Learn to Code

JavaScript

Workbook 2

Version 5.0 Y

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Module 1

Introduction to JavaScript

Section 1–1

Thinking About Programming

Programming

- **Programming is essentially the process of telling a computer what to do -- step by step -- in a language the computer understands**

- **When you program, you have be exact**
  - "Close only counts in horseshoes and hand grenades"

- **When you program, you have to use a language the computer understands**
  - There are many, maNY, MANY languages out there
  - This week, we will begin out study of JavaScript

- **JavaScript is a good language to learn**
  - There are over 1.6 billion web sites in the world, and JavaScript is used on 95% of them!

Section 1–2

Learning to be Precise

Learning to Be Precise

- **To demonstrate using precise instructions, we'll spend a little time on a paper/pen coding exercise**

- **In this first phase, we will make a monkey move to his banana and eat it using a set of specific commands**
  - Note: the ideas for this exercise came from `codemonkey.com`

- **Right now, your monkey understands 3 commands**

`Step` *number*
where *number* is the number of squares to move

Example: `Step 5`

`Turn` *direction*
where *direction* is `left` or `right`

Example: `Turn left`

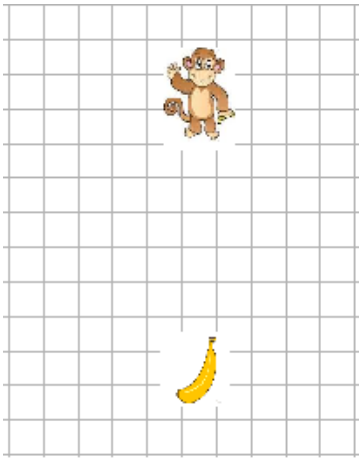
`Eat banana`
This only works if the monkey is standing on an adjacent square to the banana and facing it.

Example: `Eat banana`

Examples: "Program the Monkey"

Example

Move the monkey to the banana and have him eat it.

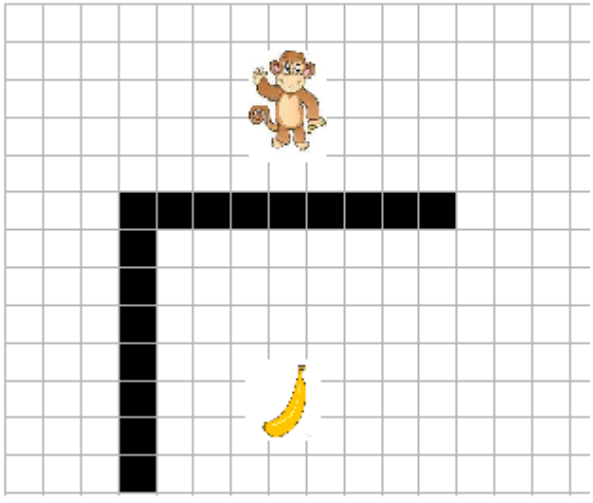


SOLUTION

```
Step 6
Eat banana
```

Example

Move the monkey to the banana and have him eat it. Avoid the barrier. Pay attention to the direction the monkey is facing.



SOLUTION

```
Turn left
Step 5
Turn right
Step 7
Turn right
Step 4
Eat banana
```

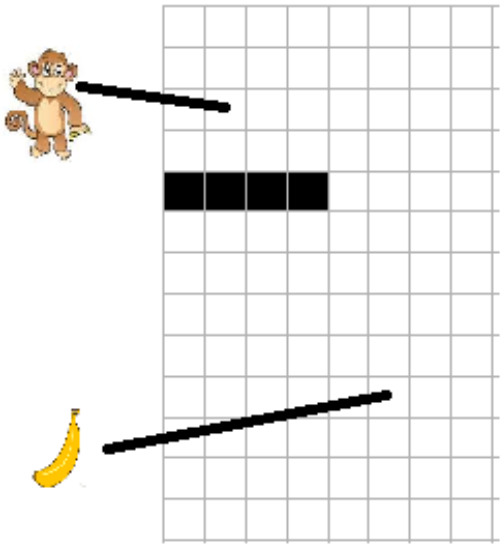
- **Note: Just like programming in real life, there is often more than one way to be successful**

Exercises: "Program the Monkey"

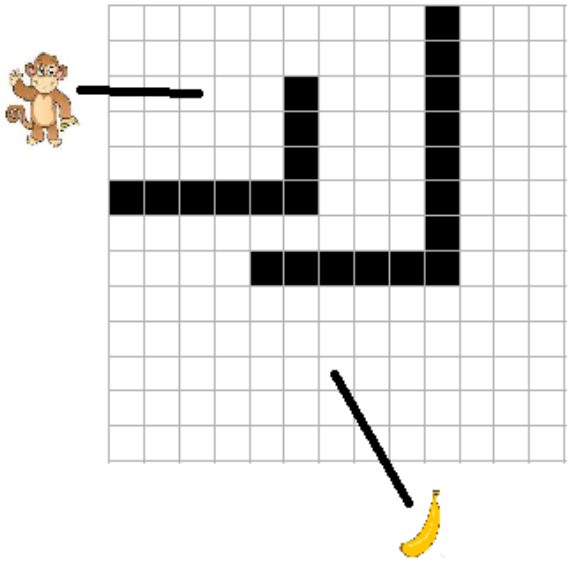
In the next few exercises, we will let you figure out the steps needed to "program your monkey" to move to and eat the banana. We are using lines to show you where the monkey and banana are so that the positions are very precise.

When you finish, talk it over in your group to see how others programmed their monkey.

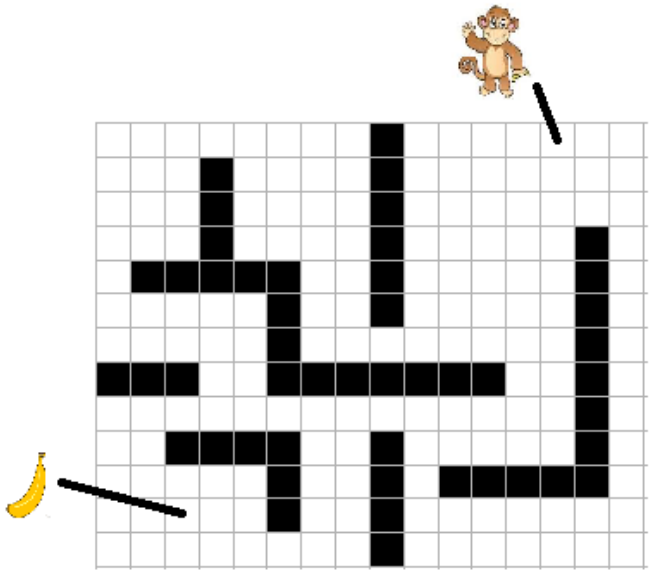
EXERCISE 1



EXERCISE 2



EXERCISE 3



Expanded Command Vocabulary

- **When you are learning a programming language, you start with just a few commands and learn to use them**
  - When you conquer them, you learn more commands and how to use them too!
  - Before long, you know a LOT about the programming language

- **Your monkey understands the commands we discussed before, plus some commands that can be used to pick up an item or drop an item**

:

`Step` *number*
where *number* is the number of squares to move

`Turn` *direction*
where *direction* is `left` or `right`

`Pickup` *item*
where *item* is `banana` or `basket`

When you pick up an item, you must be facing the item in an adjacent square.

Example: `Pickup basket`

`Drop` *item*
where *item* is `banana` or `basket`

When you drop an item, it stays in the square directly in front of the square you are standing in. NOTE: Only one item can reside on a square, however, if the banana is IN the basket that counts as one item.

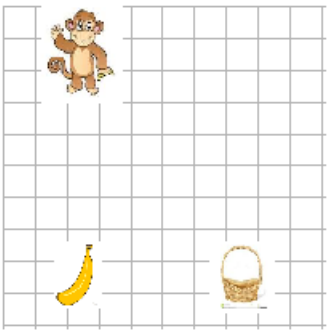
Example: `Drop basket`

`Eat banana`
This only works if the monkey is standing on square adjacent to the banana directly facing it.

Examples: "Smarter Monkey"

Example

Make the monkey drop the banana into the basket.



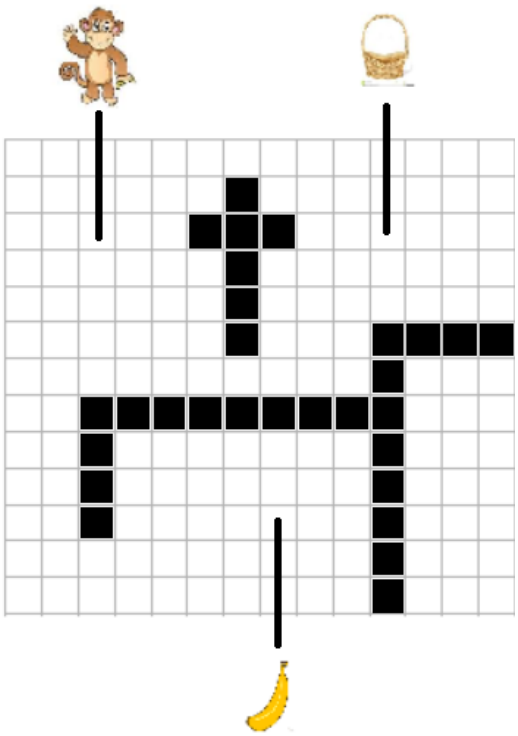
SOLUTION

```
Step 5
Pickup banana
Turn left
Step 5
Turn right
Drop banana
```

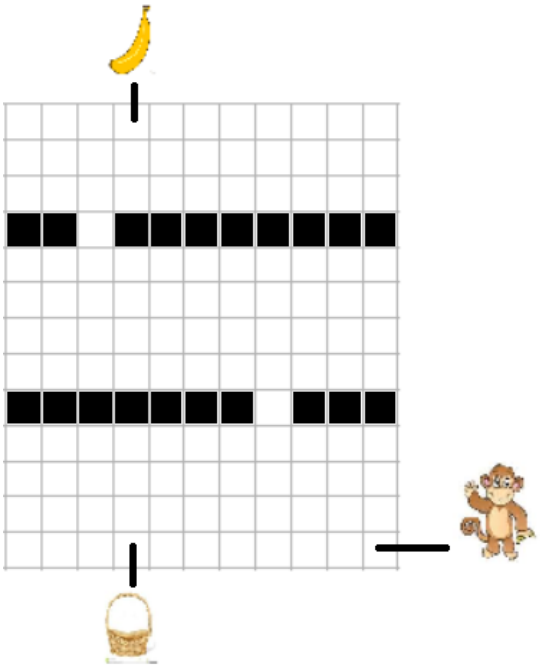
Exercises: "Program the Monkey" - Part 2

In these exercises, you need to "program your monkey" to put the banana in the basket. Like before, when you finish, talk it over in your group to see how others programmed their monkey.

