Machine Learning  
Assignment – 1

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Kavya Sree Kammari (Odd Set)

Overall, I’ve divided the Questions into multiple functions and taken inputs in the main function. Each code explains about the efficient method involved and time complexities.

**Question 1:**

Question 1 aims to find the number of pairs in each list that sums up to a target value. The function utilizes a hash map to efficiently track visited numbers while iterating through the list giving a big o notation O(n).

Pseudocode:

*Function count\_Pairs\_With\_Sum(list, target\_sum):*

*Initialize no\_of\_pairs to 0*

*Initialize list\_for\_visiting as an empty list*

*For each number in list:*

*potential\_pair = target\_sum - number*

*If potential\_pair is in list\_for\_visiting:*

*Increment no\_of\_pairs*

*Add number to list\_for\_visiting*

*Return no\_of\_pairs*

**Question 2:**

Function Question\_2 calculates the range of a given list, which is the difference between its maximum and minimum values. The code efficiently determines the range of the list by iterating through its elements and keeping track of minimum and maximum values with the big O notation of O(n).

Pseudocode:

*Function calculateRange(list):*

*minimum\_number = positive infinity*

*maximum\_number = negative infinity*

*For each element in the list:*

*If element < minimum\_number:*

*Update minimum\_number with the element*

*If element > maximum\_number:*

*Update maximum\_number with the element*

*range = maximum\_number - minimum\_number*

*Return range*

**Question 3:**

Question 3 function raises a square matrix to a given exponent using matrix multiplication function defined in it. The function checks if the matrix is square, initializing with an identity matrix, and iteratively multiplies the matrix by itself for m times (exponents).

Pseudocode:

*Function matrix\_exponentiation(matrix, exponent):*

*size = size of the matrix*

*If matrix is not square:*

*Return "Non - square matrix"*

*Define matrix\_multiply(a, b) function:*

*Return a matrix resulting from element-wise multiplication of*  *matrices a and b*

*Result\_matrix = identity matrix*

*Repeat exponent times:*

*Update result matrix by multiplying it with the original matrix*  *using matrix\_multiply function*   
*return the final result\_matrix*

**Question 4:**

Question 4 function is used to find the alphabet with the highest frequency in each string. It uses a default dict to store the frequency of each alphabet, filters out non – alphabetic character, and then determines the alphabet with the maximum occurence.

Pseudocode:

Function find\_Max\_Frequency\_Alphabet(input\_string):

empty dictionary count\_dict = defaultdict(int)

For each character in the input\_string:

If the character is an alphabet:

Increment the value of the corresponding key in count\_dict

max\_char = max(count\_dict, key = count\_dict.get)

Extract the maximum frequency value from count\_dict

return max\_char, max\_count

Ishvarya G (Even Set)

In this program, I have made the code modularized specific to each question’s functionality. The main function provides the functionality of a menu-driven system where the user is given a choice to select which functionality is required and based on that the corresponding input values are taken and a call is made to the respective function, this continues until the user enters “stop” to exit the program.

**Question 1:**

*To find the number of Vowels and consonants given an input string:*

***Explanation:***

The code uses for loop to loop through each character in the string ‘s’ and increments the count variables for keeping count of vowels and consonants accordingly.

***Pseudocode:***

Initialise 2 lists ‘vowels’ and ‘consonants’

Function VowConsCount( INPUT s):  
 SET count\_vowels=0

SET count\_consonants=0

FOR any character in s:

Check if the character is in consonants:

If so increment count\_consonants by 1

Check if the character is in vowels:

If so increment count\_vowels by 1

REPEAT until end of s

RETURN count\_vowels and count\_consonants

**Question 2:**

*To find the product of 2 matrices and return an error if not multiplicable:*

***Explanation:***

The code defines a function that uses 3 for loops that loops through the range of rows of matrix 1 and columns of matrix 2 (size of product matrix) and finally through the range of rows of matrix 2 to find each element of the product matrix by taking the sum of the product of the elements in row 1 of matrix 1 and column 1 of matrix 2 and returns it. If in case the column of matrix 1 does not match the rows of matrix 2, it returns an error.

***Pseudocode :***

Function matrixMult( INPUT mat1, INPUT mat2):

rows\_mat1,cols\_mat1 = length of mat1, length of mat1[0]

rows\_mat2,cols\_mat2 = length of mat2, length of mat2[0]

IF cols\_mat1 does not equal rows\_mat2:

RETURN “Error : Matrices A and B are not multiplicable”

SET the result\_matrix rows equal to mat1 and columns equal to mat2

FOR i in range of length of rows\_mat1:

FOR j in range of length of cols\_mat2:

FOR k in range of length of rows\_mat2:

SET result\_matrix[i][j] += mat1[i][k] \* mat2[k][j]

RETURN result\_matrix

**Question 3:**

*To find common elements in 2 lists of integers:*

***Explanation:***

The code uses list comprehension to store only numbers that are present in both the input lists into the new list that stores the common elements and returns it.

