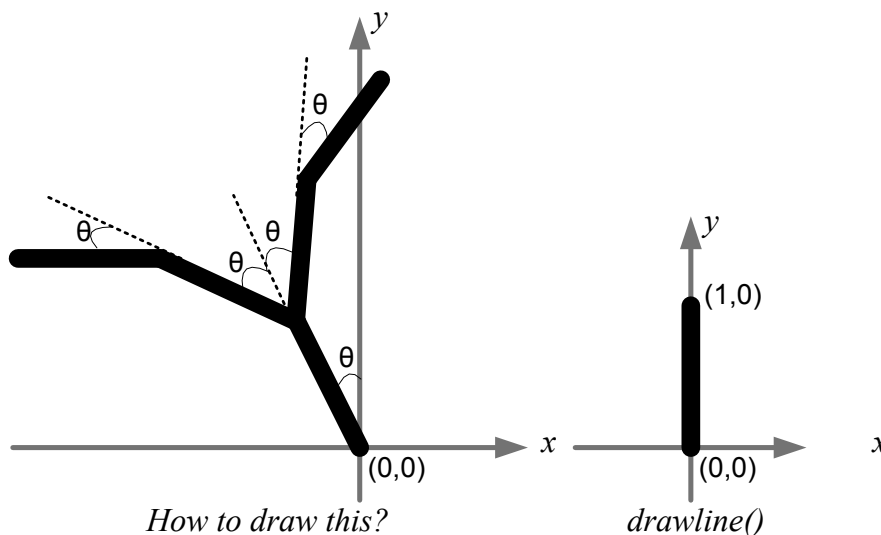


## CS4204 Computer Graphics Spring 2012 Homework Assignment 4

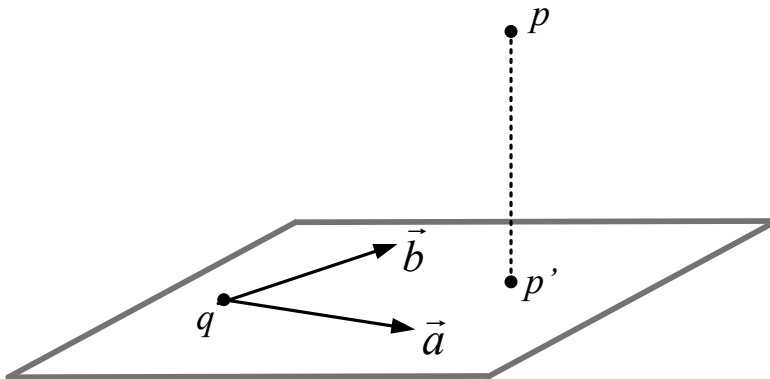
Assignment 4 is due on Wednesday, 3/21/2012 1:25pm. You need to turn your homework in before class start. Please write clearly on paper. Don't forget to write your name and student ID on each page of your homework.

Q1. (10 points) OpenGL pipeline describes how each vertex is transformed from a user-defined 3D local coordinate system to 2D display device coordinate system. Please draw each stage of OpenGL pipeline and name the coordinate system after each stage of transformation.

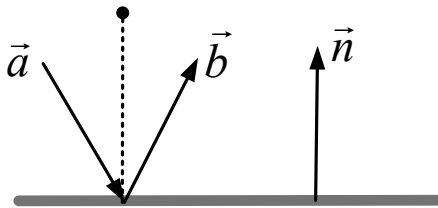
Q2. (15 points) Structure graphics. Take a look at the following figure. If an OpenGL function, *drawline()*, can draw a line segment of length 1, as shown on the right hand of the figure. Please write an OpenGL function that can draw the structured line segments as shown on the left hand of the figure. Assume each line segment has the same length of 1. Also that all the line segments are all within the plane  $z=0$ .



Q3. (20 points) Point projection. A plane is defined by two unit vectors  $\vec{a}$ , and a point  $q$ . Given a new point  $p$ , what is its projected point  $p'$  on the plane?



Q4. (15 points) Reflection. Given a surface with normal vector  $\vec{n}$  and input vector  $\vec{a}$ , as shown below, what is the reflection vector  $\vec{b}$  of the vector  $\vec{a}$ ? Assume all the vectors are normalized unit vectors.



Q5. (20 points) Perspective transformation. In camera/eye coordinate system, we have two points  $p$  and  $q$ , inside the view frustum. We then define two lines, one using  $p$  and the origin (where camera/eye is), another using  $q$  and the origin. Please prove that, after perspective transformation, these two lines are parallel to each other.