ITP20002-01 Discrete Mathematics

Programming Assignment 2

6 Nov 2018

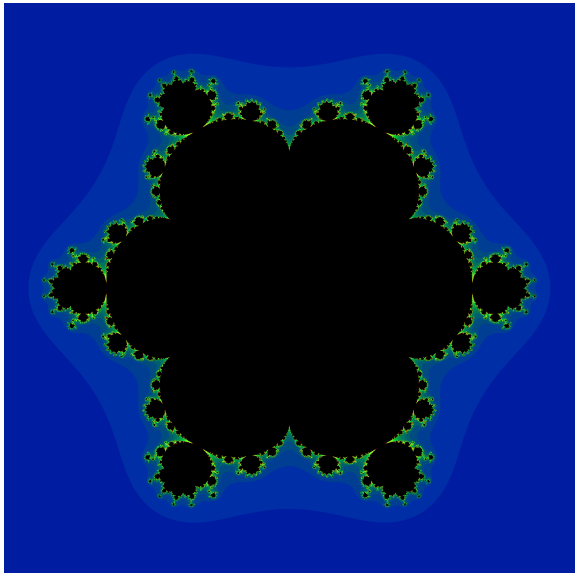
PA2. Recursion and Fractal

- Tasks
  1. Write 3 recursive programs drawing 3 different fractals
     - your programs should be written in JavaScript
     - the shapes of 2 fractals are given, and the other one is open for each team to present an interesting fractal by yourself.
  2. Write a program that finds an answer of Triomino-tiling problem
     - your programs should be written in JavaScript
- Setting
  - Due date: **11:59PM, 16 Nov (Fri)**
  - Evaluation
    - report: 60%
    - test: 30%
    - voting: 10%
  - No late submission will be accepted

What is Fractal?

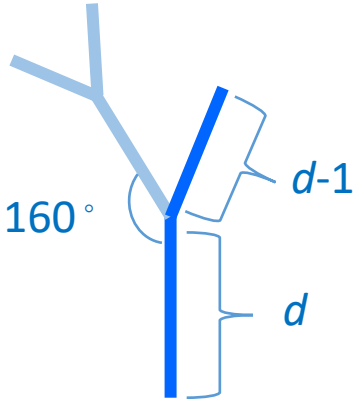
- A fractal is a geometric object whose structure is identical to the structures of its components.
  - A structural pattern is repeated recursively.

- Many structures in nature are formed as fractals.

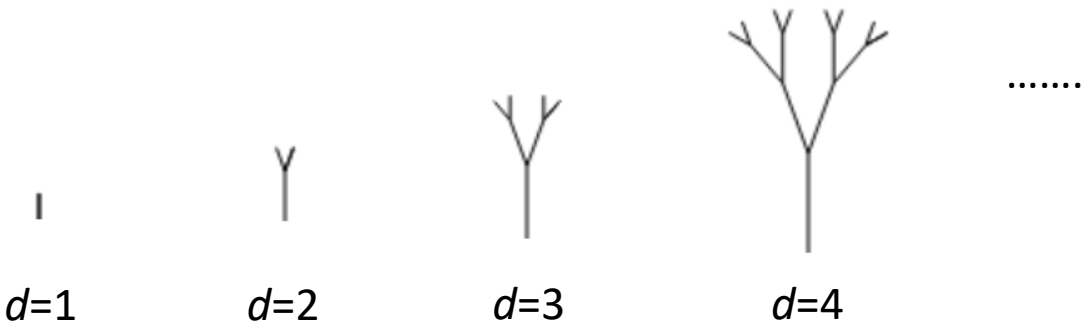


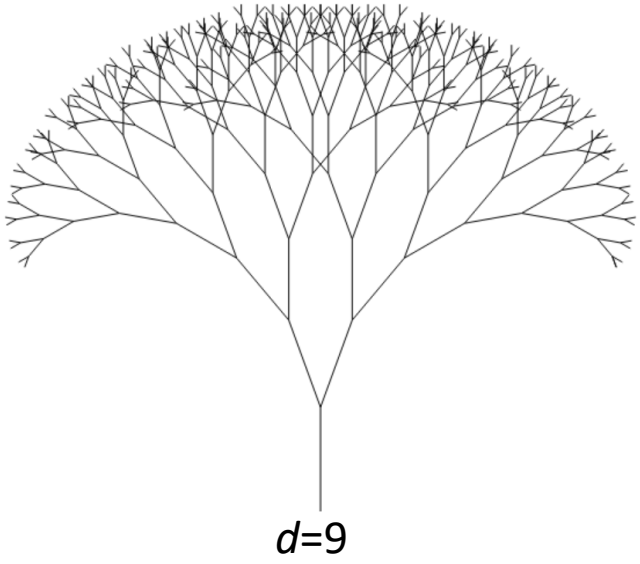
Tree Fractal

- A tree of depth *d* has one stem and two branches.
  - The length of the stem is *d*
  - The angles between the stem and the two branches are -160° and +160°, respectively.



