National University of Singapore
School of Computing
CS1010X: Programming Methodology
Semester II, 2024/2025

Mission 5 - Side Quest
Kochize

Release date: 17 February 2025
Due: 13 March 2025, 23:59

Required Files

- sidequest05.2-template.py

- hi_graph_connect_ends.py

Background:

Nature hides many beauties, and one of these, as you have seen, are fractals. Grandmaster Ben now invites you to use your new-found skills to conjure up an image that is not quite so simple: the snowflake fractal, more commonly known as the Koch snowflake.

Upon successful completion of this side quest, you will earn the "Snowflake Catcher" achievement.

Information:

The Python source file has been renamed to `hi_graph_connect_ends.py` and modified to include the function `connect_ends` which should have been previously coded. You may now use the function directly from this source file.

For your convenience, the template file `sidequest05.2-template.py` contains a line to load the Python source file `hi_graph_connect_ends.py`. Use the template file to answer the questions.

This side quest consists of **two** tasks.

Task 1: (4 marks)

We begin by drawing only part of the snowflake.

Figure 1 shows the first few approximations to the Koch curve, where we stop after a certain number of levels: a level-0 curve is simply a straight line; a level-1 curve consists of four level-0 curves; a level-2 curve consists of four level-1 curves, and so on. The figure also illustrates a recursive strategy for making the next level of approximation: a level-n curve consist of three parts. The first part is a level-$(n-1)$ curve. The second part is two level-$(n-1)$ curves, one is rotated by $\pi/3$ and the other is rotated by $-\pi/3$. The last part is another level-$(n-1)$ curve.
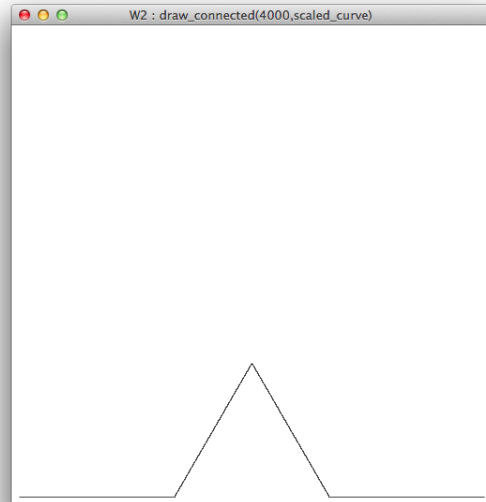
Define a function `kochize` such that the evaluation of

```
show_connected_koch(level, num_points)
```

will show `num_points` connected points of the level `level` koch curve in `window` starting with a `unit_line`, where `show_connected_koch` is defined as:
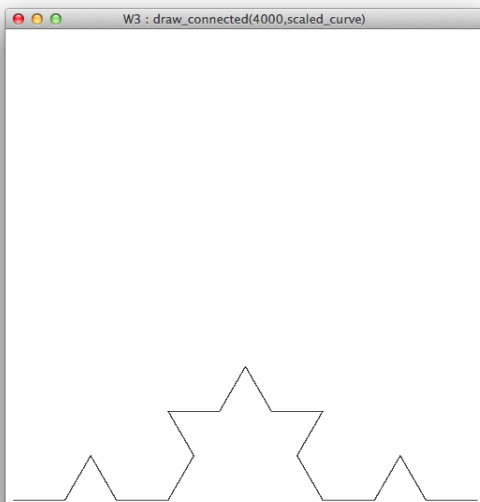
```
def show_connected_koch(level, num_points):
    draw_connected(num_points, kochize(level))
```
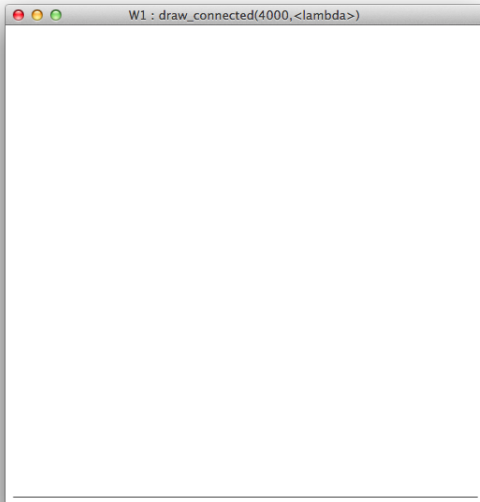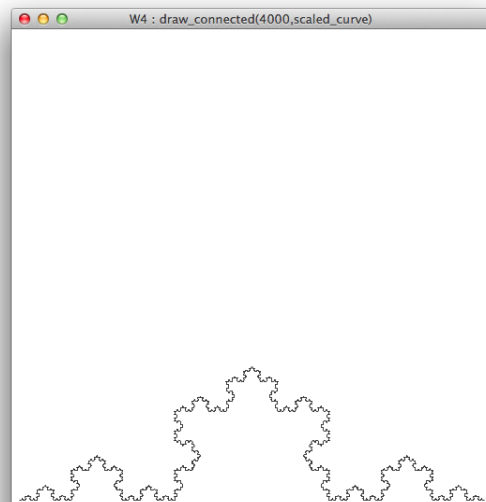

show_connected_koch(0, 1000)

show_connected_koch(1, 1000)

show_connected_koch(2, 4000)

show_connected_koch(5, 4000)

Figure 1: Samples for Koch Curve.

Task 2: (4 marks)

By completing **Task 1**, you have one third of your snowflake in hand. Now construct your complete snowflakes using a level-5 Koch curve and tools you have learned in previous missions. Precisely, define `snowflake` such that `draw_connected_scaled(10000, snowflake())` displays your snowflake within the viewport.

[Note: `draw_connected_scaled` scales proportionally and translates your curve to the center.]

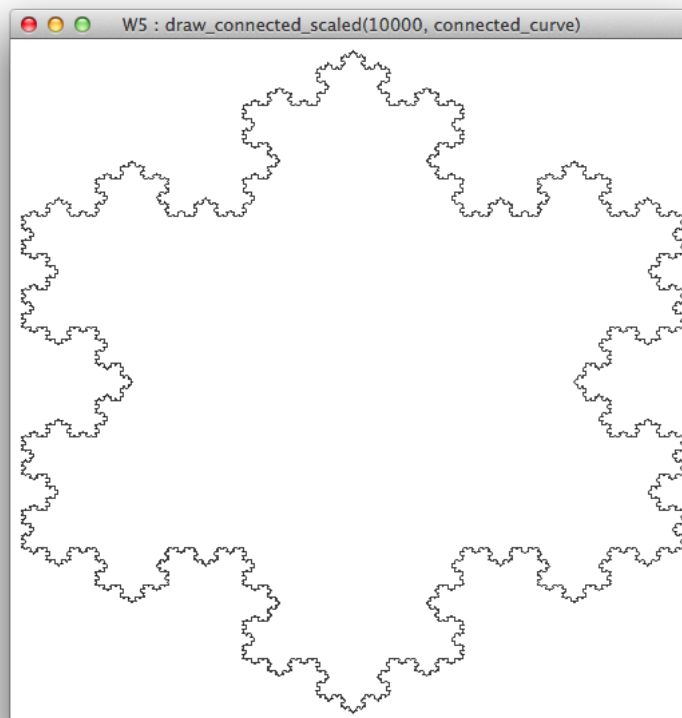An example is shown in Figure 2.

Figure 2: `draw_connected_scaled(10000, snowflake())` displays the snowflake above.