COMP 1020
Lab 10

MATERIAL COVERED

- Recursion

Notes:

- The three exercises in this lab are independent – they can be done in any order.
- Only one of the three exercises is required, but try to do as many as you can.
- The Silver exercise requires StdDraw.

A simple recursive summation

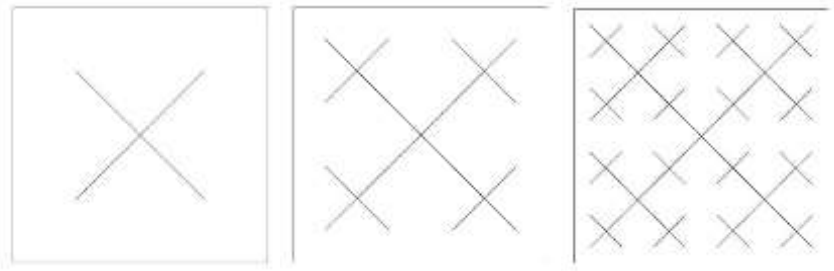
1. Start with the file **`TemplateLab10Bronze.java`**.
2. Add a *recursive* method **`double largestInList(int n, double[] list)`** which will find the largest of the first **`n`** elements of the array of doubles **`list`**. Assume **`n`** is between 1 and **`list.length`**. You *must* use recursion to do this – no loop of any kind is allowed.

Fractal graphics

A fractal image is one which is made up of smaller versions of the same image. Here's how to create a simple fractal image:

- To make a "level n" image in a square area
    a. divide it into four smaller "quadrants": the upper left, upper right, lower left, and lower right – all square areas taking up exactly ¼ of the original area each.
    b. Draw 4 lines from the center of the whole area to the centres of each of the 4 quadrants.
    c. Draw "level n-1" fractal images in each of the four quadrants, in exactly the same way.
- A "level 1" image is the smallest. A "level 0" image doesn't draw anything at all.

Here are pictures of level 1-3 images:



1. Start with the file **`TemplateLab10Silver.java`**.
2. Complete the *recursive* method **`void drawFractal(double xMin, double xMax, double yMin, double yMax, int nLevels)`** which will draw a fractal image, of level **`nLevels`**, in the rectangular area specified by the other four parameters.
3. Run the supplied main method. You can click the mouse button in the **`StdDraw`** window to advance from one level of fractal to the next, from level 1 up to level 8.

Integer sums

This is a very challenging question. Good luck!

There are 11 different ways to write a sum of positive integers (greater than 0) that add up to 6, if the order of the numbers doesn't matter:

```
6
5+1
4+2
4+1+1
3+3
3+2+1
3+1+1+1
2+2+2
2+2+1+1
2+1+1+1+1
1+1+1+1+1+1
```

Note that the numbers are always written in descending order. (Only 5+1, never 1+5.)

1. Start with the file **`TemplateLab10Gold.java`**.
2. Complete the method **`void printAllSums(int n)`** which will *print* all of the ways to write a sum of positive integers that add up to **`n`**, exactly as shown above (for **`n`**=6). This method will not be recursive itself. It should simply call the one below. (It should be a 1-line method.)
3. Create a more general *recursive* version of **`printAllSums`**, with an extra parameter or two, which will allow the sums to be easily computed and printed. The single-parameter version above should call this one. Note that this will be a ***very*** short method, but it may be difficult to figure out how to do it. Look at the patterns in the example above and try to spot a simple recursion. Good luck.
4. Run the supplied main program which will test your methods for **`n`**=1, 2, and 6.