

Assignment - 2

Title: A concave polygon filling using scan fill algorithm.

Problem statement: Write a C++ program to draw a concave polygon & fill it with desired colour using scan fill algorithm. Apply the concept of inheritance.

Prerequisite: Basic programming skills of C++

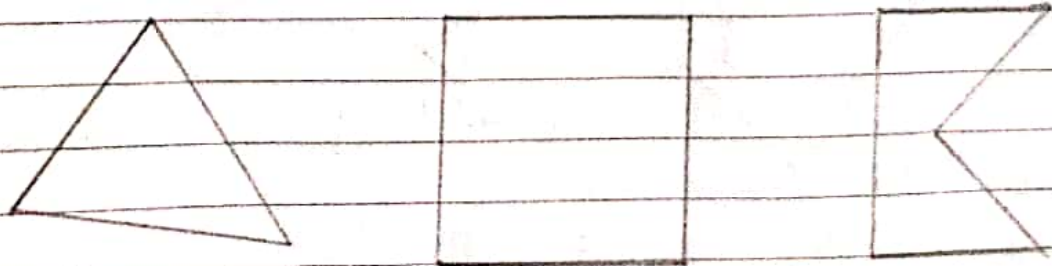
Learning objective: To understand & implement scan-line & polygon fill algorithm.

Hardware requirement: OS - Windows 8.1
System - 64 bit
RAM - 8 GB

Software requirements: MinGW Compiler
Qt Creator.

Theory:

Polygon - is a closed planar path composed of a finite no. of sequential line segments. A polygon is a 2D shape formed by more than 3 straight lines, when starting point & end point is same, then it's called polygon.



Polygons

Types of polygon

a) Concave

b) Convex

c) Complex

A convex polygon is a simple polygon, whose all interior angles are less than 180° .

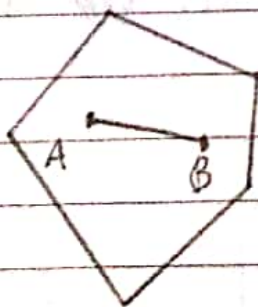
The following properties of simple polygon are all equivalent to convexity.

- i) Every internal angle is less than or equal to 180°
- ii) Every line segment between 2 vertices, remains inside or on the boundary of polygon.

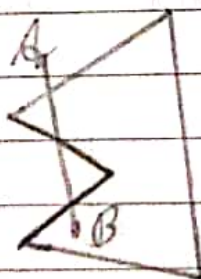
In convex, any line segment joining any 2 inside points, lies inside the polygon.

A concave polygon will always have an interior angle greater than 180° . It's possible to cut a concave polygon into a set of convex polygons. You can draw at least one straight line through a concave polygon that crosses more than 2 sides.

Complex polygon is a polygon whose sides crossover each other one or more times.



Convex



Concave

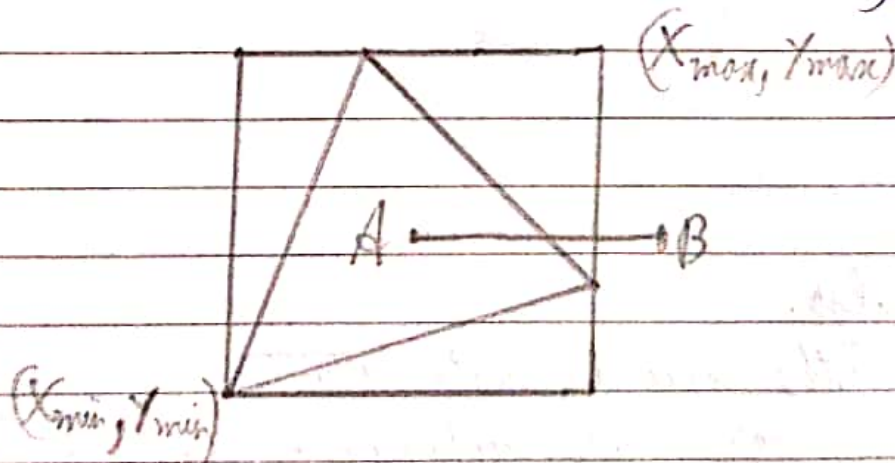


Complex

Inside - Outside test

We assume that the vertex list for the polygon is already stored & proceed as follows.

- i) Draw any point outside the range X_{min} & X_{max} , Y_{min} & Y_{max} . Draw scan-line through P upto point A.
- ii) If this scan-line
 - a) Does not pass through any of the vertices then its contribution is equal to no. of times it intersects the edges of the polygon. say C if
 - I) C is odd then A lies inside polygon
 - II) C is even then it lies outside
 - b) If it passes through any of the vertices, then its contribution of this intersection, say V,
 - I) Taken as 2 or even if other points of the 2 edges lie on 1 side of the scan-line.
 - II) Taken as 1 if the other end points of the 2 edges lie on the opposite sides of scan-line.
 - III) Here will be total contribution $(C+V)$



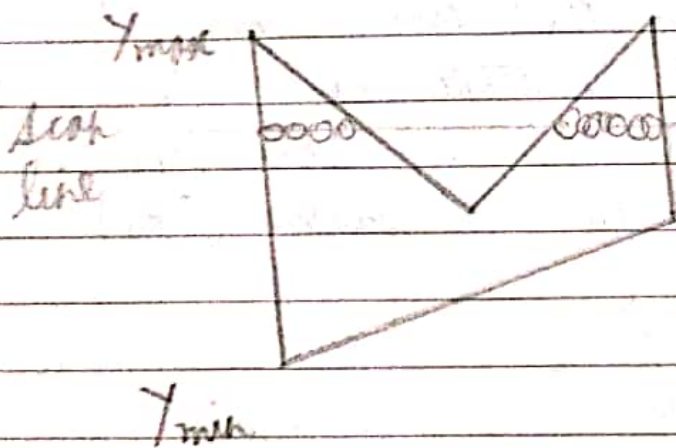
Polygon filling

For filling polygon with particular colour, you need to determine the pixels falling on the border of polygon & those which fall inside the polygon.

Scan-Fill Algorithm

A scan-fill region is performed by first determining the intersection position of the boundaries of the fill region with the screen scan lines. The scan line fill algorithm identifies the same interior region as the odd-even rule.

It's an image-space algorithm. It processes one line at a time rather than one pixel at a time. It uses concept of coherence & records edge list, active edge list. The edge list contains the co-ordinate of 2 end-points. Active edge table or list (AEL) contains edge a given scan line intersects during its sweep. The AEL should be sorted in increasing order of x . The AEL is dynamic, growing & shrinking.



Algorithm

I Start algo.

II Initialize the desired data structure

- Create polygon table containing color, edge pointers
- Establish edge table of endpoint, pointer to polygon, inverse slope
- Create active edge list, which is sorted in increasing order of x
- Create flag F which will be on or off.

III Perform following steps for all scan lines:

- a) Enter values in AEL in sorted order using y as value.
- b) Scan until F is on using BR color.
- c) When one polygon flag is on, & this is for surface S_1 enter color intensity as I_1 into refresh buffer.
- d) When 2 or more surface flag are on, sort the surface according to depth & use intensity value S_n for n^{th} surface. This surface will have atleast 2 depth values.
- e) Use concept of coherence for remaining planes.

IV) Stop Algo.

Conclusion

We have successfully drawn a concave polygon & filled it with desired color using scan fill algo. & concepts of inheritance.