CSE420: Computer Graphics, Fall 2019

Instructor: Kowshika Sarker

Problem Statement

Implement Sutherland-Hodgman polygon clipping algorithm to clip a polygon with respect to a clip rectangle formed by two vertical (left and right) and two horizontal (top and bottom) edges.

Input

- Four floating point numbers for four edges of clip rectangle: x_{min}, x_{max}, y_{min}, y_{max}
- Four characters for clipping order of four edges (L for Left, R for Right, T for Top, B for Bottom)
- No. of vertices in the polygon
- Co-ordinates (x and y values) of each vertex of the polygon. These co-ordinates will be floating point numbers.

Your program must handle file input according to the format given in sample input files.

Output

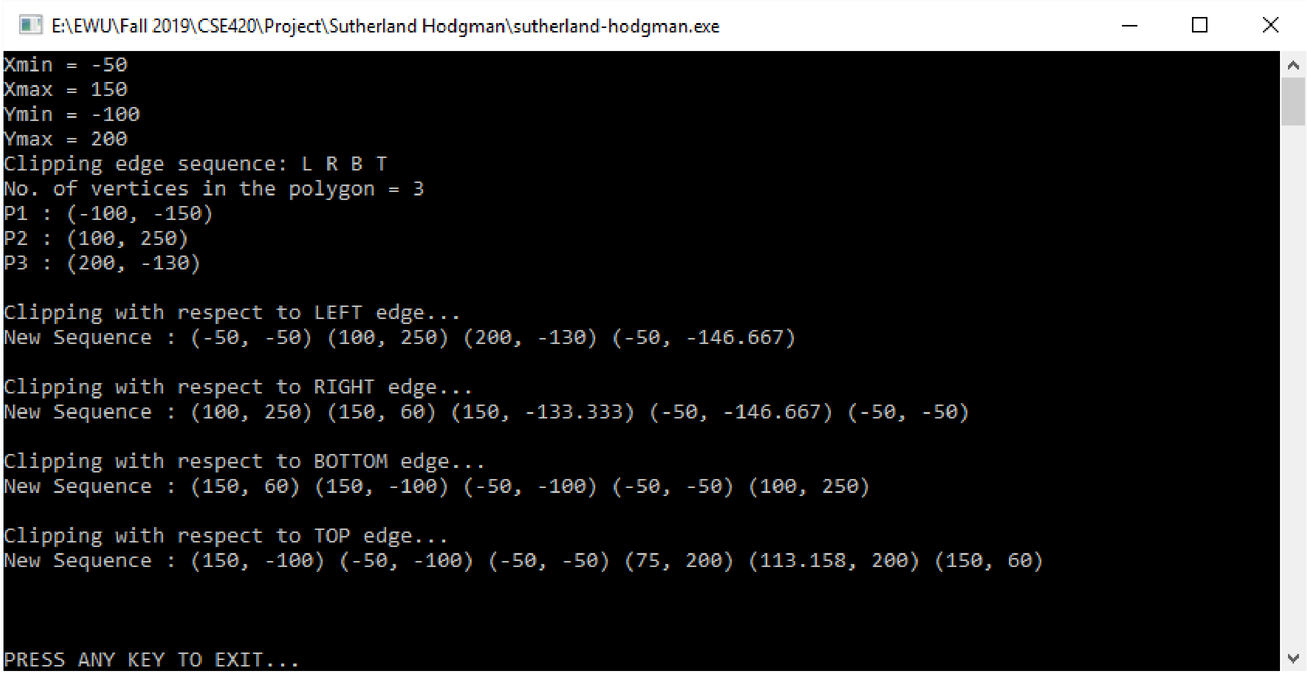
New sequence of vertex co-ordinates obtained after clipping with respect to each edge of the clip rectangle. After clipping with respect to an edge, generate a visual output displaying the original polygon and the latest clipped polygon. For each input, you will generate four visual outputs. See sample outputs for output format.

You can implement in any programming language of your choice. Whichever language you choose, find a library or feature that can draw polygons and lines from set of points. For example, you can try using openCV or matplotlib libraries for Python, JavaFX or Swing for Java, graphics.h or OpenGL libraries for C/C++, plot and fill functions for Malab or Octave etc. As you will use different languages and libraries, bring your own laptop in project evaluation.

