# Variables and Arithmetic Operators in JavaScript

## Topics

- Naming Variables
- Declaring Variables
- Using Variables
- The Assignment Statement
- Arithmetic Operators

## What Are Variables in JavaScript?

- **Variables** in JavaScript have the same meaning as variables in algebra. That is, they represent some unknown, or variable, value.

$$x = a + b$$

$$z + 2 = 3(y - 5)$$

- Remember that variables in algebra are represented by a single alphabetic character.
- They are "containers" that hold values.

## Legal Identifiers in JavaScript

- Another name for a variable in JavaScript is an identifier
- Variables in JavaScript may be given representations containing multiple characters. But there are rules for these representations.
- Legal variable names in JavaScript
  - May only consist of letters, digits, and underscores
  - Can not have blank spaces
  - May not begin with a number
  - May not be a JavaScript **reserved word (keyword)**

# Reserved Words (Keywords) in JavaScript

| | | | | |
|---|---|---|---|---|
| abstract | delete | function | null | throw |
| boolean | do | goto | package | throws |
| break | double | if | private | transient |
| byte | else | implements | protected | true |
| case | enum | import | public | try |
| catch | export | in | return | typeof |
| char | extends | instanceof | short | var |
| class | false | int | static | void |
| const | final | interface | super | volatile |
| continue | finally | long | switch | while |
| debugger | float | native | synchronized | with |
| default | for | new | this | |

## CMSC104 Naming Conventions

- For this class (and some future CS classes), we're going to use the following rules when naming variables:
  - Begin variable names with lowercase letters
  - Use meaningful names
  - Separate "words" within identifiers with underscores or mixed upper and lower case.
  - Examples:  surfaceArea   surface_Area
    surface_area
  - Be consistent!

## Case Sensitivity

- JavaScript is **case sensitive**
  - It matters whether an identifier, such as a variable name, is uppercase or lowercase.
  - Example:

    area

    Area

    AREA

    ArEa

    are all seen as <u>different</u> variables.

## Legal Identifiers vs. Naming Conventions

- **Legal identifiers** refer to the restrictions JavaScript places on naming identifiers, i.e. variable names cannot begin with a number.
- **Naming conventions** refer to the standards you must follow for this course, i.e. all variable names must begin with lowercase.

## Which Are Legal Identifiers?

| | |
|---|---|
| AREA | 3D |
| lucky*** | num45 |
| Last-Chance | #values |
| x_yt3 | pi |
| num+ | %done |
| area_under_the_curve | |

## Which follow the CMSC104 Naming Conventions?

Area

Last_Chance

x_yt3

finaltotal

area_under_the_curve

person1

values

pi

numChildren

## Declaring Variables

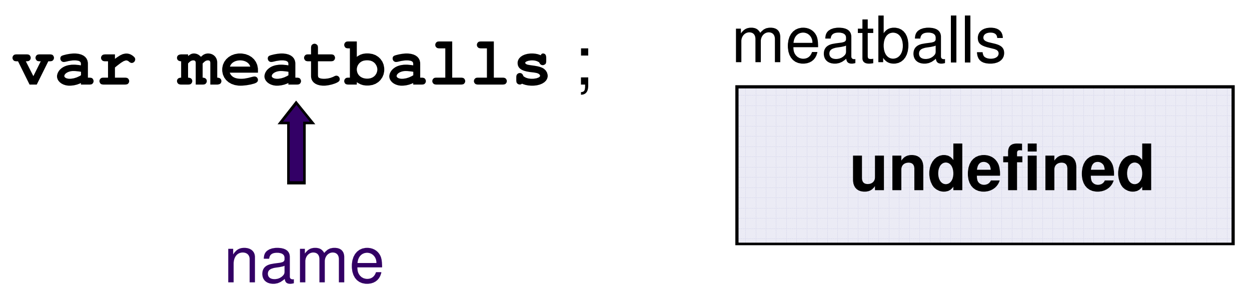
- Before using a variable, you need to **declare** it.
- The **declaration statement** includes the **var** keyword and the name of the variable.
- Examples of variable declarations:

```
var meatballs;
var area;
```

```
var meatballs, area;
```

# Declaring Variables (con't)

- When we declare a variable
  - Space is set aside in memory to hold the value
  - That space is associated with the variable **name**
  - The initial value of the variable is undefined (it is not 0!)
- Visualization of the declaration



```
var meatballs ;
```

## More About Variables

- In JavaScript variables can hold four basic types of values
  - Numbers
    - i.e. `40, 15.5, 700`
  - Strings
    - i.e. `"Hello, World!", "Linux is cool!"`
  - Booleans
    - i.e. `true, false`
  - Null
    - i.e. `null`

