

Zip Code Wilmington's Programming in JavaScript

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Preface

I'd like to thank the instructors of ZiCodeWilmington for help editing this book: Chris Nobles, Roberto DeDeus, Tyrell Hoxter, L. Dolio Durant, and Mikaila Akeredolu. Without them, this book would have remained a "nice to have". I especially wish to thank Mikaila: without his brilliant prep session slides as the starting point for this book, I would never have thought a small book on the basic fundamentals of programming would be possible or even useful.

Zip Code Wilmington is a non-profit coding boot-camp for people who wish to change their lives by becoming proficient at coding. Find out more about us at <https://zipcodewilmington.com>

About this book

This book's aim is to provide you with the most basic of fundamentals regarding JavaScript, the world's most popular programming language. You may be aware that Zip Code doesn't focus on JavaScript *per se*, and that can leave you wondering why the first book we wrote was all about JavaScript. Well...

JavaScript: Easy to Understand

JavaScript is a fairly easy programming language to learn, and we're going to use it in this book to describe the basic fundamentals of coding. Its form is modern and it is widely used. It can be used for many purposes, from web applications to back-end server processing. We're going to use it for learning simple, programming-in-the-small, methods and concepts; but make no mistake - JavaScript is world-class language capable of amazing things.

Simple to Use

JavaScript also has the advantage that one can learn to use it without a lot of setup on a computer. In fact, we recommend use of the <repl.it> web site for the running of the JavaScript examples you'll find in this book.

Gets you focused on coding

Finally, because in this book all we aim to teach you is "programming in the small". Many of the examples here are significantly less than 20 lines in length. We want you to get

better at looking at small blocks of code to see how they work. These smaller examples and concepts are a core building block as you become proficient in coding.

You'll learn it eventually

The truth is, in today's coding world, all of us eventually learn to do things with JavaScript. So, start early, get comfortable with it, and then go on and study other computer languages like Java or Python.

Coding *The Hard Way*.

Zed A. Shaw is a popular author of several books where he describes learning a programming language *The Hard Way*. Zed suggests, and we at Zip Code agree with him wholeheartedly, that the best, most impactful, highest return for your investment when learning to code, is **type the code using your own fingers** ^[1]

That's right. Whether you are a "visual learner", a "video learner", or someone who can read textbooks like novels (are there any more of these out there?), when it comes right down to it, the best way to learn to code is **to code and to code by typing out the code with your own fingers**. This means you DO NOT do a lot of copy and paste of code blocks, you really put in the work, making your brain better wired to code by **coding with your own typing of the code**.

You may have heard a friend wistfully dream of making a career at writing. "Oh," they say, "I wish I had time to write a great novel, I want to be a writer someday".

Well, I'm here to tell you that all the excuses in the world don't stop a real writer from writing. "Oh, I have to pick up the kids" "Ran out of time, I'm so busy at work." "I had to cut the grass" and so on.

Coding, like writing, isn't something you can do when all your other chores, obligations, and entertainments are done. You must make time for coding, if you're serious about learning it. Watching hours of YouTube videos *will not* make you a coder.

Reading dozens of blog posts, Medium articles, and books *will not* make you a coder.

The only way you're going to learn to code, is by doing it. Making mistakes, fixing them, learning from what worked and what didn't.

Many have heard my often-repeated admonition: **If you coded today, you're a coder. If not, you're not a coder.** It really is as simple as that.

Dedication to the mission

I happen to be among those who feel anyone can learn to code. It's a 21st century superpower. When you code, you can change the world. Being proficient at coding can be a life-changing skill that impacts your life, your family's life and you future forever. I've seen time and time again, the ability to learn to code is evenly distributed across the population, but the opportunity to learn to code is not. So, we run Zip Code, to give people a shot at learning a 21st century superpower, no matter where you come from.

And fortune favors the prepared. Some day, you may be working at a great company, making a decent living, working with professionals in a technical job. Your friends may say "You are so lucky!"

And you will think: Nope. It wasn't luck. You'll know that truly. You got there by preparing yourself to get there, and by working to get there, working *very hard*. Ain't no luck involved, just hard work. You make your own luck by working hard.

As many know, getting a spot in a Zip Code cohort is a hard thing to do. Many try but only a few manage it. I often get asked "what can I do to prepare to get into Zip Code?"

The best way is to start solving coding problems on sites like <HackerRank>. HackerRank (among others) has many programming assignments, from extremely simple, to very advanced. You login, and just do exercise after exercise, relieving you of one of the hardest of coding frustrations, that of trying to figure out **what** to code. Solving programming assignments is a good way to start to cultivate a coding mindset. Such a mindset is based on your ability to pay very close attention to detail, a desire to continually learn, and being able to stay focused on problem solving even if it takes a lot of grit.

