

CS460 Fall 2021

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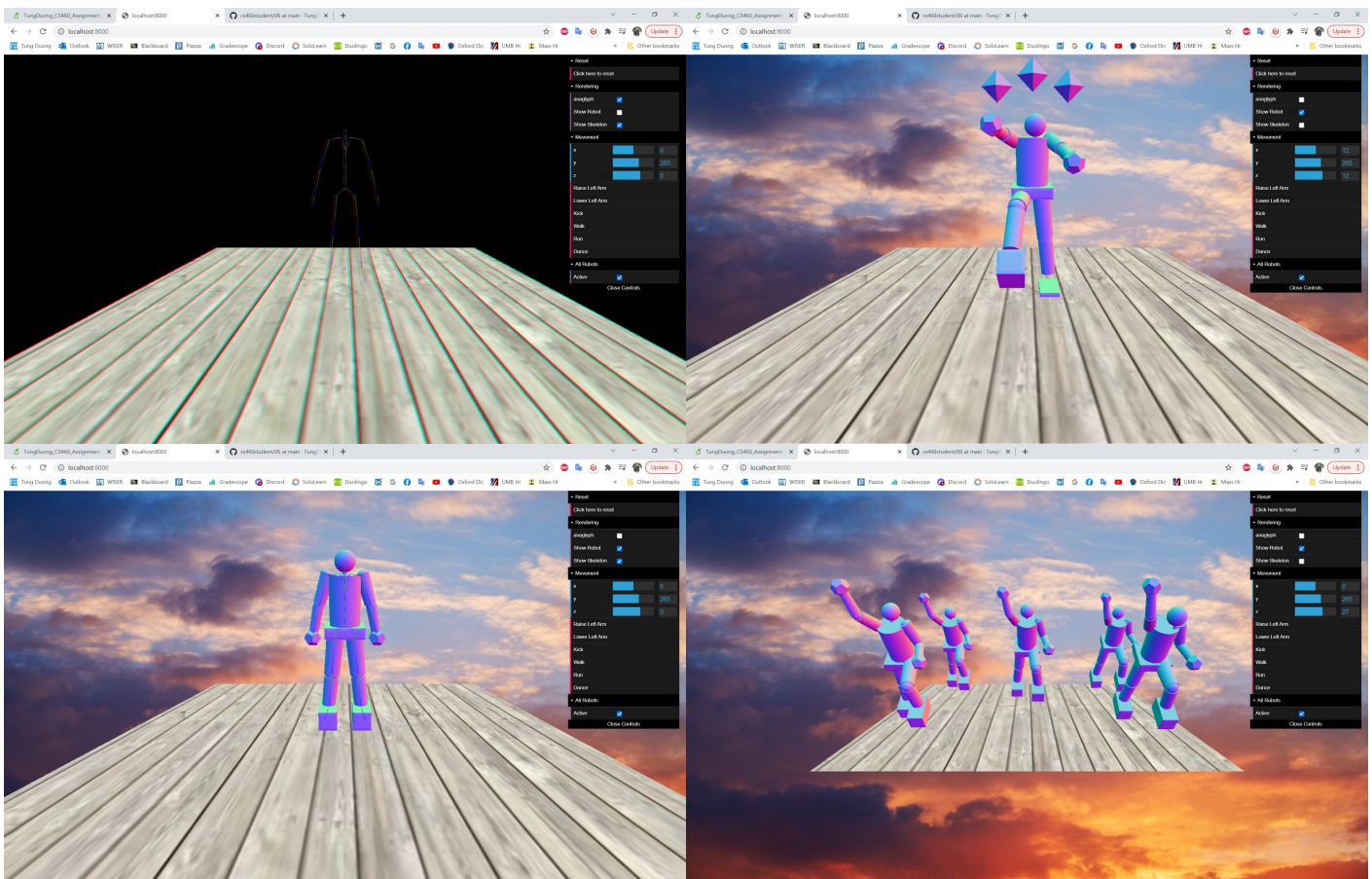
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## Assignment 6: The Virtual Robot!

We will create a virtual robot that uses a human-inspired skeleton.

In class, we started using the `THREE.Bone` class to assemble a skeleton of a virtual robot. Here, we will extend this skeleton and add code to animate certain robot movements. From a software engineering perspective, we will be writing **object-oriented code**. This allows us to create multiple robots within the same scene later on.



**Starter code for assignment 6.** In class, we pulled from the upstream repository and received the 06/index.html file. This is the official starter code. However, we already worked on it during class so your local version might include some of this assignment.

**Part 1 (2 points):** Create an empty robot.js file and include it in the index.html file using the <script>-tag..

**Part 2 (2 points):** Modify robot.js to include an empty constructor for a Robot object. The constructor should take x, y, and z parameters to configure the position of the robot.