## Using Variables: Initialization

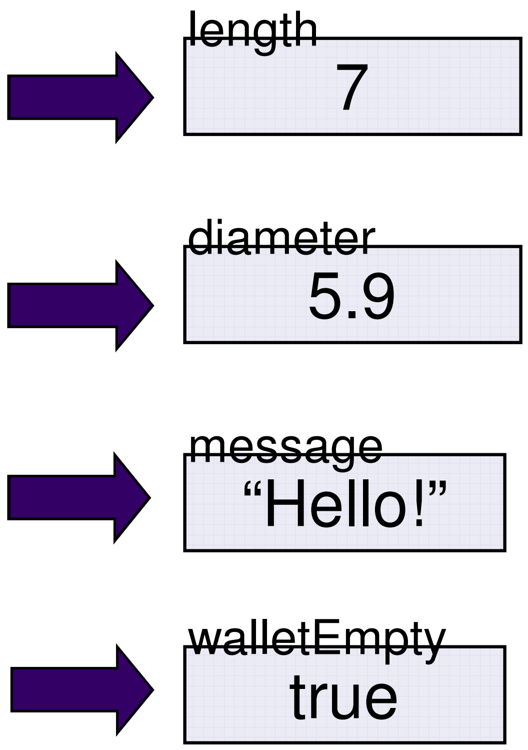
- Variables may be be given initial values, or **initialized**, when declared. Examples:

```
var length = 7;

var diameter = 5.9;

var message = "Hello!";

var walletEmpty = true;
```



## Using Variables: Initialization

- Do not “hide” the initialization
  - put initialized variables on a separate line
  - a comment is always a good idea
  - Example:

```
var height;         /* rectangle height */
var width = 6;      /* rectangle width  */
var area;           /* rectangle area   */
```

NOT `var height, width = 6, area;`

# Using Variables: Assignment

- Variables may have values assigned to them through the use of an **assignment statement**.
- Such a statement uses the **assignment operator =**
- This operator does not denote equality. It assigns the value of the righthand side of the statement (the **expression**) to the variable on the lefthand side.
- Examples:

diameter = 5.9 ;                                   area = $\overbrace{\text{length * width}}$ ;

Note that only single variables may appear on the lefthand side of the assignment operator.

## Brian's Shopping Trip Revisited

Problem: Brian bought a belt for $9 and a shirt that cost 4 times as much as the belt. He then had $10. How much money did Brian have before he bought the belt and shirt?

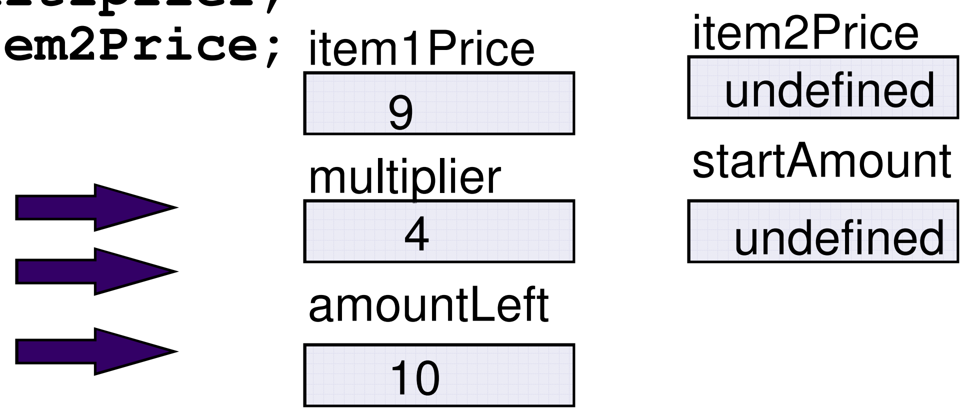
## Pseudocode

```
Display "Enter the price of the first item:  "
Read <item 1 price>
Display "Enter the multiplier:  "
Read <multiplier>
Display "Enter the amount left after shopping:  "
Read <amount left>
<item2 price> = <multiplier> X <item1 price>
<start amount> = <item1 price> + <item2 price> +
                              <amount left>
Display "The starting amount was ", <start amount>
```

# Example: Declarations and Assignments

```
<script type = "text/javascript">
  <!--
    var item1Price, multiplier;
    var amountLeft, item2Price;
    var startAmount;

    item1Price = 9;
    multiplier = 4;
    amountLeft = 10;
```



