**WS2 - Flow Control workshop**

The aim of this workshop is to practice writing conditions & loops. We will do so by implementing methods from Math library, printing various geometric shapes that have repetitive patterns, focusing on both “while” and “for” loops.

**Important notes:**

1. The relevant knowledge of the students is up to the end of week 2 (Lecture 2-2, recitation 2 - If, else, for, switch while and do-while loops, concat).
2. This is the first "serious" programming workshop - try to simplify the terms and not to use / mention functions or any other term that has never been discussed in class before.
3. Slides 38-40 on lecture 2.1 set the stage for this workshop.  
   It is recommended to start the workshop with a reminder of the relevant notes.   
   consider s as a String of 0 or more characters:
   * 1. System.out.print(s); - Prints s at the cursor position , and moves the cursor just after s.
     2. System.out.println(s); - Prints s at the cursor position,

and moves the cursor to the beginning on the next line.

* + 1. System.out.println(); - Moves the cursor to the beginning on the next line

1. During the whole workshop, it’s recommended to create sketches together with the students before writing ‘real code’ - and encourage them to do so when writing code at home.
2. Encourage the students to check their solutions by creating tracking tables - that could help them understand better what happens in every single step of the execution.
3. This workshop takes a long time and most likely you won’t be able to cover all the examples. It is important to highly recommend the students to continue the rest at home.
4. All the solutions are in the folder , make sure not to share with the students more than the first three in order to let them try solving the others by themselves.

**Introduction**

Start the workshop with the following example:

int count = 0;

while (count < 10) {

count = count + 1;

System.out.println(count);

}

Points for discussion at this point:

* What does this loop do?
* What happens if the condition is changed to “count <= 10”?

(discuss the Difference between ‘<’ and ‘<=’)

* What happens if we switch between the 2 lines in the body of the loop?
* Variables scope - variables ‘exist’ in the conditional / in the main (difference)

Practice questions: ask students to write the following loops (allow 10 to 15 mins):

* A loop which prints all numbers between 10 and 1, in **descending** order.
* A loop which prints all **even** numbers between 1 and 20.
* A loop which prints the following sequence: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024 (first 10 powers of 2).

**Geometric shapes:**

Introduce the following loop, which prints a line of asterisks.

int count = 0;

while (count < 10) {

count = count + 1;

System.out.print(“\*”);

}

Ask students to write a program which takes a String ‘s’ and an int ‘n’ (as command line arguments) and prints ‘s’ consecutively ‘n’ times, in the same line.

Here is an example with a string ‘Happy’ and n = 5, the output will be:

HappyHappyHappyHappyHappy

**Solution is** [**here**](https://drive.google.com/file/d/1OoLzHZboFyTgCKTjZyjFJy24BepIojth/view?usp=sharing)**.**

Points for discussion at this point:

* Difference between ‘print’’ and ‘println’.
* Use of loops to concatenate strings.
* Alternative use for this solution - ‘for’ loop.

**Square**:As a warmup, discuss how to write code that draws a square. The code takes an int ‘n’ which is the side length of the square.

Here is an example with n=5:

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// ADD Rectangle . square in lecture 2-1.

**Solution is** [**here**](https://drive.google.com/file/d/1fR6BPS4DQUBmiFk8Mdjdwr2ijm3RAyRa/view?usp=sharing)**.**

Points for discussion regarding the ‘for’ solution:

* What would have happened if we chose the same iteration index for both loops?

Discuss the results of creating variables with the same name in a common scope.

* Creating a first sketch of the solution - and deciding which loop would be the best solution for the case (while/for and why).

**Left-justified triangle:** We will now draw a left-justified triangle. As before, we will need a program which takes an int ‘n’ and prints a triangle of the following form with ‘n’ lines.

Here is an example with n=4:

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Points for discussion at this point:

* What does this loop do?
* What are the necessary changes? ask the students to write the program.
* Discussing the importance of the order when using nested loops.
* It’s important that the students will be guided to first sketch the following logic:
* for (i = 0; i < 1; i++) print(“\*”); println();
* for (i = 0; i < 2; i++) print(“\*”); println();
* for (i = 0; i < 3; i++) print(“\*”); println();
* for (i = 0; i < 4; i++) print(“\*”); println();
* This will drive home the need for an external loop that varies the limit from 1 to 4.

**Solution is** [**here**](https://drive.google.com/file/d/1mrKja11svoO23Yvtk5-ANbynvfGXTgiI/view?usp=sharing)**.**

**Right-justified triangle:** The next step is a right-justified triangle. Ask students to modify the previous program in order to get the following picture (again, n=5):

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Ask students to write the program and mention that they’ll need to think carefully on how to produce the ‘blanks’ at the beginning of each line.

**First , guide the students to first sketch the solution.**

Points for discussion at this point:

* Use of counter with loops - maintaining it through executing the loops (initializing outside of the loops)
* Global variables compared with local (in scope) variables.
* After writing the solution - try to ‘check’ the code and create a written track table to verify your solution.

**Solution is** [**here**](https://drive.google.com/file/d/1A29HGjzF3cgWUQjmCm0DtvqerHEnlUd9/view?usp=sharing)**.**

**Centered triangle:** Time permitting, ask students to write code which draws a centered triangle, like this:

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Points for discussion at this point:

* Locating the i++/i-- inside the loop - differences.
* Discussing the general difference between for loop and while loop
* Question regarding the solution for students - is it possible to replace the ‘k’ with ‘j’? why?

**Solution is** [**here**](https://drive.google.com/file/d/1Ir6bN70Pc--WvRKZv8A5pzR3NSZPAikO/view?usp=sharing)**.**

(Shimon is doing this exercise at the end of lecture 2.2 -

added here for extra background for what the students have already done):

**Unit Circle:** the final step is generating random points inside the unit circle, centered at (0,0).

Give the students the following assignment:

* generate a random point inside the unit square
* if the point is also inside the unit circle, we’re done
* else, keep trying

Points for discussion at this point:

* Difference between regular while loop and do-while loop

(do-while executes at least once , while executes at least zero times)

* motivation to use do-while instead of regular while loop
* General discussion - setting conditions for loops
  + First step of writing a code
  + Specifying and accurate the condition
  + Order of multiple conditions

**Solution is** [**here**](https://drive.google.com/file/d/10xBOMGcd9-mHr0NVR8zKI5TOwUDJkPdh/view?usp=sharing)**.**