Lists and Arrays

# Before Class

1. Familiarize yourself with an array data structure. Explain the terms: element and index.
2. 0D 1D 2D scalar vector matrix explanation video/webpage
3. Find out what a list is in python. What is the difference between a list and an array.

<https://www.javatpoint.com/python-array-vs-list>

Note that in subsequent tasks in this topic, a list will be used in place of an array for basic applications.

1. Watch the video on using lists in Python:

<https://youtu.be/ohCDWZgNIU0?feature=shared>

1. Watch the video on using two dimensional lists in Python

<https://youtu.be/z49F119uv6g>

1. Tworzenie tablicy jedno i dwuwymiarowej
   1. Z wartością
   2. Na podstawie listy
   3. Z zerami
   4. Z jedynką
   5. Podać link do manual Numpy
2. Try to create the following arrays. Then display the created array content.
   1. arr1 = [3,7,1,0,4]
   2. arr2 = [[2,3],[7,1],[0,4]]
   3. arr3 = [7 for i in range(5)]
   4. arr4 = [i for i in range(1,10)]
   5. arr5 = [i\*2 for i in range(1,10)]
   6. arr6 = [random.randint(1,20) for i in range(10)]
   7. arr7 = [[] for i in range(5)]
   8. arr8 = [[1 for i in range(2)] for j in range(4)]
   9. arr9 = [[random.randint(1,20) for i in range(3)] for j in range(5)]
   10. an array with values: 4,0,3
   11. 50-element array filled with zeros
   12. an array with integer values in the range of <1,30>
   13. 20-element array filled with 0 or 1 randomly
   14. two dimensional array with five rows and two columns filled with False

# During Class

## One dimensional arrays

1. An array contains values: 2, 3, 7, 5, 4. Create a program that displays:
   1. the array
   2. number of elements
   3. first value
   4. second value
   5. last value
   6. last but one value
   7. sum of the first and last value
   8. middle value
   9. all array values separated by a single space (use a loop statement)
   10. all array values from first to middle separated by a single space (use a loop statement)
2. An array contains values: 1, 2, 3, 4, 5. Create a program that modifies the array values. Display the array after each change.
   1. subtract one from the first element of the array
   2. increase the last array element by 4
   3. multiple the middle array element by 2
   4. adds 3 to each value of the array (use a loop statement)
3. An array contains numbers: -15, 8, -31, 47, -2, 19. Create a program that finds and displays the maximum and minimum number. Do not use available functions.
4. An array contains a list of Polish names: Genowefa, Onufry, Celestyna, Alojzy, Pankracy. Create a program that displays the longest name (consisting of the largest number of characters). Sample result:

Names: Genowefa Onufry Celestyna Alojzy Pankracy  
Longest name: Celestyna

1. An array contains integer numbers. Create a program that calculates and displays the number of even and odd values in the array. Use the “while” loop statement.
2. Create a program that displays the name of month for a given month number (1 to 12). Define a month(n) function that returns the name of month for the number n. Store month names in an array. Using defined function, display month names for the following month numbers: 1, 2, 11, 12.

## Two dimensional arrays

1. An array contains values: [[2,5,4],[9,0,3]]. Create a program that displays:
   1. the array
   2. size of the array (number of rows and columns)
   3. value 5 from the array
   4. value 3 from the array
   5. second row of the array as below:  
      9 0 3
   6. all values from the array as below:  
      2 5 4   
      9 0 3
   7. last column of the array as below:  
      4  
      3
2. An array contains values: [[3,9,2],[2,4,5],[7,1,6],[0,4,8]]. Create a program that calculates the sum of all even numbers.
3. An array contains values: [[True,False],[True,True],[False,False]]. Create a program that changes values of an array to the opposite. Use a loop statement.
4. An array contains values: [[0,0,0],[0,0,0],[0,0,0]]. Create a program that replaces the values of the main diagonal with 1. Use loop statements. Display the modified array as below:  
   1 0 0  
   0 1 0  
   0 0 1

# After Class

1. An array contains natural numbers: 15, 8, 31, 47, 2, 19. Create a program that displays the contents of the array in reverse order. Use any loop statement. Sample result:

existed array: 15 8 31 47 2 19   
reverse array: 19 2 47 31 8 15

1. Create a program that computes the second power of each array element. Sample result:

Array: 8 2 5 1 9  
2nd power: 64 4 25 1 81

1. An array contains values: 15, 8, 31, 47, 2, 19. Create a program that calculates and displays the array and the arithmetic mean of array values. Use the “for” loop statement.
2. An array contains values: 15, 8, 31, 47, 2, 19. Create a program that calculates and displays the array and the arithmetic mean of array values. Use the “while” loop statement.
3. An array contains integer numbers: 12, 6, 4, 9, 10. Create a program that displays the array values graphically as below. Define a function star(n) that returns the given number of asterisks as a string. Use a defined function in the program.

