BSc Computer Science
CS1541 Computer Graphics

Module I

Output Primitives

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Output Primitives

- The basic geometric objects in CG are usually called primitives or graphic output primitives
- A primitive is a graphics object that is essential for the creation or construction of complex images.
- Examples
  - Point
  - Line
  - Sector
  - Arc
  - Circle
  - Ellipse
  - Rectangle
  - Polygon
  - Characters

Scan Conversion(Rasterization)

- Process of representing graphics objects a collection of pixels. The graphics objects are continuous. The pixels used are discrete. Each pixel can have either on or off state.
- The circuitry of the video display device of the computer is capable of converting binary values (0, 1) into a pixel on and pixel off information. 0 is represented by pixel off. 1 is represented using pixel on. Using this ability graphics computer represent picture having discrete dots.

Scan Conversion Algorithms

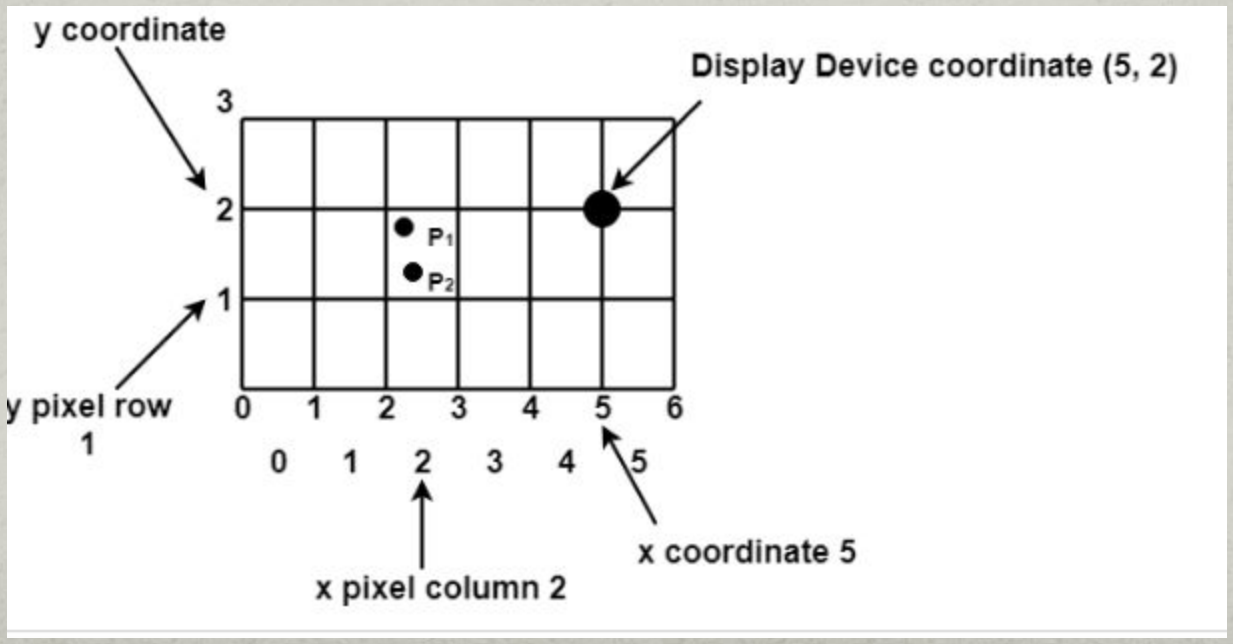
- Any model of graphics can be reproduced with a dense matrix of dots or points. Most human beings think graphics objects as points, lines, circles, ellipses. For generating graphical object, many algorithms have been developed.
- **Advantage of developing algorithms for scan conversion**
  - Algorithms can generate graphics objects at a faster rate.
  - Using algorithms memory can be used efficiently.
  - Algorithms can develop a higher level of graphical objects.

