Islamic University of Technology (IUT)

Organization of Islamic Cooperation (OIC)
Department of Electrical and Electronic Engineering (EEE)

Exercise - 01:

Problem statement: An array is given that contains the marks received by a group of students in their class test. Find out –

I.   What is the highest mark received by the group of students?
II.   What is the average mark received by the students?
III. How many students received the highest mark?
IV.   Find the index of the students who received the highest mark.
V.   What are the highest 3 marks received by the students?

Test case - 01:

➢ Input: Marks = [9, 6, 7, 6.5, 8, 9.5, 8, 9.5, 8, 8.5, 6, 7, 9]
➢ Output -
   I.   9.5
   II.   7.85
   III. 2
   IV.   [6,8]
   V.   [9.5, 9, 8.5]

Test case - 02:

➢ Input: Marks = [93, 97, 67,84,91,81,56,67,55,67,45,98,56,55,44,44,44,91,78]
➢ Output –
   I.   98
   II.   69.1
   III. 1
   IV.   12
   V.   [98,97,93]

Additional questions (HW):

Solve the 1st 4 questions above for 'lowest mark'.

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Exercise - 02:

Problem statement: An array is given that contains the number of students in different departments in IUT.

Suppose, the associated department for each index of IUT is -- {'CSE','EEE','ME','CE','BTM'} or ["CSE", "EEE'', ''ME'', ''CE'', ''BTM'']

Find out –

I. Which department(index) has the highest #students?
II. What is the total no of students in IUT?
III. What is the total no. of department in IUT?
IV. Create a 'bar plot' of the input data.
V. How many students are there in 'ME' department?
VI. Which department has 55 students?

*u cannot use hard-coding for any problem. I've kept the dataset size for better understanding but in real life, dataset can contain more than a million elements.

Test Case - 01:

➢ Input: IUT = [45,90,85,55,30]
➢ Output:
    I. 2
    II. 305
    III. 5

Test Case - 02:

➢ Input: BUET = [120,180,150,180,40,55,210,40,30,30]
➢ Output:
    I. 7
    II. 1035
    III. 10

Additional Exercise:

➢ Find how many students are in the EEE department of IUT?
➢ Find which department/departments of BUET has 40 students.

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Problem statement: A matrix is provided.

1st column of the matrix contains the student ID and

2nd column of the matrix contains the marks received by those students.

For example, a = [101, 9;

103, 6;

105, 7;

109, 8;

111, 6.5;

113, 9;

117, 9;

119, 6]

So, ID 101 received 9 marks.

Find out –

    I.   What is the highest mark received by the group of students?
    II.   Find the IDs of the students who received the highest mark.
    III.   What are the highest 3 marks received by the students?
    IV.   What is the average mark received by the students?

Output:

    I.   9
    II.   [101,113,117]
    III.   [9,8,7]
    IV.   7.5625

Additional questions (HW):

Solve the 1st 3 questions above for 'lowest mark'.

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Problem statement: The following table contains the no. of students in different departments in different universities in Bangladesh.

	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

*nan means 'not a number' [that department is not there].

A matrix is provided as the input. It contains numeric values (the colored portion). So, the size of the matrix is (7,5) i.e. 7 rows and 5 columns.

Find out –

I.   What is the total no. of students in each university?
II.   What is the total no. of students in all the 5 universities combined?
III.   What is the total no. of CSE students in all 5 universities?
IV.   How many students are there in the civil department of KUET?
V.   Which department/departments of each universities has the highest no. of students? [mark them by index for now i.e. index – (3,2) represents (ME, RUET)]
VI.   Which department of which university has the highest #students?
VII.   Try to visualize the data.

*try out different things with the matrix by yourself.

Key Takeaway:

➕ Applying vectorization technique for matrix

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Problem statement: In continuation to the previous exercise solve the following problems –

Add a new varsity to the list.

SUST = [40,60,30,100,20,30,20]

- ↓ Here the given array is a row vector of size (7,1). To add it our original matrix, we need to convert it to a column vector [size = (1,7)].
- ↓ To add something to an array or matrix, you can use –
  - ▪ a= [a , SUST]

Now answer the following (HW) –

I.   Which department of which university has the minimum #students?
II.   How many departments are there in IUT?
III.   What are the indices that contains 120 students?
IV.   Which varsity has the lowest #students.
V.   What is the average no of students in universities in Bangladesh?
VI.   Try to visualize your data and compare with your previous problem.

**so far, I've used 'numeric data type' or you can simply call them matrix. A matrix can only contain numeric values. It is called 'homogeneous data type'.

**later I'll introduce you to 'table data type'. They can contain heterogeneous data i.e. numeric data as well as string data.

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Problem statement: Take an integer 'n' as the input. Return a matrix of size –

    I.   (n,n) i.e. n-by-n , where all the elements are 0.

    II.   (n+1, n+1), where all the elements are 5.

    III.   (1, n), where all the elements are -8.

    IV.   (n, 1), where all the elements are 25.

    V.   (n, n+4), where all the elements are 5.

Test Case:

- Input: n=3
- Output:

    I.   [0,0,0;
           0,0,0;
           0,0,0]

    II.   [5,5,5,5;
           5,5,5,5;
           5,5,5,5;
           5,5,5,5]

    III.   [-8, -8, -8]

    IV.   [25;
           25;
           25]

    V.   [5,5,5,5,5,5,5;
           5,5,5,5,5,5,5;
           5,5,5,5,5,5,5]

Practice: solve for other values of n (e.g. n=8)

Key takeaway:

- Creating matrix of different sizes.
- Element-wise multiplication.
- Input prompt

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Problem Statement: Let's look back again into our data from exercise – 4.

