, 1)
    glutWireCube(1)
  glPopMatrix()
glPopMatrix()
```



3. **Robot:** Draw a hierarchical tree for the robot below, assuming the shoulder is at the origin. Use objects as nodes first, then add transformations.



4. **Lamp:** Design a model for a lamp (maybe like the Pixar lamp below). How could you make it jump? How could you locate a light source at the end of the lamp?

