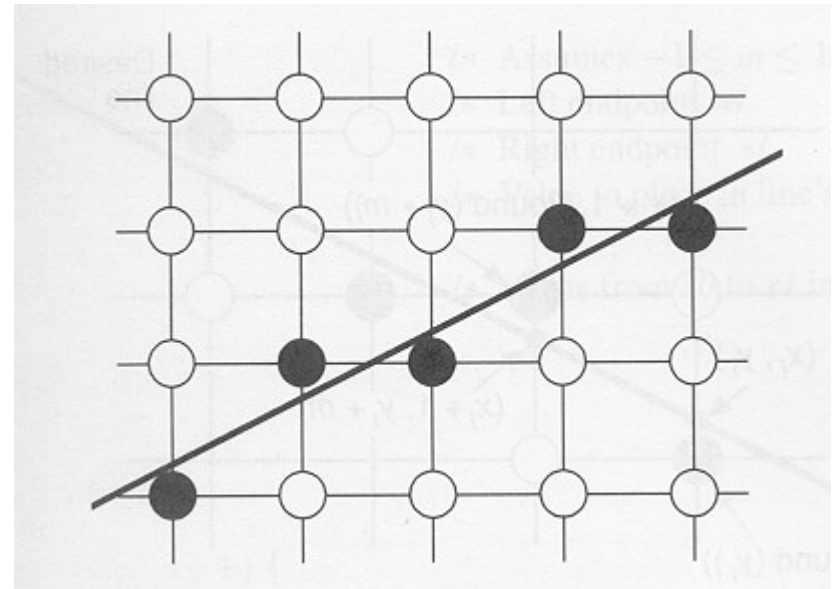# Drawing Lines & Anti-Aliasing

CSCI 4229/5229
Computer Graphics
Summer 2012

Scan Converting Lines

- Which pixels to turn on?
  - Floating point
 - Bresenham algorithm

Floating Point Algorithm

- Functional form

  $y = (x-x_0)(y_1-y_0)/(x_1-x_0)+y_0$ (use when $|y_1-y_0|<|x_1-x_0|$)

  $x = (y-y_0)(x_1-x_0)/(y_1-y_0)+x_0$ (use when $|x_1-x_0|<|y_1-y_0|$)

- Evaluate y or x at integral values of x or y

- Round result to nearest integer to decide pixel

- Slow

  – integer -> float

  – float multiply and two float additions

  – float -> integer

Bresenham Algorithm

- Select next pixel from two choices: E or NE
  - Only works when slope is <=1
  - Is midpoint above or below the line?
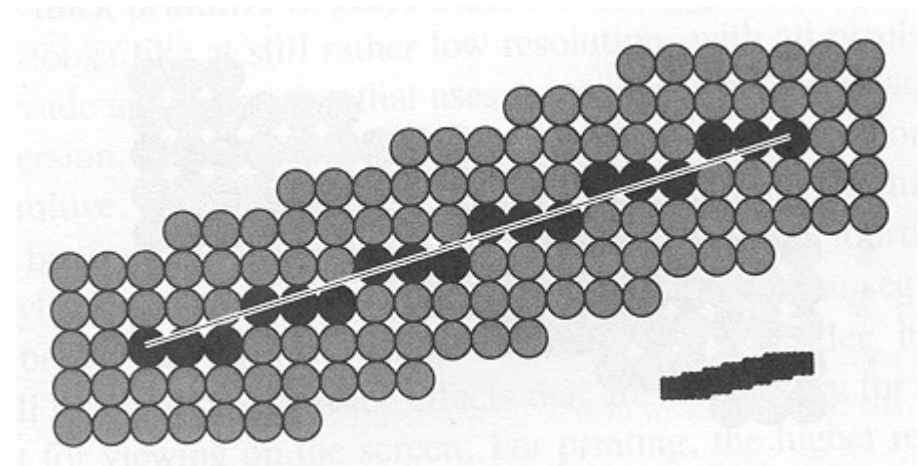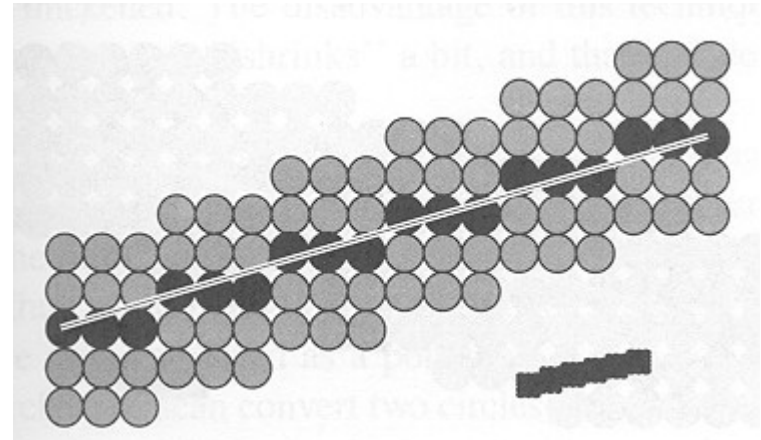- All integer operations
  - One or two adds