EXERCISE 1



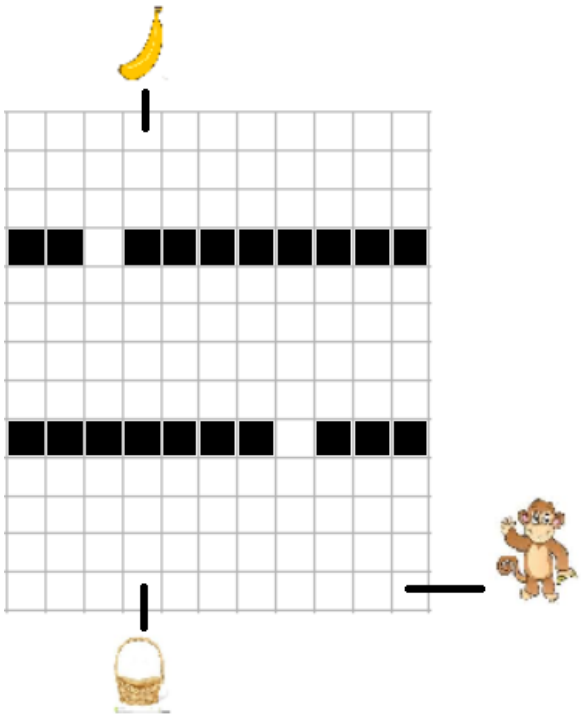
EXERCISE 2



EXERCISE 3

Would your answer change if you knew that the goal was to take the smallest number of steps possible?

The goal here is: *the banana ends up in the basket*. It doesn't say where the basket has to be. Do you pick up the banana and carry it to the basket? Do you take the basket over near the banana?



Section 1–3

Dealing with Ambiguity

Dealing with Ambiguity

- **Sometimes, it's harder to generate a list of the tasks you must perform when the process isn't quite as well defined or as visual as working with monkeys!**

- **In these situations, we often write down the steps that we need to perform in English in order to "get our head around" the problem**

- **Computers follow your exact instructions -- but learning to be precise is tricky!**

- **Watch the "Exact Instructions Challenge" in You Tube before proceeding any further!**

  `https://www.youtube.com/watch?v=Ct-lOOUqmyY`

Trying to Be Exact

- **How do you make scrambled eggs for two people?**

ATTEMPT 1

```
Get four eggs from refrigerator
Crack eggs into skillet
Scramble eggs
```

  - Do you understand the process from our first attempt
  - What's wrong with the description above?

- **The write up has some pre-conditions to scrambling eggs, but it doesn't really tell us how to scramble eggs**

ATTEMPT 2

```
Get four eggs from refrigerator
Crack eggs into skillet

Repeat
[
   Stir eggs as they cook
   Wait 30 seconds
] until they are the desired consistency

Turn stove off
```

  - Better, but where did the eggs come from?

- **How exact do you have to be?**
  - A lot of that depends on how intelligent the reader is

ATTEMPT 3

```
Open the refrigerator
Get four eggs
Close refrigerator

Crack eggs into skillet

Repeat
[
   Stir eggs as they cook
   Wait 30 seconds
] until they are the desired consistency

Turn stove off
```

- **Of course, if we are programming a computer - it has no preconceived insights and you have to be very exact**

- **You also have to describe possible error conditions**
  - For example, what if we are out of eggs?

ATTEMPT 4

```
Open the refrigerator
If we are out of eggs
[
   Make different breakfast plans
   Close refrigerator
   Exit script
]
Get four eggs
Close refrigerator

Crack eggs into skillet

Repeat
[
   Stir eggs as they cook
   Wait 30 seconds
] until they are the desired consistency

Turn stove off
```

- **Not bad -- but are you really being detailed?**
  - Where did the skillet come from?
  - Will your eggs might stick to the pan as you cook?

ATTEMPT 5

```
Open the refrigerator
If we are out of eggs
[
   Make different breakfast plans
   Close refrigerator
   Exit script
]
Get four eggs
Close refrigerator

Get skillet from rack above stove
Spray PAM all around skillet for 3 seconds
Put skillet on stove

Crack eggs into skillet

Repeat
[
   Stir eggs as they cook
   Wait 30 seconds
] until they are the desired consistency

Turn stove off
```

- **Can you see your sarcastic friend following the instructions for spraying PAM?**
  - My sarcastic friend would spray the handle and bottom of the skillet!
  - Oops! Replace with:

```
Spray PAM all around the inside of the skillet for 3 seconds
```

Complex Problems

- **When you are working with complex problems, you really have to think about all aspects of the problem**
  - Where did the PAM come from?
  - Do they know how to crack eggs?
  - What if some of the shell ended up in the pan?
  - What did they do with the shells once they put the egg in the skillet?
  - Who turned on the stove?
  - Stir the eggs with what?
  - What is "desired consistency"?
    - In my house, one of us likes eggs runny and the rest want them cooked into dried hard unappetizing flecks!"
  - Is plating the eggs part of the scope of the problem?
  - Is cleaning up your mess part of the scope of the problem?

- **Other things that might impact how you write include:**
  - The vocabulary of the user (new to the process, experienced)
  - The skills of the user (never cooked, casual cook, chef)
  - The complexity of the process
    - Sometimes, you just won't understand enough about the process to get all of the details right at the beginning
    - Software development is an iterative process!

Exercises

EXERCISE 1

Write out the process of how to "brush your teeth". This may take 4-10 minutes if you do a good job.

Then, meet with your group to go over the write-ups. Tweak the write-ups as needed.

Your team will "present" a "brush your teeth" process to the class as a whole. Your team can select one of the team member's to advance or can blend them together using steps from each team members.

Section 1–4

JavaScript Basics

JavaScript

- **JavaScript was initially created to provide dynamic behavior in web pages**
  - Programs in this language are called scripts and they are written between the `<script>` tags in a web page's HTML
  - This is often called ***client-side scripting***
- **JavaScript is fully integrated with HTML/CSS**
  - It is supported by all modern browser
- **Today, JavaScript can also execute on a server**
  - This allows it to provide back-end processing
  - This is often called ***server-side scripting***
- **In fact, today JavaScript can execute on any device that the JavaScript engine**
  - Mobile applications can even be developed using JavaScript
- **Unlike many other languages, JavaScript scripts are executed as plain text and don't need compilers to translate them into machine code first**

What Can JavaScript Do?

- **Most of the scripts you write as a Web Developer will be client-side scripts**
  - You will include them in your HTML pages
- **Their primary purpose will be to make things happen in the browser**
  - Hide and show form fields
  - Validate form data
  - Submit data to a server for processing
  - Fetch data from a server asynchronously
  - Dynamically create portions of the page
- **When JavaScript runs on a server, JavaScript can do other types of things, including:**
  - Read/write files
  - Interact with databases
  - Perform network requests

What Can't JavaScript Do?

- **When JavaScript executes in the browser, its abilities are somewhat limited**
  - This is to keep a malicious web page from accessing the user's private information or corrupting the user's data
- **JavaScript on a webpage may not:**
  - interact with the camera/mic without a user's explicit permission
  - read/write most files on the hard disk (with some exceptions)
  - directly access operating system functions

JavaScript vs ECMAScript

- **In the early days of the web, browser manufacturers each used their own proprietary language**
  - But this meant web developers had to pick a browser and code just for it
  - This was not ideal!
- **In 1995, JavaScript was created for Netscape**
  - It was eventually adopted by Mozilla for Firefox and became an ECMA standard in 1997
  - Standardization is important so that web developers can write one set of code and know that it will run in all browsers that conform to that standard
- **ECMAScript is the name of the language standard**
  - JavaScript is the name of the language that implements the standard
- **Early versions of the standard were:**
  - ECMAScript 1 (1997)
  - ...
  - ECMAScript 5 (2009)
  - ECMAScript 5.1 (2011)

- **These are often called ES1 through ES5**

- **Beginning in 2015, ECMAScript is referred to by either the year or by the ES name**
  - ECMAScript 2015 (or ES6)
  - ECMAScript 2016 (or ES7)
  - ECMAScript 2017 (or ES8)
  - ECMAScript 2018 (or ES9)

- **With all these changes, browsers are constantly playing catch up**
  - You can be sure that ***all browsers*** support ECMAScript 3
  - ***All modern browsers*** fully support ECMAScript 5
  - Go to `https://www.w3schools.com/js/js_versions.asp` to see which version of ECMAScript each browser supports

JavaScript Code Structure

- **A JavaScript script contains one or more lines of JavaScript code**
  - Each statement is typically written on a separate line
  - Each statement usually ends with a semicolon (`;`)
- **JavaScript ignores whitespace unless it is part of a quoted string**

Example

```
var message = "Welcome to JavaScript";
var name    =    "Natalie";
var age=37;

var outputString = "Name: " + name +
                   " Age: " + age;
```

- **JavaScript scripts are either contained within the `<script>` tags in an HTML page or stored in a file that ends with `.js`**
  - For example: `process_order.js`

Using Semicolons to Separate Statements

- **Each statement typically ends with a semicolon (`;`)**
  - If statements appear next to each other on the same line, the semicolon is ***required***

Example

```
// semicolon required
var name = "Natalie"; var age = 37;
```

  - If the statement ends with a newline, the semicolon is ***optional***

Example

```
// semicolon not required
var name = "Natalie"
var age = 37
```

- **Best practice says to always use the semicolon**

- **However, semicolons should not be included after block statements**
  - Block statements use curly brackets (`{ }`) to define the beginning and end of the block

Example

```
var age = 12;
var price = 19.95;

if (age >= 65) {
   price = price * .9;
} // <----------------------------no semicolon here
```

Declaring Variables

- **When you write JavaScript to operate on data, you will use *variables* to hold your data**
  - A variable might hold a name you extract from an input box in an HTML form
  - A variable might reference a div where you are going to place a message

- **You create a variable by putting the keyword `var` in front of it**

Example

```
var name;
var age;
```

- **Variable names can be made up of numbers, letters, and the characters `$` or `_`**
  - They are case sensitive
  - They may not contain spaces or start with a number

Example

```
var NAME;
var Name;
var name;   // all 3 are allowed because of case sensitivity
            // but that doesn't mean you should do this!
```

Example

```
var 1stPlaceWinner; // invalid because it starts with a number
```

- **You can declare more than one variable on a line by separating them with commas**

Example

```
var name, age;
```

- **You can't use any of JavaScript's keywords as a variable name**
  - Keywords are words that have a predefined behavior in JavaScript
    - For example, `var`, `if`, and `function`
  - Using these would cause the JavaScript parser to become confused

- **Best practice says:**
  - Start variables with a lower case letter
  - Capitalize the first letter of each additional word in the variable name (this is known as camelCase)

Example

```
var firstName;
var lastName;
var nameOfUniversity;
```

Storing Values in a Variable

- **In JavaScript, you can store a value in a variable using the assignment operator**
  - If no initial value is specified, it holds the special value `undefined`

Example

```
var name;
name = "Natalie";
```

- **Variables can store any JavaScript data type, including strings or numbers**

Example

```
var name, age;

name = "Natalie";     // strings are surrounded by quotes
age = 37;
```

- **Assignment always goes from right to left**
  - The value to the right of the assignment operator is computed before the assignment occurs

Example

```
var price, discount;

price = 22.50;

// the discount is 10% of the price
discount = price * .1;     // multiply price by .1 first
                           // and then do the assignment
```

Using `console.log()` to Display a Message

- **JavaScript can "display" data in different ways**
  - We will start with `console.log()`
- **The `console.log()` function writes text to a console window**

Example

```
console.log("Hello world");
```

  - When running under Node.js, the output will appear in an output window in Visual Studio Code
  - When running in a browser, the output will appear in the Developer's Tool window
    - In many browsers, it can be displayed by pressing F12
- **`console.log()` can also write the value of variables**

Example

```
var name;
name = "Brittany";
console.log(name);
```

- **Often, you concatenate your data to the end of a string using a plus (+) to provide a "label" to your message**

