BME1901 – Introductory Computer Sciences
Homework – 1

INFORMATION

Write appropriate scripts (m-file) in MATLAB to solve the questions. To solve the questions you may need to do some additional research and study. Show your references as a footnote where necessary. You may discuss and work with your friends to find solutions. However, everyone should **write** their **report alone** and use their **own words**. Any **cheating, copy-paste, etc.** will result in **zero grade** for students who are involved. A **report format** is given as part of this homework, use it to write your own report. Your report should include your code, your results (images, graphs, text, etc.), as well as your comments about your code and your results. The **deadline** for the report is **22.11.2020, 23:59**. You are requested to e-mail your report to the e-mail address given as **"ytubme1901@gmail.com"** in **pdf** format. Any late or no submissions will be **graded with a zero**.

QUESTIONS

1. See the image of a passive electrical circuit below. Write a m-file called **voltage_calculator** that computes the voltages at junctions A, B and C. In the m-file, you should receive two inputs from the user, **V** for the voltage of the supply in volts and **R** a vector of the values of the resistors in ohm. $\mathbf{R_1}$ in the figure is **R(1)**, that is, the first element of the vector R. In general, $\mathbf{R_N}$ is **R(N)**. The **output** of the m-file is a **three-element column vector** with the voltage levels at junctions A, B and C, respectively.

To compute the voltage levels, we can use Kirchhoff's first law that states that the sum of current flowing in and out of a junction must be zero. So, for example, here is the equation for junction A:

$$\frac{V-A}{R_1}-\frac{A-B}{R_7}-\frac{A}{R_2}=0$$

The current across a resistor is the voltage difference divided by the resistance, i.e,

$$i_N=\frac{V_{in}-V_{out}}{R_N}$$

You have to be careful that you use the correct sign for inflow and outflow. In the above equation, we assumed that A > B, so the current flows out, hence, the negative sign. But if the assumption was wrong, that will still work since A - B will then be negative, so overall, it will turn into a positive inflow value.

You need to write the remaining two equations for junctions B and C and rearrange the equations to get the canonical form so that we can use MATLAB's support for solving linear equations.

Good values to check your function with:

- $R_1 = 0$ means that A must be at V level. Same for R_3 and R_5 for B and C, respectively.
- $R_2 = 0$ makes A = 0. Same for R_4 and R_6 for B and C, respectively.
- If $\frac{R_1}{R_2}=\frac{R_3}{R_4}=\frac{R_5}{R_6}$ then A, B and C will be at the same level independent of R_7 and R_8.

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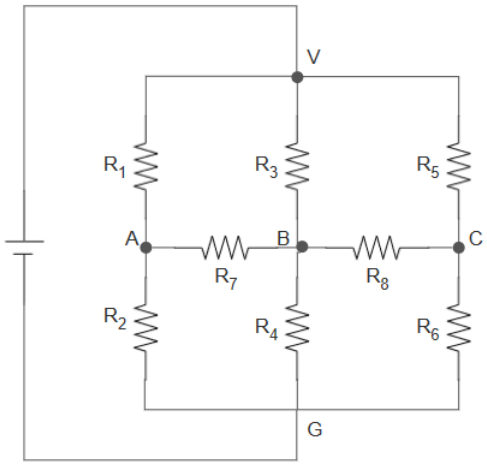
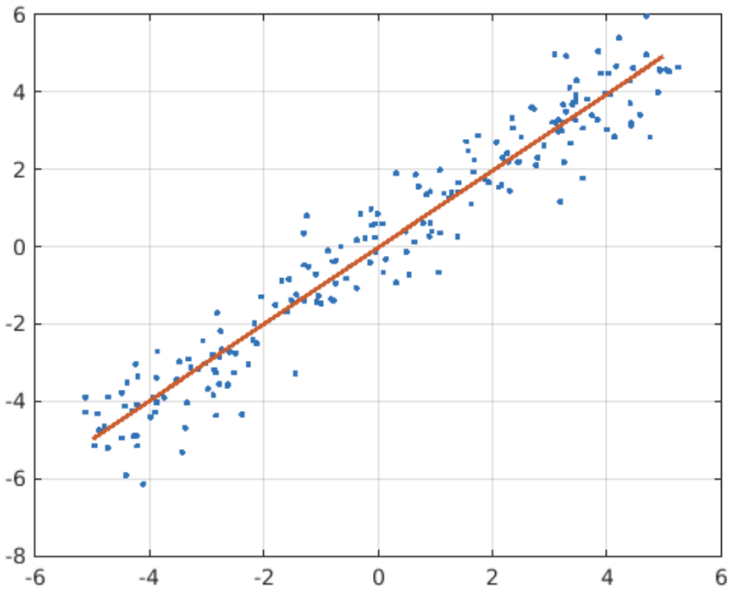


2. Given a set of approximate x and y coordinates of points in a plane, determine the best fitting line in the least square sense. Using the standard formula of a line: ax + b = y, compute a and b. That is, write a m-file called **linear_regression** that reads the two row vectors of the same length called x and y from the "x_y_coordinates.mat" file (containing x and y coordinates of points) and calculates two scalars, **a** and **b** specifying the line, as m-file outputs. **You should plot the original x and y coordinates, and also the fitted line in the same Figure**. **You should also calculate the least square error which defines the sum of differences between the original y coordinate values and y coordinates obtained from the fitted line**.

Here is what you should see when you run the "**linear_regression**" m-file:



Hint: reformulate the problem so that you can use MATLAB's built-in linear equation solving support, i.e., **the \ operator**. Keep in mind that in our case in the line equation ax + b = y, a and b are the unknowns and not x what we usually have in a system of linear equations. **Do not use any built-in function of MATLAB related with line fitting. You should use the the \ operator in order to find a and b values.**