**CSC 471 midterm 2 HOME WORK**

# DUE in class 3/8

1**) Geometric Relationships**

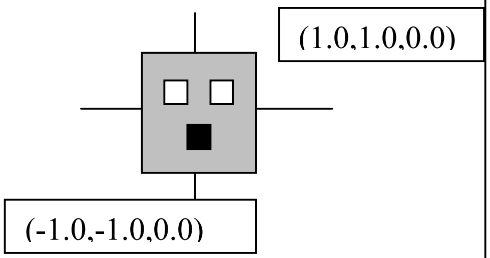
Assume that Emmet (the main character in the Lego movie) can throw a brick anywhere within 5 units away from his body. Assume the character, Lord Business is currently located at {1, 2, 1} and Emmet is located at {-2, -1, 0}

(a) Can Emmet hit Lord Business with a brick? SHOW YOUR WORK MATHEMATICALLY!

(b) Now assume there is an extremely large wall (much like a plane) (specified by the equation: 6*x+8*y+0*z+5=0). And there is a zombie located at {1, 0, 10}. Which character can the zombie eat first – assuming the zombie cannot get across the wall? SHOW YOUR WORK MATHEMATICALLY! *<hint: a plane divides 3D space into a positive half space and a negative half space – you can tell if a point is on the same "side" of a plane by plugging in the point to the equation and seeing if its value is negative or positive – if two points are positive, those 2 points lay on the same "side" of the plane>*

**2) Transforms**

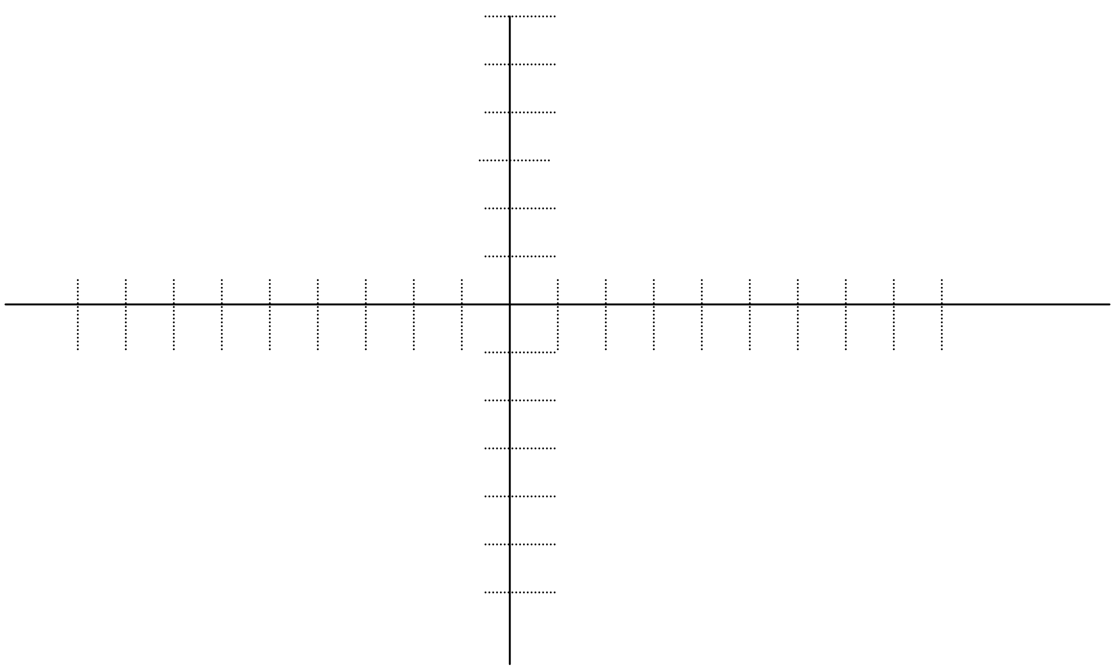
Carefully draw the result of the following OpenGL (and MatrixStack) code assuming that the DrawRobotFace() function draws the complete image below (i.e. one grey box with sides of length 2 with three small sub-boxes inside with sides of length 0.5: white eyes and a black mouth). Recall that rotations are specified as counter-clockwise. **Carefully** <u>read all the code below before drawing and be sure that it is clear what the final drawing will look like</u>:




```
/*Set up the matrix stack */
auto MV = make_shared<MatrixStack>();
 MV->loadIdentity();
MV->rotate(-90, Vector3f(0, 0, 1));
MV->translate(Vector3f(1, 1, 0));
glUniformMatrix4fv(prog->getUniform("MV"), 1, GL_FALSE, MV->topMatrix().data());
 /* Draw */
 DrawRobotFace ();

/*Set up the second matrix */
 MV->loadIdentity();
MV->translate(Vector3f(-1, 1, 0));
MV->rotate(90, Vector3f(0, 0, 1));
 glUniformMatrix4fv(prog->getUniform("MV"), 1, GL_FALSE, MV->topMatrix().data());

/* Draw */
DrawRobotFace ();
```



3) **Shading**

Given a light with the following {r, g, b} ambient, diffuse and specular terms:
light_color= {1, 1, 1}
and a material with the following ambient, diffuse and specular terms:
material_diffuse = {0.6, 0.6, 0.8}
material _ambient = {0.2, 0.2, 0.2}
material _specular= {0.0, 0.5, 0.5}
material_shininess={2}
Assuming that the light is **located at is {10, 10, 4}**. For a **point located at {10, 0, 4}** with the normal is {0, 8, 6} and the **camera is located at** {10, 3, 8}, what is the reflected color {r, g, b}, computed using the Phong model? (Assume there is no distance attenuation). **Show your work!**

**4) Camera transforms**

Given the below world frame figure (with coordinates listed for the center of the objects) – and a camera specified using LookAt(1, 4, 2, 1.0, 1.0, 2.0, -1, 0, 0}.

a. **Draw** the camera (and its frame, i.e. **u**, **v**, **w** basis vectors) in the below world frame and clearly specify what it is looking at, the star or the moon?

**b.** Compute and draw the gaze vector. **Gaze =**

**c.** If you wanted to 'zoom' out the camera, one unit along the gaze vector, what is the value of the new 'eye' position of the camera?

**d.** Why is the "up" vector different then our usual {0, 1, 0} vector?