Working With Arrays of Data

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  - Gets 5 numbers from the user
  - Outputs the average
- What variables are needed?
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  - Gets 5 numbers from the user
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- What variables are needed?
- What are the steps the program should take?

- But what if it takes 100 numbers instead of 5? 1000?

Working With Arrays of Data

- Using arrays, we can:
  - Allocate all 5 integers at once
  - Give them a single name
  - Access them by *index*

Naming Arrays of Data

- When you declare a variable the computer:
  - Allocates space for it
  - Gives it a name
- The space allocation is based on the type of the variable
  - Main memory is one long sequence of bytes
  - An integer (int) takes 4 bytes on most systems
- So why not allocate multiple ints and give them one name?
  - Requires a new syntax for allocation
  - Requires a way to specify which int you want to work with

Arrays

- Array: a collection of a fixed number of components wherein all of the components have the same data type
- In a one-dimensional array, the components are arranged in a list form
- Syntax for declaring a one-dimensional array:

```
dataType arrayName[intExp];
```

`intExp` evaluates to a positive integer

Arrays (continued)

- Example:

```
int num[5];
```

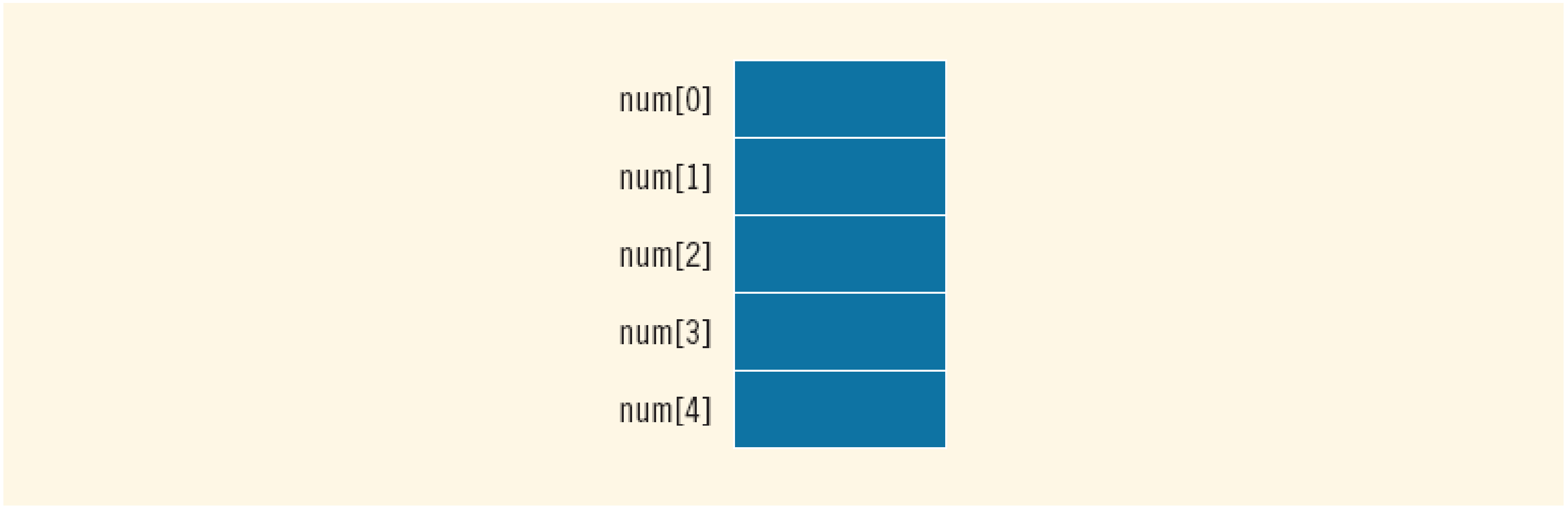


FIGURE 9-1 Array num

Accessing Array Components

- General syntax:

```
arrayName[indexExp]
```

  where `indexExp`, called an **index**, is any expression whose value is a nonnegative integer
- Index value specifies the position of the component in the array
- `[]` is the **array subscripting operator**
- The array index always starts at `0`

