CS 506 sample midterm questions:

1. For a set of objects in 2 dimensions, which of the following examples are degenerate?

   (a) 3 points on a line.
   (b) 3 points all in a box, (ie, all satisfying $0 < x < 1, 0 < y < 1$).
   (c) 3 points lying on a circle.
   (d) 3 points lying inside a circle of radius 1.
   (e) 2 lines that are parallel.
   (f) a point and a line that intersect.
   (g) a set of line segments, none of which intersect.
   (h) a set of line segments whose left endpoints all are the same point.

2. Given a polygon $P$ with $n$ sides and a point $c$ inside that polygon, show how to compute the region that is inside $P$ and visible to $c$ in polynomial time.

3. Define an efficient algorithm for determining the area of a simple polygon containing $n$ vertices. What is the running time of your algorithm?

4. Diameter and width: Define the diameter of a set of points to be the largest distance between any two points in the set.

   (a) Prove that the diameter of a set is achieved by two vertices of the convex hull of the set.
   (b) A line of support to a set is a line $L$ that touches the hull and has all points on or to one side of $L$. Prove that the diameter of a set is the same as the maximum distance between parallel lines of support for the set.
   (c) Two points $a$ and $b$ are called antipodal if they admit parallel lines of support: there are parallel lines of support through $a$ and $b$. Develop an algorithm for enumerating (listing) all antipodal pairs of a set of points in two dimensions.
   (d) Define the width as the minimum distance between parallel lines of support. Develop an algorithm for computing the width of a set of points in two dimensions.