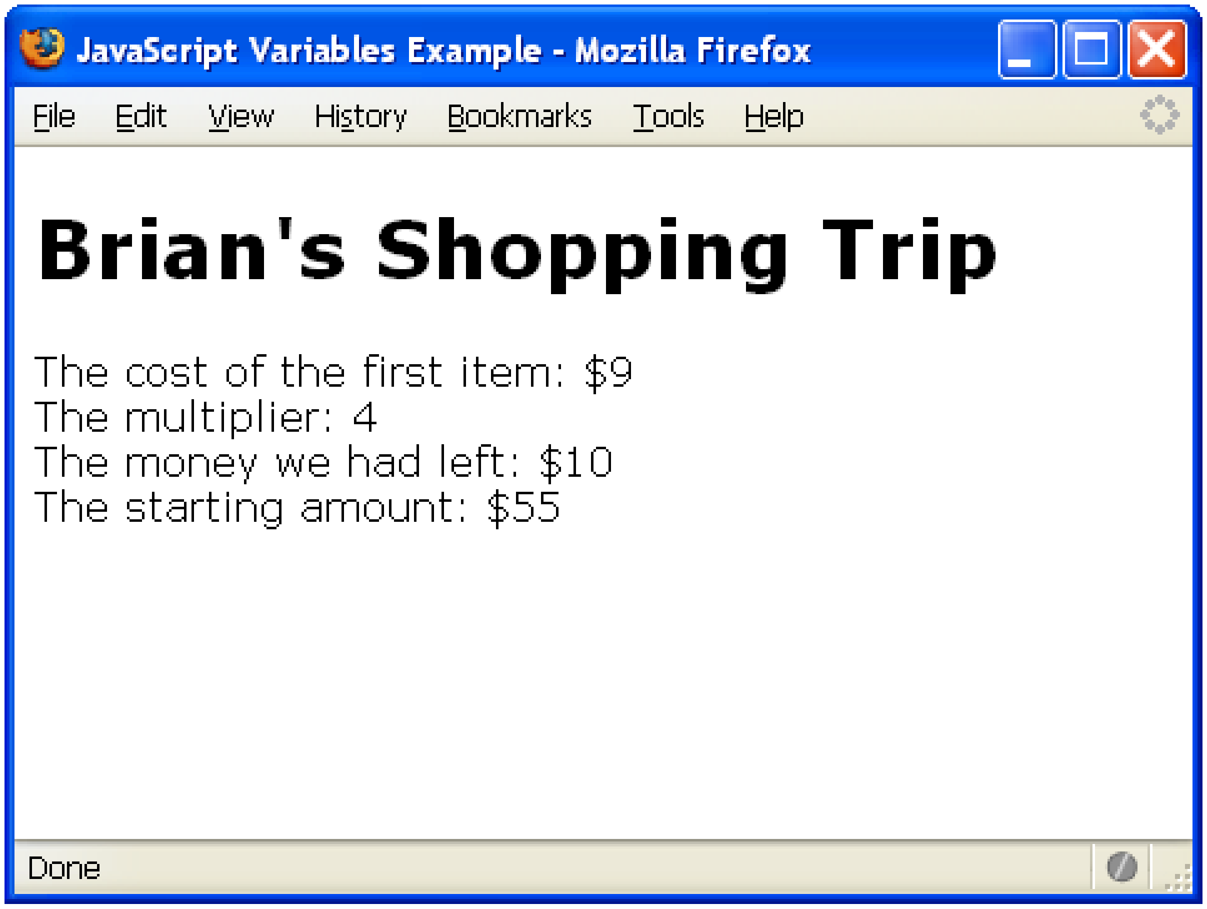
```
     item2Price = multiplier * item1Price;
     startAmount = item1Price + item2Price +
                   amountLeft;
```

(continued on next slide)

## Example: Declarations and Assignments

```
  document.write("The cost of item 1: $");
  document.write(item1Price);
  document.write("<br />");
  document.write("The multiplier: ");
  document.write(multiplier);
  document.write("<br />");
  document.write("The money we had left: $");
  document.write(amountLeft);
  document.write("<br />");
  document.write("The starting amount was: $");
  document.write(startAmount);
 //-->
</script>
```

# Screenshot of Variables Example


JavaScript Variables Example - Mozilla Firefox
File Edit View History Bookmarks Tools Help
Done

## Brian's Shopping Trip

```
The cost of the first item: $9
The multiplier: 4
The money we had left: $10
The starting amount: $55
```

*Try it!  http://userpages.umbc.edu/~dblock/variables1.html*

## Enhancing Our Example

- What is the problem with our solution?
- It produces the same results every time!
- Let’s also ask the user to enter the values for our variables, rather than **“hard-coding”** them in.