Example

```
var name;
name = "Zachary";
console.log("Your name is " + name);
```

Comments

- **JavaScript comments are used to leave notes in code to you or other programmers about how the code works**

- **There are two ways to write comments**

  – You can use // to tell the JavaScript parser to ignore the rest of the text on the current line

Example

```
var price, discount;

price = 22.50;

// find the discount amount if the discount is 10%
discount = price * .1;     // multiply price by .1 first
                           // and then do the assignment
```

  – You can create a multi-line comment by starting with /*and ending with */

Example

```
var price, discount;

price = 22.50;

// find the discount amount if the discount is 10%
discount = price * .1;     /* multiply price by .1 first
                              and then do the assignment */
```

- **JavaScript comments are visible to someone viewing the source code in a browser's Developer Tools**

  – So don't write something you don't want seen by smart users

Using Strict Mode

- **Although we have shown how to define variables, technically the language does not require it**

- **If a variable is not explicitly declared, JavaScript implicitly (automatically) declares it**

Example

```
name = "Natalie"      // assigns name a value
age = 37;             // assigns age a value
```

- **The problem with this is that a misspelled variable can cause you lots of headaches**
  - This is because the JavaScript engine just creates the misspelled one on the fly

Example

```
var number;
number = 10;
...
numbers = 12;
...
console.log(number);       // you are expecting 12 but
                           // it displays 10
```

- **ECMAScript 5 introduced a "strict mode" to JavaScript that dis-allows undeclared variables**
  - It is ignored by earlier versions of JavaScript

- **To use strict mode, you can place "use strict" at the top of a JavaScript file**

Example

```
"use strict";

var number;
number = 10;
...
numbers = 12;                // Error: numbers is undefined
...
console.log(number);
```

- **Although we may not write `"use strict"` at the top of all our examples, you can assume it is there!**

- **Strict mode is supported in:**
  - Chrome 13+
  - Edge 12+
  - Internet Explorer 10+ (recently deprecated)
  - Firefox 4+
  - Safari 5.1+
  - Opera 12+

Primitive Types

- **.JavaScript provides seven different data types, two of which are listed below**
  - Number
  - String
  - NOTE: we will learn about others later

Example

```
"use strict";

var word, num;

word = "banana";            // a String
num = 12;                   // a Number
```

- **You can perform mathematical operations on a number, but not on a string**

Example

```
"use strict";

var word, num;

word = "banana";
num = 12;

num = num + 1;                  // num is now 13

word = word + 1;                // error!  can't add 1
                                // to "banana"
```

- **But you can concatenate two strings using the + operator**

Example

```
"use strict";

var phrase1, phrase2, wholePhrase;

phrase1= "Learning to program ";
phrase2= "is fun!";

wholePhrase = phrase1 + phrase2;
       // wholePhrase contains "Learning to program is fun!"
```

Exercises

EXERCISE 1

Use `var` to create variables with good names for the following:

- a customer id
- a customer's first, middle, and last name
- their gender
- their date of birth
- their driver's license number
- their auto policy number

Example:

```
var customerId;
```

EXERCISE 2

Go to `https://www.w3schools.com/js/js_reserved.asp` and answer the following questions.

1. What are 10 of the reserved words that you can't use for variable names?

2. What are the names of 10 of the JavaScript built-in objects, properties, and methods that you should not use for variable names?

3. What are 10 of the HTML and Window objects names that you should not use for variable names?

4. What are 6 of HTML event names that you should not use for variable names:

EXERCISE 3

Write JavaScript to declare variables for your name, as well as the city and state you were born in. Then assign those variables values for represent you!

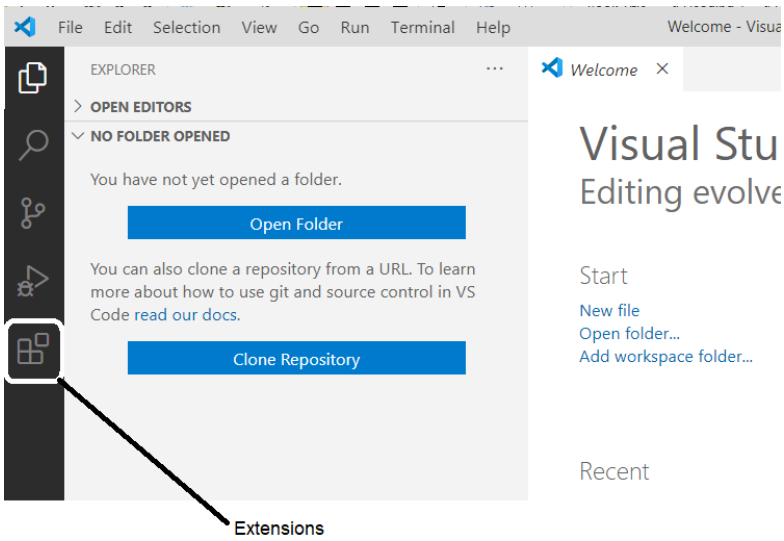
Getting Visual Studio Code Ready

- **You used Visual Studio Code in the HTML/CSS/Bootstrap portion of the class, so you should be familiar**

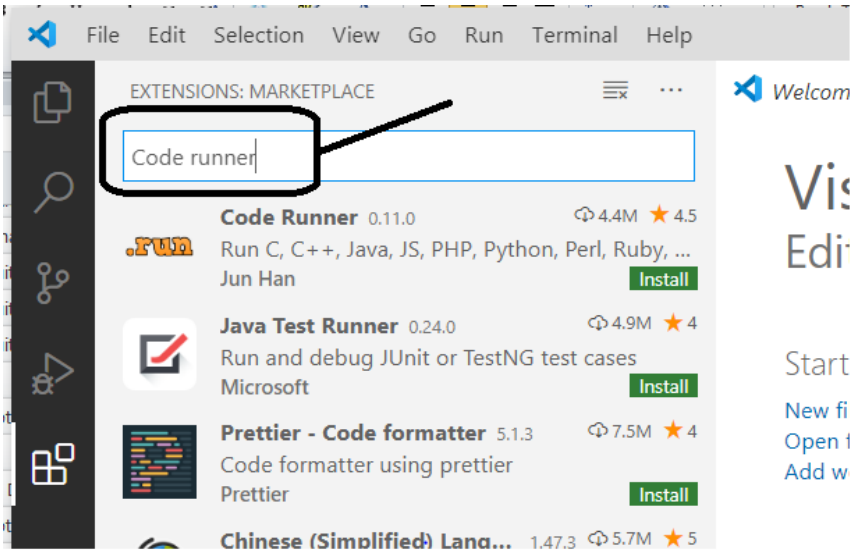
- **Before we begin coding, we are going to add a couple of extensions**
  - **Code Runner** allows us to run JavaScript scripts without having to embed them in an HTML page
  - **Live Server** creates a local development server that hosts the pages open in Visual Studio Code
    - This keeps us from having to deploy a site to a web server to test it

Installing Extensions

- **To install extensions, click on the Extensions icon on the left bar**



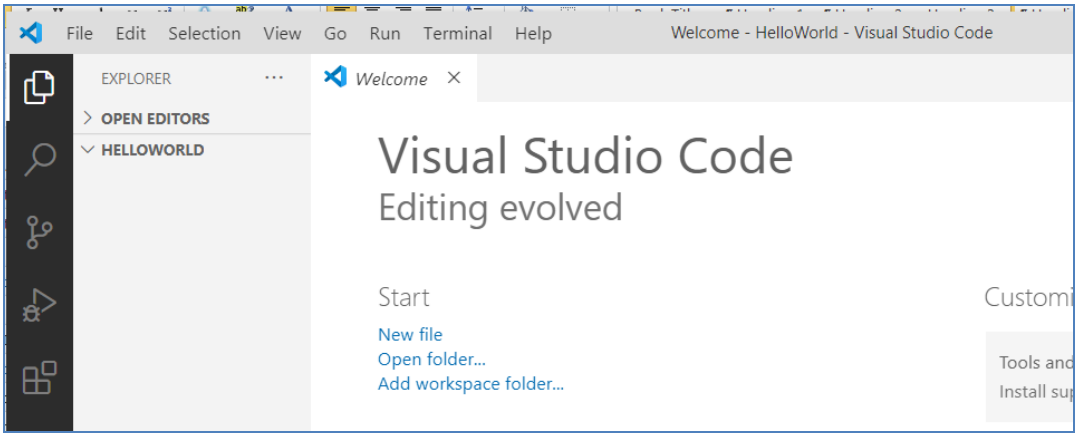
- **In the search pane, type the name of the extension you want to install**



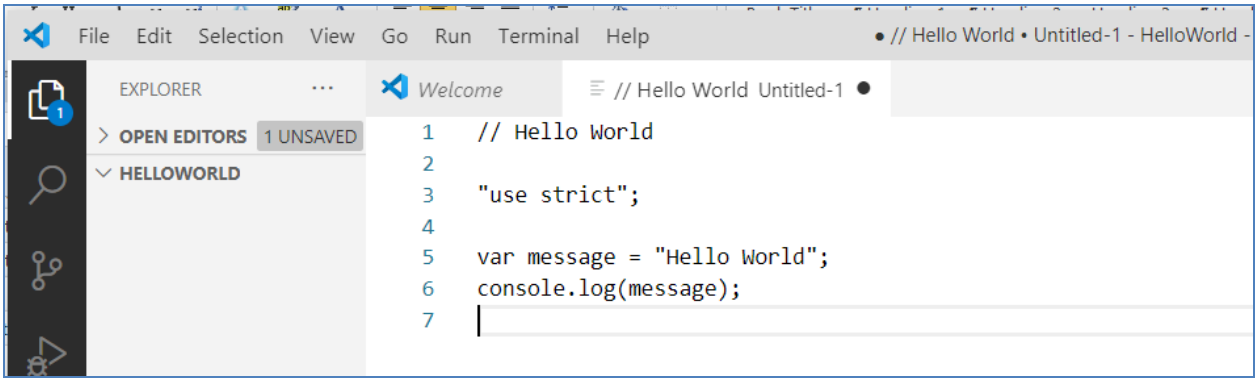
  - Then click the Install button
  - You may have to close and then re-open Visual Studio Code in order to see your extensions

"Code Along" - Hello World

- **Everybody's first program is "Hello World"**
  - It simply writes a message to the screen
- **We will do that now…**
- **To get started, let's create a place to keep code from this module**
  - Under `LearnToCode`, create a folder named `Workbook2`
- **Now, create a Git repository called `HelloWorld`**
  - Clone it to `LearnToCode\Workbook2`
- **In Visual Studio Code, use the File > Open Folder menu to navigate to your `HelloWorld` folder**