Spending even 20 minutes a day, making progress on a programming task can make all the difference. Day after day your skills will grow, and before long you'll look back on the early things you did and be astonished as to how simple the assignments were. You may even experience embarrassment at remembering how hard these simple exercises seemed at the time you did them. (It's okay, we've

all felt it.)

Working on code, everyday, makes you a coder. And coding everyday will help with your ability to eventually score high enough on the Zip Code admissions assessment that you get asked to final interviews.

[1] check out his terrific work: <https://learncodethehardway.org>

Programming with JavaScript

Output: console.log()

Let's start with a really simple program. Perhaps the simplest JavaScript program is

```
console.log("Hello, World!");
```

And while you might *not yet* understand this *technical description*,

it is a program of one *line* of code, which says "call the 'log' method on the 'console' object, using the string "Hello, World!" as the argument to be logged."

Logging, in this case, means *outputting* the string "Hello, World!" somewhere. That somewhere is the *console* a place JavaScript uses to communicate with a user (in this case, us, the programmers.)

(And if you haven't done it yet, go to <https://repl.it> and create an account for yourself. Once that's done you should create a JavaScript repl, a place where you can type the code from this book to the repl and run it, to see what each code snippet does.)

We will use `console.log` to do a lot in the coming pages. It's a simple statement, one that in other languages might be `print` or `write` or `puts` (and why we all cannot just agree on one way to do this, well, beats me.)

Here's your second `js` ^[2] program:

```
let milesPerHour = 55.0;  
console.log("Car's Speed: ", milesPerHour);
```

Which, if you typed into your repl and clicked the "Run >" button, you saw

```
Car's Speed: 55
```

as the program's output.

Cool, huh? The ability to communicate with you is one of JavaScript's most fundamental capabilities. And you've run two js programs. Congratulations, you're a coder. (well, at least for today you are.)

[2] I'm gonna use **js** or **JS** for the word JavaScript. Life is too short for me to type the hundreds of times I plan to use it in this book.

Comments

While you're not thinking about the long term, or about large JavaScript programs, there is a powerful thing in JS that helps with tracking comments and notes about the code.

In your program you can write stuff that JavaScript will ignore, it's just there for you (or readers of your code).

```
// This comment occupies a line of its own  
console.log('Hello');  
  
console.log('World'); // This comment follows the  
statement
```

Statements and Expressions

difference, and why,

how a program is just a list of lines of statements, with expressions within them, from start to finish.

the notion of a script. a script equalling a program, and maybe a foreshadowing to functions, modules and an other library/organizational tricks.

Variables and Data Types

What are variables?

In JavaScript, variables are containers used to store data while the program is running. Variables can be named just about anything, and often are named things that make you think about what you store there.

Think of them as little boxes you can put data into, to keep it there and not lose it.

There are some rules about variables.

- All Variables must be named.
- Names can contain letters, digits, underscores, and dollar signs
- Names must begin with a letter
- Names can also begin with \$ and _
- Names are case sensitive (y and Y are different variables)
- Reserved words (like JavaScript keywords) cannot be used as names
- All variable names must be unique (no two alike)

So this means the following are fine for variable names in JavaScript.


```
x  
AREA  
height  
Width  
currentScore  
playerOne  
playerTwo  
$sumOfCredits  
_lastPlay  
isPlayerAlive
```

And uppercase and lowercase letters are different. So each of these are DIFFERENT variables even though they are based on the same word(s).

```
Current_Speed  
current_speed  
CURRENT_SPEED
```

So be careful with UPPERCASE and lowercase letters in variable names.

Declaring a Variable

```
let x;
```

This creates a variable **x** that can hold any primitive type. But it has NO value assigned to it, so if we...

```
console.log(x); // -> undefined
```

There is *nothing* there.

If we were to declare a variable named 'cats' and assign it the value 3.

```
let cats = 3;  
console.log(cats); // -> 3
```

Assign a value to a variable

```
let age = 19;  
let name = "James";  
console.log(name, "is", age, "years old"); // ->  
James is 19 years old  
age = 21;  
name = "Gina";  
console.log(name, "is", age, "years old"); // ->  
Gina is 21 years old
```

Reassigning a value to a variable

```
let x = "five";  
console.log(x); // -> five  
x = "nineteen";  
console.log(x); // -> nineteen
```

Notice how we don't use "let" again, when we assign "nineteen" to x. We can assign a variable as many times as we might need to.

```
let age = 3;  
// have a birthday  
age = age + 1;  
// have another birthday  
age = age + 1;  
console.log(age); // -> 5
```

Notice here how age's current value is used, added one to it, and re-assigned *back into the variable *age**.

