

Introduction to Visual Computing
Fall 2024: VIST172/501-505
Programming Challenge 5

Instruction: All questions are compulsory.

Drawing Regular Polygons via Trigonometric Functions

Question 1: [2 Points]

Write and demonstrate a program that repetitively asks the user for a number of sides, and then draws a regular polygon with that number of sides centered in the drawing window. The program should stop requesting user input when a negative number of sides is entered. Each polygon should be drawn with a unique color, which should be generated randomly. Make a square drawing window, with a coordinate system from -2 to 2 in both x and y, so that the point (0, 0) is in the center of the window and the sides of the window are each 2 unit from the center. Size each polygon so that it would fit into a circle of radius 1.8. The first vertex of each polygon should be centered at the bottom of the window.

```
Enter the number of sides of a polygon: 3
Enter the number of sides of a polygon: 4
Enter the number of sides of a polygon: 5
Enter the number of sides of a polygon: 6
Enter the number of sides of a polygon: 8
Enter the number of sides of a polygon: 100
Enter the number of sides of a polygon: -1
```

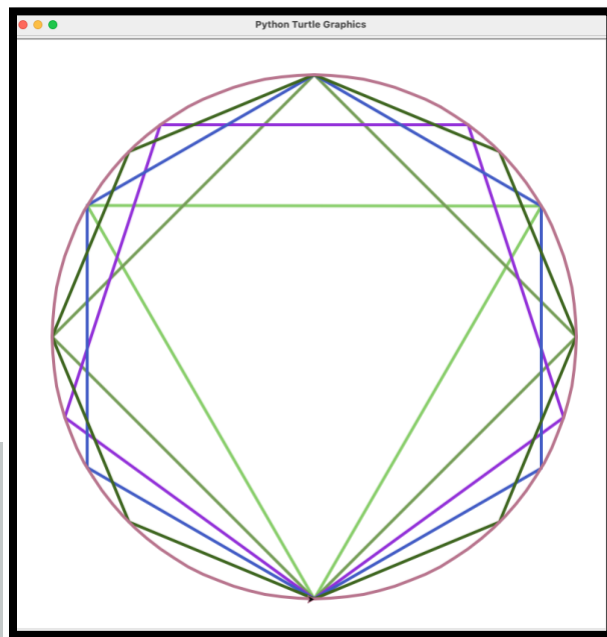


Figure 1: **Left:** Input from the terminal to the program: **Right:** Example Output

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Question 2: [3 Points]

The challenge is a continuation of the previous question. For this programming challenge question arrange the polygons so that their bottom sides are parallel with the bottom edge of the drawing window, as shown in the figure below, assuming all the experimental setup and input same as the previous question.

```
number of sides: 3
number of sides: 4
number of sides: 5
number of sides: 6
number of sides: 7
number of sides: 10
number of sides: 100
number of sides: -1
```

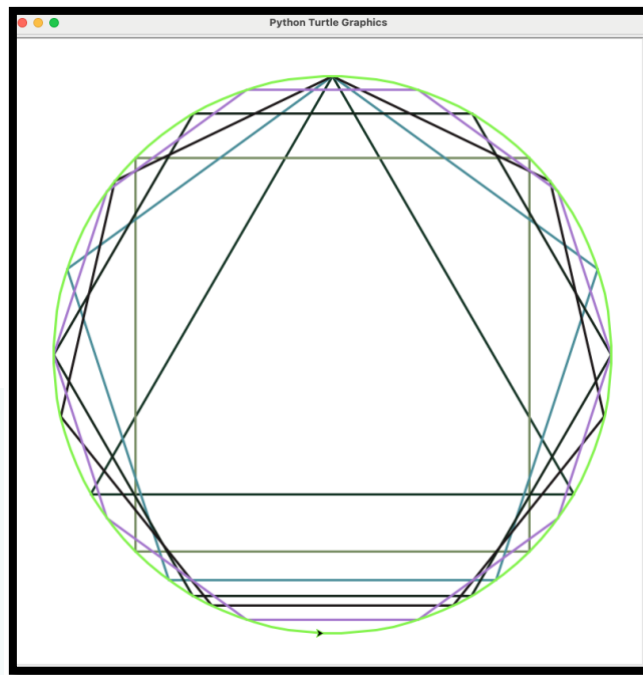


Figure 2: **Left:** Input from the terminal to the program. **Right:** Example Output

• **Question 3: [2 Points]**

Write a Python program using the Turtle graphics module to draw the sine, cosine, and tangent functions on the same graph. Each function should be plotted over one complete period (from 0° to 360°). By completing this programming challenge, you will gain experience working with mathematical trigonometric functions, scaling graphs, and using Turtle graphics to create visualizations of mathematical concepts.

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Requirements:

1. Graph Setup:

- Draw the x-axis from 0° to 360° (in degrees).
- Draw the y-axis from -1.5 to 1.5 (for the sine and cosine functions) and from -5 to $+5$ (for tangent, with restrictions to avoid undefined values).

2. Sine Function:

- Plot the sine function $y=\sin(x)$ from 0° to 360° .
- Scale the plot appropriately and ensure that the curve fits the window.

3. Cosine Function:

- Plot the cosine function $y=\cos(x)$ from 0° to 360° .
- Scale it similarly to the sine function and plot it in a different color for distinction.

4. Tangent Function:

- Plot the tangent function $y=\tan(x)$ from 0° to 360° , avoiding the vertical asymptotes at 90° and 270° .
- Use a different color for the tangent plot.

5. Customization:

- Use different colors for each function.
- Label the x-axis and y-axis, and plot tick marks at regular intervals (e.g., every 45° on the x-axis).

Hint: Use the math module to calculate the sine, cosine, and tangent values in radians (e.g., `math.sin()`, `math.cos()`, and `math.tan()`). To convert degrees to radians, use `math.radians()`.

Example Output:

- Your program should display a graph with clearly plotted sine, cosine, and tangent curves, each in a distinct color.