- Each branch is in a form of a tree of depth *d* – 1.





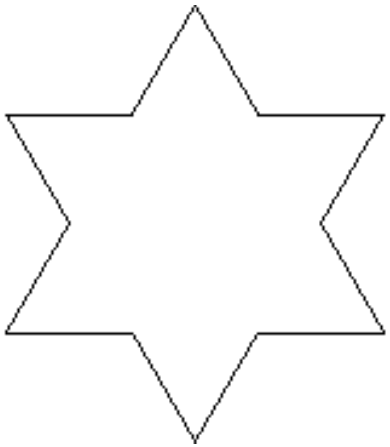
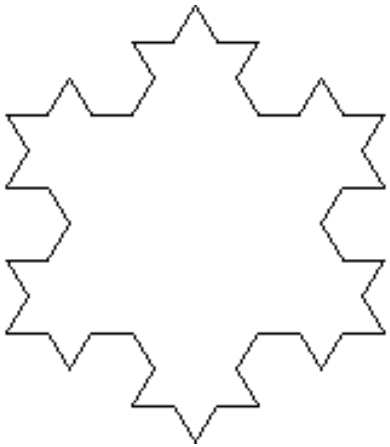
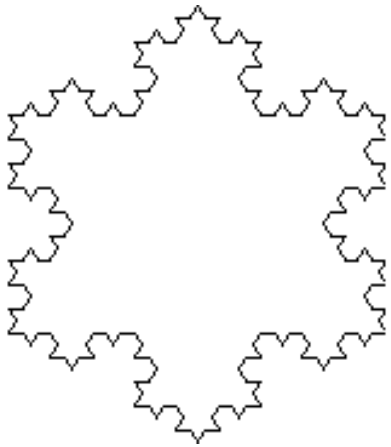
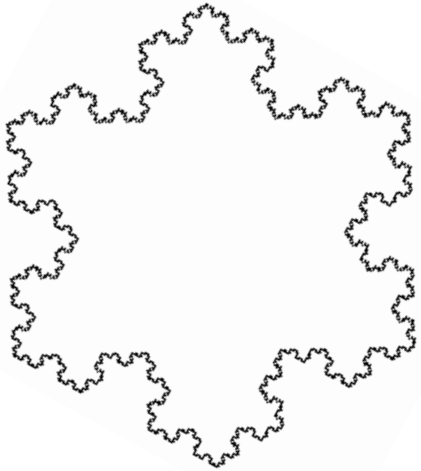
Drawing Tree Fractal

```
<html> <body>
    <canvas id="canvas" width="600" height="500"></canvas>

    <script type="text/javascript">
      var elem = document.getElementById('canvas');
      var context = elem.getContext('2d');
      context.fillStyle = '#000';
      context.lineWidth = 1;
      var deg_to_rad = Math.PI / 180.0;
      var depth = 9;

      function drawLine(x1, y1, x2, y2, brightness){
        context.moveTo(x1, y1);
        context.lineTo(x2, y2);
      }

      function drawTree(x1, y1, angle, depth){
        if (depth !== 0){
          var x2 = x1 + (Math.cos(angle * deg_to_rad) * depth * 10.0);
          var y2 = y1 + (Math.sin(angle * deg_to_rad) * depth * 10.0);
          drawLine(x1, y1, x2, y2, depth);
          drawTree(x2, y2, angle - 20, depth - 1);
          drawTree(x2, y2, angle + 20, depth - 1);
        }
      }

      context.beginPath();
      drawTree(300, 500, -90, depth);
      context.closePath();
      context.stroke();
</script>
</body> </html>
```