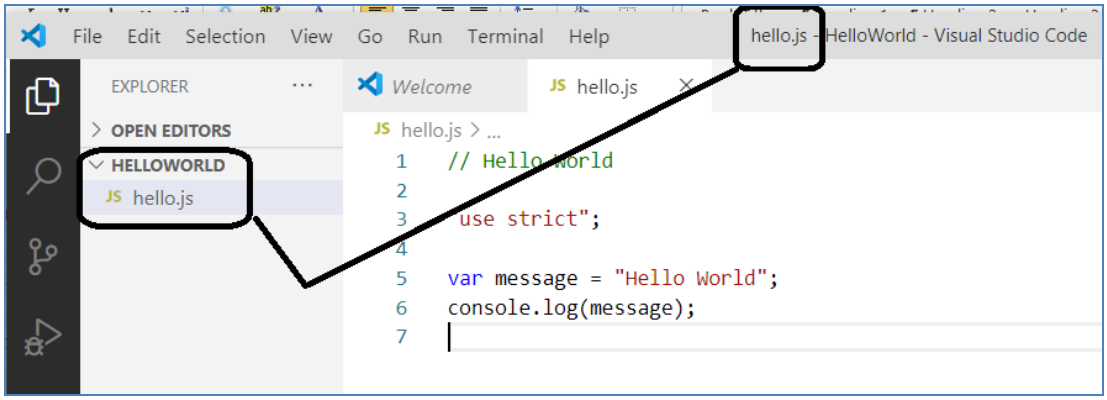
- **Use the File > New File menu to create a text file, then type the code you see below**



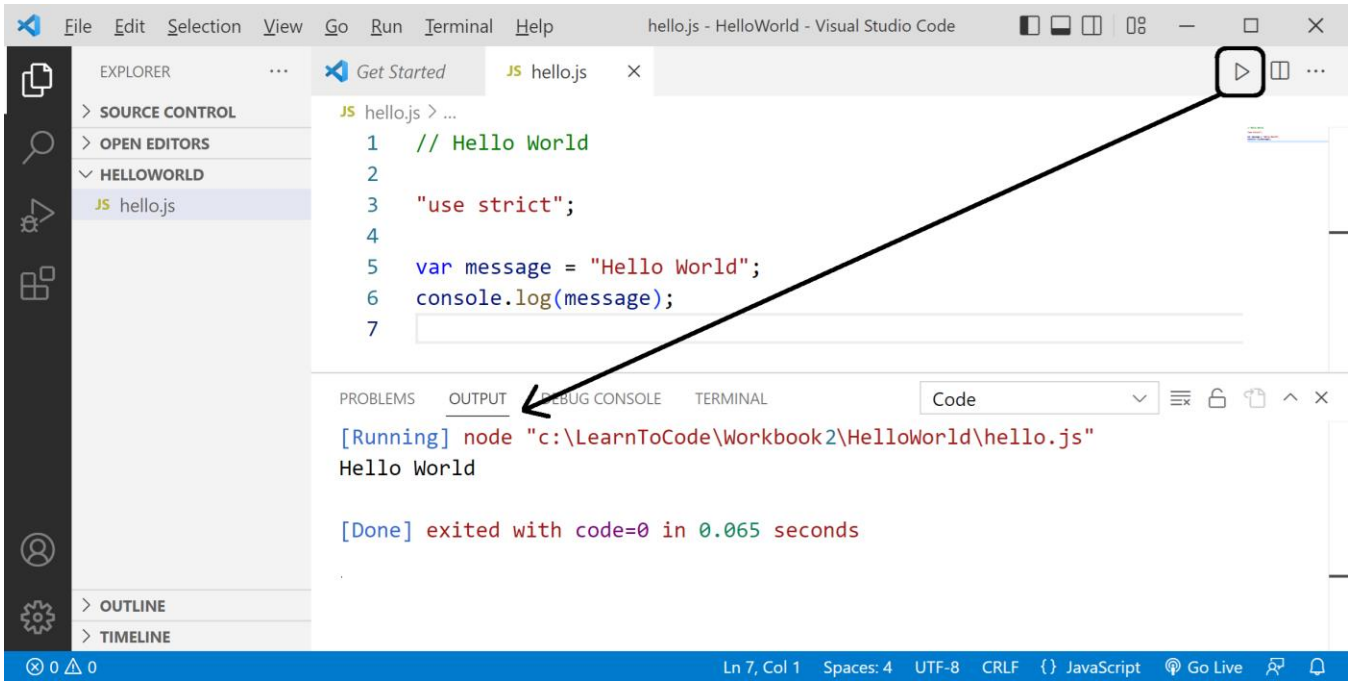
  - You can see on the far right of the menu bar, the file is named `Untitled-1`
  - To save this file, use **File > Save As** and name it `hello.js`

- **You can also click the new file icon (HELLO...) in the Explorer window on the folder to create and name a new file**

- **The file will now show up in the Explorer window**



- **To run the script, click the run icon in the top right corner and then look at the Output pane for the results**



WARNING: Sometimes CodeRunner generates an error. You can tell it is a CodeRunner error and not you if it's not YOUR file in the error message. Just re-run the script. After trying 2-3 times, sometimes you have to close VS and reopen. Yes - it is frustrating!

- Commit your changes and push your local repo to GitHub
  - NOTE: If you go to the Terminal menu, you can use the New Terminal menu option to open a command window and issue your Git commands from there
  - NOTE: If Visual Studio Code opens a Windows Command Prompt window, you can change to the Git Bash shell

Module 2

Working with Numbers

Section 2–1

Building Expressions

Expressions

- **A JavaScript expression is any set of variables, literals, and operators that evaluate to a single value**

Example

```
// assuming num1 and num2 are the names of variables

42
num1
num1 + 1
(num1 + num2) / 2
```

- **Expressions are often assigned to a variable**

Example

```
num1 = 42;
num2 = num1;
nextValue = num1 + 1;
average = (num1 + num2) / 2;
```

- **Over the next few pages, we will examine the arithmetic operators available to JavaScript programmers**
  - Over the next few weeks, we will examine other operators as well including comparison, logical, string, and more

Arithmetic Operators

- **JavaScript has both unary and binary arithmetic operators that you can use to code complex formulas**
  - An operator is binary is it has two operands
  - An operator is unary if it has a single operand

- **The binary operators include:**
  - Addition (+)
  - Subtraction (-)
  - Multiplication (*)
  - Division (/)
  - Modulo (or division remainder) (%)

Example

```
var num1 = 15, num2 = 10;
var answer;

answer = num1 + num2;          // answer is 25
answer = num1 - num2;          // answer is 5

answer = num1 * num2;          // answer is 150
answer = num1 / num2;          // answer is 1.5

answer = num1 % num2;          // answer is 5
```

- **The unary operator negate (-) allows you to reverse the sign on a number**

Example

```
var num1 = 15, num2 = -10;
var answer;

answer = -num1;                 // answer is -15
answer = -num2;                 // answer is 10
```

- **ES7 introduced an operator for exponentiation (**)**

Example

```
var num1 = 15;
var answer;

// if supported by your browser
answer = num1 ** 2;             // answer is 225
```

- **If your browser doesn't support exponentiations, we will learn another way to raise a number to a power shortly**
  - You can use `Math.pow()`
- **The operators themselves are fairly easy to understand**
  - The trick as a programmer is to find a way to use them to solve problems
- **We will spend quite a bit of time this first week trying to learn to "think like a programmer"!**

Examples: Using Arithmetic Operators

- **Addition (+)**

  Example

```
var costOfVetVisit = 70.0;
var vacinationFee = 37.50;
var totalDue = costOfVetVisit + vacinationFee;
```

- **Subtraction (-)**

  Example

```
var priceOfMeal = 72.85;
var discountCoupon = 10;
var totalDue = priceOfMeal - discountCoupon;
```

- **Multiplication (*)**

  Example

```
var pricePerGallon = 2.97;
var numberOfGallons = 11.3;
var totalDue = pricePerGallon * numberOfGallons;
```

- **Division (/)**

  Example

```
var costOfLimo = 300;
var numberOfPromGoers = 2;
var costPerPerson = costOfLimo / numberOfPromGoers;
```

- **Modulo (%)**

Example

```
// Do something if a number is even

var num = 63;
if (num % 2 == 0) {
    ...
}
```

- **Exponentiation (**)**

Example

```
var sideOfSquare = 5;
var areaOfSquare = sideOfSquare ** 2;
```

Uninitialized Variables

- **When JavaScript variables are declared, they have an initial value of `undefined`**

  Example

```
var num;
// at this point, num has the value undefined

var word;
// at this point, word has the value undefined
```

  – Because variables in JavaScript don't have a data type (like string or number), the name doesn't affect any initial value

    * If you've ever taken a C# or Java class (or many other languages), those variables are explicitly given a type (ex: `int num;  string word;`) and the initial value matches the type (0 for integers and "" for strings)

- **If you do any mathematical operation or string concatenation on a variable containing `undefined`, the result will be `NaN`**

  – `NaN` means "Not a Number"

  Example

```
var num;
num = num + 1;
   // at this point, num has the value NaN
```

- **Important: make sure your variables have values before you try and use them**

Precedence

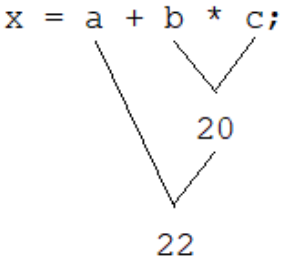
- **Operator precedence describes the order in which operations are performed in an expression**
  - It is similar to the algebraic precedence most of you learned in your early math classes

Example

```
var a = 2;
var b = 5;
var c = 4;

var x = a + b * c;          // result is 22
```

- **How did we come up with answer? Multiplication and division have higher precedence than addition and subtraction**



- **Precedence can be changed by using parentheses**

Example

```
var a = 2;
var b = 5;
var c = 4;

var x = (a + b) * c;        // result is 28
```

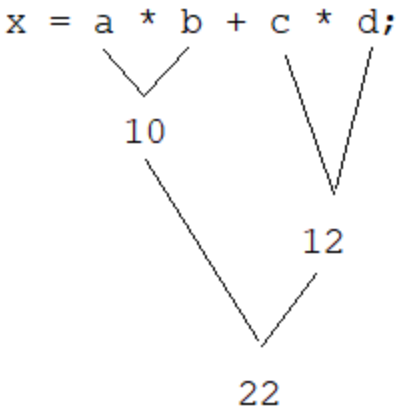
- **When operations have the same precedence, they are performed left to right**

Example

```
var a = 2;
var b = 5;
var c = 4;
var d = 3;

var x = a * b + c * d;          // result is 22
```

- **How did we calculate that result?**



Exercises

EXERCISE 1

In this exercise, you will use Visual Studio Code to create and then run a script.

SAMPLE PROBLEM: How do you calculate the total due at a restaurant given the food cost, the tax and the tip?

FORMULA: Total Due is determined by: Food Cost + Tax + Tip

SCRIPT:

```
// sample inputs
var foodCost = 79.25;
var tax = 6.54;
var tip = 12.00;

// calculation
var totalDue = foodCost + tax + tip;

// output
console.log("The total due is " + totalDue);
```

To create the script, follow the instructions below:

1. Create a GitHub repo named `WB2-exercises`
2. Clone it to your `LearnToCode\Workbook2` folder
3. In Visual Studio Code, use the File > Open Folder menu to navigate open your `WB2-exercises` folder.
4. Create a code file named `tips.js`.
5. Now type the following code into the file:

```
// sample inputs
var foodCost = 79.25;
var tax = 6.54;
var tip = 12.00;

// calculations
var totalDue = foodCost + tax + tip;

// output
```

```
console.log("The total due is " + totalDue);
```

6. Use the File > Save menu to save your script.

7. There are two ways to run your code. You can click the run icon like you did in the last module or you can use the Run > Start Debugging menu to run your script. You will see the output in a window at the bottom.