NE

Q

M

E

$P = (x_p, y_p)$

Previous pixel

Choices for current pixel

Choices for next pixel
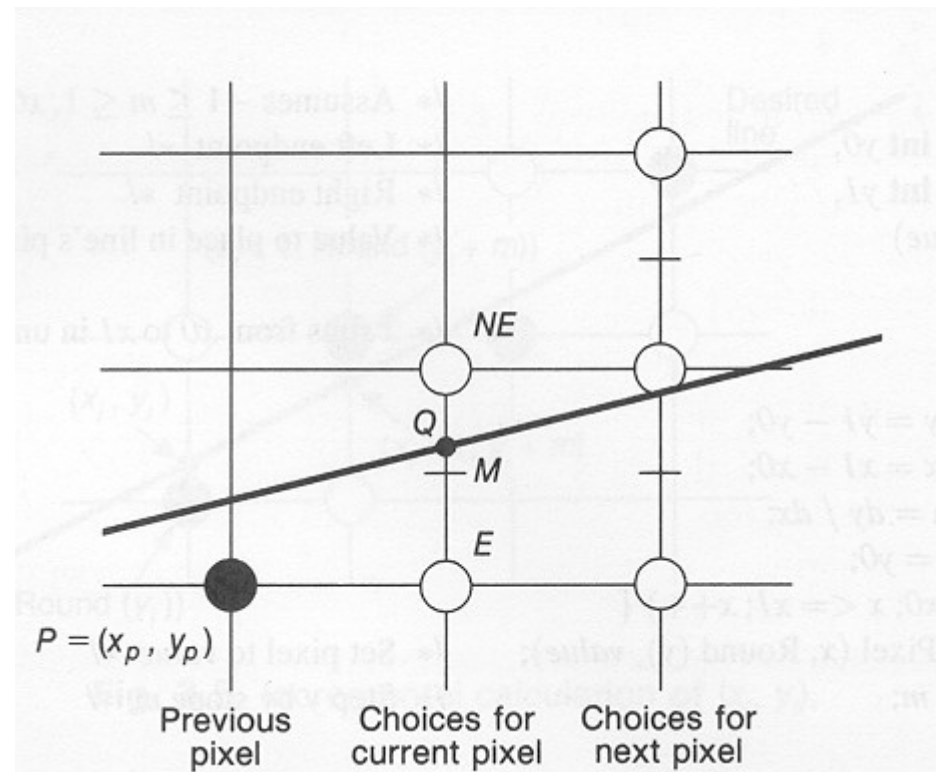
Line intensity

- Lines parallel to axes appear more dense than lines at 45 degree angles by √2

- If this is an issue you can adjust the pixel intensity inversely proportional to the cosine
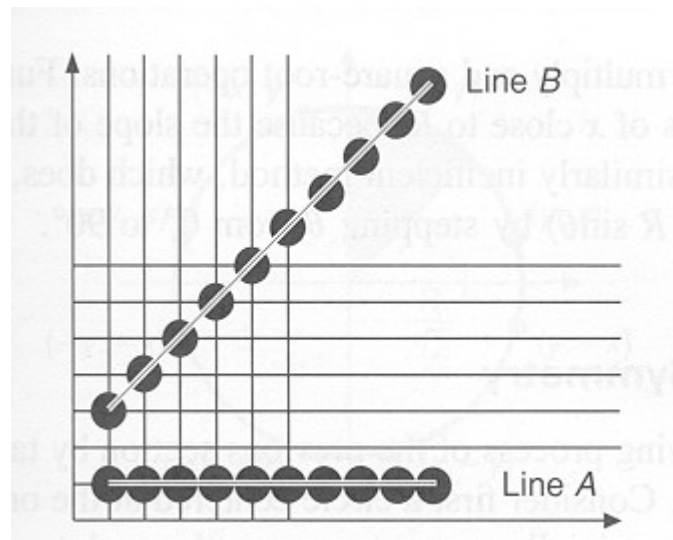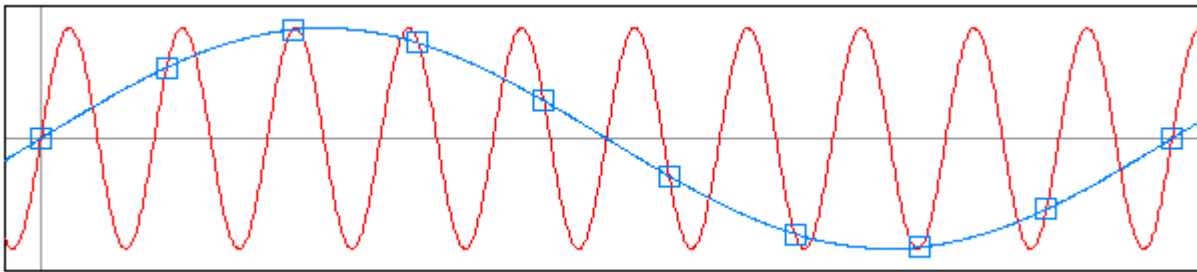
Thick Lines

- Column replication
- Rectangular pen
- Polygon fill

Anti-aliasing in signal processing

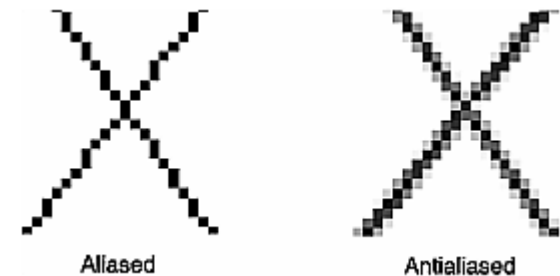- Discrete samples of a signal

- Low and high frequency samples are the same

