Problem Set for 2/12/2024

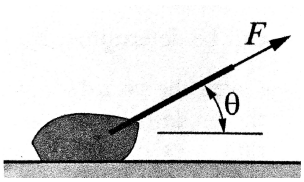
Engineering 104 - Fundamentals of Engineering Computing

Formatting, Organization & Code Comments - Complete the following problems in `Python` and include as part of the submission of the appropriate assignment. Your assignment file should include a proper heading, comments and show clear organizational structure with each problem clearly printed, separated and with each result variable clearly displayed. All problems worked should have a formatted/structured print-out. Print a string denoting each problem, with the solution to the problem clearly printed as a formatted string below the denoted problem. Separate each problem using a blank line in both the code and the printed results. Code comments should be completed throughout the file on every line of code by default. If this assignment requires you to write and submit additional auxiliary script, or any other files in the submission, please append your initials capitalized to the end of the file name.

Python, Lecture #13 Problems - Arrays II (13 Points)

Problem 13.1 (3 Points) - A 70 lb bag of rice is being pulled by a person by applying a force F at an angle θ as shown. The force required to drag the bag is given by:

$$F(\theta) = \frac{70\mu}{\mu sin(\theta) + cos(\theta)} \tag{1}$$



where $\mu = 0.38$ is the friction coefficient

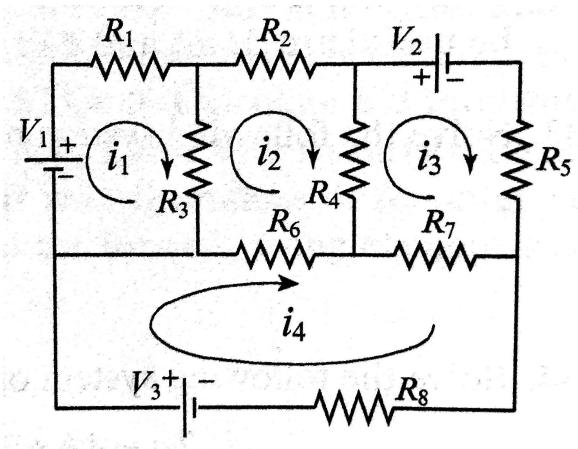
(a) Determine $F(\theta)$ for $\theta = 5°, 10°, 15°, 20°, 25°, 30°, 35°$.

(b) Determine the angle θ where F is minimum. Do it by creating a vector θ with elements ranging from $5°$ to $35°$ and spacing of 0.01. Calculate F for each value of θ and then find the minimum F AND associated θ with built-in function MIN*. Print a statement declaring these two determined values.*

Problem 13.2 (2 Points) - Solve the following system of three linear equations:

$$-2x + 5y + 7z = -17.5 \qquad 3x - 6y + 2z = 40.6 \qquad 9x - 3y + 8z = 56.2$$

Problem 13.3 (4 Points) - The electrical circuit shown consists of resistors and voltage sources. The unknown currents i_1, i_2, i_3 and i_4 can be found by deriving the linear system of equations using the mesh current method based on Kirchhoff's voltage law (see class example problem) and V=iR, given below:



$V_1 = 28$ V, $V_2 = 36$ V, $V_3 = 42$ V
$R_1 = 16\,\Omega$, $R_2 = 10\,\Omega$, $R_3 = 6\,\Omega$
$R_4 = 12\,\Omega$, $R_5 = 8\,\Omega$, $R_6 = 14\,\Omega$
$R_7 = 4\,\Omega$, $R_8 = 5\,\Omega$.

$$(R_1 + R_3)i_1 + (-R_3)i_2 = V_1 \tag{2}$$

$$(-R_3)i_1 + (R_2 + R_3 + R_4 + R_6)i_2 + (-R_4)i_3 + (-R_6)i_4 = 0 \tag{3}$$

$$(-R_4)i_2 + (R_4 + R_5 + R_7)i_3 + (-R_7)i_4 = -V_2 \tag{4}$$

$$(-R_6)i_2 + (-R_7)i_3 + (R_6 + R_7 + R_8)i_4 = V_3 \tag{5}$$

Solve the system of equations keeping the equations in symbolic form by declaring all variables and write the system in terms of the variables.

Problem 13.4 (4 Points) - A football stadium has 100,000 seats. In a game with full capacity people with the following ticket and associated cost attended the game:

	Student	Alumni	Faculty	Public	Veterans	Guests
Cost	$25	$40	$60	$70	$32	$0

Determine the number of people that attended the game in each cost category if the total revenue was $4,897,000, there were 11,000 more alumni than faculty, the number of public plus alumni together was 10 times the number of veterans, the number of faculty plus alumni together was the same as the number of students, and the number of faculty plus students together was four times larger than the number of gusts and veterans together. Use `print` *to share your results in context.*