MuJoCo Workshop: XML Editing Exercises

Exercise 1: Modify Model Appearance

Task: Change the left leg ("thigh_left" and "shin_left") color to red.

Hint:

- Locate the geom elements corresponding to thigh_left and shin_left.
- Modify their material or rgba values.

Solution:

Exercise 2: Add a New Geometry

Task: Add a blue spherical decoration (size 0.05) to the top of the head.

Hint:

- Add a new geom within the head body.
- Set type="sphere" and position it slightly above the head.

Solution:

```
<body name="head" pos="0 0 .19">
  <geom name="head" type="sphere" size=".09"/>
```

```
<geom name="decoration" type="sphere" size=".05" pos="0 0 .
1" rgba="0 0 1 1"/>
</body>
```

Exercise 3: Add a Sensor

Task: Add a touch sensor to the left foot and display its value during runtime.

Hint:

- Add a sensor element of type="touch" linked to a geom in the foot_left body.
- Use Python or other runtime scripts to access sensor data.

Solution:

Runtime Script (Python):

```
import mujoco_py

model = mujoco_py.load_model_from_path("your_model.xml")
sim = mujoco_py.MjSim(model)

while True:
    sim.step()
    print("Touch sensor value:", sim.data.sensordata)
```

Exercise 4: Modify Camera View

Task: Change the default position of the "side" camera to (0, -5, 2).

Hint:

• Locate the camera element named side and adjust its pos attribute.

Solution:

```
<camera name="side" pos="0 -5 2" xyaxes="1 0 0 0 1 2" mode="t
rackcom"/>
```

Exercise 5: Add Joint Range Limits

Task: Limit the range of the left knee joint ("knee_left") to •90 to 0 degrees.

Hint:

- Modify the joint element corresponding to knee_left.
- Adjust the range attribute.

Solution:

```
<joint name="knee_left" pos="0 0 .02" axis="0 -1 0" range="-9
0 0" class="knee"/>
```

Exercise 6: Add a Light Source

Task: Add a spotlight above the model at position (0, 0, 3) with a yellow color.

Hint:

- Add a light element in the worldbody section.
- Set its pos and diffuse attributes.

Solution:

```
light name="yellow_spotlight" pos="0 0 3" diffuse="1 1 0.5"
specular="0.2 0.2 0.2" cutoff="45"/>
```

Exercise 7: Create a New Keyframe

Task: Add a new keyframe for a pose where the model tilts to the left.

Hint:

- Add a key element in the keyframe section.
- Adjust the qpos values to create the desired pose.

Solution:

Appendix: Source XML for exercise

```
See the License for the specific language governing permiss
     limitations under the License.
-->
<mujoco model="Humanoid">
  <option timestep="0.005"/>
  <visual>
    <map force="0.1" zfar="30"/>
    <rgba haze="0.15 0.25 0.35 1"/>
    <global offwidth="2560" offheight="1440" elevation="-20" az:</pre>
  </visual>
  <statistic center="0 0 0.7"/>
  <asset>
    <texture type="skybox" builtin="gradient" rgb1=".3 .5 .7" rg</pre>
    <texture name="body" type="cube" builtin="flat" mark="cross'</pre>
    <material name="body" texture="body" texturiform="true" rgba:</pre>
    <texture name="grid" type="2d" builtin="checker" width="512"</pre>
    <material name="grid" texture="grid" texrepeat="1 1" texuni</pre>
  </asset>
  <default>
    <motor ctrlrange="-1 1" ctrllimited="true"/>
    <default class="body">
      <!-- geoms -->
      <geom type="capsule" condim="1" friction=".7" solimp=".9</pre>
      <default class="thigh">
        <qeom size=".06"/>
      </default>
      <default class="shin">
        <geom fromto="0 0 0 0 0 -.3" size=".049"/>
      </default>
      <default class="foot">
```

```
<geom size=".027"/>
  <default class="foot1">
    <geom fromto="-.07 -.01 0 .14 -.03 0"/>
  </default>
  <default class="foot2">
    <geom fromto="-.07 .01 0 .14 .03 0"/>
  </default>
</default>
<default class="arm_upper">
  <geom size=".04"/>
</default>
<default class="arm lower">
  <geom size=".031"/>
</default>
<default class="hand">
  <geom type="sphere" size=".04"/>
</default>
<!-- joints -->
<joint type="hinge" damping=".2" stiffness="1" armature="</pre>
<default class="joint_big">
  <joint damping="5" stiffness="10"/>
  <default class="hip x">
    <joint range="-30 10"/>
  </default>
  <default class="hip z">
    <joint range="-60 35"/>
  </default>
  <default class="hip_y">
    <joint axis="0 1 0" range="-150 20"/>
  </default>
  <default class="joint_big_stiff">
    <joint stiffness="20"/>
  </default>
</default>
<default class="knee">
```

```
<joint pos="0 0 .02" axis="0 -1 0" range="-160 2"/>
    </default>
    <default class="ankle">
      <joint range="-50 50"/>
      <default class="ankle_y">
        <joint pos="0 0 .08" axis="0 1 0" stiffness="6"/>
      </default>
      <default class="ankle_x">
        <joint pos="0 0 .04" stiffness="3"/>
      </default>
    </default>
    <default class="shoulder">
      <joint range="-85 60"/>
    </default>
    <default class="elbow">
      <joint range="-100 50" stiffness="0"/>
    </default>
  </default>
</default>
<worldbody>
  <geom name="floor" size="0 0 .05" type="plane" material="gr:</pre>
  <light name="spotlight" mode="targetbodycom" target="torso"</pre>
  <body name="torso" pos="0 0 1.282" childclass="body">
    <liqht name="top" pos="0 0 2" mode="trackcom"/>
    <camera name="back" pos="-3 0 1" xyaxes="0 -1 0 1 0 2" mod</pre>
    <camera name="side" pos="0 -3 1" xyaxes="1 0 0 0 1 2" mode</pre>
    <freejoint name="root"/>
    <geom name="torso" fromto="0 -.07 0 0 .07 0" size=".07"/>
    <geom name="waist_upper" fromto="-.01 -.06 -.12 -.01 .06</pre>
    <body name="head" pos="0 0 .19">
      <geom name="head" type="sphere" size=".09"/>
      <camera name="egocentric" pos=".09 0 0" xyaxes="0 -1 0</pre>
    </body>
    <body name="waist_lower" pos="-.01 0 -.26">
      <geom name="waist_lower" fromto="0 -.06 0 0 .06 0" size:</pre>
```

```
<joint name="abdomen_z" pos="0 0 .065" axis="0 0 1" rang</pre>
<joint name="abdomen_y" pos="0 0 .065" axis="0 1 0" rang</pre>
<body name="pelvis" pos="0 0 -.165">
  <joint name="abdomen x" pos="0 0 .1" axis="1 0 0" rand</pre>
  <geom name="butt" fromto="-.02 -.07 0 -.02 .07 0" size</pre>
  <body name="thigh_right" pos="0 -.1 -.04">
    <joint name="hip x right" axis="1 0 0" class="hip x'</pre>
    <joint name="hip_z_right" axis="0 0 1" class="hip_z'</pre>
    <joint name="hip_y_right" class="hip_y"/>
    <geom name="thigh_right" fromto="0 0 0 0 .01 - .34" (</pre>
    <body name="shin right" pos="0 .01 -.4">
      <joint name="knee_right" class="knee"/>
      <geom name="shin_right" class="shin"/>
      <body name="foot right" pos="0 0 -.39">
        <joint name="ankle_y_right" class="ankle_y"/>
        <joint name="ankle_x_right" class="ankle_x" axis</pre>
        <geom name="foot1_right" class="foot1"/>
        <geom name="foot2 right" class="foot2"/>
      </body>
    </body>
  </body>
  <body name="thigh_left" pos="0 .1 -.04">
    <joint name="hip_x_left" axis="-1 0 0" class="hip_x"</pre>
    <joint name="hip_z_left" axis="0 0 -1" class="hip_z'</pre>
    <joint name="hip y left" class="hip y"/>
    <geom name="thigh left" fromto="0 0 0 0 -.01 -.34" (</pre>
    <body name="shin_left" pos="0 -.01 -.4">
      <joint name="knee_left" class="knee"/>
      <geom name="shin_left" fromto="0 0 0 0 0 -.3" clas</pre>
      <body name="foot_left" pos="0 0 -.39">
        <joint name="ankle_y_left" class="ankle_y"/>
        <joint name="ankle_x_left" class="ankle x" axis:</pre>
        <geom name="foot1 left" class="foot1"/>
        <geom name="foot2 left" class="foot2"/>
      </body>
    </body>
```

```
</body>
      </body>
    </body>
    <body name="upper arm right" pos="0 -.17 .06">
      <joint name="shoulder1_right" axis="2 1 1" class="shoulder1_right" axis="2 1 1" class="shoulder1_right"</pre>
      <joint name="shoulder2_right" axis="0 -1 1" class="shoul"</pre>
      <geom name="upper arm right" fromto="0 0 0 .16 -.16 -.16</pre>
      <body name="lower_arm_right" pos=".18 -.18 -.18">
         <joint name="elbow_right" axis="0 -1 1" class="elbow",</pre>
         <geom name="lower_arm_right" fromto=".01 .01 .01 .17</pre>
