

EEE 4416: Simulation Lab
Lab – 08 Assignment

Exercise - 01

Problem statement: Amicable Pair

Amicable numbers are two different numbers related in such a way that the sum of the proper divisors of each is equal to the other number.

For example,

- 220 = 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, and 110
- 284 = 1, 2, 4, 71, and 142

The sum of the proper divisors of 220 is equal to 284.

The sum of the proper divisors of 284 is equal to 220.

Hence, 220 and 284 form an amicable pair.

Write a function named 'amicable_pair' that takes 2 numbers as input and returns a logical true or false based on whether they are amicable pairs or not.

Test Case – 01:

- Input: a=220, b=374
- Output: False

Test Case – 02:

- Input: a= 2620, b=2924
- Output: True

Test Case – 03:

- Input: a= 66928, b=66992
- Output: True

Exercise – 02

Problem statement: Goldbach's marginal Conjecture

Goldbach's conjecture states that every even integer greater than 2 can be expressed as the sum of two primes.

Goldbach's other conjecture states that -

“Every integer greater than 5 can be expressed as the sum of three primes.”

For example,

- $7 = 3+2+2$
- $19 = 11+5+3$

Write a function named 'goldbach_marginal' that takes an integer as input and provides any of the perfect solutions.

Test Case – 01:

- Input: $n = 5$
- Output: “Numbers below 5 don't satisfy the conjecture.”

Test Case – 02:

- Input: $n = 15$
- Output: $[5,5,5]$ or $[3,5,7]$ or $[2,2,11]$

Test Case – 03:

- Input: $n = 18$
- Output: $[2,5,11]$ or $[2,3,13]$

Exercise – 03*

Problem statement: Lunar Addition/Multiplication

Write a function named 'lunar_add' that takes two integers as input and performs lunar addition (default behavior). The function can also take a 3rd argument that specifies 'Addition' or 'Multiplication'.

You can check the following link to understand what lunar arithmetic is: <https://oeis.org/A087061>

There are no carries in lunar arithmetic. For each pair of lunar digits, to add, take the larger, but to multiply, take the smaller. For example:

$$\begin{array}{r} 169 \\ + 248 \\ \hline 269 \end{array}$$

$$\begin{array}{r} 169 \\ \times 248 \\ \hline 168 \\ 144 \\ 122 \\ \hline 12468 \end{array}$$

Test Case – 01:

- Input: 5, 9
- Output: 9

Test Case – 02:

- Input: 482, 24314
- Output: 24484

Test Case – 03:

- Input: 482, 24314, 'Multiplication'
- Output: 2443310

Test Case – 04:

- Input: 169, 248, 'Multiplication'
- Output: 12468

Test Case – 05:

- Input: 169, 248, 'Addition'
- Output: 269

Exercise – 04

Problem statement: Creating Tables

You've already seen the following dataset. In the previous lectures, we only used the numerical portion since a matrix cannot handle heterogeneous data types.

- Now, create a table named 'University_BD' containing the following information.

	BUET	RUET	KUET	CUET	IUT
CSE	120	120	100	80	40
EEE	180	120	150	80	80
ME	150	80	150	80	55
CIVIL	195	80	150	80	45
CE	40	nan	30	80	nan
Architecture	100	50	80	80	nan
Management	50	50	nan	80	30

After you have created the table, perform the following tasks by accessing the table -

- Find out the total number of students in CUET.
- Create a new column named 'DU' and add arbitrary values.
- Delete the management department from the table.
- Delete CUET University from the table.
- Replace the name of KUET with 'MIST' (values remain unchanged).
- Convert the department names to a categorical type.
- Summarize the table.
- Create an appropriate plot that represents the number of students in the EEE and Architecture departments of different universities. (Add proper labels, title, etc.)

Exercise - 05

Problem Statement: [Handling datasets](#)

Import the file named 'worldcities.csv' into your MATLAB and generate a live script. Perform the following tasks.

- I. How many unique country names are there? Are there any duplicates?
- II. How many cities have a population greater than 10 million?
- III. Extract the information of all cities with a population greater than 5 million.
- IV. Extract the information of all cities that are the primary capital.
- V. Create a geoscatter plot of those cities in question - IV.
- VI. Extract the information of all cities with the country names Bangladesh and the United States.
- VII. Place all the cities and their population from question 05 in a separate table. The table should have two columns: 'city' and 'population'. Use country names as rownames.

Exercise - 06

Problem Statement:

Import the file named 'BigML_Dataset.csv' into your MATLAB. Perform the following tasks.

- i. How many missing entries are there in the dataset?
- ii. Create a pie plot of the columns 'international plan' and 'churn'.
- iii. Create a histogram plot of the 'State' column.
- iv. Which state had the highest group count (i.e., number of users)?
- v. Which state had the highest number of churn users (i.e., churn = true)?
- vi. Find out how many users made more than 1 customer service call.
- vii. Add a new column 'total charge' that sums up 4 other columns – total day charge, total night charge, total evening charge, and total int charge.
- viii. Find out the average charge (make use of vii) by each state.
- ix. Check the 'phone number' column. Match it with the original CSV file. You will see it is not properly imported (the entire telephone number is not imported). This is because the data type of that column was set to number while importing, but the value includes a hyphen, which cannot be imported as a number. Import the data again with the 'phone number' column set as text data type. It will be imported as a string.
- x. Now, remove the hyphen from that column. (Hint: you can use regular expression. No need to use a for loop. You can apply the function directly to the entire column.