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Exercise - 01:

Problem statement: Write a function named 'draw_Z' that takes an integer n as the input and draws the following matrix of size n with 0 and 1.

For example, for n=5

Output: [1 1 1 1 1;

0 0 0 1 0;

0 0 1 0 0;

0 1 0 0 0;

1 1 1 1 1]

- Your program should work for any values of n.

Part-02:

- Draw a z-shape matrix of size 100.
- Interchange the positions of 0 and 1. [remember the tilde (~) operator!!!]
- Display the binary image.

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Exercise - 02:

Problem statement: Multiplication Table

Given a list of numbers(n), create a multiplication table up to x.

Name the function as 'multi_table'. Take n and x as input parameters.

Test Case – 01:

- Input: n = 1:12 , x=15
- Output:

```
[1   2   3   4   5   6   7   8   9  10  11  12  13  14  15
 2   4   6   8  10  12  14  16  18  20  22  24  26  28  30
 3   6   9  12  15  18  21  24  27  30  33  36  39  42  45
 4   8  12  16  20  24  28  32  36  40  44  48  52  56  60
 5  10  15  20  25  30  35  40  45  50  55  60  65  70  75
 6  12  18  24  30  36  42  48  54  60  66  72  78  84  90
 7  14  21  28  35  42  49  56  63  70  77  84  91  98 105
 8  16  24  32  40  48  56  64  72  80  88  96 104 112 120
 9  18  27  36  45  54  63  72  81  90  99 108 117 126 135
10  20  30  40  50  60  70  80  90 100 110 120 130 140 150
11  22  33  44  55  66  77  88  99 110 121 132 143 154 165
12  24  36  48  60  72  84  96 108 120 132 144 156 168 180]
```

- You can use a for loop for this. But try using 'broadcasting' concept that I taught in the lectures. That will simplify this problem into a one line of code.

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Exercise - 03:

Problem statement: Write a script that takes an array or a matrix as the input and provides the following –

I. Count the no. of negative numbers.
II. Find the indices of 0 (linear and subscripts both).
III. Extract the positive numbers [sequence should be maintained]
IV. Find the mean and standard deviation of the numbers.
V. Extract the square numbers from the list.
VI. Rearrange the array placing the even elements first then 0 (if present) then odd elements.

*solve this question using vectorization approach.

*for a matrix, sequence means linear index sequence.

* square numbers are 1,4,9,16, … …

Test Case – 01:

- Input: a= [4,-3,21,23,-5,6,0,-8,6,4,-2,4,5,5,11,3,6,-5,6,0,-77,-6,-90,-6,0,9,8]

Test Case – 02:

- Input: a= randi([-123,440],6,9)

- Standard deviation can be found using – std( ) function

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Exercise - 04:

Problem statement: Self-dividing Numbers

A self-dividing number is a number that is divisible by its own digits. For example, 24 is divisible by 2 and 4.

Write a function 'self_div' that takes a list of numbers and returns a logical array representing whether each of the individual numbers is a self-dividing number or not.

Test Case – 01:

- Input: a= [2,12,20,25,33,36,42,49]
- Output: [1,1,1,0,1,1,0,0]

Test Case – 02:

- Input: a=randi(5000,1,60)

Hint:

You many try using the following functions

- num2str
- str2num, str2double

- Try --- num2str(34) - '0'
  See what it does.

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Exercise - 05:

Problem statement: Refer back to exercise-07 of solved problems. There we created a checkerboard matrix (n=8).

Now do the same but each block of 0 or 1 should now be a 15-by-15 block of 0 or 1 i.e. each value of 0 should be replaced with a 15-by-15 zero matrix and each value of 1 should be replaced with a 15-by-15 ones matrix.

Display the image.

You'll be able to get a very fine picture of a chessboard for this matrix.

Say, for example, if you've a= [0, 1;

1, 0]

For 2-by-2 block, it should be like [0, 0, 1, 1;

0, 0, 1, 1;

1, 1, 0 ,0;

1, 1, 0 ,0]

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Exercise – 06:

Problem statement: While writing a doc file, you may have noticed that if you provide a space before comma, it'll issue a warning. Again, if you don't provide a space after comma, it'll issue a warning.

For example -- "Logan , you still have time."

Here, we placed a space before comma. So, Microsoft word is showing a warning. (Try see it in your own word file).

The proper way of writing would be -- "Logan, you still have time."