         <body name="hand right" pos=".18 .18 .18">
           <geom name="hand_right" zaxis="1 1 1" class="hand"/>
         </body>
      </body>
    </body>
    <body name="upper_arm_left" pos="0 .17 .06">
      <joint name="shoulder1_left" axis="-2 1 -1" class="shoul"</pre>
      <joint name="shoulder2_left" axis="0 -1 -1" class="shoulder2_left"</pre>
      <geom name="upper_arm_left" fromto="0 0 0 .16 .16 -.16"</pre>
      <body name="lower_arm_left" pos=".18 .18 -.18">
         <joint name="elbow left" axis="0 -1 -1" class="elbow",</pre>
         <geom name="lower arm left" fromto=".01 -.01 .01 .17</pre>
         <body name="hand_left" pos=".18 -.18 .18">
           <qeom name="hand left" zaxis="1 -1 1" class="hand"/;</pre>
         </body>
      </body>
    </body>
  </body>
</worldbody>
<contact>
  <exclude body1="waist_lower" body2="thigh_right"/>
  <exclude body1="waist_lower" body2="thigh_left"/>
</contact>
<tendon>
```

```
<fixed name="hamstring_right" limited="true" range="-0.3 2";</pre>
    <joint joint="hip_y_right" coef=".5"/>
    <joint joint="knee_right" coef="-.5"/>
  </fixed>
  <fixed name="hamstring_left" limited="true" range="-0.3 2">
    <joint joint="hip_y_left" coef=".5"/>
    <joint joint="knee left" coef="-.5"/>
  </fixed>
</tendon>
<actuator>
  <motor name="abdomen z"</pre>
                                                joint="abdomen z"/:
                                   gear="40"
  <motor name="abdomen_y"
                                   gear="40"
                                                joint="abdomen_y"/>
                                                joint="abdomen x"/
  <motor name="abdomen x"
                                   gear="40"
                                                joint="hip_x_right"
  <motor name="hip_x_right"</pre>
                                   gear="40"
  <motor name="hip_z_right"</pre>
                                                joint="hip_z_right"
                                   gear="40"
  <motor name="hip_y_right"</pre>
                                   gear="120"
                                               joint="hip_y_right"
                                                joint="knee_right",
  <motor name="knee_right"</pre>
                                   gear="80"
                                                joint="ankle_y_right"
  <motor name="ankle_y_right"</pre>
                                   gear="20"
                                   gear="20"
  <motor name="ankle_x_right"</pre>
                                                joint="ankle_x_right"
  <motor name="hip x left"</pre>
                                                joint="hip_x_left",
                                   gear="40"
  <motor name="hip_z_left"</pre>
                                   gear="40"
                                                joint="hip z left",
  <motor name="hip_y_left"</pre>
                                               joint="hip_y_left",
                                   gear="120"
  <motor name="knee_left"</pre>
                                   gear="80"
                                                joint="knee_left"/:
  <motor name="ankle y left"</pre>
                                                joint="ankle y left
                                   gear="20"
  <motor name="ankle_x_left"</pre>
                                                joint="ankle x left
                                   gear="20"
  <motor name="shoulder1_right"</pre>
                                   gear="20"
                                                joint="shoulder1 r:
  <motor name="shoulder2_right"</pre>
                                   gear="20"
                                                joint="shoulder2_r:
  <motor name="elbow right"</pre>
                                                joint="elbow right"
                                   gear="40"
  <motor name="shoulder1 left"</pre>
                                   gear="20"
                                                joint="shoulder1_le
  <motor name="shoulder2 left"</pre>
                                                joint="shoulder2 le
                                   gear="20"
  <motor name="elbow left"</pre>
                                   gear="40"
                                                joint="elbow_left",
</actuator>
<keyframe>
  <!--
```

```
The values below are split into rows for readibility:
  torso position
  torso orientation
  spinal
  right leg
  left leg
  arms
-->
<key name="squat"</pre>
     qpos="0 0 0.596
           0.988015 0 0.154359 0
           0 0.4 0
           -0.25 -0.5 -2.5 -2.65 -0.8 0.56
           -0.25 -0.5 -2.5 -2.65 -0.8 0.56
           0 0 0 0 0 0"/>
<key name="stand_on_left_leg"</pre>
     qpos="0 0 1.21948
           0.971588 -0.179973 0.135318 -0.0729076
           -0.0516 -0.202 0.23
           -0.24 - 0.007 - 0.34 - 1.76 - 0.466 - 0.0415
           -0.08 -0.01 -0.37 -0.685 -0.35 -0.09
           0.109 - 0.067 - 0.7 - 0.05 0.12 0.16"/>
<key name="prone"</pre>
     gpos="0.4 0 0.0757706
           0.7325 0 0.680767 0
           0 0.0729 0
           0.0077 0.0019 -0.026 -0.351 -0.27 0
           0.0077 0.0019 -0.026 -0.351 -0.27 0
           0.56 -0.62 -1.752
           0.56 -0.62 -1.752"/>
<key name="supine"</pre>
     qpos="-0.4 0 0.08122
           0.722788 0 -0.69107 0
           0 - 0.25 0
           0.0182 0.0142 0.3 0.042 -0.44 -0.02
           0.0182 0.0142 0.3 0.042 -0.44 -0.02
```

```
0.186 -0.73 -1.73

0.186 -0.73 -1.73"/>
</keyframe>
</mujoco>
```