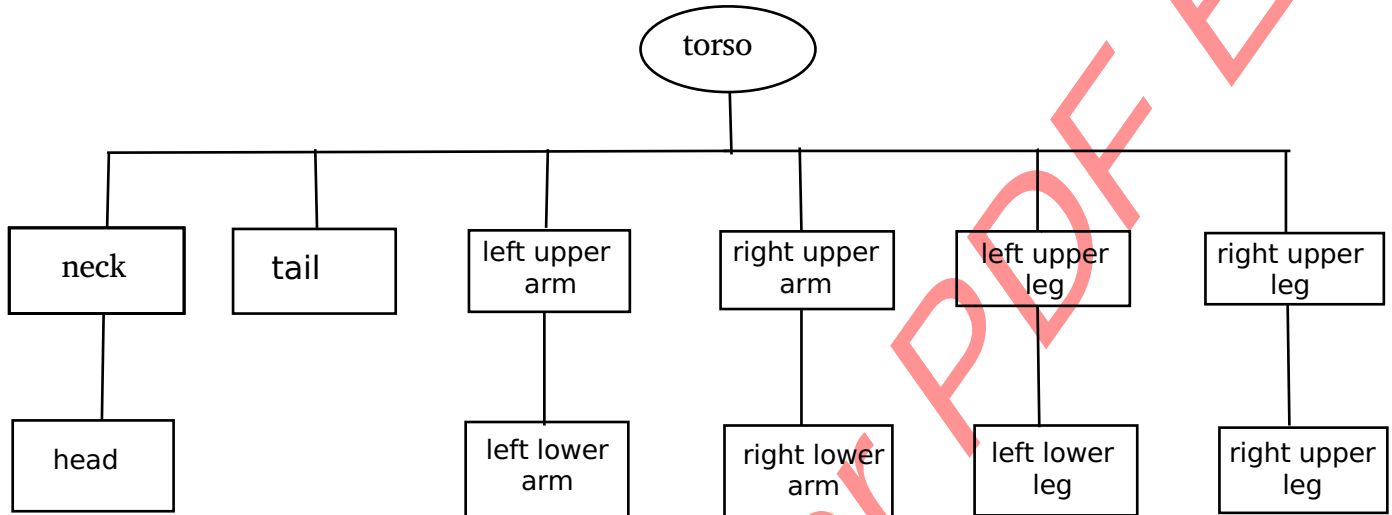


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HOMEWORK2

EXERCISE 1 :

I have modeled my bear using hierarchical modeling according to following tree figure and used cube function present in the file to create different parts of the bear:



I have used an id to refer to each node of the tree and store all hierarchical model in a linkedlist data structure. I also put all initial values of angles in an array to refer to them in initialization phase and in initNodes() function.

```
var theta = [0, 0, 0, 0, 0, 0, 0, 180, 0, 0, 180, 0, 0, 120, 0];
```

In render function, I have called traverse function with torsold as its argument in order to make my tree and model the horse starting from torso which is the root.

```
traverse(torsold);
```

EXERCISE 2 :

For this end I have used procedural texture to the body of the bear with a linear decrease of intensity from the front to the back of the body, first I have made my checkboard pattern in image1 object and then made the decrease pattern of intensity from the front to the back in image2 using following technique:

```
for ( var i = texSize; i > -1; i-- ) {  
    for ( var j = texSize; j > 0; j-- ) {  
        image2[4*i*texSize+4*j] = i;  
        image2[4*i*texSize+4*j+1] = i;  
        image2[4*i*texSize+4*j+2] = i;  
        image2[4*i*texSize+4*j+3] = 255; } }
```

In order to add the texture each part that I want I have used the function addTexture():
For simplify and also for avoiding the repetition of the codes for each part I have made this function.

```

function addTexture(){
    if(differentTexture==0)
        configureTexture();
    else
        configureTexture1();
    //texture on the body
    gl.activeTexture( gl.TEXTURE0 );
    gl.bindTexture( gl.TEXTURE_2D, texture1 );
    gl.uniform1i(gl.getUniformLocation( program, "Tex0"), 0);
    gl.activeTexture( gl.TEXTURE1 );
    gl.bindTexture( gl.TEXTURE_2D, texture2 );
    gl.uniform1i(gl.getUniformLocation( program, "Tex1"), 1);
    for(var i =0; i<6; i++) gl.drawArrays(gl.TRIANGLE_FAN, 4*i, 4);
    gl.deleteTexture(texture1);}

```

As you see I have used the variable differentTexture for controlling to have different kind of texture in our hierarchical model.

