UNIT - 2

Points & Lines :-

- Point plotting is done by converting a single co-ordinate position furnished by an application program into appropriate operatio for output device in use.
- Line drawing is done by calculating intermediate position along the line path between two specified endpoint position.
- The output device is the directed to fill in those positions ~~along~~ between the end points with some color.
- screen locations are refered with interger values. so plotted positions may also approximate actual line position between two specified end points.
- For e.g. line position of (12.36, 28.87) wolud be converted to pixel position (12, 29)
- This rounding of co-ordinate values to integer causes lines to be displayed with a stair step appearance or "the jaggies as shown in fig.

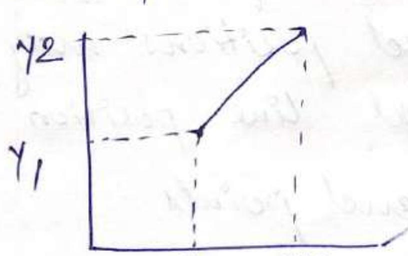
stair step effect produced when pixel position are approximated.

- The stair step shape is noticeable in ~~two~~ low resolution system and can be improved somewhat by displaying them on high resolution system.

Line Drawing Algorithm.

- The cartesian slop-intercept equation for a straight line is "$y = mx + b$" where m represents slop and b represents intercept.

- Say, the two end points are given as (x_1, y_1) ~~x_2, y_2~~ & (x_2, y_2)



we determine slop as $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{\Delta y}{\Delta x}$

for the given line interval Δx along a line, we computes the corresponding Δy as

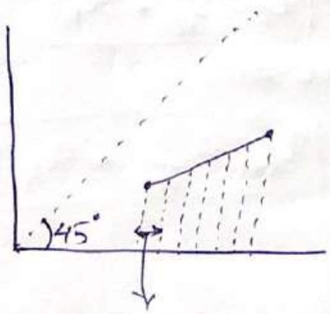
$\Delta y = m * \Delta x$

similarly for Δx

$\Delta x = \Delta y / m$

DDA Algorithm :-

- Digital differential analyzer (DDA) is scan conversion line drawing algorithm based on calculating either Δy or Δx using above equation.
- we sample the line at unit interval in one co-ordinate and find corresponding integer value nearest the line path for other co-ordinate.
- Consider first a line with positive slop & slop is less than or equal to 1 i.e. $|m| \leq 1$ then we sample at unit x interval ($\Delta x = 1$) and calculate each successive y values as follow.



$\Delta x = 1$

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

$m = \Delta y \quad (\because \Delta x = 1)$

$m = Y_2 - Y_1$

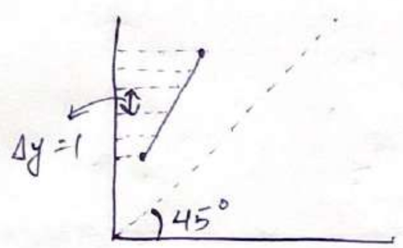
$\boxed{Y_2 = Y_1 + m}$

in general

$\boxed{Y_{K+1} = Y_K + m}$

- In above equation k takes integer value starting from 1 and increase by 1 unit the final endpoint is reached.
- As m can be any real number between 0 & 1 the calculated y values must be rounded to the nearest integer.
- Consider a case for a line with positive slop greater than 1 i.e. $|m| > 1$

Then we sample at unit y interval ($\Delta y = 1$) and calculate each ~~succeess~~ succeeding x values as



$$\Delta y = 1$$

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

$$m = \frac{1}{\Delta x}$$

$$m = \frac{1}{x_2 - x_1}$$

$$m(x_2 - x_1) = 1$$

$$m x_2 - m x_1 = 1$$

$$m x_2 = 1 + m x_1$$

$$\boxed{x_2 = \frac{1}{m} + x_1}$$

in general

$$\boxed{x_{k+1} = \frac{1}{m} + x_k}$$

- Above both equations are based on assumption that lines are to be processed from left end point to right endpoint.
- If we process line from right endpoint to left endpoint than:

If $\Delta x = -1$ eq.^{n} becomes for $|m| \leq 1$

$y_{k+1} = y_k - m$

If $\Delta y = -1$ eq.^{n} becomes for $|m| > 1$

$x_{k+1} = x_k - \frac{1}{m}$

- The above equations are also used to calculate pixel position along a line with negative slope.

To summarize:

case 1: $|m| \leq 1$ $\Delta x = 1$ $y_{k+1} = y_k + m$

plot $(x_{k+1}, \text{round}(y_{k+1}))$

case 2: $|m| > 1$ $\Delta y = 1$ calculate $x_{k+1} = x_k + \frac{1}{m}$

plot $(\text{round}(x_{k+1}), y_{k+1})$

case 3: $|m| \leq 1$ $\Delta x = -1$ calculate $y_{k+1} = y_k - m$

plot $(x_{k+1}, \text{round}(y_{k+1}))$

case 4: $|m| > 1$ $\Delta y = -1$ calculate $x_{k+1} = x_k - \frac{1}{m}$

plot $(\text{round}(x_{k+1}), y_{k+1})$