- Sample code https://rosettacode.org/wiki/Fractal_tree#JavaScript

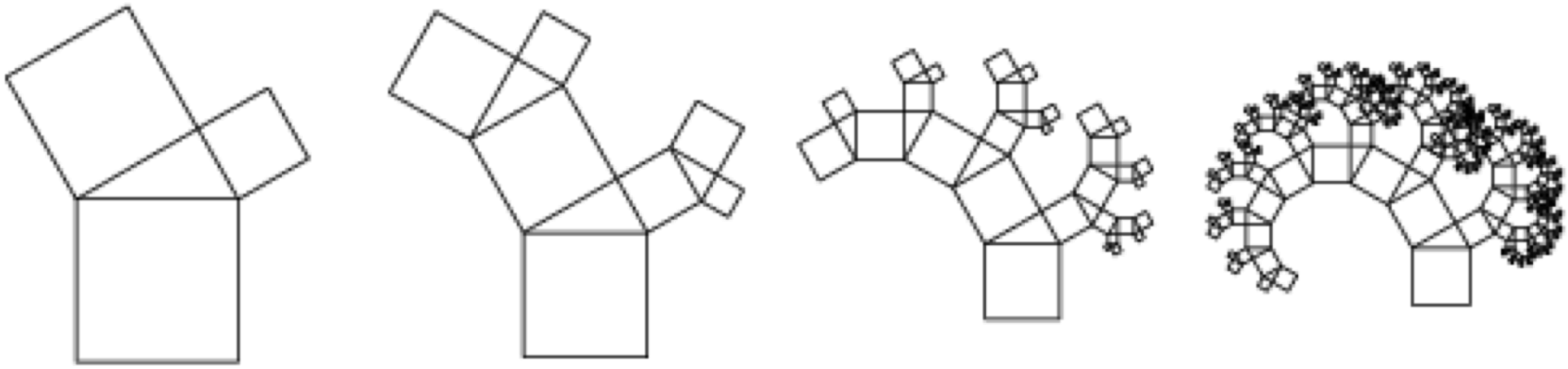
Fractal1

- Parameterize depth and different factors that matter to the shape of fractal

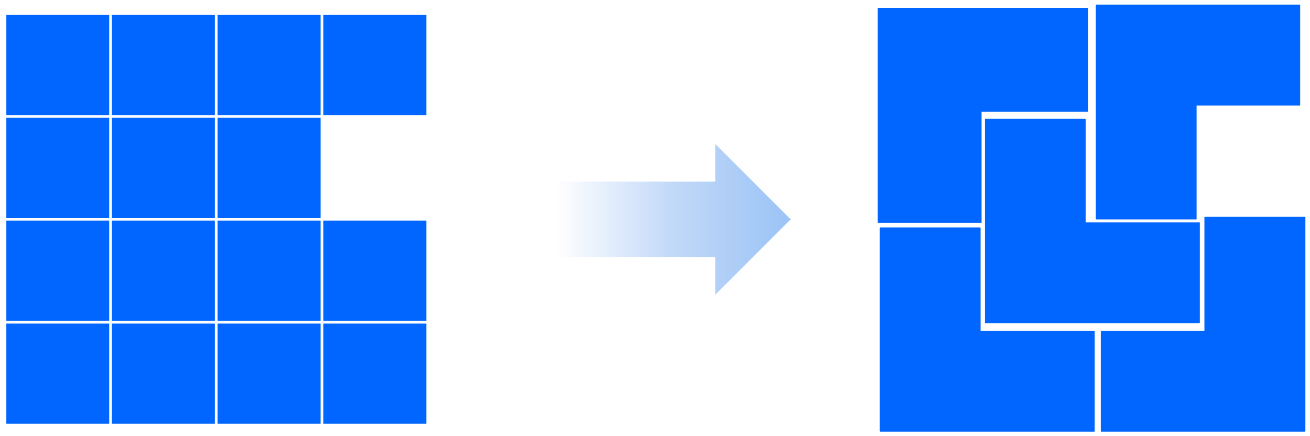
Fractal2

- Parameterize depth and different factors that matter to the shape of fractal



Task 2. Triomino-Tiling Problem

- Receive from the user a shape of $2^n \times 2^n$ checkerboard without one missing square
- Show the composition of Trionmino which fill out the shape
  - The interface is in any way you like, as long as it is intuitive to TA



Submission

- Each team should submit a report together with 4 HTML files
  - Submit both a report and 4 HTML files
  - The submission should be made via Hisnet.
  - After deadline, the submissions will be open via Piazza

- Report
  - the report must contain the followings:
    - one best looking fractal image
    - for each fractal,
      - description on the recursion that creates the fractal
      - description on parameters
      - few images generated with different parameters
  - the report must not exceed 5 pages (single-sided, A4)