8. Now change the `console.log()` statement to the following to see how to build more complicated output.

```
console.log(
   "Food cost is " + foodCost + " and tax is " + tax);
console.log("Tip is " + tip);
console.log("Total Due is " + totalDue);
```

9. Use File > Save to save your script changes and then re-run your script.

   Do you see how the tip amount doesn't have two digits to the right of the decimal point? Replace the line that displayed the tip amount with the following.

```
console.log("Tip is " + tip.toFixed(2));
```

   Save your script and re-run it. Does it look better?

10. When you are finished, continue adding scripts files to this folder.

EXERCISE 2

Create a subfolder in `WB2-exercises` named `MathScripts`. All of the scripts you write in this exercise will go in files under this folder.

For this exercise, gather in small groups to find formulas and the code scripts. Note: VS Code runs the script that is in the currently open editor window.

1. How do you calculate your net worth given your assets and debts? Figure out the formula and what the script would look like.

   Now, code your script in a file named **`net_worth.js`**

Your output should be formatted as follows:

```
Your net worth is some-number
```

When everyone on your team gets the script working, commit your changes and move on.

2. How do you calculate the area of a rectangle? Figure out the formula and what the script would look like.

   Now, code your script in a file named **`area_of_rectangle.js`**

   Your output should be formatted as follows:

   ```
   The area of the rectangle is some-number
   ```

   When everyone on your team gets the script working, commit your changes and move on.

3. How do you calculate the tip amount of a food bill given the tip percentage?

   Now, code your script in a file named **`tip_amount.js`**

   Your output should be formatted as follows:

   ```
   The tip on a $some-number food bill is $some-number
   ```

   When everyone on your team gets the script working, commit your changes and move on.

4. How do you calculate the area of a circle?

   Now, code your script in a file named **`area_of_circle.js`**

   Your output should be formatted as follows:

   ```
   The area of a circle with radius some-number is some-number
   ```

   When everyone on your team gets the script working, commit your changes and move on.

5. How long will it take a savings account worth X to double in value given an interest rate of IR? (Hint: look up the rule of 72)

   Now, code your script in a file named **`rule_of_72.js`**

   Your output should be formatted as follows:

   ```
   At a some-number% interest rate, your savings account will be
   worth some-number in some-number years
   ```

   Show your doubled balance with 2 digits to the right of the decimal point by calling `.toFixed(2)`. Also show your years with 1 digit to the right of the decimal point using a similar technique.

   When you get the script working, commit your changes.

DON'T FORGET: commit your changes when you finish these exercises.

The `Math` Object

- **The JavaScript `Math` object allows you to perform mathematical tasks**

- **It contains a property named PI**
  - `Math.PI` returns PI (approx. 3.14159)

Example

```
var radius = 5;
var areaOfCircle = Math.PI * (radius ** 2);
```

- **It has algebraic functions that feel familiar, including:**
  - `Math.abs(x)` returns the absolute value of x
  - `Math.pow(x, y)` returns the value of x to the power of y
  - `Math.sqrt(x)` returns the square root of x

Example

```
var originalPrice = 9.97;
var newPrice = 12.50;
var difference = Math.abs(originalPrice - newPrice);
```

Example

```
var radius = 5;
var areaOfCircle = Math.PI * Math.pow(radius, 2);
```

Example

```
var num = 5;
var sqrtOfNum = Math.sqrt(num);
```

- **It has functions that will return the round or truncate numbers, including:**
  - `Math.ceil(x)` returns x rounded up to the nearest integer
    - With `ceil`, 7.8 becomes 8 and -7.8 becomes -7
  - `Math.floor(x)` returns x rounded down to the nearest integer
    - With `floor`, 7.8 becomes 7 and -7.8 becomes -8
  - `Math.round(x)` rounds a number to the nearest integer
    - With `round`, 7.8 becomes 8 and -7.8 becomes -8
  - `Math.trunc(x)` returns the integer part of a number
    - With `trunc`, 7.8 becomes 7 and -7.8 becomes -7

Example

```
var numPeople = 118;

var numDozenDonuts = numPeople / 12;   // returns 9.83333

numDozenDonuts = Math.ceil(numDozenDonuts);   // returns 10
```

Example

```
var billTotal = 82.47;
var tipAmount = billTotal * 0.2;

var totalToPay = billAmount + tipAmount;   // returns 98.964

// pay with dollar bills (no change); cheapskate
totalToPay = Math.floor(totalToPay);   // returns 98
```

- **It has functions that will return the smaller or largest of a set of numbers:**

- `Math.min(x, y, ..., n)` returns the number with the lowest value
- `Math.max(x, y, ..., n)` returns the number with the highest value

Example

```
var test1 = 92, test2 = 98, test3 = 82;

var lowestTestScore = Math.min(test1, test2, test3);
var highestTestScore = Math.max(test1, test2, test3);
```

- **It has a function that returns a random number:**
  - `Math.random()` returns a random number between 0 and 1

Example

```
var randNum = Math.random();

// scale this to a number of seconds between 10-15
var numSec  = 10000 + (randNum * 5000);

// now schedule an ad to change after numSec time period
```

- **It also has many trigonometric functions, including**
  - `Math.sin(x)` returns the sine x
  - `Math.cos(x)` returns the cosine x

Rounding Floating Point Numbers

- **The `Math.round()` function returns the value of a number rounded to the nearest integer**

Example

```
var num1 = 18.49, num2 = 18.5;

var x = Math.round(num1);       //  18
var y = Math.round(num2);       //  19
```

- **Rounding numbers with decimal precision requires a little calculation (i.e. 2 digits to the right of the decimal point)**
  - Here are two techniques

Example

```
var price = 7.99;
var taxRate = .0825;

var tax = price * taxRate;   // returns .659175

// Multiply by 100 and then round to an integer to lose the
// extra digits. Then divide by 100 to move the decimal point

tax = Math.round(tax * 100) / 100;   // returns .66
```

Example

```
var price = 7.99;
var taxRate = .0825;
var tax = price * taxRate;   // returns .659175

// The toFixed(2) method call returns the value as a
// string with 2 digits to the right of the decimal
// point.  parseFloat() turns the string back to a number

tax = parseFloat(tax.toFixed(2));   // returns .66
```

Exercises

Continue adding these exercises to `MathScripts`.

EXERCISE 1

These problems will be a little harder. Gather in groups of 2 or 3 to find work together. However, after you figure out the formulas, try to code the scripts individually.

1. How do you convert a Fahrenheit temperature into Celsius?

   Code the script in a file named **`f_to_c.js`**

2. How do you convert a Celsius temperature into Fahrenheit?

   Code the script in a file named **`c_to_f.js`**

Now wait for all of your team members to get finished. Review each other's code. Were they similar? The smaller a program is, the more likely the code is to be very similar.

Now, continue the process:

3. Federal taxes are 23% of your salary every month. You make X amount of money. How much is withheld for taxes?

   Code the script in a file named **`taxes.js`**

   Make sure not to display partial pennies. Display taxes with 2 digits of precision using `toFixed()`.

4. How do you find the distance between (x1,y1) and (x2,y2)?

   Code the calculate distance in a script named **`distance.js`**

Now wait for all of your team members to get finished. Review each other's code. If anyone is struggling, discuss how you solved the problem with them.

Now, continue one more time:

5. You have a room whose dimensions are length x width feet. You are going to tile the room and there are 12 1 foot x 1 foot tiles per box. How many boxes of tiles do you need? You cannot by a partial box.

   You want to by 10% more tiles than you actually need to handle chips, breakage, and mess-ups. How many boxes will you buy?

   Code the script in a file named **`tiles.js`**

6. There are X people going on a tour. Charter vans seat 15 passengers each. How many vans do you need? Vans cost $250 day to rent (including cost of the driver). How much will it cost to rent the vans? What is that cost if you split it per person?

   Code the script in a named **`rentals.js`**

   Test your script with 38 people. Now do some hand calculations. How much money did your script say you had to charge per person? _____ If you multiply that out, how much did you collect? _____ How much were the vans? _____ Why do you have leftover money?

   _____

   _____

DON'T FORGET: commit your changes when you finish these exercises.

Pre/Post Increment/Decrement

- **JavaScript has four unusual operators**
  - pre-increment
  - post-increment
  - pre-decrement
  - post-decrement

- **Let's start with the pre- and post- increment operator (++)**
  - At their simplest, they add one to a number

Example

```
var num1 = 1;
var num2 = 1;
var num3 = 1;

// one way to increment a number
num1 = num1 + 1;

// another way to increment a number
++num2;          // pre-increment

// a third way to increment a number
num3++;          // post-increment
```

- **But there is a difference between the pre- and post-increment operators**
  - You will see it when you try to use them in a more complex expression

Example

```
var x = 5;
var y;

// when you use pre-increment, it does the increment first
// before the other operators
y = ++x;

   // increment x first (now x is 6)
   // then assign x to y (so y is 6 too)
```

Example

```
var x = 5;
var y;

// when you use post-increment, it does the increment after
// the other operators
y = x++;

   // first assign x to y (so y is 5)
   // then increment x (so x is 6)
```

- **The same concept would hold with the pre- and post-decrement operator (--)**

Example

```
var num = 5;

--num;           // num is now 4
num--;           // num is now 3
                 // no apparent difference between them
```

Example

```
var x = 5;
var y;

// when you use pre-decrement, it does the decrement first
// before the other operators
y = --x;

   // decrement x first (now x is 4)
   // then assign x to y (so y is 4 too)
```

Example

```
var x = 5;
var y;

// when you use post-decrement, it does the decrement after
// the other operators
y = x--;

   // first assign x to y (so y is 5)
   // then decrement x (so x is 4)
```

- **These operators are mostly used when writing loops**

Example

```
for (var i = 1; i <= 10; i++) {

}
```

– We will see loops in the next few week

Assignment Operators

- **The basic JavaScript assignment operator simply moves a value from one variable into another**

Example

```
var x = 5;
var y;

y = x;
```

- **But JavaScript also has assignment operators that also include a math aspect**
  - For example, += adds the value on the right to the variable on the left

Example

```
var onHand = 10;
var qtyReceived = 6;

onHand += qtyReceived;
```

  - These type of assignment operators exist for all of the arithmetic operators we've examined so far (ex: += -= *= /= %=)

Example

```
var onHand = 62;
var qtyPurchased = 6;

onHand -= qtyPurchased;
```

Precedence (again)

- **With what we know, our precedence char has now expanded to include:**

OPERATOR	ASSOCIATIVITY
`()`	left-to-right
`++  --`	
`- (negation)  + (unary plus)`	right-to-left
`*  /  %`	left-to-right
`+  -`	left-to-right
`=  +=  -=  *=  /=  %=`	right-to-left

Section 2–2

Parsing Strings into Numbers

Parsing Strings into Numbers

- **You can't perform mathematical operations on strings**
  - + performs concatenation when the operands are strings

Example

```
var x = "123";
var y = "456";
var z = x + y;
console.log(z);       // displays 123456
```

- **JavaScript has several functions that can parse a string value and return the numeric equivalent, including**
  - `parseInt()` parses a string and returns an integer
  - `parseFloat()` parses a string and returns a floating point number
  - `Number()` parses a string and returns a number value

- **You will need these functions quite a bit when you start building web pages and let users enter data in forms**
  - Why? Because for fields return strings no matter what type of data the user entered!

