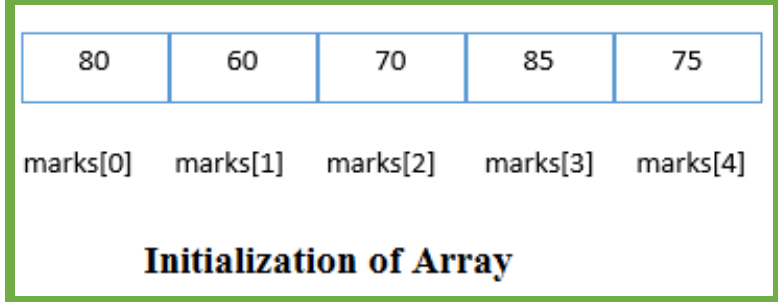
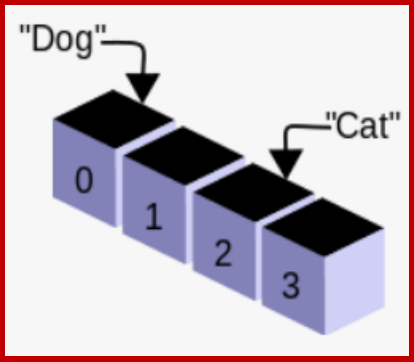
DATA STRUCTURE AND PROGRAMMING

Topic 8- Array

int marks[5];



char animals[4][20];



Outline

- An overview of the lessons

- Introduction
  - Problem when not using array
- Array
  - What is array?
  - How to use array?
  - More on array

Introduction

❑ Problem

- **Problem #1**: Suppose we want to get 100 students' names then display theirs names in a list.

Will you use 100 variables?

```
Var name1, name2, ..., name100 : Sequence of characters
Begin
   read(name1, name2, ..., name100)
End
```

Disadvantages:
Too many creation of variables?
What if we have more than 100 variables?

- **Problem #2**: Suppose we want to get 100 subjects' scores of a students then do summation of those score.

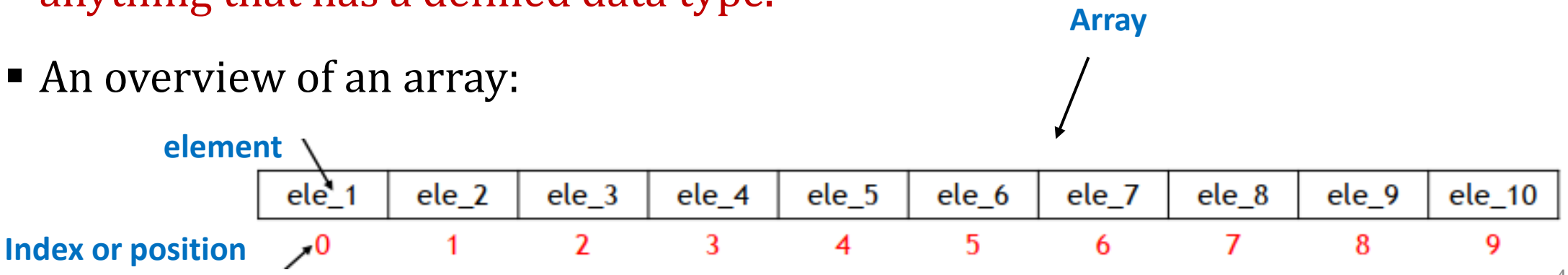
Will we need 100 variables to store those scores?

```
Var score1, score2, …, score100, sum : float
Begin
   read(score1, score2, ..., score100)
   sum ← score 1+ score2 + … + score100
End
```

Array

❑ What is an array?