***Pseudocode :***

Function commonElem ( Input list1, Input list2):

SET common\_elements to [number present in list1 only if the same number is present in list2]

RETURN common\_elements

**Question 4:**

*To find the transpose of a matrix:*

***Explanation:***

The code defines a function transpose that takes in an input matrix, ‘mat’. We define a new matrix ‘transposed’ and using 2 for loops we assign the elements along the rows of ‘mat’ to the columns of ‘transposed’.

***Pseudocode:***

Function transpose(INPUT mat):

SET transposed to 0s with number of rows equal to rows of mat and number of columns equal to columns of mat

FOR I in range of length of mat:

FOR j in range of length of mat[0]:

SET transposed[j][i] = mat[i][j]

RETURN transposed

Sharanya Vanraj Thambi (Odd Set)

The program is created by having separate functions for each question and the main method allows the user to choose which question they desire to choose. This is done using a switch case built by if else conditions. Each program is done with the approach of iterating through the necessary elements of the list. The usage of extra variables has been minimised to save memory and all inputs are taken dynamically by the user.

**Question 1:**

Consider the given list as [2, 7, 4, 1, 3, 6]. Write a program to count pairs of elements with sum equal to 10.

**Explanation:**

The program iterates through each element and compares each by further looping through all the elements, matching the selected number with each in the list, when the selected number and another number from the list adds up to 10 count is incremented by 1, count is then returned.

**Pseudo code:**

*Function PairOfElements(list):*

*Initialise sum to 0*

*Initialse count to 0*

*Loop i from 0 to 6:*

*Loop j from i to 6:*

*If((list1[i]+list1[j]) is equal to 10:*

*Increment count by 1*

*return count*

**Question 2:**

Write a program that takes a list of real numbers as input and returns the range (difference between minimum and maximum) of the list. Check for list being less than 3 elements in which case return an error message (Ex: “Range determination not possible”). Given a list [5,3,8,1,0,4], the range is 8 (8-0).

**Explanation:**

The program initialises max to zero because it is the least possible value above which anything is greater is not possible and initialises min to highest value possible so that all numbers are lesser than it, now all the numbers in the list are traversed through and if the numbers are lesser than min variable value then min is updated to that number. If the number is greater than that in max then the max variable is updated to that number. Then the range subtracting max and min is returned.

**Pseudo code:**

*Function rangeFind(list2):*

*Initialise max to -sys.maxsize*

*Initialise min to sys.maxsize*

*Loop I from 0 to length of list2*

*if list2[i] is greater than equal to max:*

*max=list2[i]*

*if list2[i] is lesser than equal to max:*

*min=list2[i]*

*return (max-min)*

**Question 3:**

Write a program that accepts a square matrix A and a positive integer m as arguments and returns Am.

**Explanation:**

The matrix is input in the main method after which it is passed to the function. Then by iterating through appropriate elements the computed elements of the multiplied matrix are appended to the new matrix this matrix is the passed through the function again in a loop iterating till m-1 present in the main section, where m is the power value input from user.

**Pseudo code:**

*Function matrixmulti(matrix,n):*

*Initialise a list multi to empty*

*Initialise x to 0*

*Loop interating i from 0 to length*

*Initialse list row to empty*

*Loop interating j from 0 to length*

*Initialise x to 0*

*Loop interating k from 0 to length*

*Assign x to x+matrix[i][j]\*matrix[k][j]*

*Append x to row*

*Append row to multi*

*return multi*

*In #main*  
*Input the power to raise matrix to as m*

*Iterate i till m-1:*

*Assign matrix\_input to matrixmulti(matrix\_input, n)*

**Question 4:**

Write a program to count the highest occurring character & its occurrence count in an input string. Consider only alphabets. Ex: for “hippopotamus” as input string, the maximally occurring character is ‘p’ & occurrence count is 3.

**Explanation:**

The program loops through each letter of the word and then compares each letter by further looping through each letter and comparing the selected letter with all other letters and if a match is found it increments count by 1, if this count is greater than max\_count which is initialised as zero in the beginning it is updated. This way the maximum count will be stored in max\_count along with the corresponding stored in maxletter.

**Pseudo code:**

*Function word\_count(word):*

*Declare list3 and initialise it to empty*

*max\_count to 0*

*Loop through each character i in the word:*

*Initialise count to 0*

*Loop through each character j in word:*

*if i= = j :*

*Increment count by 1*

*if count >= max\_count*

*Assign count to max\_count*

*Initialise maxletter to i*

*Return max\_count and maxletter*