In our case we have just one different texture for the head part so I have done in this way:

```
differentTexture=1;
```

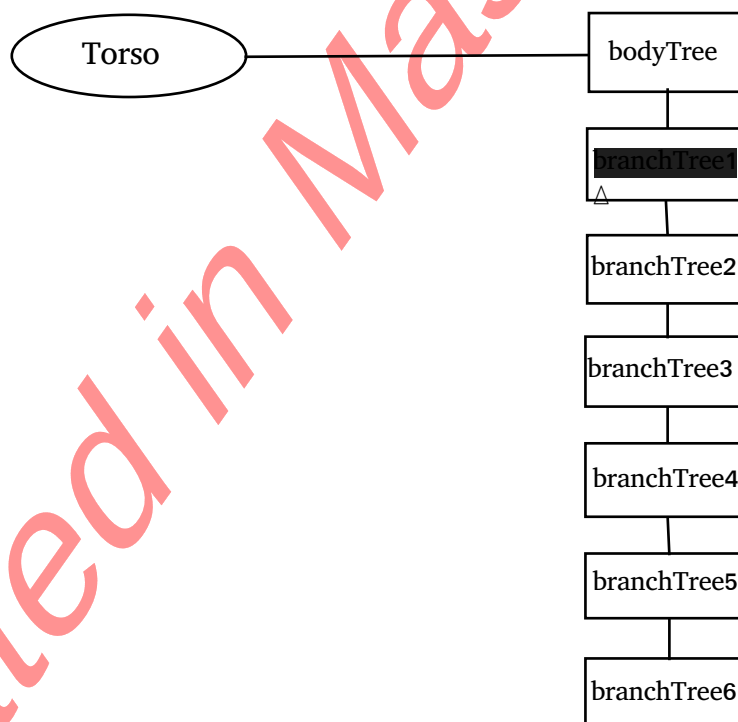
```
addTexture();
```

```
differentTexture=0;
```

After calling addTexture in the function head() I changed differentTexture to 0 for calling the default texture for another part.

EXERCISE 3 :

In order to make the tree, I have set the first treeBody of the obstacle as sibling of the torso in hierarchical model, and then using the idea of robot arm model, I have set the next branchTree as the child of previous and so on as following:



EXERCISE 4 :

In order to apply animation to the bear, I have used the following variables:

```

var animateTorso = 0;
var moveLeg1 = 2.0;
var moveLeg2 = -2.0;
var movefoot1 = 3.0;
var movefoot2 = 3.0;
var a1 = 0;
var a2 = 0;
var a3 = 0;
var a4 = 0;
var b1 = 0;
var b2 = 0;
var b3 = 0;
var b4 = 0;
var x = 0;
var y = 0;
var run = false;
var TI=180;
var reset=1;

```

I have set an animateBear() function in order to define the movement of the bear. In order to move the bear, I have used animateTorso variable and whenever the animateBear() function has been called, animateTorso will be increased in each time frame:

```

animateTorso += 0.06;
case torsoId:
m = mult(m, translate(animateTorso, 0, 0));

```

I have used a1 for the movement of left upper arm and a2 for the movement of right upper leg and increase their values by moveLeg1 value because they both have to move together so that the movement of the legs seems natural.

```

a1 += moveLeg1;
a2 += moveLeg1;
if (a1 > 30 && a2 > 30){
moveLeg1 = -moveLeg1;}
if (a1 < -30 && a2 < -30){
moveLeg1 = -moveLeg1;}

```

And then used the rotation to rotate the left upper arm and right upper leg with the same rotation angle and in the same direction.

```

m = mult(m, rotate(a1, 1, 0, 0));

```

The technique is the same for the movement of other upper and lower legs. a3 and a4 are the angles responsible for the movement of right upper arm and left upper leg. b1 and b2 are angles to move left lower arm and right lower leg. When a1 and a2 are between 0 and 30 degrees, the related lower parts will be moved by the value which is movefoot1. And when b1 and b2 get to more than 50 degree and less than 0 degree, I have changed the direction of movement by changing the sign of movefoot1 variable. So the movement will be reversed.

```

if (a1 >= 0 && a1 < 30 && a2 >= 0 && a2 < 30){
b1 += movefoot1;
b2 += movefoot1;
if ((b2 >= 50 && b1 >= 50) || (b1 <= 0 && b2 <= 0))
{
movefoot1 = -movefoot1;
}}

```

in order to move in the opposite side of the tree, first I have checked if the bear has arrived to the tree ,if yes I have changed all the parameters to the default and also stepwise I have changed the rotation of the bear in this way :

```
if(animateTorso > 5.0 && animateTorso < 5.3)
```

```
{
    x=0;
    y=0;
    a1=0;
    a2=0;
    a3=0;
    a4=0;
    b1=0;
    b2=0;
    b3=0;
    b4=0;
    moveLeg1 = 2.0;
    moveLeg2 = -2.0;
    movefoot1 = 3.0;
    movefoot2 = 3.0;
    if(theta[torsoId]<180 && theta[torsoId]>-180){
        theta[torsoId]-=1;    changing stepwise the rotation of the bear in the opposite side
        for(i=0; i<numNodes; i++) initNodes(i);
    }
}
```

Advanges and Disadvantages:

The idea of hierarchical modeling can be extended to an entire scene, encompassing: many different objects, lights, camera position.

The disadvantages of this model is that every node inherits the properties from the root and this can cause a problem to some extend like coloring, texture etc.

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