

Arrays

Topics

- Definition of a Data Structure
- Definition of an Array
- Array Declaration, Initialization, and Access
- Program Example Using Arrays

Data Types

- So far, we have seen only simple variables.
- Simple variables can hold only one value at any time during program execution, although that value may change.
- A **data structure** is a data type that can hold multiple values at the same time.
- The **array** is one kind of data structure.

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Arrays

- An array is a group of related data items that all have the same name.
- Arrays can be of any data type we choose.
- Each of the data items is known as an **element** of the array. Each element can be accessed individually.

Array Declaration

```
var numbers = new Array(5);
```

- The name of this array is "numbers".
- It does not initialize the array to 0 or any other value. They contain garbage.

Initializing and Modifying Elements

- Each element in an array has a **subscript (index)** associated with it.

numbers →

--	--	--	--	--

0 1 2 3 4

- We can put values into the array using indexing.

```
numbers[0] = 5 ;  
numbers[1] = 2 ;  
numbers[2] = 6 ;  
numbers[3] = 9 ;  
numbers[4] = 3 ;
```

numbers →

5	2	6	9	3
---	---	---	---	---

0 1 2 3 4

Accessing Array Elements

- For this class, subscripts are integers and always begin at zero.
- Values of individual elements can be accessed by **indexing** into the array. For example,

```
alert("The third element = " + numbers[2]);  
would give the output  
The third element = 6.
```

Accessing Array Elements

- A subscript can also be an expression that evaluates to an integer.

```
numbers[(a + b) * 2];
```

- Caution! It is a logical error when a subscript evaluates to a value that is out of range for the particular array. Some language will handle an **out-of-range error** gracefully and some will not.



Filling Large Arrays

- Since many arrays are quite large, initializing each element individually can be impractical.
- Large arrays are often filled using a for loop.

```
for ( i = 0; i < 100; i++ )
{
    values [ i ] = 0;
}
```

would set every element of the 100 element array "values" to 0.



More Declarations

```
var scores = new Array(39);
var gradeCount = new Array(5);
```

- Declares two arrays: **scores** and **gradeCount**.
- Neither array has been initialized.
- **scores** contains 39 elements (one for each student in a class).
- **gradeCount** contains 5 elements (one for each possible grade, A - F).



Example Using Arrays

Problem: Find the average test score and the number of A's, B's, C's, D's, and F's for a particular class.



Example Using Arrays

```

    .
    .
    .
<body>
<script type="text/javascript">
  <!--
    var i;
    var scoreTotal = 0;
    var scores = new Array(39);
    var gradeCount = new Array(5);
    var averageScore;

    PrintInstructions();
```



Example Using Arrays

```
/* Initialize grade counts to zero */
for (i = 0; i < 5; i++)
{
    gradeCount[i] = 0;
}

/* Fill score array with scores */
for (i = 0; i < 39; i++)
{
    scores[i] = parseInt(prompt("Enter score:"));
}
```



Example Using Arrays

```
/* Calculate score total and count number of each grade */
for (i = 0; i < 39; i++)
{
    scoreTotal += scores[i];
    switch (Math.floor(scores[i]/10))
    {
        case 10:
        case 9: gradeCount[4]++;
                break;
        case 8: gradeCount[3]++;
                break;
        case 7: gradeCount[2]++;
                break;
        case 6: gradeCount[1]++;
                break;
        default: gradeCount[0]++;
    }
}
```

Example Using Arrays

```
average = FindAverage (scoreTotal, 39);

/* Display the results to the user */
string = "The class average is: ";
string += average.toFixed(2) + "%";
string += "\nThe grade distribution is:\n";
string += gradeCount[4] + " A's\n";
string += gradeCount[3] + " B's\n";
string += gradeCount[2] + " C's\n";
string += gradeCount[1] + " D's\n";
string += gradeCount[0] + " F's";
alert (string);

//-->
</script>
</body>
```

Example Using Arrays

```
/* PrintInstructions - prints the user instructions
** Inputs: None
** Outputs: None
*****/
function PrintInstructions()
{
    var string;

    string = "This program calculates the average score\n";
    string += "for a class of 10 students. It also reports the\n";
    string += "number of A's, B's, C's, D's, and F's. You will\n";
    string += "be asked to enter the individual scores.\n";
    alert (string);
}
```

Example Using Arrays

```
/* FindAverage - calculates an average
** Inputs: sum - the sum of all values
           num - the number of values
** Outputs: the computed average
*****/
function FindAverage(sum, num)
{
    var average;

    /* Make sure we don't do division by 0 */
    if (num != 0)
    {
        average = sum / num;
    }
    else
    {
        average = 0;
    }
    return average;
}
```

Improvements ?

- We're trusting the user to enter valid grades. Let's add input error checking. For this program, the highest possible score is 110.
- If we aren't handling our array correctly, it's possible that we may be evaluating garbage rather than valid scores. We'll handle this by adding all the cases for F's (0 - 59) to our switch structure and using the default case for reporting errors.

Improved Input with Error Checking

```
/* Fill score array with scores */
for (i = 0; i < 39; i++)
{
    scores[i] = parseInt(prompt("Enter score:"));

    /* Make sure score is within correct range */
    while (scores[i] < 0 || scores[i] > 110)
    {
        alert("Your number must be between 0 and 110.");
        scores[i] = parseInt(prompt("Enter score:"));
    }
}
```

Improved switch() statment

```
switch (Math.floor(scores[i]/10))
{
    case 10:
    case 9: gradeCount[4]++;
           break;
    case 8: gradeCount[3]++;
           break;
    case 7: gradeCount[2]++;
           break;
    case 6: gradeCount[1]++;
           break;
    case 5: case 4: case 3: case 2: case 1: case 0:
           gradeCount[0]++;
           break;
    default: alert("Error in score!");
            break;
}
```



Working Version of Grades Program

- A working version of the improved program can be found at:

<http://userpages.umbc.edu/~dblock/arrays.html>

- Note that it will ask for only 10 scores rather than 39.

