

# COMP 1020

## Lab 10

### MATERIAL COVERED

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- 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 recursion

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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.



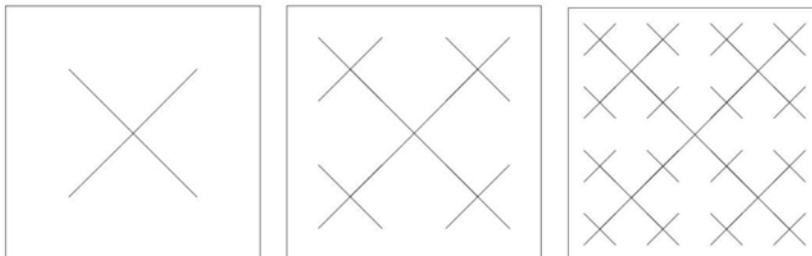
### Fractal graphics

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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  $\frac{1}{4}$  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

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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 integers are in descending order:

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

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**.