CS4204 Computer Graphics Fall 2007
Homework Assignment 2

Assignment 2 is due on Tuesday, 10/03/2007 3:30pm. You need to turn your homework in before midterm start. Please write clearly on paper.

Note: There are 10 points for each question.

Q1. Viewport transform is a 2D transformation that maps normalized device coordinate system on to window coordinate system. What is the 2D transformation matrix for the following OpenGL command?
   
   ```c
   glViewport( 20, 30, width/3, height*1.5 );
   ```

Q2. Please explain when windows reshape callback event happens. And display callback event?

Q3. What is the 2D transformation matrix for rotate 60 degree around point (-1, 2)?

Q4. For scan conversion for lines, we have Bresenham (midpoint) algorithm.
   (a) What is implicit function \( F(x, y) \) of a line?
   (b) Given the following figure. If our current choice is \( P(x, y) \), how can we choose the next point \( P'(x+1, y) \).

Q5. Let’s represent 2D translation as \( TR(x, y) \), rotation as \( R(\theta) \), scale as \( S(s_x, s_y) \). Please write down the series of transformations produces the reflection of a two dimensional point about an arbitrary line \( y = 3x+5 \)?
Consider the following three coordinate systems (O, A, B) for questions 6-10:

Notation: $M_{ST}$ is a 3x3 homogeneous matrix that transforms points from coordinate system $S$ to coordinate system $T$.

Q6. What are the coordinates of P in coordinate system $O$?

Q7. What are the coordinates of P in coordinate system $A$?

Q8. What are the coordinates of P in coordinate system $B$?

Q9. Express $M_{OB}$ in terms of $M_{AO}$ and $M_{BA}$.

Q10. Given a vector $a$ and a plane with normal vector $n$, what is the angle between $a$ and the projection of $a$ on the plane?

Q11. What is the difference between orthographical projection and perspective projection?

Q12. Please draw the diagram for OpenGL transformation pipeline.