Using `parseInt()`

- **`parseInt()` parses a string and returns an integer**
  - An integer is a whole number (ex: 7, 1023, or -17)

Example

```
var hrsWorked = "33";                // a String object

hrsWorked = parseInt(hrsWorked);     // now a Number object
```

- **Leading and trailing spaces are allowed**

Example

```
var hrsWorked = "  33  ";

hrsWorked = parseInt(hrsWorked);          // value is 33
```

- **If the first character can't be converted to a number, `parseInt()` returns `NaN`**
  - You will then have to use an `if` to detect the issue and respond accordingly

Example

```
var hrsWorked = "Thirty three";

hrsWorked = parseInt(hrsWorked);          // value is NaN

if (isNaN(hrsWorked)) {
   // tell user about the problem with hrsWorked
}
```

Example

```
var a = parseInt("10.00");          // a is 10
var b = parseInt("10.33");          // b is 10
var c = parseInt("10 11 12");       // c is 10
var d = parseInt("10 years ago");   // d is 10
var e = parseInt("over 10");        // e is NaN
```

- **If the string begins with `0x`, it assumes base 16**
  - Color codes are often specified using base 16, or hexadecimal as it is usually called
    - For example, `0xFF0000` is red, `0x00FF00` is green, `0x0000FF` is blue, and `0x808080` is gray
  - However, we will not have to convert hex into decimal in this class

Example

```
var a = parseInt("0x3FA2");    // a is 16290 in base 10
```

Using `parseFloat()`

- **`parseFloat()` parses a string and returns a floating point number**
  - A floating point number can have a decimal point (ex: 7.123, .000505, or -17.2)

Example

```
var payRate = "10.75";              // a String object

payRate = parseFloat(payRate);      // now a Number object
```

- **Leading and trailing spaces are allowed**

Example

```
var payRate = "  10.75  ";          // a String object
payRate = parseFloat(payRate);      // now a Number object
```

- **If the first character can't be converted to a number, `parseFloat()` returns `NaN`**

Example

```
var a = parseFloat("10.00");            // a is 10
var b = parseFloat(".33");              // b is .33
var c = parseFloat("10.5  11.6");       // c is 10.5
var d = parseFloat("10.5 years ago");   // d is 10.5
var e = parseFloat("over 10");          // e is NaN
```

Using `Number()`

- **`Number()` converts different object values to their numeric equivalent**
  - Strings (containing numbers) are parsed to numeric values
  - Booleans are parsed to numbers
    - true is 1 and false is 0
  - Dates are parsed to a numbers (which is a millisecond value)

Example

```
var a = Number("123");          // a is 123
var b = Number("45.67");        // b is 45.67
var c = Number("40 years");     // c is NaN

var d = Number(true);           // d is 1
var e = Number(false);          // e is 0

var f = new Date(1990, 5, 20);
var g = Number(f);              // g is 1561006800000
```

- **Used like shown below, it can convert the *type of* object a variable refers to!**

Example

```
var payRate = "10.75";     // payRate references a String object

payRate = Number(payRate); // now it references a Number object
```

Unary + Also Converts to Number

- **You can also use the unary + to convert a value to a number**
  - It can convert string representations of numbers, as well the values `true`, `false`, and `null`
    - `true` is converted to 1 and `false` is converted to 0
    - `null` is converted to 0

Example

```
var payRate = "10.75";          // a String object

payRate = +payRate;             // now a Number object
```

Exercises

Create a new subfolder in `WB2-exercises` named `NumericConversions`. This exercise should be placed there.

EXERCISE 1

Create a script named `conversion_tests.js` file. Add a comment the top the script using the format below:

```
// Description:  This script tests various numeric
//               conversion techniques
// Author: Jordan Q. Newprogrammer
```

Define the following variables in your script:

```
var a = "  101.1   ";
var b = "55";
var c = "402 Stevens";
var d = "Number 5  ";
```

Now, perform the following tasks:

1. Convert each using `parseInt()` and display the results
2. Convert each using `parseFloat()` and display the results
3. Convert each using `Number()` and display the results
4. Convert each using the unary + operator and display the results

Was the output of each what you expected? Complete the following table with your answers.

Expression	parseInt() result	parseFloat() result	Number() result	Unary + result
`"  101.1   "`				
`"55"`				
`"402 Stevens"`				
`"Number 5  "`				

DON'T FORGET: commit your changes when you finish these exercises.

Module 3

Programming with Conditionals

Section 3–1

Making Decisions with an `if/else`

Making Decisions using the `if` Statement

- **Up until now, all of our logic has been sequential**
  - Step 1, step 2, step 3!

- **In JavaScript, you can use an `if` statement to perform actions based only when specified conditions are true**

Syntax

```
if ( /* some condition */ )
   single-statement;
```

- **In order to build the condition, you have to use comparison operators**
  - Comparison operators are used to see how two values relate to each other

Comparison Operators

- **The more commonly used comparison operators are:**
  - == returns true if the values are equal
  - != returns true if the values not are equal
  - > returns true if the first value is greater than the second
  - >= returns true if the first value is greater than or equal to the second
  - < returns true if the first value is less than the second
  - <= returns true if the first value is less than or equal to the second

Example

```
var numKids = 12;
var price;

price = numKids * 9.95;    // price is $9.95/kid

if (numKids >= 6) {
   price = price * .9;     // a 10% discount
}
console.log(price);
```

Example

```
var amount = 12.50;
var tax = amount * .08;          // 8% sales tax
var taxExempt = false;           // a Boolean variable
...

if (taxExempt == true) {
   tax = 0;
}
console.log(tax);
```

Using the `if` Statement

- **If you want to execute more than one line of code in the `if`, you must place them in between curly brackets**

Syntax

```
if ( /* some condition */ ) {
   statement(s);
}
```

Example

```
var numKids = 12;
var price;

price = numKids * 9.95;    // price is $9.95/kid

if (numKids >= 6) {
   price = price * .9;     // a 10% discount
}
console.log(price);
```

- **Best practice is to always use curly brackets**

Using the `if / else` Statement

- **In JavaScript, your `if` statement can have an `else`**
  - The `else` specifies an action you want to perform when the `if` statement is false

Syntax

```
if ( /* some condition */ ) {
   statement(s);
}
else {
   statement(s);
}
```

Example

```
var amount = 12.50;
var taxExempt = /* value not shown */;

var tax;
var totalDue;
...

if (taxExempt == false) {
   tax = amount * 0.08;         // 8% tax rate
}
else {
   tax = 0;
}

totalDue = amount + tax;
console.log(totalDue);
```

Exercises

Create a new folder in `WB2-exercises` named `IfScripts`. These exercises should be placed there.

EXERCISE 1

In a file named `pay_rules.js`, create a script to calculate gross pay given the variables `payRate` and `hoursWorked`. If the person works more than 40 hours, pay the overtime hours at 1.5 times the rate of regular hours.

When you are finished, review your script with a colleague. Are your algorithms similar? Do you believe each other's code will work?

Run your script several times with different values for `payRate` and `hoursWorked` and confirm the output is right.

Examples of good test data might be:

Pay Rate	Hours Worked	Gross Pay	Reason
`12.50`	`20`	`250.00`	Under 40 hours
`25.00`	`40`	`1000.00`	Exactly 40 hours
`17.30`	`45`	`821.75`	Over 40 hours

(Optional - Challenge!!) EXERCISE 2

In a file named `gregorian_calendar.js`, create a script to determine whether a given year is a leap year in the Gregorian calendar. You will need to do a little research to determine what makes a year a leap year.

When you are finished, review your script with a colleague. Are your algorithms similar? Do you believe each other's code will work?

Run it several times with different values for the year. Make sure to test the years 1900, 1950, 1999, 2000, 2001 and 2012.

DON'T FORGET: commit your changes when you finish these exercises.

Using an `if / else / if` Statement

- **Sometimes, you must look through a set of mutually exclusive conditions to make a decision**
  - You may need to chain your `if/else` statements

Syntax

```
if (condition1) {
  //  executed if condition1 is true
}
else if (condition2) {
  //  executed if condition1 is false
  //  and condition2 is true
}
else {
  // executed if none of the above is true
}
```

Example

```
var name = "Robert";
var nickname;

if (name == "Andrew") {
   nickname = "Andy";
}
else if (name == "Robert") {
   nickname = "Bob";
}
else if (name == "Cynthia") {
   nickname = "Cindy";
}
else {
   nickname = name;
}
```

Example

CLASSIFICATION	HOURS EARNED
Freshman	0 - 29
Sophomore	30 - 59
Junior	60 - 89
Senior	90+

```
var hoursEarned = 103;
var classification;

if (hoursEarned <= 29) {
   classification = "Freshman";
}
else if (hoursEarned <= 59) {
   classification = "Sophomore";
}
else if (hoursEarned <= 89) {
   classification = "Junior";
}
else {
   classification = "Senior";
}
```

Exercises

Continue working in the `IfScripts` folder

EXERCISE 1

Create a script named `greeting.js`. Define a variable that contains the current hour (0- 23). Display one of the greetings below based on the current hour.

Time	Greeting
until 10:00AM	Good morning!
10:00AM to 4:59PM	Good day!
5:00PM or later	Good evening!

Remember to run the script several times with different values for the hour.

EXERCISE 2

Now, create a script named `complex_taxes.js` that will calculate federal tax based on the values of annual gross income (a number) and a filing status ("Single" or "Joint").

Start by copying your gross pay calculation code from the earlier lab and including it here. That code calculates a WEEKLY gross pay. Use that number to estimate ANNUAL gross pay (multiply by 52!) and save it in a new variable.

Now use a series of `if` statements to determine and save the TAX RATE.

The tax table for single filers is:

Annual Income Range	Tax Rate
under 12,000	5%
12,000 - 24,999.99	10%
25,000 - 74,999.99	15%
75,000 and over	20%

The tax table for joint filers is:

Annual Income Range	Tax Rate
under 12,000	0%
12,000 - 24,999.99	6%
25,000 - 74,999.99	11%
75,000 and over	20%

Use the tax rate to determine the tax withheld from the WEEKLY gross pay. The output of your script might resemble:

```
You worked 45 hours this period.
Because you earn $10.00 per hour, your gross pay is $475.00
Your filing status is Single
Your tax withholdings this period is $47.50
Your net pay is $427.50
```

To truly test you code, you will need to run it more than once with different values for hours worked, pay rate and filing status.

Examine the tax tables and see if you can determine a set of good test values. Discuss it with your small group. Then test!

DON'T FORGET: commit your changes when you finish these exercises.

Making And / Or Decisions

- **Sometimes your decisions are complicated and must incorporate several pieces of information before you can make a decision**
  - For example, if I'm in the city of Marietta and the state is Georgia, do one thing. But if the state is Texas, do something else.

- **JavaScript has AND (`&&`) and OR (`||`) operators to help with this**
  - When using AND, an expression is true only of both parts are true

Example

```
var city = /* some value */;
var state = /* some value */;

if (city == "Marietta" && state == "Georgia") {
   // do something
}
```

  - When using OR, an expression is true if either part is true

Example

```
var state = /* some value */;

if (state == "Texas" || state == "Maryland") {
   // do something
}
```

Exercises

Continue working in the `IfScripts` folder.

EXERCISE 1

Create a script named `min_max.js` that displays the smallest of three numbers. Then it displays the largest of three numbers.

Name your variables `a`, `b` and `c` and give them values. Then use `if/else` statements to determine and display the answer. Do not use `Math.min()` or `Math.max()`

Change the values in the variables and run the script again.

EXERCISE 2

Create a script named `show_major.js` that defines two variables for a student: `studentName` and `studentMajor`. The `studentMajor` variable will contain the major code (ex: CSCI).