Accessing Array Components (continued)

```
int list[10];
```

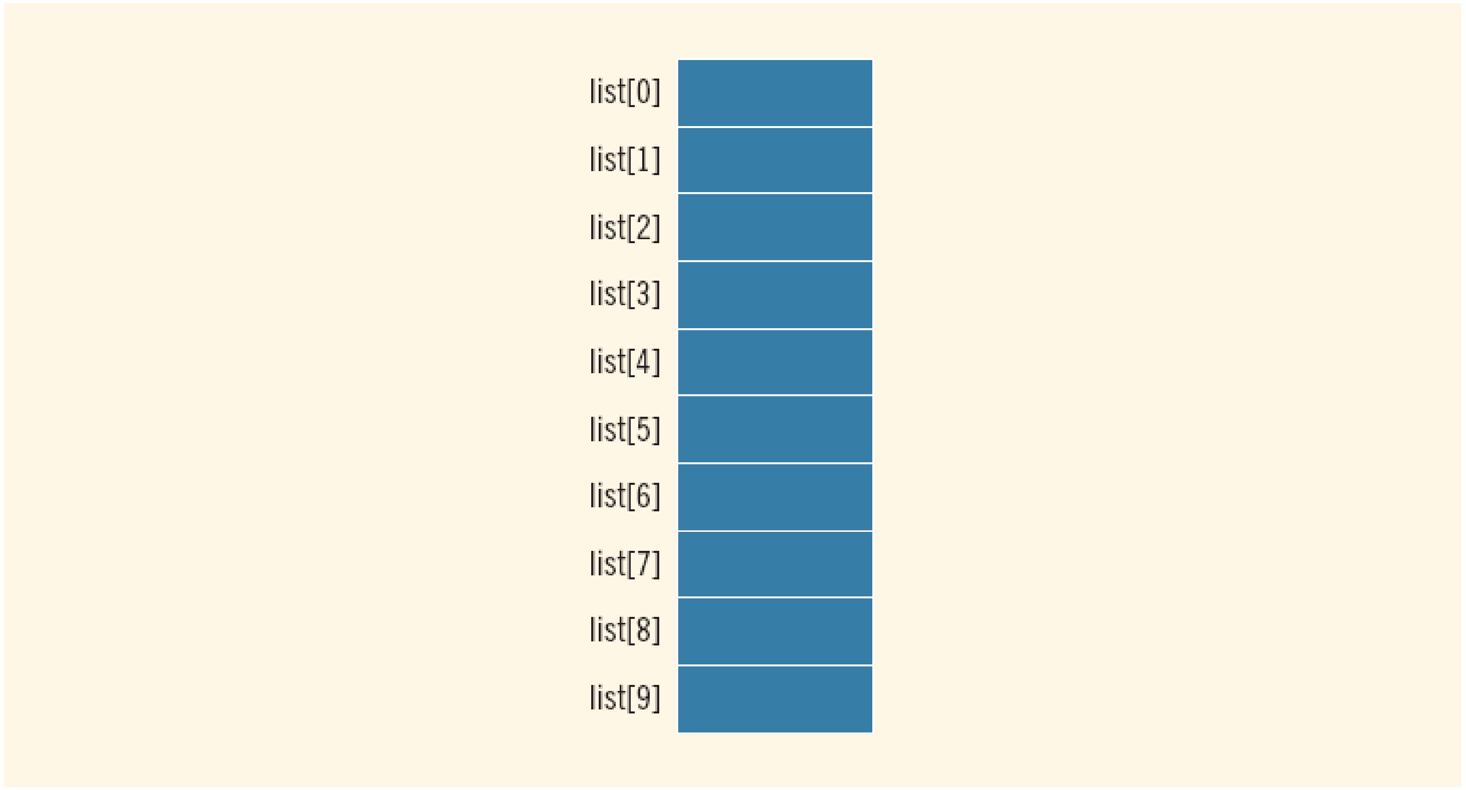


FIGURE 9-2 Array `list`

Accessing Array Components (continued)

```
list[5] = 34;
```