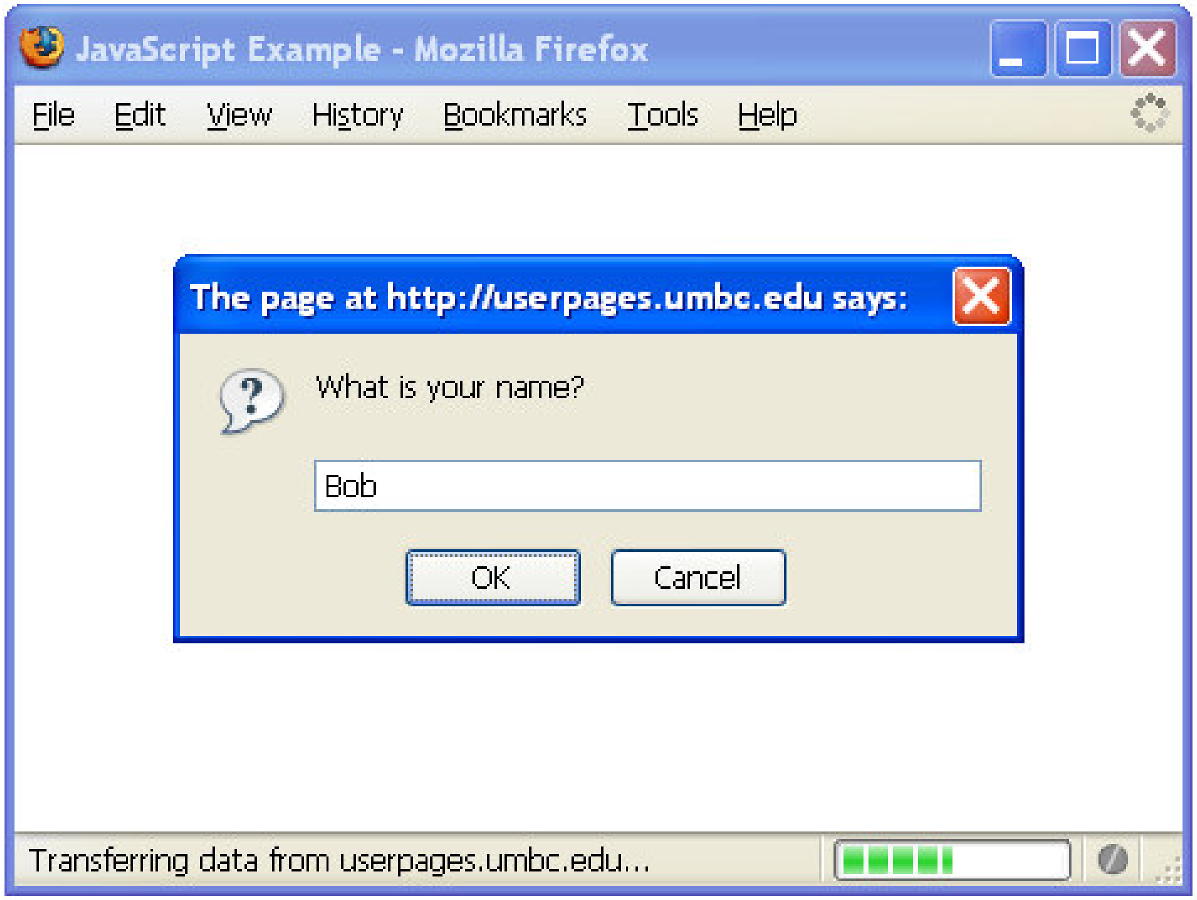
## Getting User Input

- Use the prompt() function
  - Will display a pop-up window asking the user to enter data
- Examples:

```
name = prompt("What is your name?");
payRate = prompt("Enter your pay rate: ");
score = prompt("Please enter the score: ");
```

**The prompt() function is equivalent to the Display/Read in pseudocode.**

## Screenshot of prompt() example


JavaScript Example - Mozilla Firefox

The page at http://userpages.umbc.edu says:

What is your name?

Bob

Transferring data from userpages.umbc.edu...

## Enhanced Variables Example

```
<script type = "text/javascript">
  <!--
    var item1Price, multiplier;
    var amountLeft, item2Price;
    var startAmount;

    item1Price = prompt("Please enter the cost of the first item: ");
    item1Price = parseFloat(item1Price);
    multiplier = prompt("Please enter the multiplier: ");
    multiplier = parseFloat(multiplier);
    amountLeft = prompt("Please enter the amount left: ");
    amountLeft = parseFloat(amountLeft);

    item2Price = multiplier * item1Price;
    startAmount = item1Price + item2Price +
                  amountLeft;
```

# Enhanced Variables Example

```
  document.write("The cost of item 1: $");
  document.write(item1Price);
  document.write("<br />");
  document.write("The multiplier: ");
  document.write(multiplier);
  document.write("<br />");
  document.write("The money we had left: $");
  document.write(amountLeft);
  document.write("<br />");
  document.write("The starting amount was: $");
  document.write(startAmount);
 //-->
</script>
```