Anti-aliasing in Computer Graphics
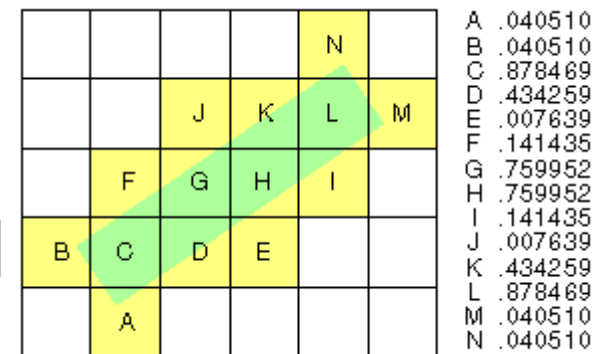
- Aliased lines

  - Discrete pixels are turned on

  - Nearest pixel selected

  - Leads to "jaggies"

- Anti-aliased lines

  - Pixels are partially turned on

  - Level selected by line overla

  - Leads to smoother lines

Aliased   Antialiased

A .040510
B .040510
C .878469
D .434259
E .007639
F .141435
G .759952
H .759952
I .141435
J .007639
K .434259
L .878469
M .040510
N .040510

OpenGL Anti-aliased Lines

- glEnable(GL_LINE_SMOOTH);
- glEnable(GL_BLEND);
- glBlendFunc (GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA);
- glLineWidth(1.5);