12: \*\*\*\*\*\*\*\*\*\*\*\*  
 6: \*\*\*\*\*\*  
 4: \*\*\*\*  
 9: \*\*\*\*\*\*\*\*\*  
10: \*\*\*\*\*\*\*\*\*\*

1. Define a function compare(array1, array2) that returns True if both arrays are the same. Two arrays are the same if they have the same number of elements and values of elements in cells of arrays with the same index are equal. Then create a program and try to compare the following arrays:
   1. ["water","book","sky"] ["water","book","sky"]
   2. [True,False] [True,False,True]
   3. [5,3,1] [5,3,1]
   4. [3,2,1] [3,2]

Display both arrays and the result of comparison. Sample result:

Array1: water book sky  
Array2: water book sky  
Comparison: arrays are the same

1. Two arrays contain the following integer numbers [4,36,12,28,9,44,5] and [5,1,36]. Create a program that displays the numbers from the first array that do not appear in the second array.
2. Create a program that sorts elements of an array containing integer numbers. Apply the Bubble Sort sorting algorithm. Define a function bubblesort(array) that returns the sorted array. Try to sort and display any three arrays.
3. Create a program that displays all unique elements in an array. Sample result:

Array: 2 3 2 5 8 1 9 8  
Unique elements: 3 5 1 9

1. Define a function occurs(number, array) that returns True if a given number is present in an array. Then create a program that checks whether the number entered from the keyboard is present in the array [15, 38, 7, 23, 14]. Sample result:

Number: 23  
Array: 15 38 7 23 14  
Result: number 23 appears in the array

1. Write a program to find the second largest element in an array. Sample result:

Array: [5,1,9,6,1]  
Result: 6

1. Write a program that displays the difference between the largest and smallest values in an array of integers. Sample result:

Array: [5,1,9,6,1]  
Result: 8

1. Define a median(array) function that returns the median of the given array of numbers. Do not use built-in functions. The median is the middle value in the ordered sequence of numbers (<https://en.wikipedia.org/wiki/Median#/media/File:Finding_the_median.png>). Then, using the defined function, calculate and display the median for the following values:
   1. [1,0,9,4,6]
   2. [6,8,3,1,0,5,7]
2. Write a program that, for the given array of real numbers, displays the number of elements that are greater than the given value entered from the keyboard.
3. Create a function minmax(array) that, for the given array of integers, returns a two-element array containing the smallest and largest values in the given array. Sample result:

Array: [4,2,8,4,7,9,5]  
Result: [2,9]

1. Write a program to separate even and odd numbers of a given array of integers. Put all even numbers first, and then odd numbers.
2. Define a function that returns the elements of the array as a string, separated by commas. Using defined functions, display the contents of any array. Sample result:

Array: [5,4,3,2,6,5]  
String: 5,4,3,2,6,5

1. The array contains integer numbers from 1 to 999. Write a program that displays elements of the array formatted as below.

-----------------------------------------  
| 1| 23| 5| 382| 1| 17| 4| 906|  
-----------------------------------------

1. Write a program that checks whether the first array is a subset of the second one (whether all elements of the first array appear in the second array).
2. Define a function rand\_elem(array) that returns a randomly selected array element. Using the function, display a few randomly selected array elements.
3. A two-dimensional array of size 2 by 4 contains integer numbers. Create a program that displays array values in rows and columns.
4. A two-dimensional array contains the following numbers:

7 3 7 9 0  
2 9 0 1 5  
3 8 6 4 7  
8 7 1 1 5

Create a program that calculates the sum of values in the last column.

1. A function create\_2d\_arr(x,y) creates and returns two dimensional array with values of 0. Create a program and the function. Then create a two-dimensional array with dimensions of 3 by 5. Display the created array.
2. An array contains values: [[0,0,0,0,0],0,0,0,0,0],[0,0,0,0,0],[0,0,0,0,0],[0,0,0,0,0]]. Create a program that modifies the array values to create a multiplication table as below. Use loop statements. Display the array.  
   1 2 3 4 5  
   2 4 6 8 10  
   3 6 9 12 15  
   4 8 12 16 20  
   5 10 15 20 25
3. An array contains integer numbers: [[-38, 19], [5,40],[-7,11],[29,16]]. Create a program that finds the smallest and largest values in the array and in which row and column they are located.
4. A two-dimensional array of the size 3 by 5 contains integer numbers. Create a program that swaps the first and the last row. Display array values in rows and columns before and after changes.
5. A two-dimensional array of the size 3 by 5 contains integer numbers. Create a program that swaps the first and the last column. Display array values in rows and columns before and after changes.
6. Create a function identity\_matrix(n) that returns an identity matrix of size n (https://en.wikipedia.org/wiki/Identity\_matrix). Then create a function that displays a 2D array in rows and columns. Finally, create a program that displays three identity matrices with dimensions of 3, 5 and 8.
7. Create a function transpose\_matrix(m) that returns transposed matrix m. Then create a program that displays transposed matrices, in rows and columns, for the following matrices.
   1. 1 2 3  
      4 5 6  
      7 8 9
   2. 1 2 3 4 5  
      6 7 8 9 0
   3. 5 6 7 8
8. Create a function that convert two-dimensional (2D) array into 1D. Then create a program that displays 1D array for the following 2D arrays.
   1. 2 3  
      1 5
   2. 5 0 3 7 5  
      9 0 9 1 2
   3. 2 1  
      3 5  
      7 4  
      2 6