Source: Computer Graphics by Donald Hearn and M. Pauline Baker
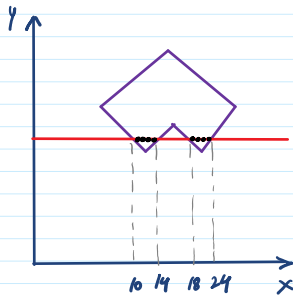
Polygon area filling :—

Examples with polygons since boundaries of polygon are linear.

① Scan - line Polygon Fill Algorithm

④ Boundary Fill Algorithm.

Scan - Line Algorithm :—

by determining the overlap intervals for scan lines than crosses the area.

Interior pixel along a scan line passing through a polygon area.

① For each scan line crossing a polygon, algorithm locates the intersection points of the scan line with the polygon edges.

② Sort these intersection points from left - to - right.

③ For every pixel between these intersection points are set to specified fill color.
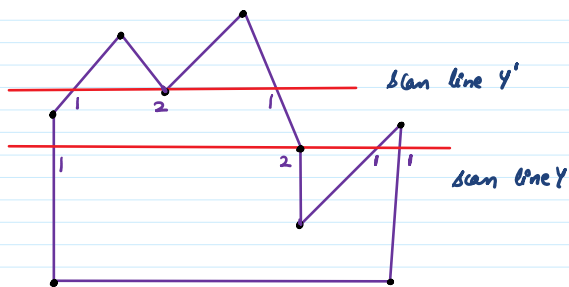
scan line Y' generates odd no. of intersections.

scan line Y generates even no. of intersections.

↳ can be easily identified for pairs to
   fill the pixel along line Y.

⇒ Scan line intersection at polygon vertices
   require special handling.

→ The topological difference between scan line y
   and scan line y' is identified by
   notify the position of intersecting edges
   relative to the scan line.

→   y → two intersecting edges sharing a vertex
     are   on opposite sides of scan line
     y' → two intersecting edges are both
          above the scan line.

Takes advantage of coherence properties
of a scene.

Coherence Property : —

        Properties of one part of a scene are
        related in some way to other parts of the scene
        so that the relationship can be used to
        reduce processing.

        Involves incremental calculations applied along
        a single scan line or between successive
        scan lines.

(x_{k+1}, y_{k+1}) scan line $y_k + 1$
(x_k, y_k) scan line y_k
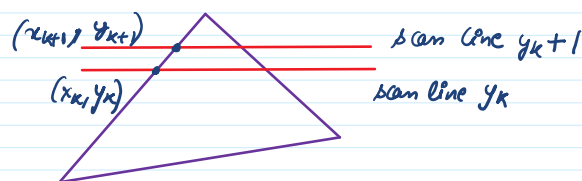
        Two successive scan lines
        intersecting a polygon boundary.

        Slope of this polygon boundary line
        can be expressed as,

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

$$x_{k+1} - x_k$$

Since,

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

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

Each successive x-intercept can thus be calculated by adding the inverse of the slope and rounding to the nearest integer.

Along an edge with slope m, the intersection x_k value for scan line k above the initial scan line can be calculated as
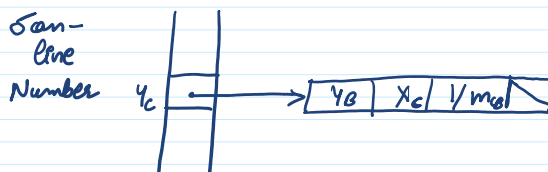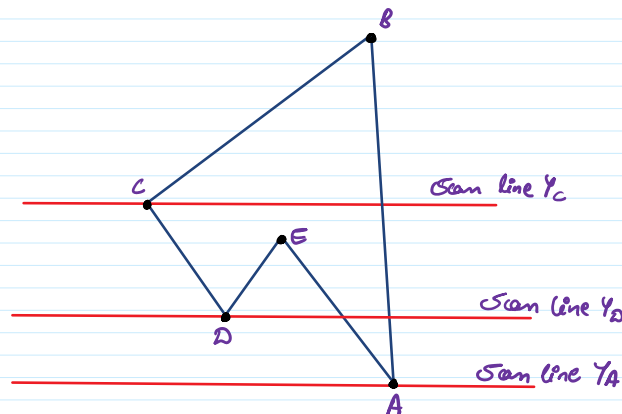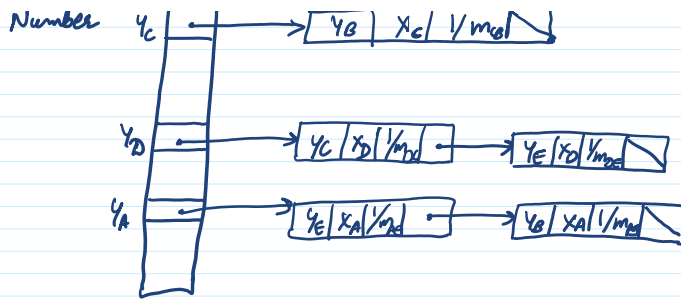
$$x_k = x_0 + \frac{k}{m}$$

In a sequential fill algorithm, the increment of x values by the amount $1/m$ along an edge with integer operations as

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

$\Rightarrow$ Incremental calculations of x-intercept becomes

$$x_{k+1} = x_k + \frac{\Delta x}{\Delta y}$$

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

Number y_C → y_B | x_C | $1/m_{cb}$

y_D → y_C | x_D | $1/m_{cd}$ → y_E | x_D | $1/m_{De}$

y_A → y_E | x_A | $1/m_{Ae}$ → y_B | x_A | $1/m_{ab}$

A polygon and its sorted edge table.

① Store the polygon boundary in a <u>sorted edge table</u>.

② Process the scan lines from bottom of the polygon to its top producing an an <u>active edge list</u> for each scan line crossing the polygon boundary.

③ The active edge list for a scan line contains all edges crossed by that scan line, with iterative coherence calculations used to obtain the edge intersections.

④ Fill from left-most x-intersept to one pixel before right-most x-intercept.

Boundary - Fill Algorithm :-

Start at a point inside a region and paint the interior outwards towards the boundary.

Inputs :-

① Coordinates of an interior point (x,y)

② Fill Color

③ Boundary Color.

(a)   (b)

Fill methods applied to a
(a) 4-connected area.
(b) 8- connected area

open circles are pixels to be tested from the current test position, shown as a solid color.

Fill_algorithm :—

```
Boundary_fill4 (x, y, fill, boundary)
    {
        current = 1
        current = get_pixel (x,y);
        if ( (current != boundary && (current != fill))
            {
                set color ( fill);
                set pixel (x,y);
                Boundary_fill4 (x+1, y, fill, boundary);
                Boundary_fill4 (x-1, y, fill, boundary);
                Boundary_fill4 (x, y+1, fill, boundary);
                Boundary_fill4 (x, y-1, fill, boundary);
            }
    }
```

Flood- fill Algorithm :—

for area filling within multiple
color boundries.

How?.