Now, one of the weird (to me anyway) things JavaScript can do is change the type of a variable while the program is running. A lot of languages won't let you do this. But it can be handy in JavaScript. In JavaScript, variables are dynamic (can contain any data) which means a variable can be a string and later be a number.

```
let height = 62.0 // inches maybe?  
console.log(height); // -> 62  
  
height = "very tall";  
console.log(height); // -> very tall  
// yep, first height is a number  
// and then it's a string.
```

You can't see it, but I am slowly shaking my head in disbelief.

Constants

Constants are like let variables but they contain values that do NOT change such as a person's date of birth. Convention is to capitalized constant variable names.

```
const DATE_OF_BIRTH = "04-02-2005";  
DATE_OF_BIRTH = "04-10-2005"; // <-error
```

An attempt to re-assign a value to a constant will fail.

JavaScript Data Types

JavaScript can keep track of a number of different kinds of data, and these are known as "primitive Data Types". There are 5 of them.

- **Number** - there are two kinds of numbers: integers and floats
 - **Integers** are like 0, -4, 5, 6, 1234
 - **Floats** are numbers where the decimals matter like 0.005, 1.7, 3.14159, -1600300.4329
- **String** - an array of characters -
 - like 'text' or "Hello, World!"
- **Boolean** - is either **true** or **false**
 - often used to decide things like `isPlayer(1).alive()` [true or false?]
- **Null** - no value at all
- **Undefined** - a variable not yet assigned - "let x;"
 - this is a weird type, and not very common.

It is common for a computer language to want to know if data is a bunch numbers or text. Tracking what *type* a piece of data is is very important. And it is the programmer's job to make sure all the data get handled in the right ways.

So JavaScript has a few fundamental **data types** that it can handle. And we will cover each one in turn.



Create variables for each primitive data type:

- boolean,
- float,
- integer,
- string
- constant (integer)

Store a value in each.

```
// Here are some samples.  
  
// integer  
let x=0;  
  
// boolean  
let playerOneAlive = true;  
  
// float  
let currentSpeed = 55.0;  
  
// string  
let playerOneName = "Rocco";  
  
// constant integer  
const maxPainScore = 150000;
```

Now, you try it, write down a variable name and assign a

normal value to it.

Arithmetic Operators

JavaScript can do math. And many early programming problems deal with doing fairly easy math. There are ways to do lots of useful things with numbers.

Basics

Operator	Name	Description
+	Addition	Add two values
-	Subtraction	Subtract one from another
*	Multiplication	Multiply 2 values
/	Division	Divide 2 numbers
%	Modulus	returns the remainder
++	Increment	Increase value by 1
--	Decrement	Decrease value by 1

Say we needed to multiply two numbers. Maybe 2 times 3. Now we could easily write a program that printed that result.

```
console.log(2 * 3);
```

And that will print 6 on the console. But maybe we'd like to

make it a little more complete.

```
let a = 2;
let b = 3;
// Multiply a times b
let answer = a * b;
console.log(answer); // -> 6
```

Using this as a model, how would you write programs to solve these problems?



- Lab 1: Subtract A from B and print the result
- Lab 2: Divide A by B and print the result
- Lab 3: Use an operator to increase A by 1 and print result

```
let a = 9;
let b = 3;

let L1 = b - a;
let L2 = a / b;
let L3 = a + 1;
//or using increment
L3 = a++;
console.log(L1); // -> -6
console.log(L2); // -> 3
console.log(L3); // -> 10
```


Division and Remainder

We know that we can do regular division. If have a simple program like this, we know what to expect.

```
let a = 6 / 3; // -> 2
let a = 12 / 3; // -> 4
let a = 15 / 3; // -> 5
let a = 10 / 4; // -> 2.5
```

But we have, sometimes, a need to know what the remainder of a division is. The remainder operator %, despite its appearance, is not related to percents.

The result of a % b is the remainder of the integer division of a by b.

```
console.log( 5 % 2 ); // 1, a remainder of 5
divided by 2
console.log( 8 % 3 ); // 2, a remainder of 8
divided by 3
```

Now what's this about '%' (the remainder) operator?

```
let a = 3;
let b = 2;
// Modulus (Remainder)
let answer = a % b;
console.log(answer); // -> 1
```

```
let a = 19;  
let b = 4;  
// Remainder  
let answer = a % b;  
console.log(answer); // -> 3
```

Order is Important

A strange thing about these operators is the order in which they evaluated. Let's take a look at this expression.

$$6 \times 2 + 30$$

We can do this one of two ways:

- Say we like to do multiplication (I know, who is that?)
 - we would then do the "6 x 2" part first, giving us 12.
 - then we'd add the 30 to 12 giving us 42 ^[3]
- But say we don't like multiplication, and want to save it for later
 - we would then do the add first, 2 + 30 giving us 32
 - and then we multiply it by 6, and whoa we get 192!