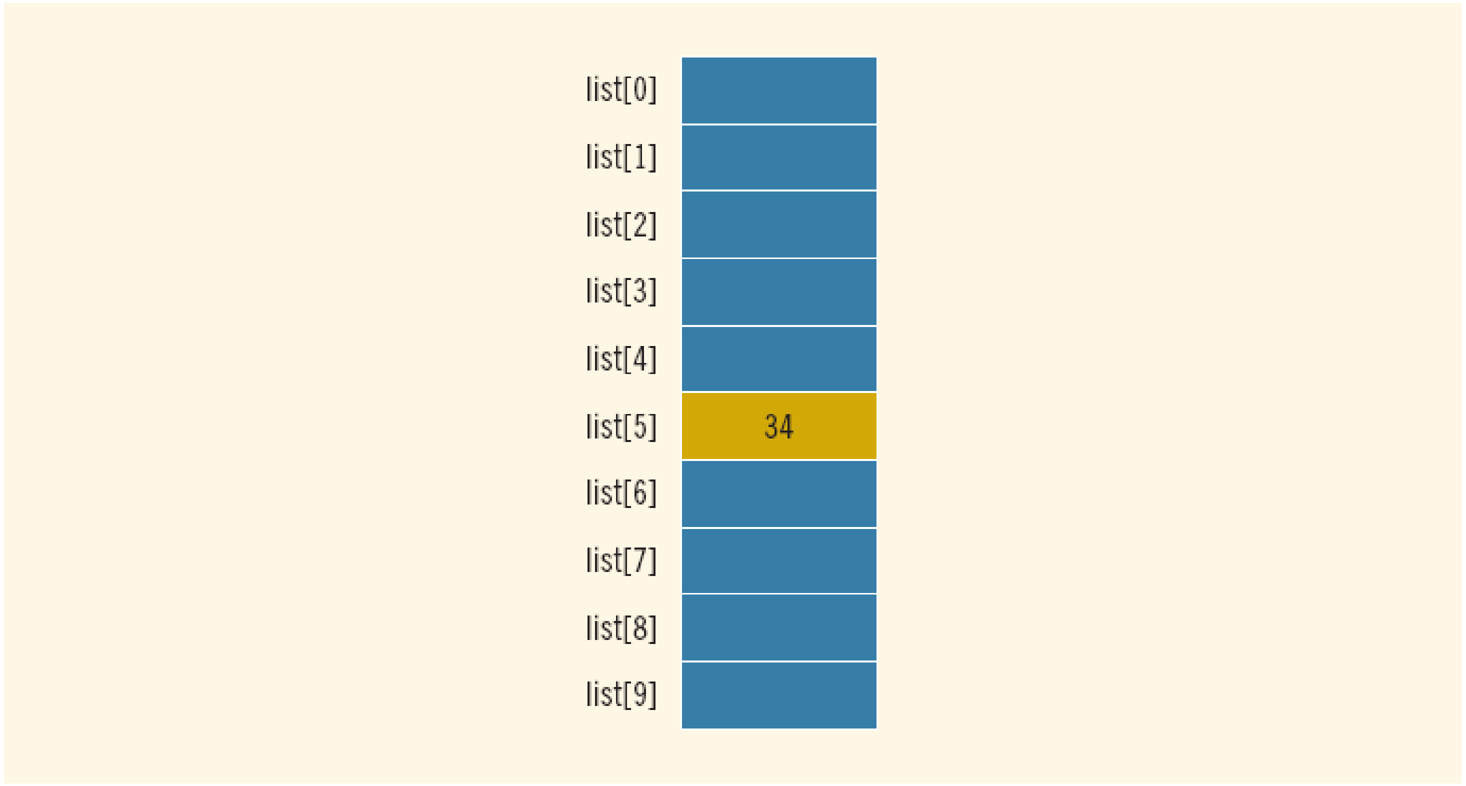


FIGURE 9-3 Array `list` after execution of the statement `list[5]= 34;`

Accessing Array Components (continued)

```
list[3] = 10;
list[6] = 35;
list[5] = list[3] + list[6];
```