Your script will use look up the student's major code in the table below and displays the name of the major and the location of the department's office. Use the following:

Major Code	Name of Major	Department Office
BIOL	Biology	Science Bldg, Room 310
CSCI	Computer Science	Sheppard Hall, Room 314
ENG	English	Kerr Hall, Room 201
HIST	History	Kerr Hall, Room 114
MKT	Marketing	Westly Hall, Room 310

Output should resemble the following, although the values displayed will depend upon your variables:

```
Student: Betty
Major: English
Advising Location: Kerr Hall, Room 201
```

What should your program do if the major code is not one of the ones in the table? Let's display `<unknown>` for both major and nothing for advising location.

Run the script several times with different values for name and major code.

DON'T FORGET: commit your changes when you finish these exercises.

`var` vs `let`

- **When JavaScript was first introduced, we used `var` to declare variables**

Example

```
var name = "Dana";
var count = 0;
var message;
```

- **ES6 introduced the keywords `let` and `const` as a replacement for `var`**
  - a variable defined using `let` is changeable
  - a variable defined using `const` is not changeable (`const` stands for constant)

Example

```
const name = "Dana";
let count = 0;
let message;

count++;                                // valid
message = "Hello " + name;              // valid

name = "Mark";                          // error: name is const
```

- **There are some differences between `var` and `let`/`const` with regard to scope**
  - It isn't significant with the skills you have thus far
  - We will talk about scope when we introduce functions

Section 3–2

Making Decisions with a `switch`

The `switch` Statement

- **The `switch` statement can be used to make decisions too, but it works differently**
  - The value of a variable or expression is compared against values listed in `case` statements
  - If a match is found, it executes the code in the `case` statement

Syntax

The `break` statement is used to direct flow to the end of the `switch` once the `case` has executed.

```
switch(expression) {
  case value1:
    // code block
    break;
  case value2:
    // code block
    break;
  default:
    // code block for none of the above
}
```

Using the `switch`

Example

```
let dayNum = 3;
let dayName;

switch (dayNum) {
  case 0:
    dayName = "Sunday";
    break;
  case 1:
    dayName = "Monday";
    break;
  case 2:
    dayName = "Tuesday";
    break;
  case 3:
    dayName = "Wednesday";
    break;
  case 4:
    dayName = "Thursday";
    break;
  case 5:
    dayName = "Friday";
    break;
  case 6:
    dayName = "Saturday";
    break;
  default:
    dayName = "<unknown>";
    break;                          // this break isn't "needed"
                                    // but is included for style
}
```

- **The last `case` doesn't have to have a `break` statement**

- **If more than one case perform the same actions, you can group them together as shown below**
  - If the `case` statement doesn't have a `break`, the code will "fall into" the next case

Example

```
let dayNum = 3;
let dayName;

switch (dayNum) {
  case 0:
  case 6:
    dayName = "Weekend";
    break;
  case 1:
  case 2:
  case 3:
  case 4:
  case 5:
    dayName = "Weekday";
    break;
  default:
    dayName = "<unknown>";
}
```

Exercises

Create another subfolder in `WB2-exercises` named `SwitchScripts`. These exercises should be placed there.

EXERCISE 1

Write a script named `dept_converter.js` that uses a `switch` statement to determine and print a department name based on a department code.

Assume the following department codes:

1	Marketing
5	Human Resources
10	Accounting
12	Legal
18	IT
20	Customer Relations

Test your script with several different codes.

(Optional) EXERCISE 2

Recode the login from `show_major.js` in a new file called `show_major2.js`. This time, use a `switch` instead of `if` statements.

DON'T FORGET: commit your changes when you finish these exercises.

Module 4

JavaScript in the Browser

Section 4–1

Building HTML Pages that Use JavaScript

Console Scripts vs Browser-Based Apps

- **So far this week, we have focused on the syntax of JavaScript and created many scripts that do math and make decisions**
  - We placed these scripts in our `LearnToCode` repo
  - We ran them using CodeRunner
- **Now it is time to see how to use JavaScript within a browser**
  - We will combine HTML/CSS/Bootstrap and JavaScript to create dynamic web sites
- **In these browser-focused demos and exercises, we will use a different project structure**
- **To get started with this module, create a folder under `WB2-exercises` named `HelloWorldWebsite`**
  - We will do a few demos before we get to the exercises

The <script> Element

- **To include JavaScript in a web page, you must use a <script> element to include it**

- **The <script> element can:**
  - contain the script
  - point to an external script file

- **Code in script runs when the HTML loading process encounters the script**

Example

We placed the <script> at the bottom of the body in this example so that the messageDiv was created before the script tried to reference it.

```
<html>
  <head>
    <title>Demo</title>
  </head>
  <body>
    <div id="messageDiv"></div>

    <script>
      const messageDiv = document.getElementById("messageDiv");
      messageDiv.innerHTML = "Hello World!";
    </script>
  </body>
</html>
```

- **IN-CLASS DEMO: In your `HelloWorldWebsite` folder, create a subfolder named `SimpleVersion`.**
  - Within `SimpleVersion`, create an `index.html` file and add the code just shown to it

- To run it, right click on the HTML file in the editor window and choose Run with Live Server
- Commit your local changes

JavaScript Functions

- **Before we can start adding code to web pages, we need to take a peek at JavaScript functions**

- **A JavaScript function is a block of code that is designed to perform a specific task when called**

- **In its simplest form, a JavaScript function is defined using:**
  - the keyword `function`
  - the name of the function
  - a set of parentheses `( )`.
  - a set of curly brackets `{ }` that contains the body of the function

Syntax

```
function function_name() {
   // code to executed
}
```

Example

```
// This is the function
function showGreetingInConsole() {
   let message = "Hello world!";
   console.log(message);
}
```

- **You call the function by using its name, followed by parenthesis**

Example

```
// This is a call to the function

showGreetingInConsole();
```

- **We use JavaScript functions quite a bit, especially when adding dynamic behavior to a web page**

External Scripts

- **Instead of embedding the script in the page, you can move it into a function in an external file**
  - Code in the HTML page can then "call" the function

- **NOTE: If you specify a value for the `src` attribute, the `<script>` element must be empty!**

Example

HTML

```
<html>
  <head>
    <title>Demo</title>
  </head>
  <body>
    <div id="messageDiv">
    </div>
    <script src="greetings.js"></script>
  </body>
</html>
```

greetings.js

```
"use strict";

function showGreeting() {
   let messageDiv = document.getElementById("messageDiv");
   messageDiv.innerHTML = "Hello World!";
}

showGreeting();
```

  - When the script is loaded, any code NOT in a function runs right then -- and in this case the `showGreeting()` function call executes

- **IN-CLASS DEMO: Add a new subfolder to `HelloWorldWebsite` named `BetterVersion`**
  - Within it, add the code just shown
  - To run it, right click on the HTML file in the editor window and choose Run with Live Server

DON'T FORGET: commit your changes when you finish these demo.

Organizing Scripts

- **Many people like to organize their script files into a subfolder in the web site**

  Example

  If the site had a subfolder named `scripts`, it would be used in the `<script>` tag's `src` attribute

```
<script src="scripts/greetings.js"></script>
```

- **Using a `scripts` folder is considered a best practice**

- **IN-CLASS DEMO: Modify your `BetterVersion` to have the script be in a `scripts` folder**

  – To run it, right click on the HTML file in the editor window and choose Run with Live Server

Section 4–2

Interacting with Page Elements

Accessing Elements on the Page using `getElementById`

- **To interact with an HTML element programmatically, you must have a reference to it**

- **`document.getElementById` is the most efficient way to get a reference to an HTML element if the element has an `id` attribute**

- **Often, we hold the reference in a variable defined using `const`**
  - `const` variables that reference form elements can't be changed to reference other elements

Example

HTML

```
<div id="messageDiv"> ... </div>
<input type="text" id="nameField" />
<input type="text" id="ageField" />
<input type="button" id="clickMeBtn" value="Click Me" />
```

JavaScript

```
const messageDiv = document.getElementById("messageDiv");
const nameField = document.getElementById("nameField");
const ageField = document.getElementById("ageField");
const clickMeBtn = document.getElementById("clickMeBtn");
```

- **If an element with the specified `id` doesn't exist on the page, `getElementById` returns `null`**

Working with Contents of an Element using `innerHTML`

- **You can set or get the value of an HTML element using it's `innerHTML` property**
  - This is used most often with `<p>`, `<span>` or `<div>` elements

Example

HTML

```
<p id="orderStatusPara"></p>
```

JavaScript

```
let orderNum = 10254;
let orderStatus = "processing";

let message =
   "Order " + orderNum + "'s status is: " + orderStatus;

const orderStatusPara =
    document.getElementById("orderStatusPara");
orderStatusPara.innerHTML = message;
```

- **JavaScript string interpolation can simplify the message**
  - Use backticks around the string and place variables/values you want inserted between **`${ expression-here }`**

JavaScript

```
let orderNum = 10254;
let orderStatus = "processing";

let message =
   `Order ${orderNum}'s status is: ${orderStatus}`;

const orderStatusPara =
   document.getElementById("orderStatusPara");
orderStatusPara.innerHTML = message;
```

Working with `<input>` Elements

- **If you want to get or set the value of an `<input>` element, you must:**
  - get a reference to the form field using `getElementById`
  - use the reference to access the `value` property
    - the `value` property is a string

- **We usually want to process user input after they have had a change to enter the data**
  - Often, we process user input when they click a button

Example

HTML

```
<p>Name <input type="text" id="nameField" /></p>
<p>Age <input type="text" id="ageField" /></p>
<p><input type="button" id="showBtn" value="Show" /></p>

<p id="messagePara"></p>
```

JavaScript

```
// We would want this code to run when the user clicks the Show button

const nameField = document.getElementById("nameField");
const ageField = document.getElementById("ageField");

let name = nameField.value;
let age =  ageField.value;      // age is a string here

let message =
  `Hi ${name}! I hear you are ${age} years old!`;

const messagePara = document.getElementById("messagePara");
messagePara.innerHTML = message
```

- **You can also put a value into the element using `value`**
  - Because the `value` property returns a string, you may have to convert it to a number to use it in a mathematical equation

Example

HTML

```
<p>Year you were born:
  <input type="text" id="yearBornField" />
</p>
<p>
  <input type="button" id="findAgeBtn" value="Find Your Age" />
</p>
<p>Age on Dec 31:
  <input type="text" id="ageField" readonly />
</p>
```

JavaScript

```
// We would want this code to run when the user clicks the
// "Find Your Age" button

let currentYear = 2021;

const yearBornField = document.getElementById("yearBornField");
let yearBorn = Number(yearBornField.value);

let ageAtYearEnd = currentYear - yearBorn;

const ageField = document.getElementById("ageField");
ageField.value = ageAtYearEnd;
```

- **Any script you created and ran with CodeRunner could be turned into a cool, yet simple, web page**

Example

HTML

```
<p>Hours worked: <input type="text" id="hrsWorkedField" /></p>
<p>Pay rate: <input type="text" id="payRateField" /></p>
```

```
<p><input type="button" id="calcPayBtn"
          value="Calculate Your Pay" /></p>

<p id="resultPara"></p>
```