Wait! Which is right? How can the answers be so different, depending on the order we do the math in? Well, this shows us that the Order of Operations is important. And people have decided upon that order so that this kind of confusion goes away.

Basically, multiply and divide are higher priority than add and subtract. And exponents (powers) are highest priority of all.

There is a simple way to remember this.

P.E.M.D.A.S

Use this phrase to memorize the default order of operations in JavaScript.

"Please Excuse My Dear Aunt Sally"

- Parenthesis ()
- Exponents 2^3
- Multiplication * and Division /
- Addition + and Subtraction -



Divide and Multiply rank equally (and go left to right) So, if we have $5 * 3 / 2$, we would do the multiply first and then the divide. $6 * 3 / 2$ is 9

Add and Subtract rank equally (and go left to right) So if we have $9 - 6 + 5$, we do the subtract first and then the add. $9 - 6 + 5$ is 8



$30 + 6 \times 2$ How should this be solved?

Right way to solve $30 + 6 \times 2$ is first multiply, $6 \times 2 = 12$, then add $30 + 12 = 42$

This is because the multiply is *higher priority* than the addition, _even though the addition is before the multiply in the expression. Let's check it in JavaScript.

```
let result = 30 + 6 * 2;  
console.log(result);
```

Gives us 42.

Now there is another way to force JavaScript to do things "out of order" with parenthesis.



$(30 + 6) \times 2$

What happens now?

```
let result = (30 + 6) * 2;  
console.log(result);
```

What's going to happen? Will the answer be 42 or 72?

JavaScript Math Object

There is a useful thing in JavaScript called the Math object which allows you to perform mathematical tasks on numbers.

- `Math.PI`; - returns 3.141592653589793
- `Math.round(4.7)`; // returns 5
- `Math.round(4.4)`; // returns 4

- `Math.pow(x, y)` - the value of `x` to the power of `y` - x^y
- `Math.pow(8, 2);` // returns 64
- `Math.sqrt(x)` - returns the square root of `x`
- `Math.sqrt(64);` // returns 8

What does "returns" mean?

When we ask a 'function' like `sqrt` to do some work for us, we have code something like:



```
let squareRootTwo = Math.sqrt(2.0);  
console.log(squareRootTwo);
```

We will get "1.4142135623730951" in the output. That number (`squareRootTwo`) is the square root of 2, and it is the result of the function and *what the function `sqrt` "returns"*.

`Math.pow()` Example

Say we need to compute " $6^2 + 5$ "

```
let result = Math.pow(6,2) + 5;  
console.log(result);
```

What will the answer be? 279936 or 41?

How did JavaScript solve it?

Well, 6^2 is the same as $6 * 6$. And $6 * 6 = 36$, then add $36 + 5 = 41$.

You'll learn a lot more about working with numbers in your career as a coder. This is really just the very basic of beginnings. == JavaScript Algebraic Equations

Some of the most fundamental of computer programs have been ones that take the drudgery of doing math by a person, and making the computer do the math. These kinds of *computations* rely on the fact that the computer won't do the wrong thing, if it's programed carefully.

Given a simple math equation like:



$a = b * 3 - 6$ and if b equals 3, then a equals ?

In math class, your teacher would have said "How do we solve for a ?" The best way to solve for $a = b * 3 - 6$ is to

- figure out what b times 3 is (well, if b equals 3, then 3 times 3 is 9)
- subtract 6 from b times 3 (and then 9 minus 6 is 3)

```
// And in JavaScript:  
// a = b * 3 - 6  
  
let b = 3;  
let a = b * 3 - 6;  
console.log(a); // -> 3
```

Now you try it.



Solve the equation with JavaScript...

$$q = 2j + 20$$

if $j = 5$, then $q = ?$

Take a moment and write down your solution before reading on.

```
let q = 0;  
let j = 5;  
q = 2 * j + 20;  
console.log(q); // -> 30
```

Let's try another...



Solve the equation with JavaScript...

$$x = 5y + y^3 - 7$$

if $y=2$, $x = ?$

and print out x .