**Part 3 (2 points):** Add properties to the Robot class. Each property is pre-fixed with this. which refers to the current robot if we created multiple robots. Please add the following properties: this.head, this.neck, this.torso.

**Part 4 (2 points):** Initialize THREE.Bone objects for this.head, this.neck, and this.torso.

**Part 5 (1 points):** Create the **scene graph** hierarchy with this.head as root.

```
this.head.add(this.neck);
this.neck.add(this.torso);
```

**Part 6 (10 points):** Now we create the limbs of the robot. Let's start with the left and right arms. Each arm has three elements: upper\_arm, lower\_arm, and hand. Please create the hierarchy of the left and right arms. The parent node of the arms is this.neck. And, please do not forget to create THREE.Bone objects for all elements.

**Part 7 (10 points):** What about the legs? Please create the left and right legs. Each leg consists of a hierarchy of three elements: upper\_leg, lower\_leg, and foot. The parent node of the legs is this.torso. Also, please use THREE.Bone objects for all elements.

**Part 8 (15 points):** Write a Robot.prototype.show(scene) method that displays the robot by using the THREE.SkeletonHelper object. Then, change index.html code to create the robot and call the show method.

In robot.js add

```
Robot.prototype.show = function(scene) {

    var rGroup = new THREE.Group();
    rGroup.add( this.head );

    var helper = new THREE.SkeletonHelper( rGroup );
    helper.material.linewidth = 3; // make the skeleton thick

    scene.add(rGroup);
    scene.add(helper);

};
```

And in index.html add

```
// ...
var r = new Robot(0, -55, 0); // any position works
r.show(scene);

animate();
// ...
```

But nothing shows up! We need to adjust positions of the bones in part 9.

**Part 9 (15 points):** Please adjust the positions of all properties. All our properties are now THREE.Bone objects which have a position associated. Please modify the position to layout the robot's skeleton as we did in class. And remember, in this scene graph hierarchy, all positions are relative to the parent element.

Example:

```
Robot = function(x, y, z) {  
  
    this.head = new THREE.Bone();  
    this.head.position.set( x, y, z );  
  
    // ...  
  
    this.neck.position.y = -10;  
    this.torso.position.y = -30; // the torso is 3x as long as the neck
```

The robot should now appear when reloading the local website!

**Part 10 (20 points):** A static robot is no fun! Let's add some movement. Let's first include the dat.GUI library and add sliders to change the x, y, and z position of the robot.

```
<script src="https://threejs.org/examples/js/libs/dat.gui.min.js" type="text/javascript"></script>
```

And configure the menu (and at the same time add the anaglyph rendering):

```
var controller = {  
    anaglyph: false  
}  
  
var gui = new dat.GUI();  
var rendering = gui.addFolder( "Rendering" );  
rendering.add( controller, 'anaglyph' );  
rendering.open();
```

For anaglyph rendering, replace the `render()` call in `animate()` with `effect.render()` depending on the controller.anaglyph flag. Note: use the `renderer.setClearAlpha(1)` to deactivate the sky background if anaglyph is active.

Then, add sliders for movement in x,y,z:

```
var moving = gui.addFolder( "Movement" );  
moving.add( r.head.position, "x", -1000, 1000 );  
// ... add y and z  
moving.open();
```

There is slider bug in dat.GUI and we need to set up the trackball controls only on the domElement:

```
controls = new THREE.TrackballControls( camera, renderer.domElement );
```

**Part 11 (20 points):** Finally, let's add some animations! We can use `slerp` interpolation between quaternions to move the robots' limbs. We will need a `Robot.prototype.onAnimate` function that is called from the `animate()` loop. Then, please add the following functionality

```

Robot.prototype.raise_left_arm = function() {
  this.movement = 'raise left arm';
};

Robot.prototype.lower_left_arm = function() {
  this.movement = 'lower left arm';
};

Robot.prototype.kick = function() {
  this.movement = 'kick';
};

Robot.prototype.onAnimate = function() {
  if (this.movement == 'raise left arm') {
    // ... TODO slerp
  } else if (this.movement == 'lower left arm') {
    // ... TODO slerp
  } else if (this.movement == 'kick') {
    // ... TODO slerp and check once it is done for a backwards slerp
    // you can use the identity quaternion for a backwards slerp
  }
};

```

And then, please connect dat.GUI to these actions!

**Part 12 (1 points):** Please update the screenshot above with your own and then post the github pages url here:

<https://tungduong2.github.io/cs460student/06/>

**Bonus (33 points):**

**Part 1 (11 points):** Use the window.onclick callback and a THREE.RayCaster to place the robot on the floor plane if the user clicks while holding shift. Don't forget to update the dat.GUI sliders with the new position (look at the .listen() function of dat.GUI).

**Part 2 (22 points):** Add a Robot.prototype.dance function that makes the robot go crazy (a lot of movements). Please add some screenshots.