## Changes Made to Include User Input

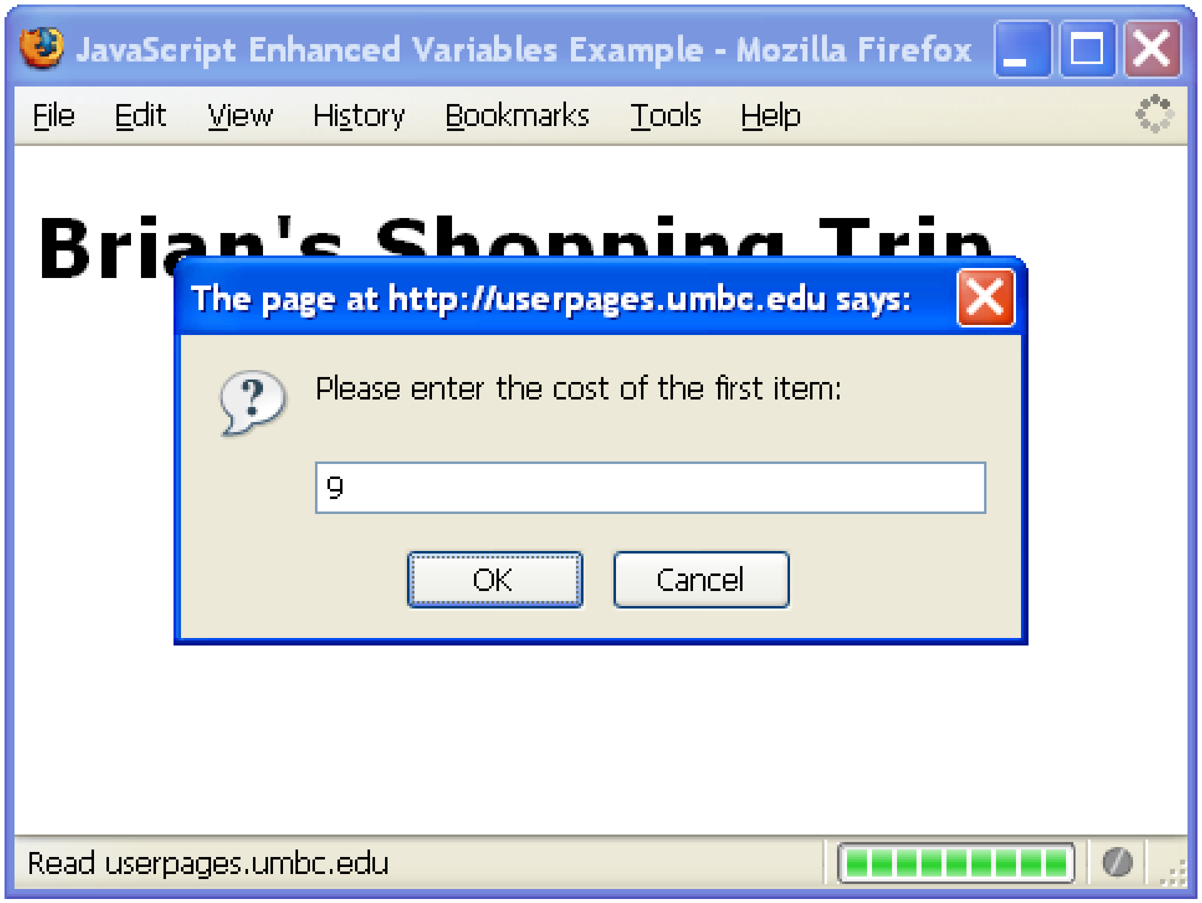
- Instead of giving the variables explicit initialization values, as in:

```
item1Price = 9;
multiplier = 4;
amountLeft = 10;
```

- we used the following:

```
item1Price = prompt("Please enter the cost of the first item: ");
item1Price = parseFloat(item1Price);
multiplier = prompt("Please enter the multiplier: ");
multiplier = parseFloat(multiplier);
amountLeft = prompt("Please enter the amount left: ");
amountLeft = parseFloat(amountLeft);
```

## Screenshot of Enhanced Variables Example


JavaScript Enhanced Variables Example - Mozilla Firefox
File Edit View History Bookmarks Tools Help