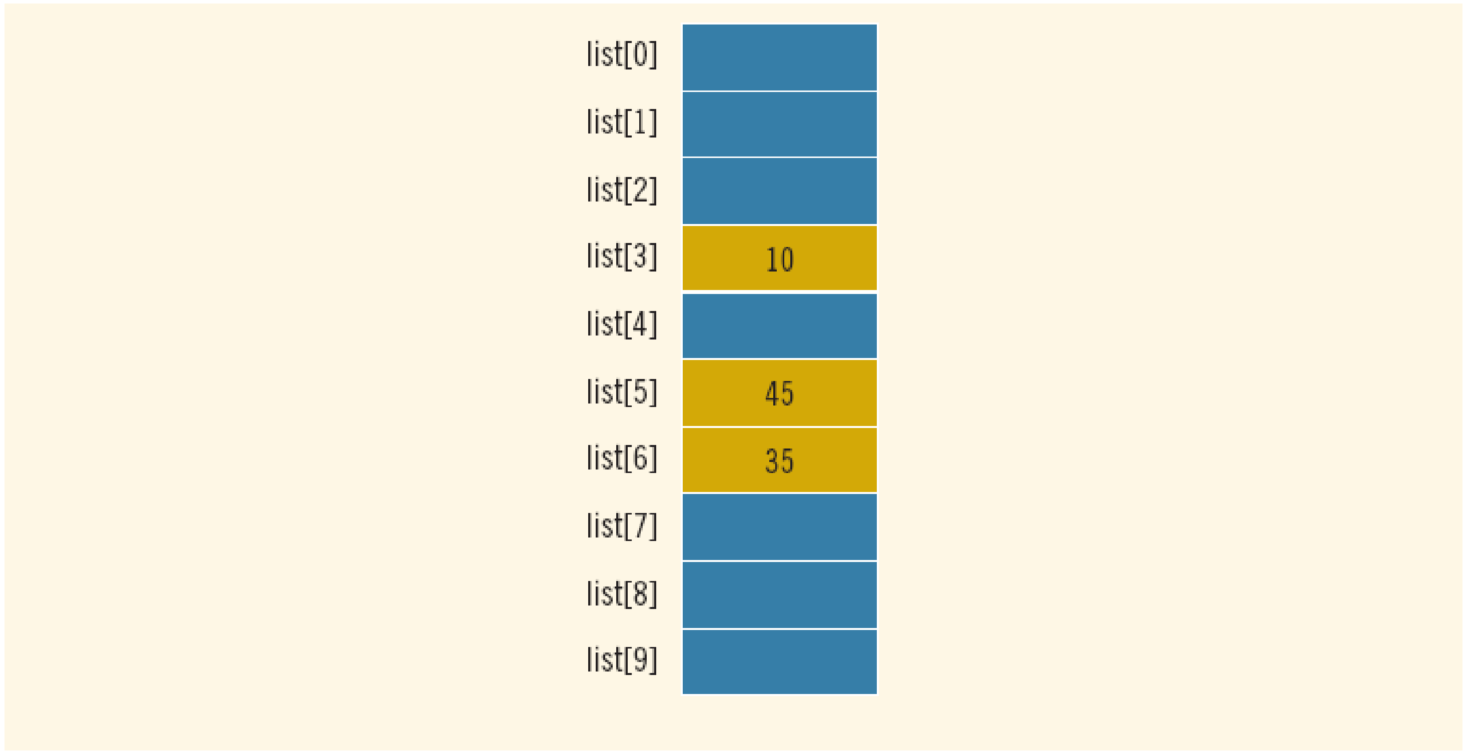
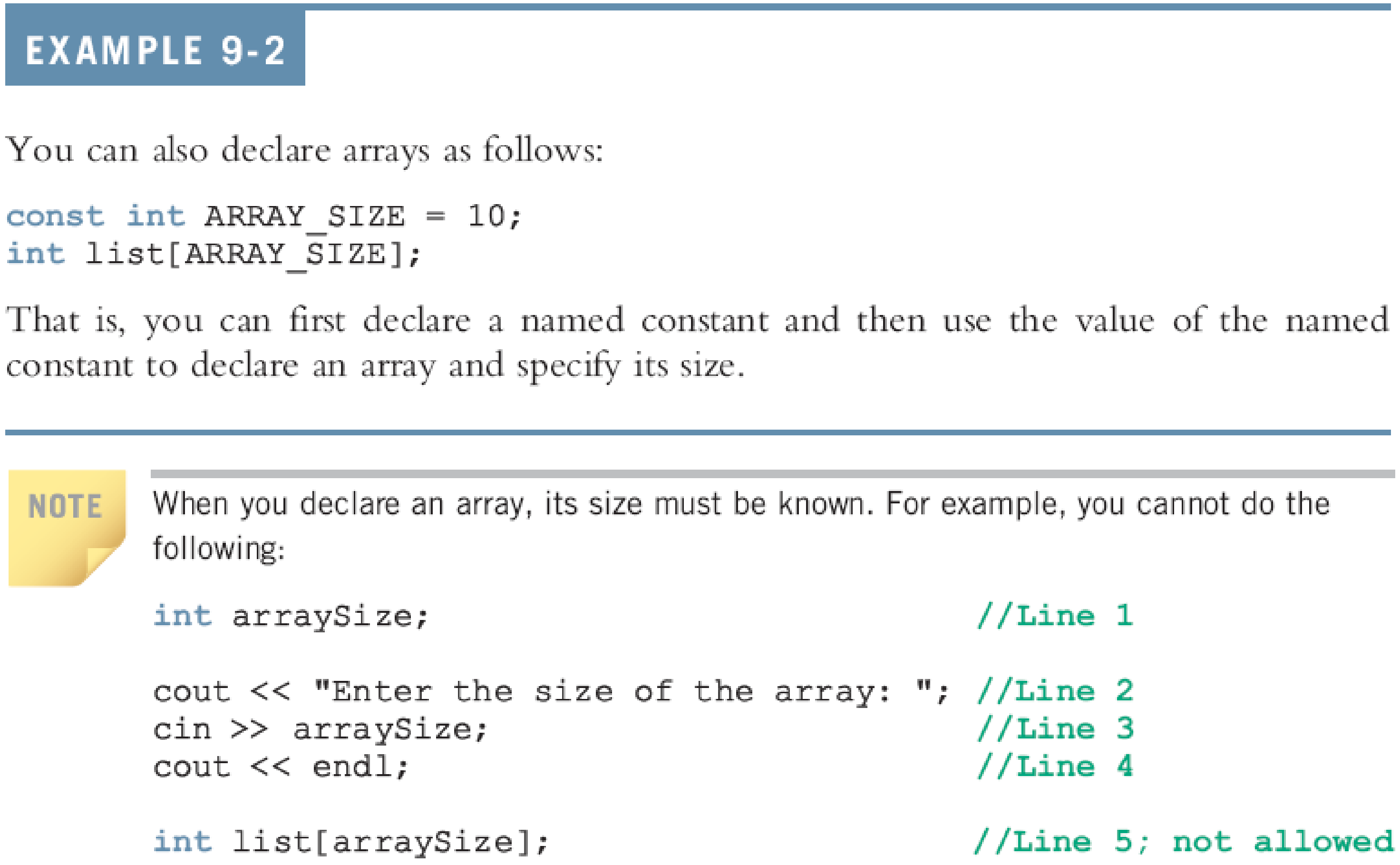


