Vg101 Introduction to Computers and Programming

Homework 1

Assigned: May 21, 2020

Due: May 28, 11:59pm

Submission:

There are in total 10 problems. For all problems in Homework 1, except readability: 1, please name your script for each solution as ex1_1.m, ex2_1.m… respectively. Then compress all files in a zip/tar file. There will be an assignment section on canvas for you to submit it. In a zip file, name it with following formats: StudentID_Studentname_Homework1.zip Write comments at the beginning of each file, including your name , student ID, and docstrings for how you solve this problem or how your code works.

Total: 100 points

1. Basic data types (10 points)

Review: In this part, we learn basic data types, values and operations. We can now use matlab as a basic calculator and achieve some basic logic! You might feel that it would be great to use some specific built-in functions. Well, it turns out that all roads lead to Rome. Not necessarily one way.

a. Write a program that takes three numbers from the command line and print them out on the screen in descending order. Requirement: Use the built in max() and min() function only. Conditional statements are NOT allowed (10 points).
b. Write a program that takes three numbers from users and print 1 if the values they provide are strictly ascending or descending. Conditional statements and built-in function *issorted* are NOT allowed (10 points).
c. Write a program that takes a matrix from the command line, and print out this matrix with the first column and the last column swapped (10 points).

d. Write a program that takes a scalar number n and a vector s from the command line, and print out 1 if this vector contains this scalar number, print out 0 if not. Requirement: Conditional statements and built-in function *ismember* are NOT allowed (10 points).

e. Write a program that takes a binary string from the command line, and output the number of 1's in the string. Note: Conditional and loop statements and built-in function *find*, *count* are NOT allowed (10 points).

2. Control:(10 points)

Review: In this part, we learn basic control statements: looping and conditional.

a. Write a program that takes a number n from the command line, and print a vector on the screen in the form of 1, 2, 2, 3, 3, 3, 4, 4, 4, 4, …., where n determines the length and values of the last series of sequence in the vector. For example, if n = 3, then print out 1 2 2 3 3 3 (10 points).

b. Background: Finding out the outlier, an observation that differs significantly from other observations, is a common problem in data science. In reality, for example, when a swarm of robots are deployed to monitor an area as a team, if a user in the control room notice that the location of a robot falls far away from other robots. The user will immediately know that the robot could be malfunctioning.

Now assume that a user, called Charlie, programmed the robot teams to survey the area following a direct line. Given the location report from the leader robot at the time t, find out the outlier robot, represented by its index. The location report will be imported into your program manually via the command line. The location report is represented as a n-by-2 matrix, where elements in each row i represents the geo-location of robot i.

For example, for the input [0 1; 1 3; 2 5; 3 8], the program will output number 4 since the location reported by the last robot is not following the same line as the rest three robots. (15 points).

3. Simulations: (20 points).

A major usage of computers is to conduct simulations. Simulation aim at approximating the real-world scenario based on some simplified models using the computers. It serves as a great reference to a problem if the real-world data is not available or the solution is costly to experiment in the real world.

a. 2D random walk

Background: Approximating the movement behaviour of users in an area is important for conducting research in social networking, city planning, and etc. Random walk is probably the most simplified model to represent the moving behaviour of a user. In our random walk model, a user is located in one point of a rectangular grid. Each time step it could move 1 unit distance at any one of the four directions (north, south, east, or west) .

Question: We have a user, named Charlie, following random walk model. Now write a program that takes one integer number n from the command line and output how many steps, represented as stepCount, it takes Charlie to hit the boundary of a 2*n-by-2*n square centered at the zero point, and output the trajectory Charlie has been through in this defined area before hitting the boundary.

4. Readability: (25 points)

Review: Always remember that code is meant to be read by human, and only incidentally executed by the computers.

a. Search online to find out what a README file is and what it should contain. Answer this question in a README file(5marks)
b. Search online what a binary search is, explain it in a README file; write a program that takes a sorted integer vector and an integer number from the command line, output the location (index) of this integer using binary search. (assume that we already know that

this integer is in this vector, we just do not know its location) Note that in Matlab, array index starts from 1. (20 points)