Brian's Shopping Trip

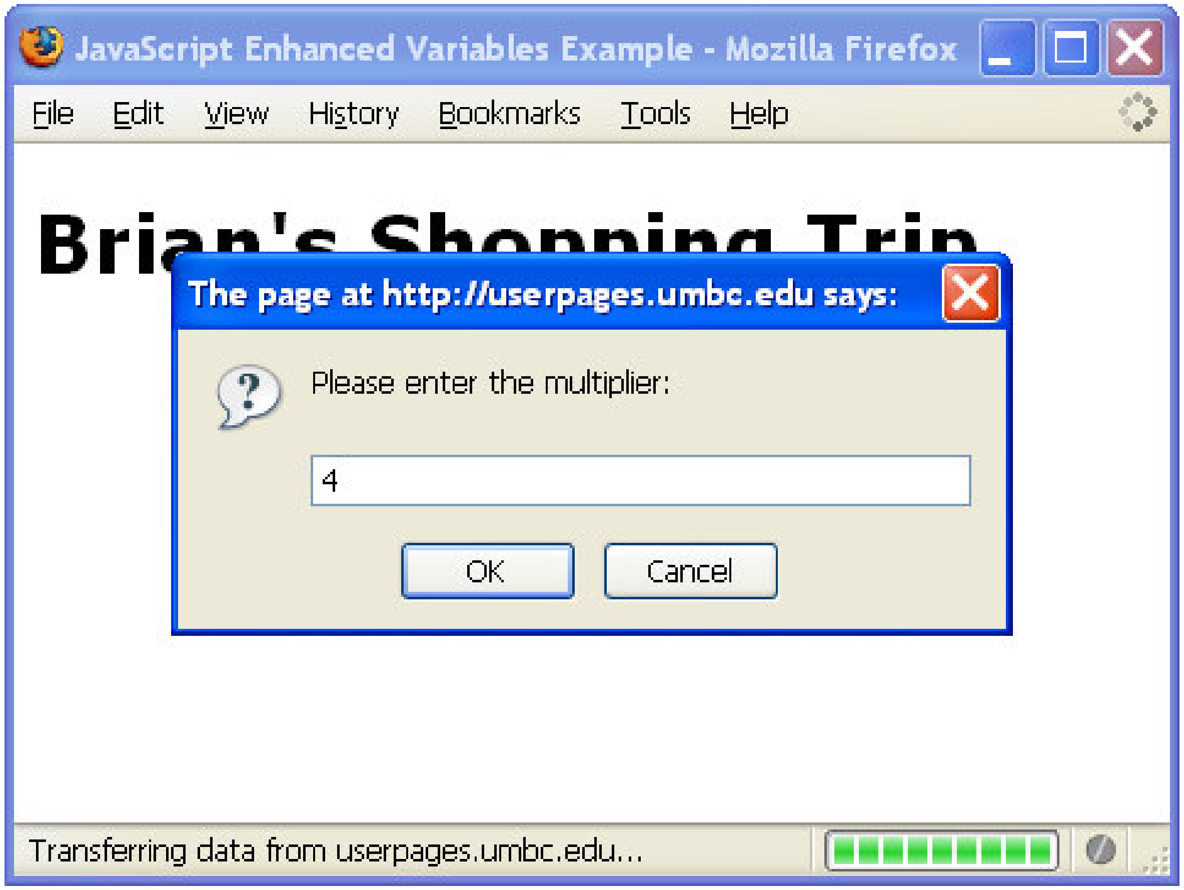
The page at http://userpages.umbc.edu says:

Please enter the cost of the first item:

9

OK
Cancel
Read userpages.umbc.edu

## Screenshot of Enhanced Variables Example


JavaScript Enhanced Variables Example - Mozilla Firefox
File Edit View History Bookmarks Tools Help
OK
Cancel