Sample I/O

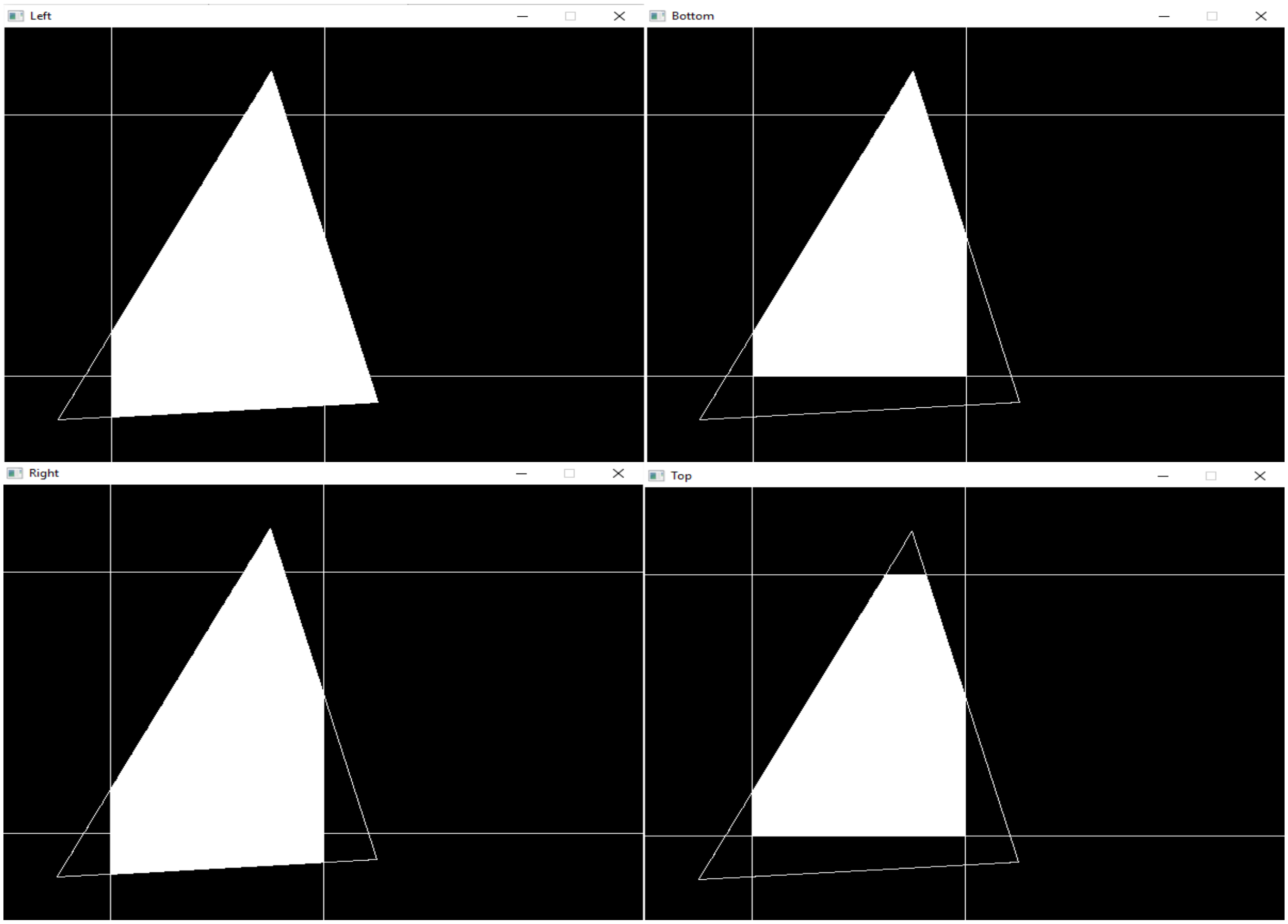
You are provided a sample *sutherland-hodgman.exe* and five sample input files in described format(*in-1.txt* to *in-5.txt*). The .exe program by default expects input from a file named *in.txt*. Rename any sample input file to *in.txt* or write your own input in a file named *in.txt*. Place the *in.txt* and the *sutehrland-hodgman.exe* in same folder and then double click on the .exe to view generated output.