My solution is pretty simple.

```
let y = 2;  
let x = 5 * y + Math.pow(y, 3) - 7;  
console.log(x); // -> 11
```

Trigonometry

The word trigonometry comes from the greek word - trigonon "triangle" + metron "measure. We use trigonometry to find angles, distances and areas.

For example, if we wanted to find the area of a triangular piece of land, we could use the equation **AreaOfaTriangle** = **height * base / 2**

(TODO: INSERT a simple triangle diagram)

Therefore we just need to create variables for each and use the operators to calculate the area



Calculate Area of a Triangle in JavaScript
Height is 20 Base is 10 Formula: $A = h * b / 2$

```
let height = 20;  
let base = 10;  
let areaOfaTriangle = height * base / 2;  
console.log(areaOfaTriangle); // -> 100
```



Calculate the area of a circle whose radius
is 7.7 Formula: $area = \pi * radius^2$

Hint: You'll need to use a constant Math property!


```
let radius = 7.7;  
let area = Math.PI * Math.pow(radius, 2);  
console.log(area); // -> 186.26502843133886 (wow)
```

[3] The answer to life, the universe and Everything.

Simple Calculation Programs

How far can we go in the car?

Let's create a simple problem to solve with Javascript.

Our car's gas tank can hold 12.0 gallons of gas. It gets 22.0 miles per gallon (mpg) when driving at 55.0 miles per hour (mph). If we start with the tank full and carefully drive at 55.0 mph, how many miles can we drive (total miles driven) using the whole tank of gas?

BONUS:

how long will it take us to drive all those miles?

What do we need figure out? We need a variable for our result: `totalMilesDriven`. So we start our program this way...

```
let totalMilesDriven = 0;

// print result of computation
console.log(totalMilesDriven);
```

It's often good to start with a very simple template. If we run that, we will see 0 (zero) as the result, right?

Next step, let's add the variables we know.

```
let totalMilesDriven = 0;
let totalHoursTaken = 0;

let totalGasGallons = 12.0;
let milesPerGallon = 22.0;
let milesPerHour = 55.0;

// print result of computation
console.log(totalMilesDriven);
```

Okay, good. We've added all the stuff we know about the computation. Well, except the part of the *actual computation*.

You probably know that if you multiply the milesPerGallon by the totalGasGallons, that will give you totalMilesDriven. And if you divide the totalMilesDriven by the milesPerHour, you will get the totalHoursTaken.

So let's add those as JavaScript statements.

```
let totalMilesDriven = 0;
let totalHoursTaken = 0;

let totalGasGallons = 12.0;
let milesPerGallon = 22.0;
let milesPerHour = 55.0;

totalMilesDriven = milesPerGallon *
totalGasGallons;
totalHoursTaken = totalMilesDriven / milesPerHour;

// print result of computation
console.log(totalMilesDriven, totalHoursTaken);
```

We get as a result 264 miles driven in 4.8 hours. And that's how a simple JavaScript program can get written.

Let's do another.

The Cost of a "Free" Cat

A friend of ours is offering you a "free cat". You're not allergic to cats but before you say yes, you want to know how much it'll cost to feed the cat for a year. (and then, about how much each month.)

We find out that cat food costs \$2 for 3 cans. Each can will feed the cat for 1 day. (Half the can in the morning, the rest in the evening.) There are 52 weeks in the year and 7 days in the week. (Sometimes you just gotta say the Very Obvious to make sure you're thinking it all through.) But, we know there are 365 days in a year. So how much will it cost to feed the cat for a year?

Looking at it, this may be quite simple. If we know each can feeds the cat for a day, we then know that we need 365 cans of food. So we can describe that as

```
let totalCost = 0;
let cansNeeded = 365;
let costPerCan = 2.0 / 3,0;

totalCost = cansNeeded * costPerCan; // right?

// print result of computation
console.log(totalCost);
```

What's going to be the answer? ^[4] Run it in your Repl.it window. Notice how the weeks stuff disappeared wasn't used in this problem. Sometimes that happens, a problem describes some stuff you can ignore.

And let's do one more.

You Used Too Much Data!

