

# WarmUp Programming Exercise

Dr. 何明昕, He Mingxin, Max

c.max @ yeah.net

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## Software Engineering

# Exercise 04 (March 20)

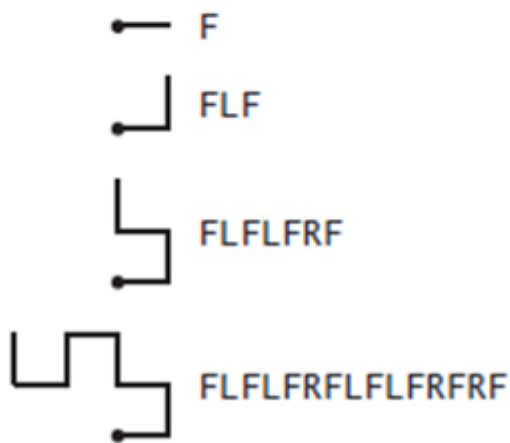
- 1) Read 2.3, 2.4 of TextBook. (in 1-2 weeks)
- 2) Read Appendix G (p449-476) of TextBook (in 3-4 weeks)

## WarmUp Prog. Exercise for SE (March 20)

Solve the following 4 problems by programming. Test all your programs in your own environment. Put all your code with input data and output data in separate sub-folders for each problem, zip them in a package like *2345AdamSmith-WarmUpProg.zip* and send it to [c.max@yeah.net](mailto:c.max@yeah.net) with an email subject like: *SE-2345AdamSmith: WarmUp Prog. Exercise.* before (including) March 26.

( Continue to write work-log as before 😊 )

**P3-1 Dragon curves.** Write a program to get an integer  $N$  from command-line arguments and print the instructions for drawing the dragon curve of order  $N$ . The instructions are strings of F, L, and R characters, where F means “draw line while moving 1 unit forward,” L means “turn left,” and R means “turn right.” A dragon curve of order  $n$  is formed when you fold a strip of paper in half  $n$  times, then unfold to right angles. The key to solving this problem is to note that a curve of order  $n$  is a curve of order  $n-1$  followed by an L followed by a curve of order  $n-1$  traversed in reverse order, and then to figure out a similar description for the reverse curve.



*Dragon curves of order 0, 1, 2, and 3*

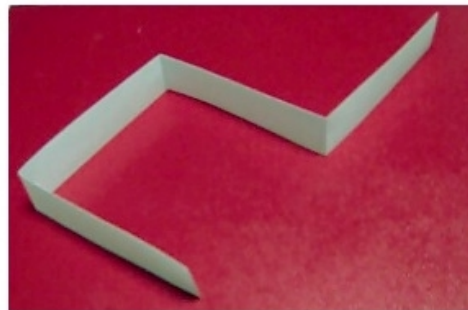
(Tips: You may search “*Dragon curves*” or “龙形曲线” online for help.

For example: <https://www.cnblogs.com/WhyEngine/p/4013245.html> )

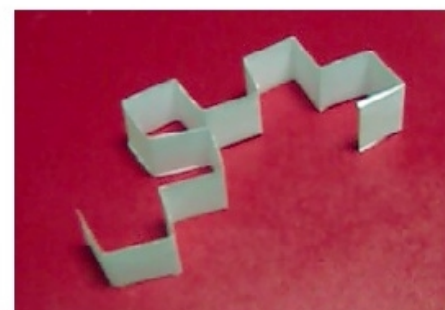
### 分形之龙形曲线 ( Dragon Curve )

龙形曲线 ( Dragon Curve ) 又叫分形龙,是一种自相似碎形曲线的统称,因形似龙的蜿蜒盘曲而得名。

一种简单的生成分形龙的方式是:拿着一条细长的纸带,把它朝下的一头拿上来,与上面的一头并到一起。用一句简单的话说,就是将纸带对折。接着,把对折后的纸带再对折,又再对折,重复这样的对折几十次.....这就生成了分形龙的图形。