Output for *in-1.txt*

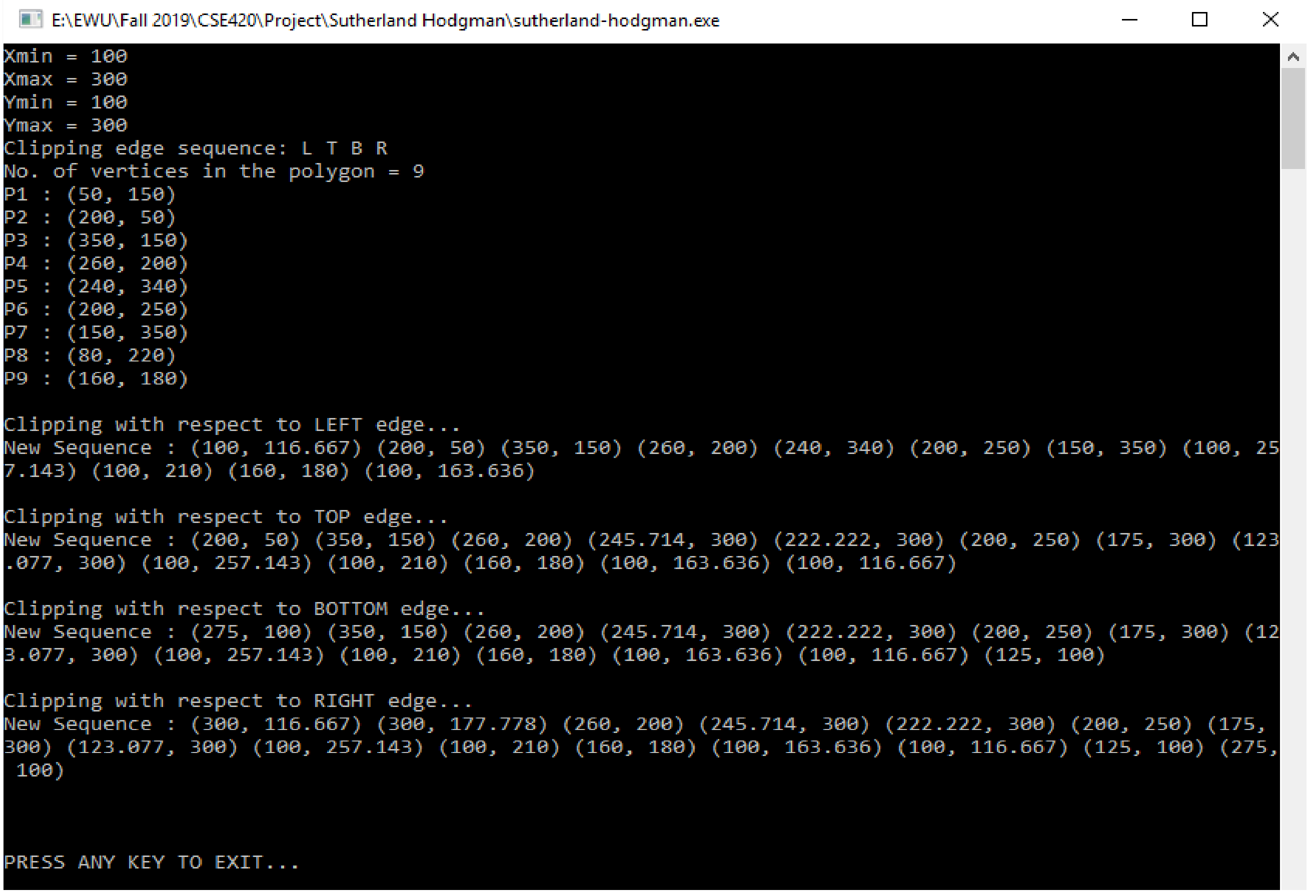


E:\EWU\Fall 2019\CSE420\Project\Sutherland Hodgman\sutherland-hodgman.exe

```
Xmin = -50
Xmax = 150
Ymin = -100
Ymax = 200
Clipping edge sequence: L R B T
No. of vertices in the polygon = 3
P1 : (-100, -150)
P2 : (100, 250)
P3 : (200, -130)

Clipping with respect to LEFT edge...
New Sequence : (-50, -50) (100, 250) (200, -130) (-50, -146.667)

Clipping with respect to RIGHT edge...
New Sequence : (100, 250) (150, 60) (150, -133.333) (-50, -146.667) (-50, -50)

Clipping with respect to BOTTOM edge...
New Sequence : (150, 60) (150, -100) (-50, -100) (-50, -50) (100, 250)

Clipping with respect to TOP edge...
New Sequence : (150, -100) (-50, -100) (-50, -50) (75, 200) (113.158, 200) (150, 60)



PRESS ANY KEY TO EXIT...
```