A cell phone company charges a monthly rate of \$12.95 and \$1.00 a gigabyte of data. The bill for this month is \$21.20. How many gigabytes of data did we use? Again, let's use a simple template to get started.

```
let dataUsed = 0.0;

// print result of computation
console.log("total data used (GB)", dataUsed);
```

Let's add what we know: that the monthly base charge (for calls, and so on) is \$12.95 and that data costs 1 dollar per gigabyte. We also know the monthly bill is \$21.20. Let's get all that written down.

```
let dataUsed = 0.0;
let costPerGB = 1.0;
let monthlyRate = 12.95;

let thisBill = 21.20;

// print result of computation
console.log("total data used (GB)", dataUsed);
```

Now we're ready to do the computation. If we subtract the `monthlyRate` from `thisBill`, we get the total cost of data. Then, if we divide the total cost of data by the cost per gigabyte, we will get the `dataUsed`.

```
let dataUsed = 0.0;
let costPerGB = 1.0;
let monthlyRate = 12.95;

let thisBill = 21.20;
let totalDataCost = thisBill - monthlyRate;

dataUsed = totalDataCost / costPerGB;

// print result of computation
console.log("total data used (GB)", dataUsed);
```

How many GBs of data did we use? Turns out to be 8.25 gigabytes.

Now if the bill was \$24.00? How many GBs then? (go ahead, I'll wait...) ^[5]

[4] totalCost will be \$243.33

[5] total data used (GB) 11.05

Boolean Expressions

When you are coding, you often have to make a choice about what to do next based on some kind of condition. Something like `is the gas tank empty?` or `are we moving faster than 100mph?` In real life, these are considered to be YES or NO kinds of questions. So when if the tank is empty, the question results in a TRUE condition. If there is some gas in the tank, then the question's result is FALSE, "no, it is NOT empty."

And while this may seem super simple to you, and it is, it is also very powerful when used in a program.

Comparison Operators

```
let x = 5;
```

is x less than ???

is x greater than or equal to ???

Operator	Description	Example
==	Equal to	<code>x == 5</code>
===	Equal value and type	<code>x === '5'</code>
!=	Not equal to	<code>x != 55</code>
!=	Not equal to value and type	<code>x != '5'</code>

Operator	Description	Example
>	Greater than	<code>x > 1</code>
<	Less than	<code>x < 10</code>
>=	Greater than or equal to	<code>x >= 5</code>
≤	Less than or equal to	<code>x ≤ 5</code>

Logical Operators

Operator	Description	
&&	Logical AND	<code>playerOneStatus == 'alive' && spacecraft.hasAir()</code>
	Logical OR	<code>room.Temp > 70</code>

Both sides need to be Boolean expressions



- Create 2 variables to use for comparison
- Use at least two comparison operators in JS
- Just put them in a `console.log(2 > 1)`

Strings

Strings are perhaps the most important data type in JavaScript. Many other computer languages have strings, and they are used in almost ALL modern program. Knowing how to manage them, create and modify them to do what you need them to do, is a "sub-superpower" within JavaScript.

Pay close attention, this stuff is Very Important.

What is a String?

Think about the words on this page. The text here is made up of a bunch of letters, and spaces. Now, when we write by hand, we don't really think about the space between the words, do we? If we truly ignored the notion of space between the words, we would end up with text like this. And while it is possible to read, our modern eyes are trained on well-edited texts, no spaces tires us pretty quickly.

So yes, what we see as text in this book is really a series of letters and spaces strung together in a line - line after line, paragraph after paragraph. In modern computing, that kind of data is often called a **String**. It is one of the most fundamental aspects of coding, the manipulation of strings by programs to transform, present or store text in some fashion.

Many programming languages use some kind of quote or double quote to show where strings start and end. So a string like "the quick brown fox" would be a string from the 't' to the 'x'. And notice the three spaces within the string. If

they were not there, the string would be "thequickbrownfox". And that's important, because to the computer, if it keeps these two strings around, it doesn't really understand that 'the' and 'quick' are just two common english words, the spaces are there to retain more of what the human meant.

No, to the computer, each letter, including the space 'letter', is just a piece of data and very important.

String - a string of letters and numbers and spaces and punctuation, kept altogether for some use. Here are some strings for you to consider.

```
"the quick brown fox"  
"The New York Times"  
"And lo, like wave was he..."  
"oops"  
"Hello, World!"  
"supercalifraglisticexpealadocious"  
"On sale for $123.99!!"  
"Pi is approximately 3.14159"  
"Merge left at the ramp to the right, the  
restaurant is on the right"  
"He said, \"Wait there is more!\""
```

Strings can be thought of tightly packed list. Each item, each letter, is numbered. The entire string can be "indexed", meaning I can reach in copy out, say, the fifth letter easily. String indexes are zero-based therefore the first character(element) is in index position 0

```
012345  
Hello
```

So here, "H" is at 0, "e" is at 1, 'l' is at 2 and 3, 'o' is at index position 4. Computers often start lists at 0, not at one. It just one of those things.

Declaring a string

```
let name = "Wacka Flocka";
```

Now we have a string variable named **name** and it's value is "Wacka Flocka".

String Properties

A common and often used string property is **length**.