Basic Algorithms

- Line Drawing Algoritghms
  - Simple DDA
  - Symmetrical DDA
  - Bresenham's
- Circle Generation
  - Midpoint
  - Bresenham's
- Ellipse Generation
- Filling Algorithms
  - Polygon Filling Algorithm
  - Boundary Fill Algorithms
  - Flood Filling Algorithms

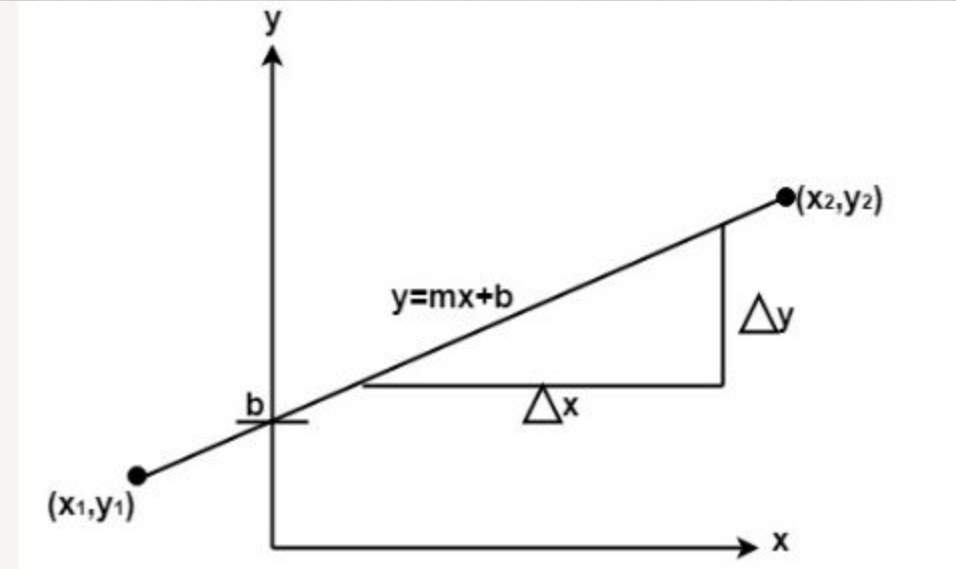
Scan Converting a Point

- Each pixel on the graphics display does not represent a mathematical point. Instead, it means a region which theoretically can contain an infinite number of points. Scan-Converting a point involves illuminating the pixel that contains the point.
- **Example:** Display coordinates points as shown in fig(P1,P2) would both be represented by pixel (2, 1). In general, a point p (x, y) is represented by the integer part of x & the integer part of y that is pixels [(INT (x), INT (y).



Scan Converting a Line

- A straight line may be defined by two endpoints & an equation. In fig the two endpoints are described by (x_1,y_1) and (x_2,y_2). The equation of the line is used to determine the x, y coordinates of all the points that lie between these two endpoints.



Scan Converting a Line

Using the equation of a straight line, $y = mx + b$ where $m = \frac{\Delta y}{\Delta x}$ & b = the y interrupt, we can find values of y by incrementing x from $x = x_1$, to $x = x_2$. By scan-converting these calculated x, y values, we represent the line as a sequence of pixels.

Line Drawing Algorithms

- Slope-Intercept Equation

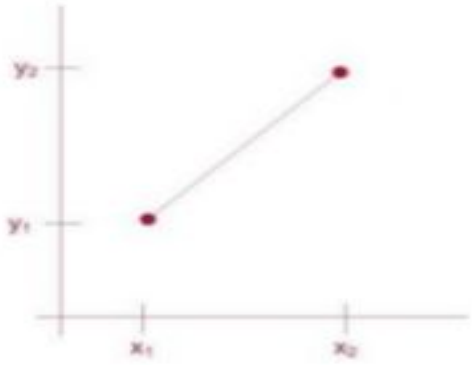
$$y = m.x + b$$

- Slope

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

- Intercept

$$b = y_1 - m.x_1$$



- Interval Calculation

$$\Delta y = m.\Delta x \qquad \Delta x = \frac{\Delta y}{m}$$

Properties of Good Line Drawing Algorithm

1. **Line should appear Straight**
2. **Lines should terminate accurately**
3. **Lines should have constant density**
4. **Line density should be independent of line length and angle**
5. **Line should be drawn rapidly**

Thank You