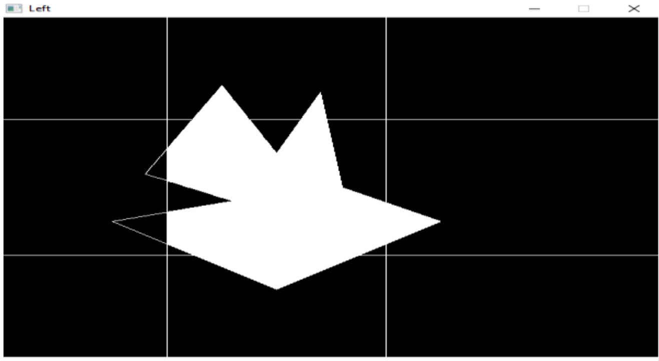


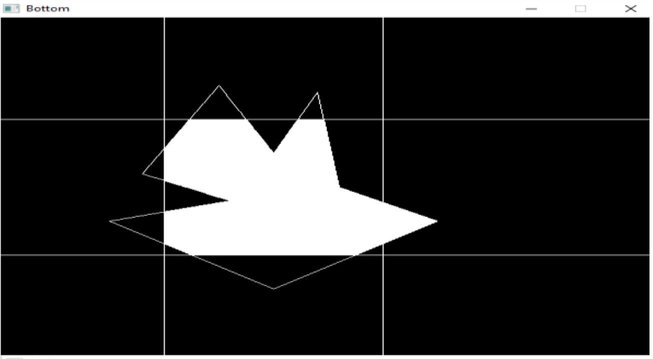
Output for *in-2.txt*

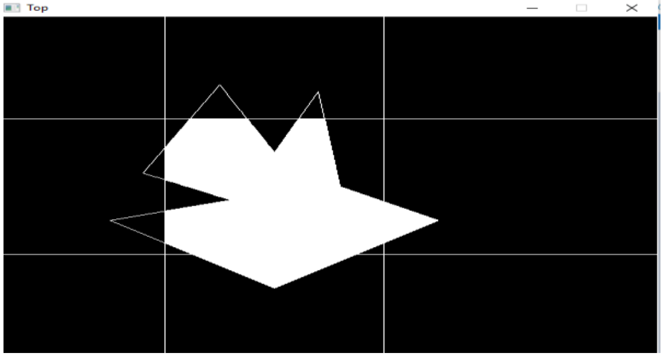


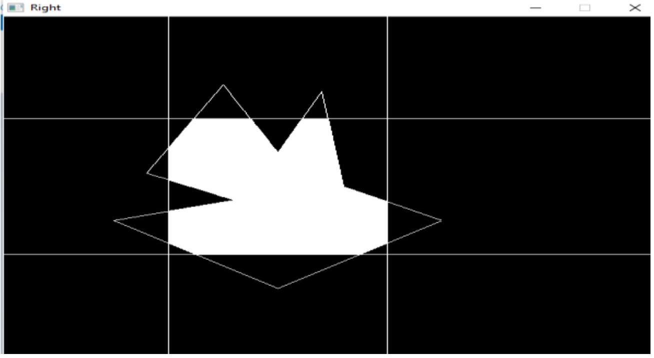
E:\EWU\Fall 2019\CSE420\Project\Sutherland Hodgman\sutherland-hodgman.exe

```
Xmin = 100
Xmax = 300
Ymin = 100
Ymax = 300
Clipping edge sequence: L T B R
No. of vertices in the polygon = 9
P1 : (50, 150)
P2 : (200, 50)
P3 : (350, 150)
P4 : (260, 200)
P5 : (240, 340)
P6 : (200, 250)
P7 : (150, 350)
P8 : (80, 220)
P9 : (160, 180)

Clipping with respect to LEFT edge...
New Sequence : (100, 116.667) (200, 50) (350, 150) (260, 200) (240, 340) (200, 250) (150, 350) (100, 25
7.143) (100, 210) (160, 180) (100, 163.636)

Clipping with respect to TOP edge...
New Sequence : (200, 50) (350, 150) (260, 200) (245.714, 300) (222.222, 300) (200, 250) (175, 300) (123
.077, 300) (100, 257.143) (100, 210) (160, 180) (100, 163.636) (100, 116.667)

Clipping with respect to BOTTOM edge...
New Sequence : (275, 100) (350, 150) (260, 200) (245.714, 300) (222.222, 300) (200, 250) (175, 300) (12
3.077, 300) (100, 257.143) (100, 210) (160, 180) (100, 163.636) (100, 116.667) (125, 100)

Clipping with respect to RIGHT edge...
New Sequence : (300, 116.667) (300, 177.778) (260, 200) (245.714, 300) (222.222, 300) (200, 250) (175,
300) (123.077, 300) (100, 257.143) (100, 210) (160, 180) (100, 163.636) (100, 116.667) (125, 100) (275,
 100)


PRESS ANY KEY TO EXIT...
```

