

CPSC 314 Homework 4



Term: Jan 2009, Instructor: Wolfgang Heidrich, heidrich@cs.ubc.ca, <http://www.ugrad.cs.ubc.ca/~cs314>

NOTE: These homework problems are not graded. **However**, I strongly encourage you to take them seriously as a preparation for the second quiz and the final exam.

This problem sheet deals with scan conversion. Solutions will be discussed in the labs in the week of February 23-27.

1 Scan Conversion of Lines

a) Give pseudo-code for the DDA (Digital Differential Analyzer) algorithm for scan-converting lines. Assume the start point is to the left of the endpoint, and the slope is in the range $0 \dots 1$.

See lecture slides

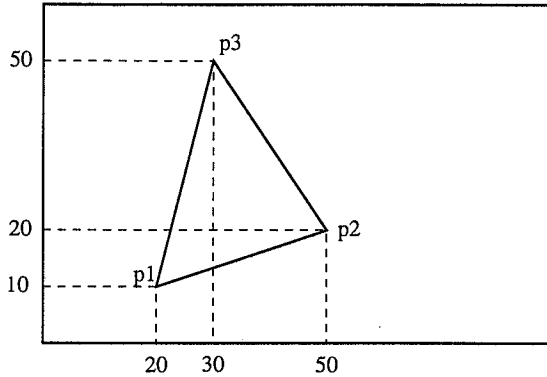
b) What are the key differences between the DDA and the Bresenham algorithm? What are the respective advantages and disadvantages?

*Bresenham: + pure integer algorithm (good for hardware implementation)
- conditional test (if) inside the inner loop
(bad for modern CPUs)*

*DDA: - float algorithm
+ no conditionals
- possible accumulation of error (adding slope in over and over)*

2 Scan Conversion of Triangles

a) Derive the **edge equations** for scan-converting the triangle given in device/pixel coordinates below. Pay attention to the sign of the equations, so that positive values correspond to the inside of the triangle.



Generic form:

$$L: -(y_e - y_s)(x - x_s) + (y - y_s)(x_e - x_s) = 0$$

for counter-clockwise triangles

So: edge $\overline{P_1 P_2}$: $L_1 = (20 - 10)(x - 20) + (y - 10)(50 - 20)$
 $= -10x + 30y - 100$

edge $\overline{P_2 P_3}$: $L_2 = -(50 - 20)(x - 50) + (y - 20)(30 - 50)$
 $= -30x + 20y + 1900$

edge $\overline{P_3 P_1}$: $L_3 = -(10 - 50)(x - 30) + (y - 50)(20 - 30)$
 $= 40x - 10y - 700$

check these by

plugging in
coordinates of

$P_1 \dots P_3$

b) Derive the **plane equation** for interpolating some property c across the triangle. The values at the vertices are $c_1 = 0$, $c_2 = 1$, and $c_3 = 2$, respectively. You don't need to solve any equation systems that may arise.

$$c = Ax + By + C$$

with

$$c_1 = 0 = 20A + 10B + C$$

$$c_2 = 1 = 50A + 20B + C$$

$$c_3 = 2 = 30A + 50B + C$$

→ 3 eqns, 3 unknowns
 don't need to solve in this question