We can use `.length` to find the length of a string

```
let str = "Wakanda Forever!";  
let answer = str.length;  
console.log(answer); // -> 16
```

Accessing Characters in a String

As mentioned before, we can reach into a string and copy out the stuff we find there.

```
let word = "Hello";  
// Access the the first character (first by index,  
second by function)  
console.log( word[0] ); // H  
console.log( word.charAt(0) ); // H  
// the last character  
console.log( word[word.length - 1] ); // o  
console.log( word.charAt(word.length - 1)); // o
```

When you see something like **word[0]**, it is pronounced like "word sub zero". If you have **word[5]**, you would say "word sub five". This is just verbal shorthand for the expression.

String Concatenation (Joining strings)

This simply means joining strings together using the `+` operator or the `concat()` method. Either one is commonly used.

```
let price = 20;  
let dollarSign = "$";  
let priceTag = dollarSign + price; // $20  
//or  
let priceTag = dollarSign.concat(price); // $20  
console.log(priceTag); // -> $20
```

Or perhaps a little more useful example:

```
let name = "Mikaila"  
let hoursWorked = 12;  
  
let workReport = "Today, " + name + " worked a  
total of " + hoursWorked + " hours."  
console.log(workReport);
```

The output would be

Today, Mikaila worked a total of 12 hours.

SubStrings

The getting a substring is a common operation. This is how we extract the characters from a string, between two specified indices. (Which is why it's important to remember the indexes start at 0.) There are 3 methods in JavaScript to get a substring: `substring`, `substr` and `slice`. Let's look at each one. (Although, honestly, they all do exactly the *same thing!*)

`someString.substring(start, end)`

`someString.substr(start, end)`

`someString.slice(start, end)`

A start position is required, where to begin the extraction. Remember, first character is at position 0. Characters are extracted from a string between "start" and "end", not including "end" itself.

```
let firstName = "Christopher";
```

Now let's use the 3 substring methods on `firstName` and extract and print out "Chris"

```
let firstName = "Christopher";  
console.log(firstName.substring(0,5)); // "Chris"  
//or  
let a = firstName.slice(0,5); // "Chris"  
console.log(a);  
//or  
let b = firstName.substr(0,5); // "Chris"  
console.log(b);
```

Yep. They all print "Chris". (Act impressed... thanks!)

Let's try a little harder idea...



```
let firstName = "Christopher";
```

- Your turn to use the `substring/substr/slice` method on `firstName`
- Extract and print out "STOP" from inside the string above
- And make it uppercase! ("stop" to "STOP")

Well?

```
let firstName = "Christopher";  
console.log(firstName.substring(4,8).toUpperCase()  
);
```

Want to bet there is also a "toLowerCase()" method as well?

Summary of substring methods

```
let rapper = "mikejones";  
console.log(rapper.substr(0,4)); // mike  
//includes second index  
console.log(rapper.substr(1,3)); // ike  
console.log(rapper.substring(0,4)); //mikeik  
//excludes second index  
console.log(rapper.substring(1,4)); //ike  
//excludes second index  
console.log(rapper.slice(0,4)); //mike //excludes  
second index  
console.log(rapper.slice(1,4)); //ike  
console.log(rapper.slice(1,3)); //ik
```

Strings are perhaps the most important data type in almost any language. Being able to manipulate them easily and do powerful things with them, makes you a better coder.

Arrays

JavaScript Arrays

 * Can store multiple values in a single variable * We start counting from index position zero * Elements can be primitive or/and Objects

Declaring Arrays

Creating an arrays in JavaScript:

```
let donuts = ["chocolate", "glazed", "Jelly"];
let arrayofCharacters = ['c','h','r','i','s'];
let mixed = ['one', 2, true];
```

<section data-bbox="115 526 880 600" data-kind="parent" data-rs="2">data-background="https://media.giphy.com/media/3ofSBlkao9ggDDU0Kc/giphy.gif">

Accessing elements of an Array

Use square brackets to grab elements by index

```
let donuts = ["chocolate", "glazed", "Jelly"];
console.log(donuts[0]);
console.log(donuts[1]);
console.log(donuts[2]);
```

Insert elements into an Array

Use square brackets to grab elements by index

```
let donuts = ["chocolate", "glazed", "Jelly"];  
donuts[3] = "strawberry"  
console.log(donuts);
```

Getting the size of an Array

We can use the length property to find the size

```
let donuts = ["chocolate", "glazed", "Jelly"];  
console.log(donuts.length);
```