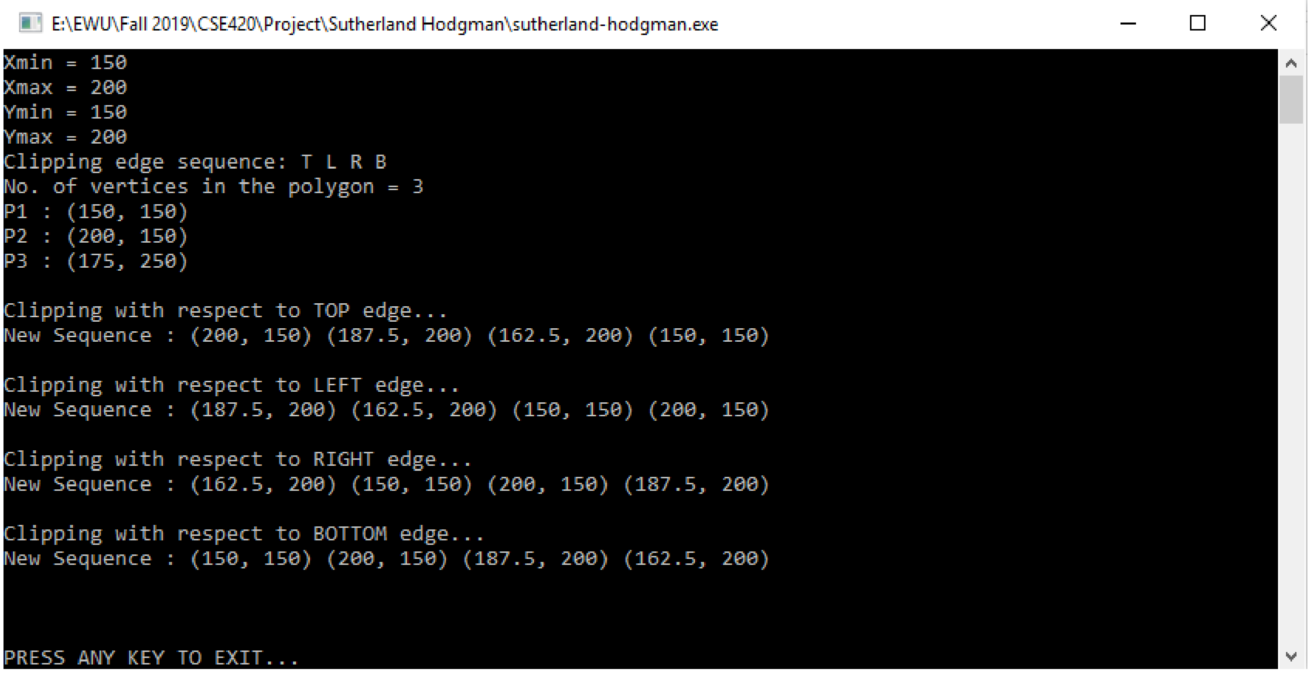






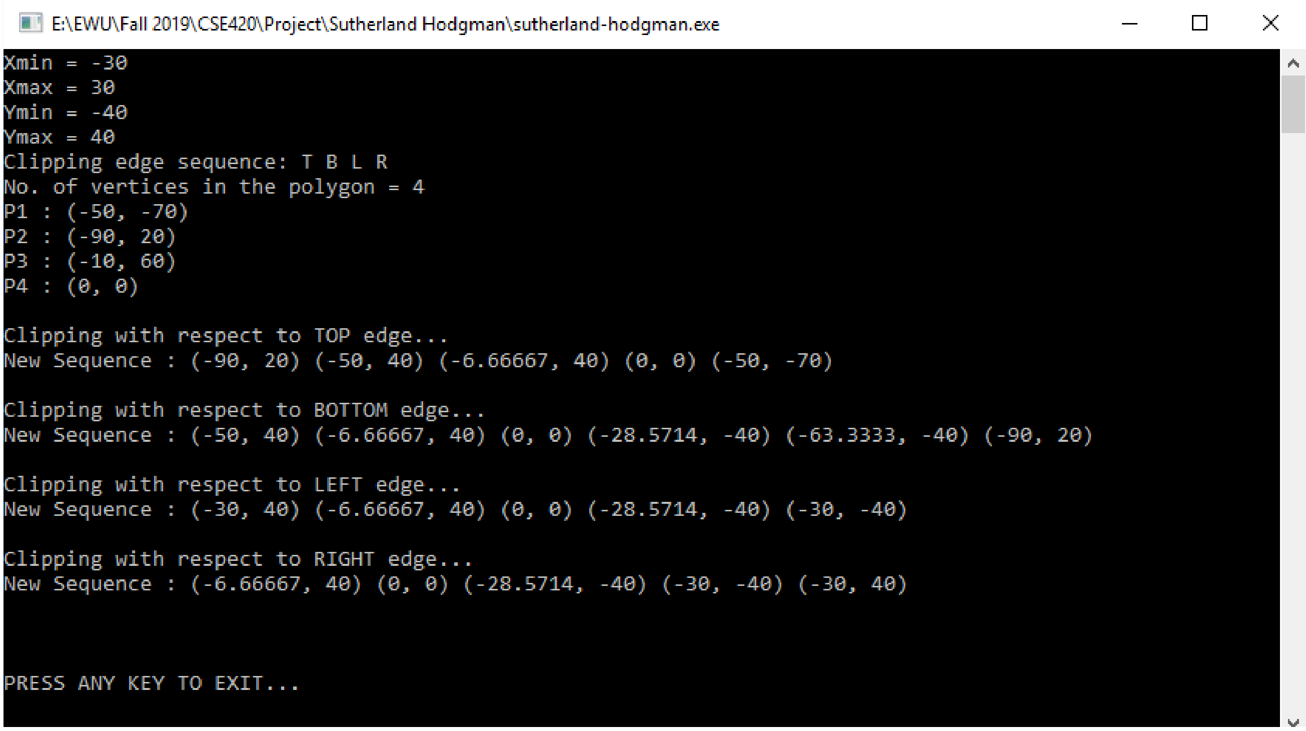


Output for *in-3.txt*


E:\EWU\Fall 2019\CSE420\Project\Sutherland Hodgman\sutherland-hodgman.exe

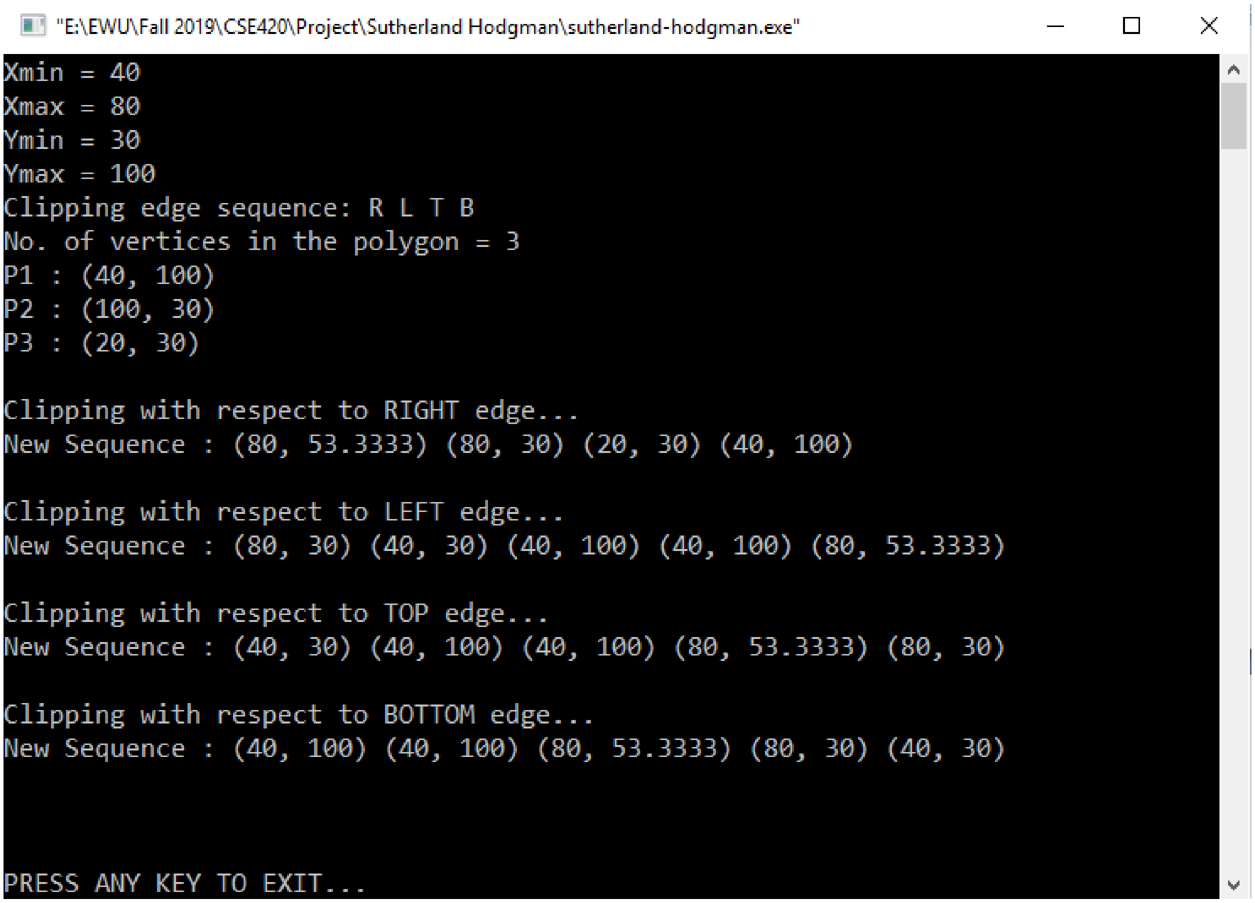
```
Xmin = 150
Xmax = 200
Ymin = 150
Ymax = 200
Clipping edge sequence: T L R B
No. of vertices in the polygon = 3
P1 : (150, 150)
P2 : (200, 150)
P3 : (175, 250)

Clipping with respect to TOP edge...
New Sequence : (200, 150) (187.5, 200) (162.5, 200) (150, 150)

Clipping with respect to LEFT edge...
New Sequence : (187.5, 200) (162.5, 200) (150, 150) (200, 150)

Clipping with respect to RIGHT edge...
New Sequence : (162.5, 200) (150, 150) (200, 150) (187.5, 200)

Clipping with respect to BOTTOM edge...
New Sequence : (150, 150) (200, 150) (187.5, 200) (162.5, 200)



PRESS ANY KEY TO EXIT...
```