- Array is a kind of data structure that stores many variables (elements) as a **single special variable.**
- **Each variable** in an array is called an **array element** and they have the **same variable type**
- You could have an **array of integers** or an **array of characters** or an array of anything that has a defined data type.
- An overview of an array:



Array

❑ Declaring (creating) an array

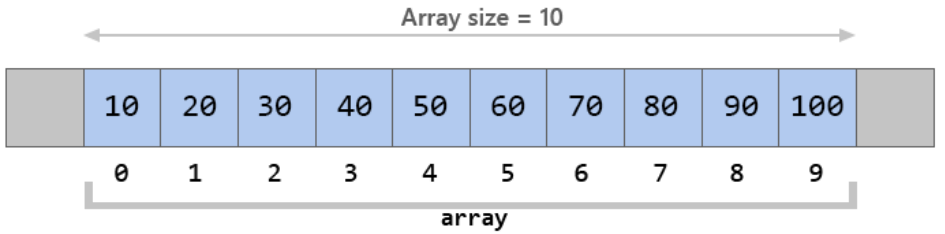
- To declare an array, we have to choose
  - Type of element in the array
  - Number of elements in the array
- Syntax

```
Var identifier[number of elements] : Type of element in array
```

- Examples: Creating array

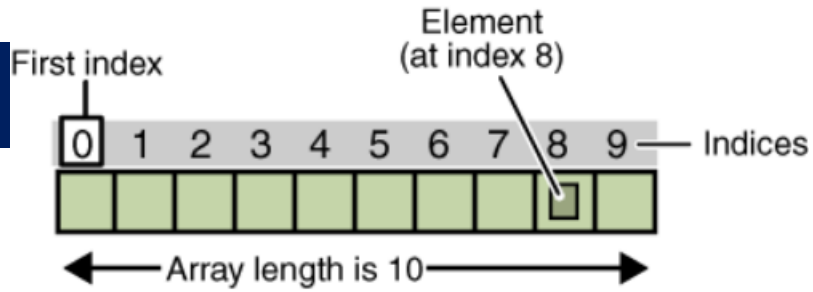
```
Var num[20] : Integer
Var scores[10] : Float
Var name[50] : Array/sequence of characters
Var s[5][100] : Array of string (5 elements)
```

Suppose that we add values (10, 20, .., 100) to the array.
The array now look like this:



Array

❑ Index or position



- In array, the value of index is
  - Start from 0 (some language may start with index 1)
    - **E.g**: In C language, index starts from 0 **but** in Matlab index starts from 1
  - Integer number
  - Last value of index is equal to number of elements in array minus 1

  (when its index starts with 0)
- Index in the bracket can either be a direct integer value or a variable or an expression

```
Var score[10] : Integer
Begin

     score[0] ← 70
     score[1] ← 80
End
```

```
Var n : Integer
Var score[10] : Integer
Begin
     n ← 0
     score[n]   ← 70
     score[n+1] ← 80
End
```

Array

❑ Access/use to an array

- To display array's elements, we need to access to each element
- To access a specific element in an array, use **arrayName[index]**
  - Ex: Suppose the array named **ele**
  - Then to access: **ele**[0], **ele**[1], …., **ele**[9]
- Examples

```
Var scores[10] : Float
Begin
   read(scores[0])
   read(scores[1])
   write("Score student 1: ", scores[0])
   write("Score student 2: ", scores[1])
End
```

```
Var i : Integer
Var num[10] : Integer
Begin
     for (i←0; i<10; i←i+1) do
        read(num[i])
     end for

     for (i←0; i<10; i←i+1) do
        write(num[i])
     end for
End
```

What does this algorithm do?

Array

❑ Access/use to an array

- To access a specific element in an array, use **arrayName[index]**
  - Suppose we have an array named **ele**
  - Usage: **ele**[0], **ele**[1], …., **ele**[9]

What does these algorithms do?

