

EE2021 Computer Tools for Electrical Engineering

Final Exam

Due: January 26, 2021 at 13:00

Please compress all files (longestSequence.m, numberOfRegions.m and multisimReport.pdf) to “name_surname_studentno.zip”, and upload it to ues.marmara.edu.tr until due date and time.

1. (15 pts) Write a function **longestSequence(X)** which accepts an array of positive numbers **X** and returns the length of the longest array containing successive numbers from the array **X**.

The following table shows a possible list of outputs of the function **longestSequence(X)**.

Function call	Output
longestSequence([1, 4, 10, 2, 3, 1, 2, 6])	4
longestSequence([20, 11, 13, 13, 12, 9, 1, 10, 14])	6
longestSequence([8, 9, 7, 5, 3, 8, 8, 4])	3

Table 1: A list of possible outputs of the function longestSequence

2. (50 pts) Suppose that you have a matrix consisting of 1s and 0s that represent the pixels of a black & white image where 1s and 0s correspond to black and white pixels, respectively.

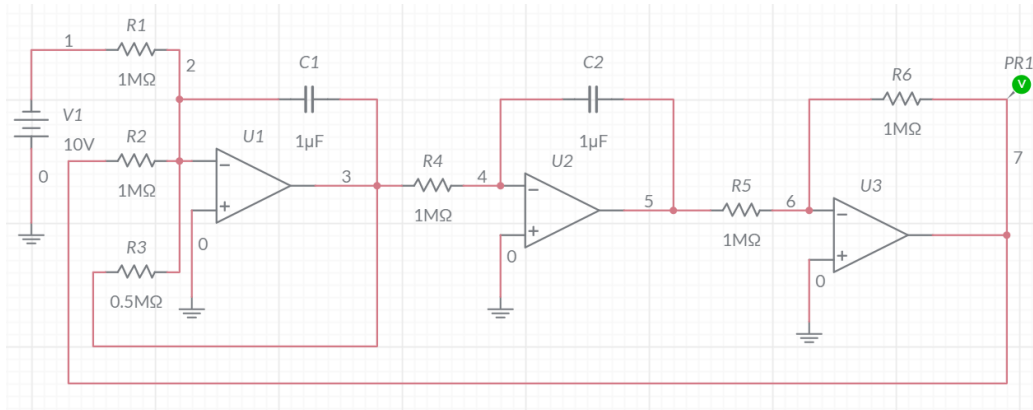
Two black pixels are said to be in the same black region if they share a common edge or corner. Note that a black pixel surrounded by white pixels is assumed to be a black region itself by definition.

Your objective is to write a function **numberOfRegions(X)** that returns the number of regions consisting of 1s in the matrix **X** (i.e., the number of black regions in the image) and the number of 1s in the largest region (i.e., the number of black pixels in the largest black region).

The following table shows a possible list of images, corresponding matrices and the outputs of the function.

3. (35 pts) OPAMPS and capacitors can be used together to build circuits that can solve ordinary differential equations. The following figure shows an electrical circuit which solves the differential equation

$$\ddot{x}(t) + 2\dot{x}(t) + x(t) = 10, \quad x(0) = 4, \quad \dot{x}(0) = 1.$$



Construct the electrical circuit in MULTISIM and obtain the waveform at the end of the circuit (PR1). Your report must include a screenshot of your circuit and the waveform observed at PR1.

Hint 1: Set the initial condition of C1 to 1V and C2 to 4V. Then set the *Initial Conditions* option to *User Defined* in *Simulation Settings*.

Hint 2: The solution of the differential equation is $x(t) = e^{-t}(-5t + 10e^t - 6)$.

Good luck!