

## Lab11b - Homework

You are tasked with writing several programs that will solve the following problems. Once you have completed (written and tested) all the problems, submit files separately.

1. Write a function that takes an integer as input and returns a list of prime factors.  
Input: `my_factor(240)` Output: `[2, 2, 2, 2, 3, 5]`
2. Write a python function that will take two parameters as input, the coefficient matrix and the solution vector. The function should return the solution to the unknown variables. Optional: If no solution exists, the function print "No Solution."
3. Using your function from 7, solve the following problems using the console. Call your function from the command line – copy and paste your results into a single pdf for parts a-f.

$$x + y = 4$$

a.  $x - y = 2$

$$3x + 2y = 4$$

b.  $5x - 2y = 12$

$$x - 2y + 3z = 9$$

$$-x + 3y = -4$$

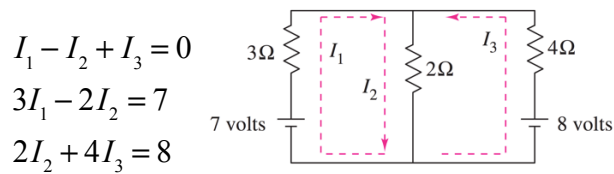
c.  $2x - 5y + 5z = 17$

$$6x - y + z = -1$$

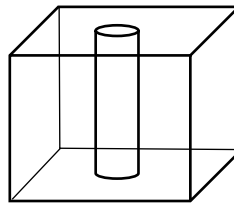
$$4x - 3z = -19$$

d.  $2y + 5z = 25$

- e. A mixture of 12 liters of chemical A, 16 liters of chemical B, and 26 liters of chemical C is required to kill a destructive crop insect. Commercial spray X contains 1, 2, and 2 parts, respectively, of these chemicals. Commercial spray Y contains only chemical C. Commercial spray Z contains only chemicals A and B in equal amounts. How much of each type of commercial spray is needed to get the desired mixture?
- f. Applying Kirchhoff's Laws to the electrical network in the figure, the currents and are the solution of the system



4. A sample of Aluminum powder was irradiated in the NSC Triga reactor. Measurements indicate that there are two isotopes of Aluminum ( $^{28}\text{Al}$  and  $^{29}\text{Al}$ ). Download the dataset `Al_decay.txt` and write a python program to display the data. The plot should utilize a dashed line for  $^{28}\text{Al}$  and a green dash dot line for  $^{29}\text{Al}$ . Be sure to label both axis and include a title and legend. Save the plot as a .png file.
5. Download the dataset `height.out`. Write a python program that will create and display a histogram of the height data. Be sure to label the plot and add a text box to indicate where the most probable data occurs.
6. In all cases, the key idea is to write a single function. However, in all cases, **you should create a program that will essentially “test” the function**. For example, you might include several function calls and the results, or create a program where a user can enter values and see the results. You may feel free to make multiple functions within any one of these programs.
  - a. Imagine that you have a block of material in which a hole has been drilled:



Write a function that will take in the dimensions of the box, length, width, and height, and the radius of the hole, and determine the volume of material remaining. Assume the hole has been drilled along the height direction. Note: first write the function assuming the hole has radius less than  $\min(\text{length}/2, \text{width}/2)$  – you will still receive a majority of credit (more than 70%) for this result. For full credit, you will need to account for larger radii.

- b. Imagine that you have three parallel lists of the same length, one with the names of several production facilities, another with the annual cost to operate each of those facilities, and a third with the value of the products produced at each facility. Return the name and net profitability (profitability is the value of what’s produced minus the cost to operate) of the least profitable facility.
- c. Write a function that takes in two parallel lists: a list of times (in increasing order), and a list of distance traveled by that point in time. The function should return a new list giving the average velocity between consecutive time measurements. The new list should have length one less than the original lists.