**Mini Project: Working with Polygons**

**Introduction**

Upon opening the program, a turtle cursor (as indicated by the orange arrow) is placed at the origin coordinates (0,0), ready for drawing of a polygon. The program also contains a menu bar housing all the buttons needed to create a polygon as well as edit it.

Chart

Description automatically generated

**Features**

1. Drawing of a Polygon

The program allows the user to draw a polygon (minimum 3 vertices and above). The program takes in 3 user inputs, the first being for the number of vertices required. For each vertice that the user keys in, the program would prompt the user to key in its x and y-coordinates respectively, limited to a range of -300 to 300 for both x and y-coordinates.

Currently, the program is limited to 10 vertices maximum as it can get tedious keying x and y coordinates for 10 vertices or more, but the program is able to take in an unlimited amount of vertices theoretically.

For each vertice that the user successfully keys in the x and y-coordinates for, the program would draw a line linking this new vertice to the previous vertice (recall that the initial vertice is (0,0). The final vertice is linked back to the origin. The x and y-coordinates are stored in a separate list.

Text

Description automatically generated with low confidence

As you can see above, after keying the coordinates (60,60), a new line is being drawn connecting the origin to the new vertice. An added function of this program is that it is able to exclude self-intersecting polygons, which refers to polygons whose sides cross each other.

Text

Description automatically generated with medium confidence

As shown in the image above, if a line intersects with any of the previous lines drawn on the screen, it would erase the existing polygon and prompt the user to redraw a new polygon fulfilling the requirements.

1. Polygon Display

This function allows for cosmetic changes to the polygon, including outline colour as well as fill color. The outline color is currently restricted to three colours, red, black and blue, depending on the user input, and the fill color is currently unlimited, based on hex codes, and also based on user input. The user will need to key in his/ her preferred colours before drawing a new polygon.

Chart

Description automatically generated

1. Add/ Remove vertices

This function allows for the user to add or remove vertices. Depending on user input, the add vertice or remove vertice function is called. For adding of vertices, it takes in a new x and y-coordinate input from the user, and adds it to the list of coordinates stored.

Graphical user interface

Description automatically generated with medium confidence

For example, a new polygon is created with 4 vertices. Upon clicking Add/ Remove Vertices and selecting the Remove Vertice function, the x and y-coordinates list are displayed in the output window. The user can key in the vertice to be removed e.g. keying in 3 removes Vertice 3 from the polygon. The polygon will then redraw itself based on the remaining coordinates provided. It also checks if there are any new self-intersections developed from the removal of one vertice, and if so, will delete the polygon and prompt the user to redraw.

Removing vertice number 3 above leads to the image below:

Chart

Description automatically generated

Similarly for adding of vertices, user will be prompted on the x and y-coordinates of the new vertice, and redraw the polygon connecting the last drawn vertice to the new vertice. If self-intersection is detected, then the polygon is erased as well.

1. Rotate Polygon

This function takes in an input from the user on the degree of rotation, and the polygon would rotate to the left by the inputted degree.

A picture containing graphical user interface

Description automatically generated

*Rotated by 60 degrees*

A picture containing chart

Description automatically generated

*Rotated by another 89 degrees*

1. Move Polygon

The Move Polygon function allows for the user to first rotate the polygon in any direction, then keying in a set x and y coordinate (between -300 to 300) to allow the polygon to move to that point. This will allow the user to move the polygon to any point with any orientation.

A picture containing chart

Description automatically generated

*Polygon moved to coordinates (180,180)*

1. Perimeter of Polygon

This function calculates the perimeter of the polygon by calculating the length of line joining each vertice. The length is calculated via the length formula of two points in a Cartesian plane. The length is then summed up and outputted on the screen.

A picture containing chart

Description automatically generated

The font colour of the text can be changed via Polygon Display, and changing the outline colour.

1. Area of Polygon

This function calculates the area of the polygon via the shoelace method of all the coordinates of the vertices, and outputted on the screen similar to the Perimeter function.

Chart

Description automatically generated with medium confidence

**Strengths and Weaknesses**

This program allows the user a fair degree of autonomy in designing a polygon, and also has a failsafe method to prevent self-intersection of polygons. Additionally, it has inbuilt functions to add and remove vertices with no issues, as well as make cosmetic changes to the polygon. Basic mathematical functions such as calculating area and perimeter of the polygon are included as well.

This program has a few weaknesses, which include not being able to save polygon files or import new polygon files. Also, this program is unable to scale the polygon shape that was drawn and not being able to identify whether a point is in the polygon or not. This could be a further area for me to explore as I continue my understanding and learning of Python functions, which would no doubt aid me in the future.