FIGURE 9-4 Array `list` after execution of the statements `list[3]= 10;`, `list[6]= 35;`, and `list[5] = list[3] + list[6];`

Accessing Array Components (continued)



EXAMPLE 9-2

You can also declare arrays as follows:

```
const int ARRAY_SIZE = 10;
int list[ARRAY_SIZE];
```

That is, you can first declare a named constant and then use the value of the named constant to declare an array and specify its size.

NOTE

When you declare an array, its size must be known. For example, you cannot do the following:

```
int arraySize;                                  //Line 1

cout << "Enter the size of the array: ";        //Line 2
cin >> arraySize;                               //Line 3
cout << endl;                                   //Line 4

int list[arraySize];                            //Line 5; not allowed
```

Working With Arrays of Data

- Using arrays, we can:
  - Allocate all 5 integers at once
  - Give them a single name
  - Access them by *index*

- Using arrays together with for loops, we can:
  - Allocate any number of integers
  - Give them a single name
  - Access them by index
  - Repeat instructions over any number of integers
    - Usually by using a `for` loop counter

Processing arrays

- For loop is almost always the answer
  - How do you print an array?
  - How do you search an array?
  - How do you copy an array?
  - Etc…
- The for loop counter is used as the array index
  - To access each element in the array sequentially

```
for( int i=0; i<length; i++ )
{
   cout << some_array[i] << endl;
}
```

- Notice that you have to know the length of the array!

Size, length, count, etc.

- Every array has 2 critical numbers associated with it
  - Maximum Size: how many elements can it store?
    - Also called size some times
  - Actual Count: how many valid pieces of data are in it
    - Also called length, size, count, etc.
    - (not technical terms)
- Every array element *always* has a value
  - You can't really delete anything from an array, only overwrite things
- Data is *always* stored in contiguous elements!
  - Starting from element 0, no empty spaces
  - The last valid element is always at index length-1

Summary

- Array variables allow you to allocate and name a sequence of values
  - The elements are accessed by index
  - Data is stored from element 0 to element length-1
  - This works really well with for loops
    - If the question involves an array, the answer is usually a for loop!
- Computers are really good at counting and repetitive tasks
  - Arrays allow you, the programmer, to specify things once and allow the computer to do it ten times, a hundred times, a million times…

Exercises

- Declare an array of 150 doubles
  - Declare a constant SIZE and use it in the array declaration
- Syntax checks!
  - (you rarely access individual array elements like this)
  - Set the 10th element in the array of doubles to 5.6
  - Print the 10th element
    - e.g. “The 10th element is 5.6”
  - Set the 72nd element to the value of the 12th element
  - Ask the user to enter a value and store it in the 113th element
  - Set the 43rd – 46th elements to the values 7, 8, 9, 10
    - Use a for loop!

Exercises

- Store 100 copies of the number 50 in your array
  - Declare an integer *length*, set it to 100
  - Set the first *length* elements to 50
- Print all the valid elements in the array
  - Your answer should use *length*
- Store the numbers 1 through 100 in your array
  - e.g. first element is 1, second element is 2, etc.
- Using a for loop, set the first 10 elements in the array to the value of the last 10 valid elements (in reverse)
  - e.g. first element ends up with 100, second with 99, etc.