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.
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

```javascript
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.

- We can put values into the array using indexing.

```plaintext
numbers[0] = 5 ;
nnumbers[1] = 2 ;
nnumbers[2] = 6 ;
nnumbers[3] = 9 ;
nnumbers[4] = 3 ;
```
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,
  
  ```javascript
  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.

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

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

```javascript
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();
   
</script>
</body>
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:"));
}
/ * 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:
                  break;
        case  8: gradeCount[3]++;
                  break;
        case  7: gradeCount[2]++;
                  break;
        case  6: gradeCount[1]++;
                  break;
        default: gradeCount[0]++;
    }
}
Example Using Arrays

```javascript
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

```javascript
/**
  ** 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

```javascript
/* 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() statement

```javascript
switch (Math.floor(scores[i]/10))
{
    case 10:
             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;
}
```
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.