

# COMP163 Homework Assignment 1: Due Wednesday, January 23, 2008

*Reading:* Please read Chapter 1 of the Text.

*Problems:* Please begin the solution to each problem on a new piece of paper. Remember to cite \*ALL\* your sources.

1. Left Turn: Given points  $A = (x_1, y_1)$ ,  $B = (x_2, y_2)$ , and  $C = (x_3, y_3)$ , the determinant  $D =$

$$\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

gives twice the signed area of triangle  $\Delta ABC$  where the sign is + if and only if  $A, B, C$  appear in counterclockwise order on the boundary of  $\Delta ABC$ . In other words,  $A, B, C$  forms a left turn if and only if  $D > 0$ . Use analytic geometry to derive and verify this fact to yourself.

You do \*NOT\* need to hand-in a written solution to this problem!

2. Point Inclusion: Consider the problem of **point inclusion** that we discussed in class last Wednesday:

Given a polygon  $P$  with  $n$  vertices and a query point  $q$ , decide whether point  $q$  lies in the interior of polygon  $P$ .

Write up solutions to the following two versions of this problem in your own words:

- (a) Provide as efficient an algorithm as you can for **point inclusion** if  $P$  is monotone in the specific direction of the line  $y = x$ . Analyse its complexity and verify its correctness.
- (b) Provide as efficient an algorithm as you can for **point inclusion** if  $P$  is starshaped relative to the origin (i.e. the point  $(0,0)$  is inside the polygon and can see every point on the boundary of the polygon). Analyse its complexity and verify its correctness.