Brian's Shopping Trip

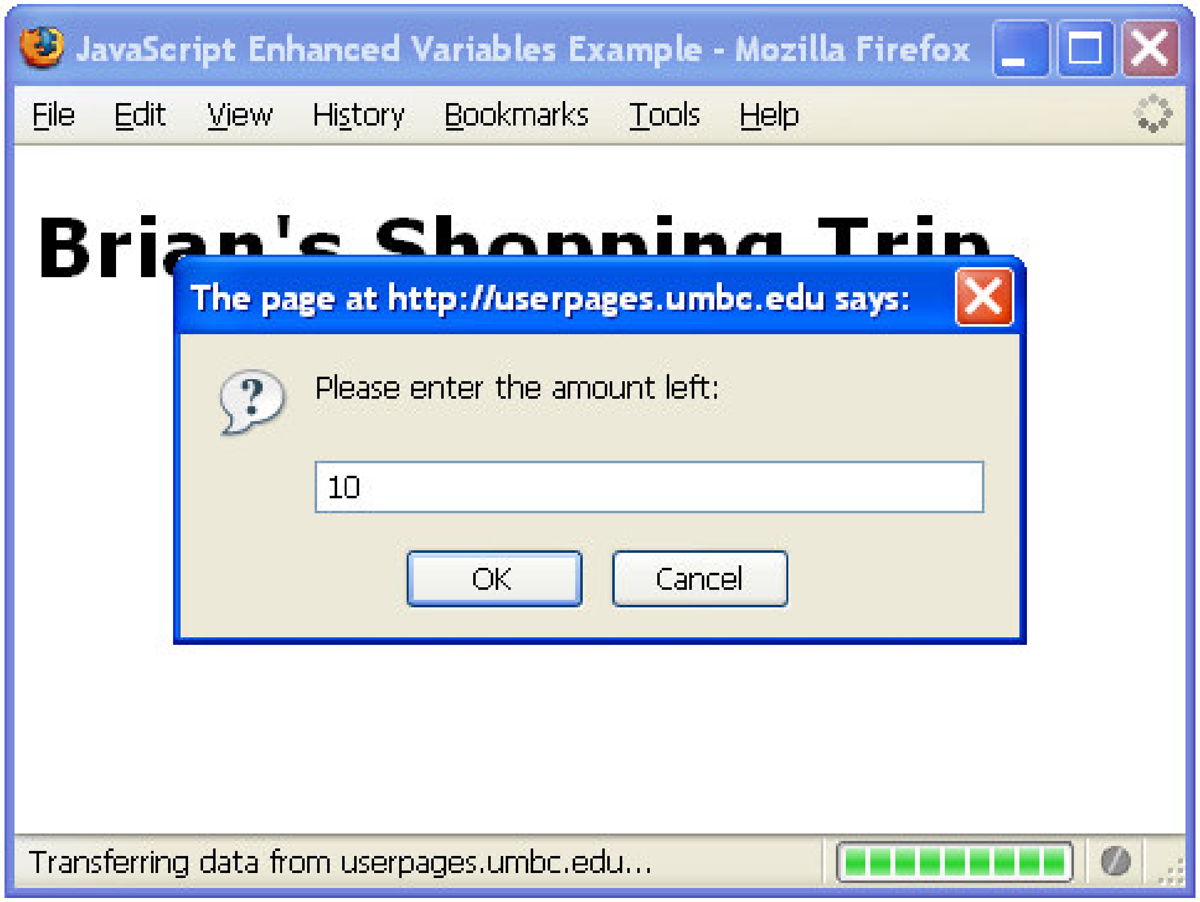
The page at http://userpages.umbc.edu says:

Please enter the multiplier:

4

Transferring data from userpages.umbc.edu...

## Screenshot of Enhanced Variables Example


JavaScript Enhanced Variables Example - Mozilla Firefox
File Edit View History Bookmarks Tools Help
OK
Cancel

Brian's Shopping Trip

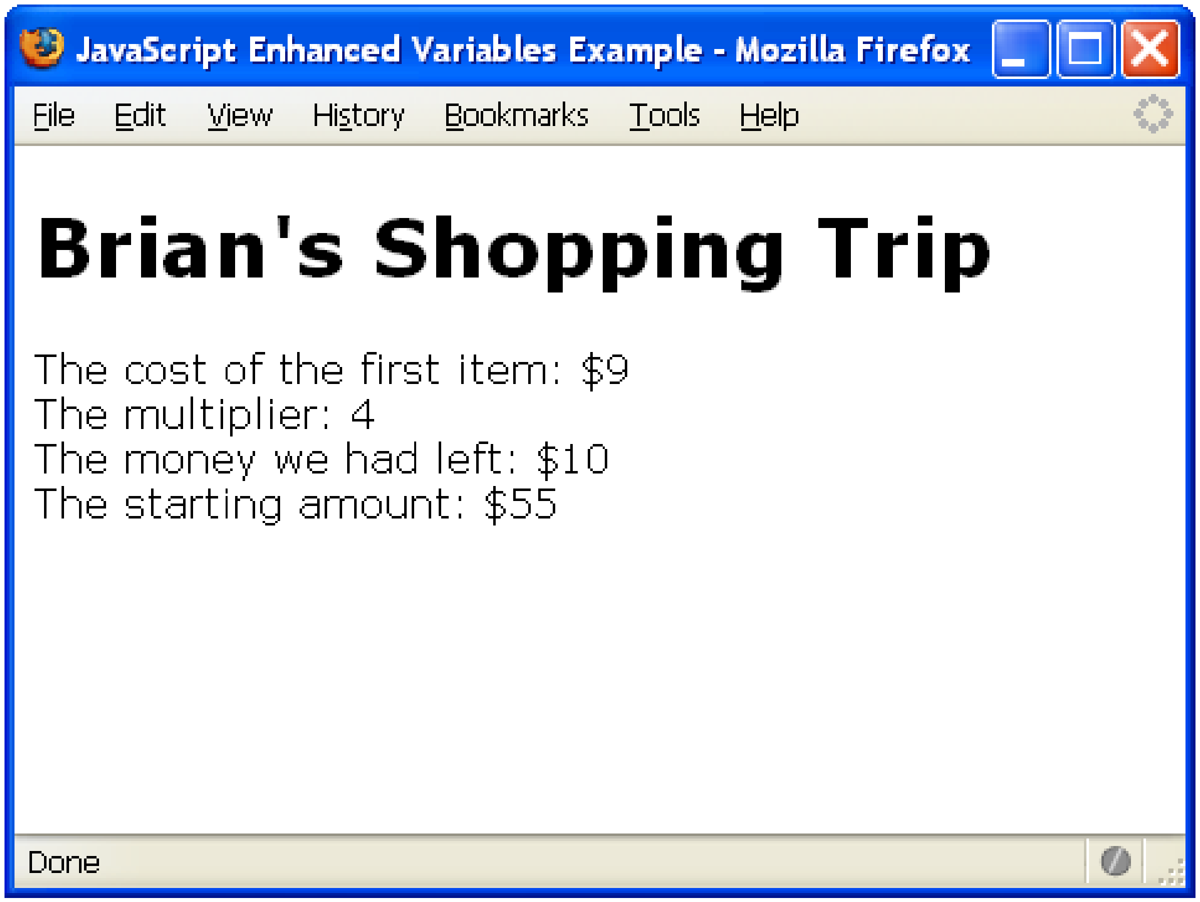
The page at http://userpages.umbc.edu says:

Please enter the amount left:

10

Transferring data from userpages.umbc.edu...

## Final Screenshot of Enhanced Variables Example


JavaScript Enhanced Variables Example - Mozilla Firefox
File Edit View History Bookmarks Tools Help
Done

```
Brian's Shopping Trip

The cost of the first item: $9
The multiplier: 4
The money we had left: $10
The starting amount: $55
```

*Try it! http://userpages.umbc.edu/~dblock/variables2.html*

## Good Programming Practices

- Place a comment before each logical “chunk” of code describing what it does.
- Do not place a comment on the same line as code (with the exception of variable declarations).
- Use spaces around all arithmetic and assignment operators.
- Use blank lines to enhance readability.

## Good Programming Practices

- Place a blank line between the last variable declaration and the first executable statement of the program.
- Indent the body of the program 2 to 3 spaces -- be consistent!

## Arithmetic Operators in JavaScript

| Name | Operator | Example |
|---|---|---|
| Addition | + | num1 + num2 |
| Subtraction | - | initial - spent |
| Multiplication | * | radius * 2 |
| Division | / | sum / count |
| Modulus | % | m % n |

## Modulus

- The expression **m % n** yields the integer remainder after **m** is divided by **n.**
- Modulus is an integer operation -- both operands MUST be integers.
- Examples : 17 % 5 = 2

  6 % 3 = 0

  9 % 2 = 1

  5 % 8 = 5

## Detailed Modulus Example

- $17 \% 5 = \textcircled{2}$

The whole number left over (remainder) is the answer.

$$\begin{array}{r} 3 \\ 5\overline{)17} \\ \underline{-15} \\ R\,\textcircled{2} \end{array}$$

## Another Detailed Modulus Example

- 5 % 8 = 5

The whole number left over (remainder) is the answer.

$$\begin{array}{r} 0 \\ 8\,\overline{)\,5\;} \\ \underline{-0} \\ R5 \end{array}$$

## Uses for Modulus

- Used to determine if an integer value is even or odd

  5 % 2 = 1 odd      4 % 2 = 0 even

  If you take the modulus by 2 of an integer, a result of 1 means the number is odd and a result of 0 means the number is even.

- The Euclid's GCD Algorithm (from the Algorithms 1 lecture)

## Arithmetic Operators
## Rules of Operator Precedence

| Operator(s) | Precedence & Associativity |
|---|---|
| ( ) | Evaluated first. If **nested (embedded)**, innermost first. If on same level, left to right. |
| * / % | Evaluated second. If there are several, evaluated left to right. |
| + - | Evaluated third. If there are several, evaluated left to right. |
| = | Evaluated last, right to left. |

## Using Parentheses

- Use parentheses to change the order in which an expression is evaluated.

  a + b * c — Would multiply b * c first, then add a to the result.

  If you really want the sum of a and b to be multiplied by c, use parentheses to force the evaluation to be done in the order you want.

  (a + b) * c

- Also use parentheses to clarify a complex expression.