Output for *in-4.txt*


E:\EWU\Fall 2019\CSE420\Project\Sutherland Hodgman\sutherland-hodgman.exe

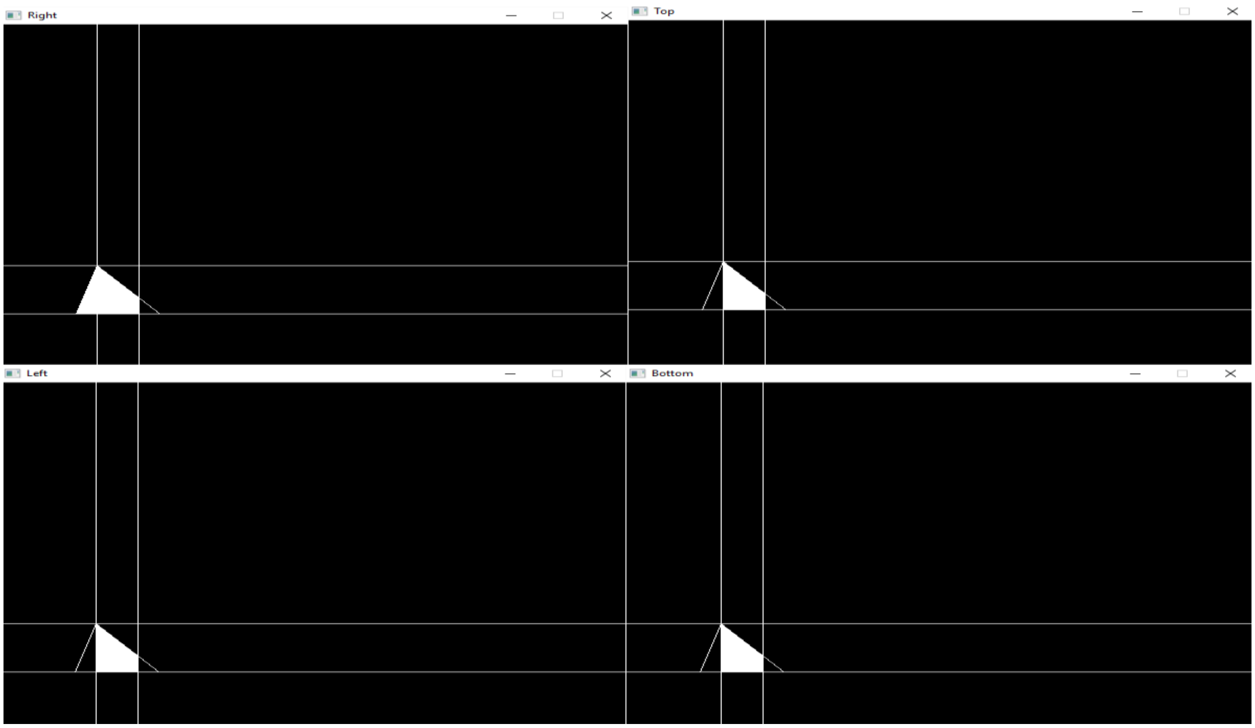
```
Xmin = -30
Xmax = 30
Ymin = -40
Ymax = 40
Clipping edge sequence: T B L R
No. of vertices in the polygon = 4
P1 : (-50, -70)
P2 : (-90, 20)
P3 : (-10, 60)
P4 : (0, 0)

Clipping with respect to TOP edge...
New Sequence : (-90, 20) (-50, 40) (-6.66667, 40) (0, 0) (-50, -70)

Clipping with respect to BOTTOM edge...
New Sequence : (-50, 40) (-6.66667, 40) (0, 0) (-28.5714, -40) (-63.3333, -40) (-90, 20)

Clipping with respect to LEFT edge...
New Sequence : (-30, 40) (-6.66667, 40) (0, 0) (-28.5714, -40) (-30, -40)

Clipping with respect to RIGHT edge...
New Sequence : (-6.66667, 40) (0, 0) (-28.5714, -40) (-30, -40) (-30, 40)



PRESS ANY KEY TO EXIT...
```