Now, say you want to write a program that will automatically solve this problem i.e. it'll remove the space before comma if user by mistakenly places any. That way, you wont have to worry about that anymore while writing a doc.

Write a function named 'comma_check' that will take a sentence as input and will provide the corrected sentence as output.

Test Case – 01:

- Input: "Logan , you still have time."
- Output: "Logan, you still have time."

Test Case – 02:

- Input: "Brothers, oh brothers , my days here are done; the dornishmans taken my life , but what does it matter , for all men must die."
- Output: "Brothers, oh brothers, my days here are done; the dornishmans taken my life, but what does it matter, for all men must die."

Test Case – 03:

- Input: "He is the white wolf, the king in the North."
- Output: "He is the white wolf, the king in the North."

*****in this case, the input string doesn't have any issue. It's been written properly. So, no change.

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Exercise - 07:

Problem statement: Capitalize the 1st letter of each of the string. Other letters should be made lowercase.

Look at the test cases carefully.

Test Case – 01:

- Input: a= ”pandas”
- Output: “Pandas”

Test Case – 02:

- Input: a= ”Cats and Dogs”
- Output: “Cats and dogs”

Test Case – 03:

- Input: a= ”763potus”
- Output: “763Potus”

***Test Case – 04:**

- Input: a= {'**GldosgGf','asbd','$$$123','ASDR'}
- Output: {'**Gldosggf','Asbd','$$$123','Asdr'}

Hint:

- Similar to ‘regexprep’, there is ‘regexp’ function. It returns the index(position) of your desired match.

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Exercise - 08:

Problem statement: Perfect Number

A number is said to be a perfect number if the number itself is equal to the summation of its divisors.

Write a function named 'perfect_num' that returns True/False depending on the input is a perfect number or not.

For example,

6 is a perfect number because its divisors are 1,2 and 3 where 1+2+3=6.

Test Case – 01:

- Input: 28
- Output: True

Test Case – 02:

- Input: 128
- Output: False

- In our discussion, we'd already created our own function for figuring out the proper divisors of a number. You can just simply use it here same like a built-in function. This way, your created functions will come very much handy while solving many different problems.
- Make sure your user-defined function for proper divisors is in the same directory.

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Exercise – 09:

Problem statement: Say I want to perform different mathematical operations between two inputs a,b. The operations are given as the 3rd parameter to your function. But sometimes 3rd parameter may not be given.

Operations –

i. "add" -- stands for addition (a+b)
ii. "sub" -- stands for subtraction (a-b)
iii. "mul" -- stands for multiplication (a*b)
iv. "div" -- stands for division (a/b)
v. If not given, then perform modulo operation (mod(a,b))

Write a function named 'arith_op' that takes two or three arguments as the input and performs the aforementioned tasks.

Test Case – 01:

- Input: a=20, b=10, 'sub'
- Output: ans = 10

Test Case – 02:

- Input: a=5, b=10, ''div"
- Output: ans = 0.5

Test Case – 03:

- Input: a=22, b=10
- Output: ans = 2

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Exercise – 10:

Problem statement: Goldbach Conjecture

The Goldbach conjecture states that every even integer greater than 2 is the sum of two primes.

For example, 8 = 5 + 3

20= 17 + 3 = 13 + 7

As you can see, there can be multiple ways an even integer satisfies the Goldbach conjecture.

Write a function named 'goldbach' that takes an integer(even or odd) as in input and provides any of the perfect solutions.

Test Case – 01:

- Input: n = 10
- Output: [3,7] or [5,5]

Test Case – 02:

- Input: n = 101
- Output: "Odd numbers don't satisfy the necessary criteria"

Key Takeaway:

- An important part of writing a program is that it should satisfy all possible scenario, not just the ones that are shown in test cases. If you look at the problem above, there is an important corner case – n=2. Although I didn't write a test case for that, you should make sure that your program handles that case as well.
- Generating test cases by yourself is another important part of writing a code.

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Exercise – 11:

Problem statement:

Write a function named ‘repeat_elem’ that takes an integer n as input provides the following output-

Test Case – 01:

- Input: n = 3
- Output: [1,2,2,3,3,3]

Test Case – 02:

- Input: n = 5
- Output: [1,2,2,3,3,3,4,4,4,4,5,5,5,5,5]

Each element is repeated by its number of times. E.g. 4 is repeated 4 times.

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