对折两次



对折四次



对折五次



对折六次

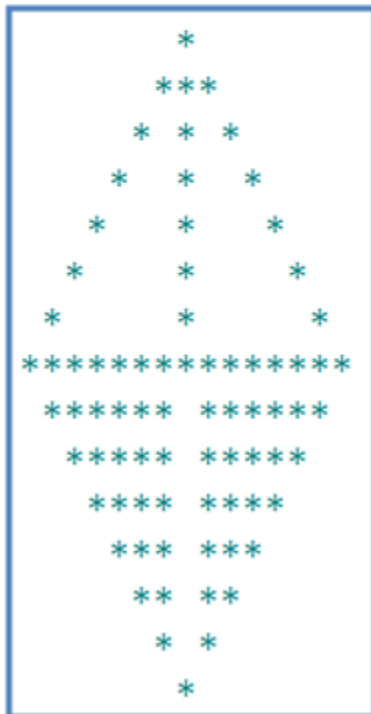
**P3-2** Write a program to output the following digit diamond in the console.

```

      0
    1 0 1
  2 1 0 1 2
3 2 1 0 1 2 3
4 3 2 1 0 1 2 3 4
5 4 3 2 1 0 1 2 3 4 5
6 5 4 3 2 1 0 1 2 3 4 5 6
7 6 5 4 3 2 1 0 1 2 3 4 5 6 7
8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8
9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9
8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8
7 6 5 4 3 2 1 0 1 2 3 4 5 6 7
6 5 4 3 2 1 0 1 2 3 4 5 6
5 4 3 2 1 0 1 2 3 4 5
4 3 2 1 0 1 2 3 4
3 2 1 0 1 2 3
2 1 0 1 2
1 0 1
0
```

**P3-3** Write 2 overloading static methods to construct a String that compose a diamond:

```
public static String diamond ();  
public static String diamond (int n, char... color);  
System.out.print( diamond() ) will output as left below:
```



System.out.print( diamond( 5 ) ) will output as right above.

`System.out.print( diamond( 7, '$' ) )` will output as left below:

```
  $
  $$$
 $ $ $
 $ $ $
$   $   $
$   $   $
$ $ $ $ $ $ $ $ $ $ $
$ $ $ $ $ $ $ $ $
$ $ $ $ $ $ $
  $ $ $ $ $
    $ $ $
      $ $
        $
```

```
.....@
.....@@@
...@.@.@
..@..@..@
.@...@...@
@@@@@@@@@@@@@@@@
.@@@@.@@@@
..@@@.@@@
...@@.@@
....@.@
.....@
```

`System.out.print( diamond( 6, '@', '.' ) )` will output as right above.

(Tips: in `diamond(int n, char... color)` declaration, where declared a **variable-length argument (varargs)** `color` that works like a `char[]` in the method body and may have a color without any entry, i.e., `color.length` may be 0 and `color = {}` .

```
1 import static java.lang.System.out;
2 import java.util.Arrays;
3 public class MyMath {
4     public static int max (int... numbers) { // Varargs
5         int max = numbers[0];
6         for (int i = 1; i < numbers.length; i++)
7             if (max < numbers[i]) max = numbers[i];
8         return max;
9     }
10
11     public static double max (double... numbers) { // Varargs
12         double max = numbers[0];
13         for (int i = 1; i < numbers.length; i++)
14             if (max < numbers[i]) max = numbers[i];
15         return max;
16     }
17
18     public static int max3 (int a, int b, int c) { // Exe 2.1.1
19         return max( a, b, c );
20     }
21
22     public static double max3 (double a, double b, double c) { // Exe 2.1.1
23         return max( a, b, c );
24     }
```



**P3-4** (*Largest block*) Given a square matrix with the elements 0 or 1, write a program to find a maximum square submatrix whose elements are all 1s. Your program should prompt the user to enter the number of rows in the matrix. The program then displays the location of the first element in the maximum square submatrix and the number of the rows in the submatrix. Here is a sample run:

Enter the number of rows in the matrix: 5

Enter the matrix row by row:

1 0 1 0 1

1 1 1 0 1

1 0 1 1 1

1 0 1 1 1

1 0 1 1 1

The maximum square submatrix is at (2, 2) with size 3

# Tips:

If `int[][] a = int[N][N]` with elements 0 or 1,

let `int[][] s = int[N][N]`, `s[r][c]` denotes the size of the maximum sub-matrix start from `a[r][c]` towards right-down direction.

Then we could compute `s[r][c]` in the following way (using pseudo-code):

```
s[N-1][N-1 .. 0] = a[N-1][N-1 .. 0]    // last row
s[N-2 .. 0][N-1] = a[N-2 .. 0][N-1]    // last column
```

```
for (r from N-2 down to 0)
```

```
    for (c from N-2 down to 0)
```

```
        s[r][c] = (a[r][c] == 0) ? 0 :
                  1 + min(s[r][c+1], s[r+1][c], s[r+1][c+1])
```

The Output may be changed to the following example.

```
a[][]:  
[1, 0, 1, 0, 1]  
[1, 1, 1, 0, 1]  
[1, 0, 1, 1, 1]  
[1, 0, 1, 1, 1]  
[1, 0, 1, 1, 1]  
s[][]:  
[1, 0, 1, 0, 1]  
[1, 1, 1, 0, 1]  
[1, 0, 3, 2, 1]  
[1, 0, 2, 2, 1]  
[1, 0, 1, 1, 1]  
The maximum square submatrix is at (2, 2) with size 3
```

Next Up

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**Reactive Systems**

**Use Cases**

**Domain Models**

**Sample Case Studies** (self-learning in 3-4 weeks)

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