Data= [120   120   100   80   40

180   120   150   80   80

150   80   150   80   55

195   80   150   80   45

40   NaN   30   80   NaN

100   50   80   80   NaN

50   50   NaN   80   30]

Now we want to modify our original data. Re-create the data for the following cases -

i.   BUET (1st column) wants to add 30 students to each department.
ii.   IUT (5th column) wants to double the no. of students in each department.
iii.   All the universities want to decrease the no. of EEE students by 10.
iv.   All the universities want to remove CE department (remove the row 5).
v.   RUET wants to increase their civil department students by 30.
vi.   KUET wants to increase each departments student by [5,10,5,10,10,5] respectively.
vii.   Extract the data of IUT after modification.

*take a closer look what is happening for the nan cases.

Key Takeaway:

➤ Broadcasting
➤ Matrix manipulation
➤ Deleting rows/columns
➤ Extracting rows/columns

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Exercise – 07:

Problem Statement: A matrix is given. Perform the following operations –

A= [16   2   3   13

    5   11   10   8

    9   7   6   12

    4   14   15   1]

   i.   Create a random matrix of size (4,2). Multiply it with A.
   ii.   Create a random matrix of size (2,2). Multiply it with A. [can u guess what will happen]
   iii.   Multiply the 1st row with [2,4,6,8].
   iv.   Divide the matrix A by 3.
   v.   Add magic matrix of size 6 with A.
   vi.   Subtract identity matrix of size 4 with A.
   vii.   Extract the diagonal elements from A.

Key Takeaway:

   ➢ Matrix multiplication
   ➢ Arithmetic operation on matrix
   ➢ magic(), rand(), eye(), diag(), randi()

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Exercise – 08:

Problem Statement: An array or a matrix is given.

   i.   Create a list of all the even numbers in that matrix.
   ii.   Find the index (linear) of all the even numbers in that matrix.
   iii. Find the subscripts of all the even numbers in that matrix.

Test Case – 01:

➢ input:
    a= [213 209 310   49 251 139 134 230 346   80 269 361   80 120 199
    356 201 111 214 230 166 6 282 203 153]
➢ output: even = [310 134 230 346   80   80 120 356 214 230 166 6 282]
         index= [3   7   8   9   10   13   14   16   19   20   21 22 23]

Test case – 02:

➢ i/p:

   b= [26 158 365   28   57

     144   22 128 381 205

      94 151 132   64 289

      82 310   82 115 372

     326   67 307 275 293]

➢ o/p: even = [26 144   94   82 326 158   22 310 128 132   82 28   64 372]
         index= [1   2   3   4   5   6   7   9   12   13   14 16   18   24]

Additional Ques: instead of solving for even numbers, solve for

   I.   odd numbers.
   II.   Numbers that are divisible by 3 , 11

Key Takeaway:

   ➢ linear index, subscripts, logical indexing
   ➢ find(), ind2sub(), sub2ind(), mod()

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Problem Statement: An array is given. Perform the following tasks:

  i.   sort the array in descending order. [high to low]
  ii.   sort the array in ascending order.
  iii. Find the unique elements of the array.
  iv.   Find the unique elements of the array. [keep the sequence unchanged]

Test Case:

  ➢ Input: a= [2,12,65,4,5,2,2,12,7,4]
  ➢ Output:
      i.   [65,12,12,7,5,4,4,2,2,2]
      ii.   [2,2,2,4,4,5,7,12,12,65]
      iii. [2,4,5,7,12,65]
      iv.   [2,12,65,4,5,7]

Exercise – 10:

Problem Statement: let's work on a string example.

Given a character array, find out –

    I.   how many times 'a' appeared?
    II.   How many characters are there?
    III.   Convert all the characters to lowercase.
    IV.   Bring out the 1st and the last element.
    V.   Change the 2nd element to 'x'.

Test Case – 01:

- Input: x= 'Asif Newaz'
- Output:
  - I.   1
  - II.   10
  - III. 'asif newaz'
  - IV. ['A' , 'z']
  - V.   'Axif Newaz'

Test Case - 02:

- Input: x= 'Can a man still be brave if he is afraid? That is the only time a man can be brave.'
- Output:
  - I.   11
  - II.   83
  - III. 'can a man still be brave if he is afraid? that is the only time a man can be brave.'
  - IV. ['C','e']
  - V.   'Cxn a man still be brave if he is afraid? That is the only time a man can be brave.'

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Problem Statement: A character array is given. Find out its abbreviated form i.e. take the 1st element from each word and compile them together.

Test Case – 01:

➢ Input: x= 'convolutional neural network'
➢ Output: y = 'CNN'

   *The output should be capital letter.

Test Case – 02:

➢ Input: x= 'Long Term Evolution'
➢ Output: y = 'LTE'

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