JavaScript

```
// We would want this code to run when the user clicks the
// "Calculate Your Pay" button

const hrsWorkedField =
   document.getElementById("hrsWorkedField");
const payRateField = document.getElementById("payRateField");

let hrsWorked = Number(hrsWorkedField.value);
let payRate = Number(payRateField.value);

let pay = hrsWorked * payRate;

const resultPara = document.getElementById("resultPara");
resultPara.innerHTML = `Pay is $${pay.toFixed(2)}`;
```

Combining Finding the HTML Element and Getting the Value

- **So far, we've shown a two-step process: 1) find the HTML element and then 2) get its value**

Example

```
// Find the fields
const nameField = document.getElementById("nameField");
const ageField = document.getElementById("ageField");

// Get the values
let name = nameField.value;
let age = ageField.value;

// Use the values
let message = name + " is " + age;
```

- **But you don't necessarily need to put the value from the HTML element into a separate variable**

Example

```
// Find the fields
const nameField = document.getElementById("nameField");
const ageField = document.getElementById("ageField");

// Use the values
let message = nameField.value + " is " + ageField.value;
```

- **You can even get the value and use it in one step if you don't think you'll need a reference to the HTML element**

Example

```
// Use the values
let message = document.getElementById("nameField").value +
   " is " + document.getElementById("ageField").value;
```

Section 4–3

Event Handling

Events

- **Events are notifications of things that happen to elements on the web page**

- **For example:**
  - the user has "clicked" a button
  - an input field has lost focus
  - the web page has finished loading

- **You can react to these events in JavaScript by writing *event handlers***
  - An event handler is a JavaScript function that executes when the event occurs

- **There are several ways to define event handlers and we will see some of them over the next few pages**
  - We will see even more as the course progresses

Event Attributes

- **HTML elements have attributes that allow you to assign event handlers**

- **Some of the event attributes include:**
  - `onload` - runs code when the browser has finished loading the page
  - `onclick` - runs code when the user clicks an HTML element
  - `onchange` - runs code when an HTML element has been changed
  - `onfocus` - runs code when the HTML element gains focus
  - `onblur` - runs code when the HTML element loses focus
  - `onkeydown` - runs code when the user presses a keyboard key
  - `onmouseover` - runs code when the user moves the mouse over an HTML element
  - `onmouseout` - runs code when the user moves the mouse off an HTML element

Coding Event Logic in an HTML Attribute

- **The HTML event attributes can be assigned code to execute when the event occurs**
  - For example, the `onclick` attribute of a form element can specify the code to run when the element is clicked

Example

```
<input type="button" value="Say Hello"
       onclick="alert('Hi there!');" />
```

  - ***However, this is rarely done***

- **A *slight* improvement to the code below would be to have the `onclick` attribute call a function**

Example

```
<html>
<head>
   <title>Demo</title>
   <script>
      "use strict";

      function sayHi() {
         alert("Hi there!");
      }
   </script>
</head>
<body>
   <input type="button" value="Say Hello" onclick="sayHi();" />
</body>
</html>
```

  - ***Although easier to read, code like this is still rarely written***

Assigning Event Handlers When the Window Finishes Loading

- **A common way to associate an event handler to an event is to programmatically assign it when the window finishes loading**
  - The `window.onload` event handler executes when the web page has completely loaded all content (including images, script files, CSS files, etc.).

Example

HTML

```
<html>
<head>
   <title>Demo</title>
</head>
<body>
   <input id="helloBtn" type="button" value="Say Hello" />

   <script src="scripts/index.js"></script>
</body>
</html>
```

JavaScript

```
"use strict";

window.onload = init;

function init() {
   const helloBtn = document.getElementById("helloBtn");
   helloBtn.onclick = onHelloBtnClicked;
}

function onHelloBtnClicked() {
   alert("Hi there!");
}
```

"Code Along" - Hello World (again)

Create a new folder under `HelloWorld` named `DynamicVersion`. This demo should be placed there.

Create a web page named `index.html`. Type the following code in the `.html` file:

```
<html>
<head>
   <title>Demo</title>
</head>
<body>
   <input id="helloBtn" type="button" value="Say Hello" />

   <script src="scripts/index.js"></script>
</body>
</html>
```

Create a subfolder named `scripts` and add `index.js` to the folder. Type the following code in the `.js` file:

```
"use strict";

window.onload = init;

function init() {
   const helloBtn = document.getElementById("helloBtn");
   helloBtn.onclick = onHelloBtnClicked;
}

function onHelloBtnClicked() {
   alert("Hi there!");
}
```

Browse to your page using `Live Server`. When you click the button, do you see the message?

Now, go back and add a `<p>` to the page with the id `messagePara`.

In your script, how can we change the code in `onHelloBtnClicked()` to place the message in `messagePara`? Try it out and retest!

DON'T FORGET: commit your changes when you finish this demo.

Important Note!

- **Because we are handling a button's `onclick` event in these examples, HTML5 validation attributes like `required` or `maxlength` will not work**

- **We will learn how to make them work in the next workbook**
  - Hint: We will have to use an HTML form, submit buttons, and handle the form's `onsubmit` event!

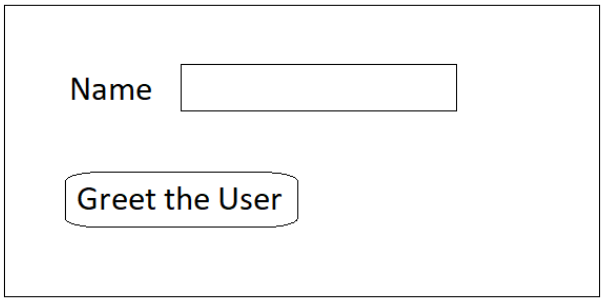
Exercises

EXERCISE 1

Now that you've typed in code exactly as we've shown, let's try writing some simple code by yourselves

Create a folder under `WB2-exercises` named `GreetByName`. This exercise should be placed there.

This page will provide a form that allows the user to enter their name. When they click a button, the greeting will be personalized for them.



Step 1: Create a web page named `index.html`. Design it like shown above. Both the input field and the button will need an `id`.

```
<p>Name <input type="text" id="nameField" /></p>

<p><input id="greetBtn" type="button"
          value="Greet the User" /></p>
```

Step 2: Create a `scripts` subfolder, then add a script named `index.js` to it.

Step 3: In `index.js`, write code to connect the `window.onload` event to an event handler named `init`.

Step 4: In the `init()` function, find the button and connect it to an event handler named `onGreetUserBtnClicked`

Step 5: Code the `onGreetUserBtnClicked()`. Within it:

- find the name text field using `getElementById`
- extracts the name from the text field
- use the name to create a string that contains "Hello *userNameHere*"
- displays the message using `alert`

Step 6: Include `index.js` in a `<script>` element at the bottom of the `<body>` element in `index.html`

Finally, test your page. What happens when you enter your name in the input field and click the button?

DON'T FORGET: commit your changes when you finish this exercise.

EXERCISE 2

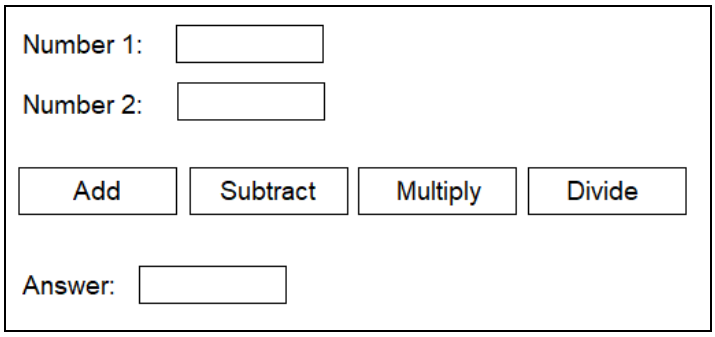
Starting now, we will place some of our "cooler" web applications in their own repos. This will allow you to build a portfolio of the increasingly complicated projects to show off!

Create a folder under `LearnToCode` named `WebProjects` . You will keep your portfolio here.

For this exercise, create a repo on GitHub named `Calculator` and clone it in `WebProjects`.

Create an `index.html` web page that provides a simple calculator to the user.

Design the page as shown below. Give your input fields the ids `number1Field`, `number2Field`, and `answerField`. Make `answerField` read only in HTML.



Create an `index.js` file and include it in the page. Include all of your JavaScript there.

Connect the `window.onload` event to an `init` function.

In the `init` event handler, find each button and assign its `onclick` to an event handler. Name the event handlers something like `onAddBtnClicked`, `onSubtractBtnClicked`, etc.

Within the click event handler for the Add button:

- extract the value from the number 1 input field and convert it to a number using `Number()`
- repeats the process for number 2
- add the two numbers together and save it in a variable
- display the results in the answer field

Test.

Once you get the Add button working, use it as a pattern for the other three buttons.

Commit your changes and push to the remote repo.

Adding a Little Error Handling

- **You might recall we said that JavaScript has a value called `NaN`**
  - It stands for **not-a-number** and happens when a conversion or math operation results in a value that isn't numeric
- **You can test for `NaN` using the `isNaN` function**
- **Adding logic to your program that detects invalid user input using this technique moves our academic programs closer to real-life programs**
- **Let's consider the calculator you just finished; it probably contains some HTML similar to this below**

Example

```
<input type="number" id="number1Field">
...
<input type="number" id="number2Field">
...
<input type="button" id="addBtn" value="Add">
...
<input type="text" id="answerField" readonly>
```

- **If we want to display a message describing user input errors, we will need to add a <p> element**

Example

```
<input type="number" id="number1Field">
<input type="number" id="number2Field">
<input type="button" id="addBtn" value="Add">
...
<input type="text" id="answerField" readonly>
<p id="messagePara"></p>
```

- **After you convert user input to a number, check its value**
  - If it is `NaN`, display a message
  - If it isn't `NaN`, calculate the answer, display the answer, and then clear any message that might be in `messagePara`

Example

```
function onAddBtnClicked() {
  // find the HTML elements
  const number1Field = document.getElementById("number1Field");
  const number2Field = document.getElementById("number2Field");
  const messagePara = document.getElementById("messagePara");

  // get user inputs
  let number1 = Number(number1Field.value);
  let number2 = Number(number2Field.value);

  // check to see if user inputs were invalid
  if (isNaN(number1) || isNaN(number2)) {
    messagePara.innerHTML =
      "One or more of your input values are invalid";
    return;  // exit the addBtnClicked function
  }

  // display the results
  let answer = number1 + number2;
  const answerField = document.getElementById("answerField");
  answerField.value = answer;

  // clear any previous error message
  messagePara.innerHTML = "";
}
```

Mini-Project

Let's put this project in its own repo to show it off for visitors to GitHub! Create a GitHub repo named `TemperatureConverter`. Clone it into a `WebProject` folder located under `LearnToCode`.

In this exercise, you will create three web pages:

- a home page
- a page with a calculator that converts Fahrenheit temperatures to Celsius
- a page with a calculator that converts Celsius temperatures to Fahrenheit

Configure the site structure by:

- adding a nav bar to all three pages that will allow navigation between them
- adding two paragraphs of lipsum text from `https://www.lipsum.com` to your home page

On the each calculator page, create an HTML form with a place for an input temperature, a convert button, and a place to put the output temperature.

Use the `window.onload` event on each page to connect the button to an event handler with a good name (ex: `onConvertBtnClicked`). Then, code the button behavior on each form.

Test your pages. Make sure you see an error message if the input temperature isn't a number.

Now add a reset button to each page. Test to make sure it clears your form

DON'T FORGET TO commit and push.