Output for *in-5.txt*



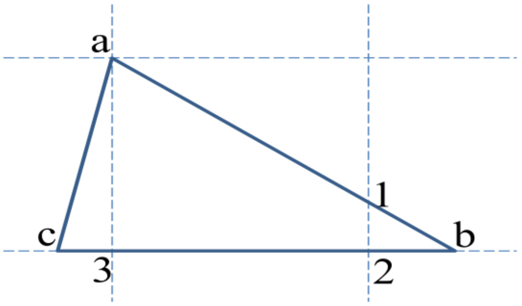
"E:\EWU\Fall 2019\CSE420\Project\Sutherland Hodgman\sutherland-hodgman.exe"

```
Xmin = 40
Xmax = 80
Ymin = 30
Ymax = 100
Clipping edge sequence: R L T B
No. of vertices in the polygon = 3
P1 : (40, 100)
P2 : (100, 30)
P3 : (20, 30)

Clipping with respect to RIGHT edge...
New Sequence : (80, 53.3333) (80, 30) (20, 30) (40, 100)

Clipping with respect to LEFT edge...
New Sequence : (80, 30) (40, 30) (40, 100) (40, 100) (80, 53.3333)

Clipping with respect to TOP edge...
New Sequence : (40, 30) (40, 100) (40, 100) (80, 53.3333) (80, 30)

Clipping with respect to BOTTOM edge...
New Sequence : (40, 100) (40, 100) (80, 53.3333) (80, 30) (40, 30)



PRESS ANY KEY TO EXIT...
```



Special Case

Consider the polygon abc of *in-5.txt*. Vertices a, b and c fall on edges of the clip rectangle. In cases like this, where a polygon vertex fall on some edge of clip rectangle, clipped output may contain duplicate vertices. Notice the new sequences after clipping with respect to left, top and bottom edges duplicate copies of a.



i. Right
ab in-out 1
bc out-in 2c
ca in-in a

New: 12ca

ii. Left
12 in-in 2
2c in-out 3
ca out-in aa
a1 in-in 1

New: 23aa1

iii. Top
23 in-in 3
3a in-in a
aa in-in a
a1 in-in 1
12 in-in 2

New: 3aa12

iv. Bottom
3a in-in a
aa in-in a
a1 in-in 1
12 in-in 2
23 in-in 3

New: aa123

In your implementation, handle the above mentioned scenario so that duplicate vertices are not passed to next stage. For example, if left clipping produces 23aa1, pass 23a1 to top clipping; if top clipping produces 3aa12, pass 3a12 to bottom clipping, if bottom clipping produces aa123, present a123 as final output.

N.B: Given sample *sutherland-hodgman.exe* does not handle this duplicate vertex scenario.

Mark Distribution

Task	File Input	Text Output	Visual Output	Duplicate Vertex	Algorithmic Computation	Viva	Total
Mark	2	2.5	2.5	1	4.5	2.5	15

Deadline

14 December, 2019 (Saturday)

Implementation Overview

You may follow the following structure in your program. Of course, maintaining this structure is completely optional.

```
// keep two list of vertices, one list prev for the old sequence, another list next for the
updated  sequence

// ensure that while clipping with respect to each edge, the sequence resulted from the
previous clipping is in prev and the sequence after the current clipping is in next

left_clip(){

        iterate the vertex sequence from prev and in each iteration add output
        vertices (according to the Sutherland-Hodgman clipping rules) in the list next

}

right_clip(){

        similar as left clip

}

top_clip(){

        similar as left clip

}

bottom_clip(){

        similar as left clip

}

sutherland_hodgman(){

        for i = 1 to 4

                check which edge comes at $i^{th}$ position of clipping order and call
                the corresponding clip function

                print the updated vertex sequence from next

                copy the sequence from next to prev

}

main() {

        take input from file

        sutherland_hodgman()

}
```