VG101 — Introduction to Computer and Programming

Assignment 3

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- MATLAB: write each exercise in a different file
- C/C++: use the provided assignment template
- Include simple comments in the code
- If applicable, split the code over several functions
- Extensively test your code and impove it
- Write a single README file per assignment
- Zip all the files and upload the archive on Canvas

Ex. 1 — *Accurate calculations*

When an ancient Indian Brahmin invented the game of Chess he showed it to his king who was really impressed. He was so pleased that he allowed him to chose his own reward. The inventor replied that he wanted one grain of wheat on the first square of the chess board, two on the second, four on the third, eight on the fourth, and so forth...It took more than a week to the treasurer to calculate the amount a wheat required. Write a MATLAB script to help him determine how many grains of wheat had to be exactly given to the creator of Chess. The story ends with the creator of Chess becoming the new king.

Ex. 2 — *Structures*

The following table summarizes a wardrobe inventory. Create an appropriate MATLAB structure to represent the data, and write a script to determine (i) which item (Type+Color) is in the largest quantity and (ii) how old are the items in average – age in years, rounded down.

Type	Color	Quantity	Bought
Jumpers	Blue	2	04/2005
	Brown	3	02/2013
	Green	5	01/2015
Trousers	Black	3	06/2012
	Grey	2	04/2011
	White	1	12/2013
T-shirts	Blue	1	05/2010
	Green	2	09/2014
	Red	3	01/2012
	White	2	03/2008
	Yellow	1	11/2012

Ex. 3 — *Input and output*

Write a MATLAB function which takes as input an integer n and dumps in a file all the multiples $n \times i$, $0 \leq i \leq 10$. Respect the following format (do not output the dots, and the line numbers):

```
1 23 x 0 = 0
2 23 x 1 = 23
3 23 x 2 = 46
4 ...
```

Ex. 4 — *Ploting*

Plot a simple house and a car using basic geometric shapes such as rectangles, trapeziums, circles, and triangles.

Ex. 5 — *Algorithm, function, conditional statements, and loops*

Given a continuous function f over an interval $[a, b]$ such that $\text{sign}(f(a)) \neq \text{sign}(f(b))$ find $r \in [a; b]$ such that $f(r) = 0$. The bisection method consists in dividing the interval $[a; b]$ into two sub-intervals $[a; c]$ and $[c; b]$ of equal size. Then either $f(a)$ and $f(c)$ or $f(c)$ and $f(b)$ will have different signs. In case $c = r$ we stop and return c, otherwise the process is repeated over the interval where the sign changes. The process of narrowing down the interval will only end when the error is smaller than a bound specified by the user.

1. Write a clear algorithm describing the bisection method
2. Implement the previous algorithm using a MATLAB function

Note: the degree of accuracy should be at least 0.001 (strictly positive and less than 0.001).

Ex. 6 — *Input and output*

Pascal's triangle is a triangular array composed of the binomial coefficients. Write a MATLAB function taking as input an integer n and which outputs n lines of Pascal's triangle in a text file. For instance in the case $n = 6$ the file should contain the following:

```
     1
    1 1
   1 2 1
  1 3 3 1
 1 4 6 4 1
1 5 10 10 5 1
```

Hint: either generate it using the fact that each number in the triangle is the sum of the two numbers directly above it or using the functions `pascal` `diag`*, and* `rot90`*.*