# CS 355 Homework #1:
# More With Points, Vectors, and Lines

Due: October 5, 2013

1. A line passes through the points $\mathbf{p}_1 = (10, 20)$ and $\mathbf{p}_2 = (30, 40)$.

   (a) Express this line in parametric form as described in Section 9.2.1 of your book.

   (b) Express the line in implicit form as described in Section 9.2.2 of your book.

   (c) How close is the point (22,29) from the line?

2. A circle has center at $\mathbf{c} = (10, 12)$ and radius $r = 3$.

   (a) Show mathematically whether the point $\mathbf{p} = (12, 13)$ is within the circle.

   (b) What point on the circle is closet to the point $\mathbf{p} = (20, 15)$?

3. An ellipse has center at $\mathbf{c} = (10, 12)$ with width 20 and height 10.

   (a) Show mathematically whether the point $\mathbf{p} = (19, 13)$ is within the circle.

   (b) What are the corners of the bounding box for this shape?

4. A square with length 10 on each side is centered at position $\mathbf{c} = (60, 80)$. Show mathematically the steps you would do to determine whether the point $\mathbf{p} = (64, 74)$ is within the square.

5. A rectangle with height 20 and width 10 is centered at $\mathbf{c} = (60, 80)$ is rotated counterclockwise by 30 degrees. Show mathematically the steps you would do to determine whether the point $\mathbf{p} = (64, 54)$ is within the rotated square.

6. An object is centered at position $\mathbf{c} = (130, -50)$ and has orientation $\theta = 162$ degrees. As discussed in class, the transformation from this object's coordinate system to the world coordinate system may be written in the form $\mathbf{p}' = \mathbf{R}\mathbf{p} + \mathbf{t}$. What are the rotation matrix $\mathbf{R}$ and the translation vector $\mathbf{t}$ for this transformation? What would they be for the inverse transformation (world to object)? [You may write your answers in terms of sines and cosines and don't have to actually calculate them.]