- Get 10 numbers from the user.
- Then sum all those numbers together.
- Finally, display the result.

```
Var i : Integer
Var num[10] : Integer
Var s: Integer
Begin
     for (i←0; i<10; i←i+1) do
        read(num[i])
     end for
     s←0
     for (i←0; i<10; i←i+1) do
         s ← s + num[i]
     end for
     write(s)
End
```

- Get 10 gender from the user.
- Then count all males and females
- Finally, display display #male, #female

```
Var i : Integer
Var gender[10] : Sequence of character
Var m, n: Integer
Begin
     for (i←0; i<10; i←i+1) do
        read(gender[i])
     end for
     m←0
     n←0
     for (i←0; i<10; i←i+1) do
        if (gender[i]=='M') then
             m=m+1
        else if (gender[i]=='F') then
             n=n+1
        end if
     end for
     write(m, n)
End
```

Array

❑ Using array to solve the previous problems?

- **Solution for Problem #1**:
  - *Use an array with the size of 100 and its type is a string (sequence of characters)*

```
Var names[100][20] : Sequence of characters
Begin
   for(i←0; i<=99; i++) do
       read(names[i])
   end for
End
```

- **Solution for Problem #2**:
  - *Use an array with the size of 100 and its type is a float*
  - Combine those variables into one by declaring an array then do loop to find summation.

```
Var scores[100] : float
Var sum : float
Begin
   sum ← 0
   for(i←0; i<=99; i++) do
       read(scores[i])
   end for

   for(i←0; i<=99; i++) do
       sum ← sum + scores[i]
   end for
   write("Total scores: ", sum)
End
```

Example 1

ection B.c | Array.c | Ex5 correction B.c | While loop.c | while loop A.c | Ex5 correction C.c | Number prediction prog

```c
#include<stdio.h>

main(){
    int n[7];

    //Get input numbers and store in array
    for(int k=0; k<=6; k=k+1){
        printf("Enter number #%d: ",k+1);
        scanf("%d", &n[k]);
    }

    //Display data in array
    printf("\n\n");
    for(int p=0; p<=6; p=p+1){
        printf("%d ", n[p]);
    }


}
```

Select C:\!Data\Datastructure\Array.exe

```
Enter number #1: 9
Enter number #2: 2
Enter number #3: 5
Enter number #4: 0
Enter number #5: -12
Enter number #6: 98
Enter number #7: 100


9 2 5 0 -12 98 100
Process returned 0 (0x0)
Press any key to continue.
```

Example 2: Array example with initialization values

```
1
2   #include<stdio.h>
3   main(){
4
5       //int num[10]; //create an array with size 10
6       int num[10] = {9, 10, 3, 6, 12}; //create an array with value initialization
7
8       //printf("Enter 10 numbers separated by space: ");
9       //scanf("%d %d %d %d", &num[0], &num[1])
10
11  //    for(int k=0; k<10; k=k+1){
12  //        printf("Enter number #%d: ", k+1);
13  //        scanf("%d", &num[k]);
14  //    }
15
16      int s=0;
17      for(int p=0; p<10; p=p+1){
18          s = s + num[p];
19      }
20
21      printf("\n\t Total sum = %d", s);
22
```

Assignment

Deadline: **1 week**

❑ Practice exercises

1- Write C programs for the problems below:

a. Declare and store an array with 5 English’s vowels

b. Declare and store an array with English’s alphabet A-Z

c. Declare and store an array with even integer numbers 2, 4, … 100

d. Declare and store an array of 10 user names. Ask the user to input all those 10 names. Then display their names on the screen

Assignment

Deadline: **1 week**

2- Write a C program to ask a user for 20 scores then

- Find the **average** of those scores
- Show the scores that are greater than the average
- Count number of students who got score more than average

```
Input number #1: 10
Input number #2: 20
.....
Input number #20: 200

=>OUTPUT: Average is: 105. Scores that are more than average are: 110, 120,
130,140,150,160,170,180,190,200
```

Coding hour

Assignment

Deadline: **1 week**

3-Write a program in C get 10 numbers input by a user and store in an array.

Then find the sum all elements in the array. Display the result.

4-The same to exercise #1. We also would like to count a total number of duplicate elements and non-duplicate elements in the array.

5-The same to exercise #1. In addition, we also want to print all unique elements in an array