Computer Programming

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Session: Need for Arrays

Quick Recap of Relevant Topics

- Variables to store data values
- Input, output, and assignment statements
  - C++ rules for evaluating expressions
- Sequential and conditional execution of statements
- Iteration idioms in programming
  - “for” statement in C++

Overview of This Lecture

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- Need for representing a set of values, such that
  - The entire set has a single name
  - Individual elements of the set can be used in computations
- An array structure, as known in mathematics
- Accessing elements of an array
  - Index expressions

Finding sum of given values - A look-back


```
int main(){
   // program to find the sum of 4 numbers
   int v1, v2, v3, v4, sum;
   cin >> v1 >> v2 >> v3 >> v4;
   sum = v1 + v2 + v3 + v4;
   cout << sum;
return 0;
}
```

Need for handling multiple values

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- What do we do when we have a large number of values?
- If we only need to find their sum, we can use only one location to input a new value, and iteratively add it to a running sum

A program to find sum of marks of N students


```
int main(){
  // program to find the sum of N marks
  int marks , sum = 0, count, N;
  cin >> N;
  for (count =1; count <= N; count = count +1){
      cin >> marks; sum = sum + marks;
  }
  cout << sum;
return 0;
}
```

A program to find sum of marks of N students


```
int main(){
  // program to find the sum of N marks
  int marks , sum = 0, count, N;
  cin >> N;
  for (count =1; count <= N; count = count +1){
      cin >> marks; sum = sum + marks;
  }
  cout << sum;
return 0;
}
```

Limitations of using ordinary variables

- This works, when we only need to find sum
  - or a value based on sum, such as average
- We get the required result; but lose individual values
- We may need to retain, access, and use these values later
- Suppose we need to
  - Find both, the sum AND standard deviation of given marks
  - To arrange and print all marks in descending order

Arrays – the way we know in mathematics

- Used in mathematics to represent a set of numbers, often arranged as a table of rows and columns (a matrix)
- We use array, as one dimensional matrix, with just one row
- An array a, containing some 11 integers, may be written as

  a = { 73, 14, 3, 128, 3926, 374, 4231, 1024, 2176, 128, 825}
- We use notation a_i , to represent the i^{th} element of array a
  - 'i' is said to be an 'index' for indicating a specific element
  - What is a_2 ? 14 What is a_5? 3926

Arrays – the way we know in mathematics

- For this array

  a = {73, 14, 3, 128, 3926, 374, 4231, 1024, 2176, 128, 825}

- We denote the sum of N elements of the array as

$$sum = \sum_{i=1}^{N} a_i$$

- If N is 4, the sum $= a_1 + a_2 + a_3 + a_4$

$$73 + 14 + 3 + 128 = 218$$

What we need in C++

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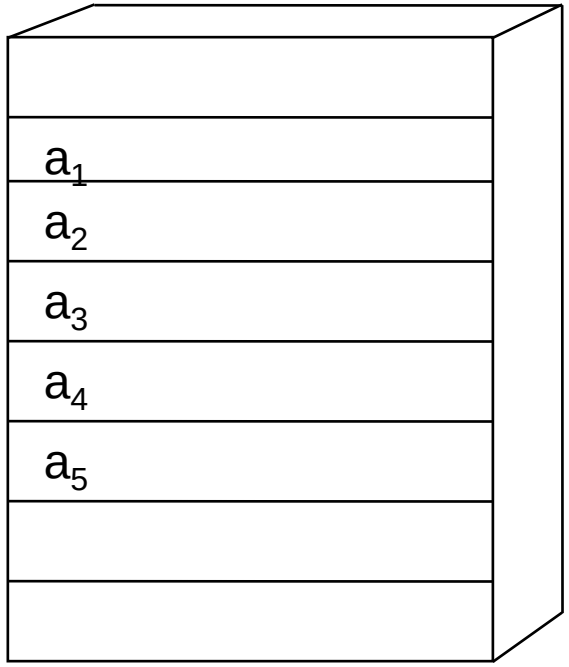
- A set of adjacent storage locations, collectively referred to by a single name, say a
  - Individual elements are identified by an ‘index’



Arrays in C++

- C++ provides a data structure called **Array**
- Provides a ***single name*** for entire *collection*
  - Permits access to individual elements using an **index**

- In a program, how do we declare an array?
- How do we write references to individual elements
  - Can we use a variable like i, as an index?

Summary

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- We need an array to store a large number of similar values
  - We must be able to access individual elements of the collection
- An array is a collection of adjacent memory locations
  - An index is used to refer to an individual element
- C++ provides us with such a data structure
  - We will next study the details of using C++ arrays