Note: A string is an ARRAY of single characters

Grabbing the last element of an array no matter the size

```
let donuts = ["chocolate", "glazed", "Jelly"];  
donuts[3] = "strawberry";    // -> ["chocolate",  
"glazed", "Jelly", "strawberry"]  
console.log(donuts[donuts.length - 1]); //  
strawberry  
donuts[4] = "powdered"      // -> ["chocolate",  
"glazed", "Jelly", "strawberry", "powdered"]  
console.log(donuts[donuts.length - 1]); //  
powdered
```

- Reverse a String

Now let's reverse the string STOP to say POTS

Step 1 - Use the `split()` to return an array of strings

Step2 - Use the `reverse()` method to reverse the newly created array of string characters

Use the `join()` method to join all elements into a String

Print out the reversed string

Solution

```
var str = "Christopher";  
var res = str.substring(4, 8).toUpperCase();  
// -> "STOP"  
var spl = res.split("");  
// -> ["S", "T", "O", "P"]  
var rev = spl.reverse();  
// -> ["P", "O", "T", "S"]  
var result = rev.join("");  
// -> "POTS"  
console.log(result); // -> POTS
```

== Control Flow

(more needed)

== Conditional Statements

While we have been seeing programs which consist of of a list of statements, one after another, where the "flow of control" goes from one line to the next, and so on to the end of the list of lines. There are more useful ways of breaking up the "control flow" of a program.

== If statement

(start simple)

```
let timeOfDay = "Afternoon";
if (timeOfDay == "Morning") {
  console.log("Time to eat breakfast");
} else if (timeOfDay == "Afternoon") {
  console.log("Time to eat lunch");
} else {
  console.log("Time to eat dinner");
}
```

Write code to check if a user is old enough to drink.

- if the user is under 18. Print out "Cannot party with us"
- Else if the user is 18 or over, Print out "Party over here"
- Else print out, "I do not recognize your age"

You should use an if statement for your solution!

Finally, make sure to change the value of the age variable in the repl, to output out different results and test that all three options can happen. What do you have to do to make the **else** clause happen?

(should there be a page break here?)

==== If Statement solution

```
let userAge = 17;
if (userAge < 18) {
  console.log("Cannot party with us");
} else if (userAge >= 18) {
  console.log("Party over here");
} else {
  console.log("I do not recognize your age");
}
```

(more...) === Switch Statements

Switch statements are used to perform different actions based on different conditions.

```
let timeOfDay = "Afternoon";
switch(timeOfDay){
  case "Morning":
    console.log("Time to eat breakfast");
    break;
  case "Afternoon":
    console.log("Time to eat lunch");
    break;
  default:
    console.log("Time to eat dinner");
}
```

Write code to check if a user is old enough to drink.

- if the user is under 18. Print out cannot party with us
- Else if the user is 18 or over. Print out party over here
- Else print out. I do not recognize your age ===

You should use a switch statement. Finally, make sure to change the value of the age variable to output out different results.

Loops

Loops allow you control over repetitive steps you need to do. JavaScript has two different kinds of loops we will talk about, **while** loops and **for** loops. Either one can be used interchangeably, but as you will see there are couple cases where using one over the other makes more sense.

While Loop

Loop through a block of code WHILE condition is true.

```
while (condition_is_true) {  
  
    // execute the code statements  
    // in the loop body  
  
}
```

See the code below. In this case, we start with a simple counter in `x = 1`. Then the loop starts, it checks to see if `x < 6`, and 1 is less than 6, so the loop body gets executed. We print out 1 and then increment `x`. Then we go to the top of the loop, and check to see if `x` (now 2) is less than 6. That's true so we print out 2 and increment `x` again. This continues like this for three more times, printing 3, 4, and 5.

Then, `x` is incremented to 6, and the check is made again, `6 < 6` ... well, no that is false. So we don't execute the loop's body, we fall through to the last `console.log` line, and print out `x`.


```
let x = 1;

while (x < 6) {
  console.log(x);
  x++;
}

console.log("ending at", x); // ? what will print
here ?
```

While loops work well in situations where the condition you are testing at the top of the loop is one that may not be related to a simple number.

```
while (player[1].isAlive() == true) {
  player[1].takeTurn();
  game.updateStatus(player[1]);
}
```

This will keep letting player[1] take a turn in the game until the player dies. Another way to do something like this is with an *infinite loop*. (No, infinite loops are not necessarily a bad thing, watch.) We're going to use both **continue** and **break** in this example, and we will describe them better after we're done with loops.

```
let player = game.newPlayer();

while (true) { // <- notice right here, an
  infinite loop

    player.takeTurn();
    game.updateScores();
    game.advanceTime();

    if (player.isAlive() == true) {
      continue; // start at top of loop again.
    } else {
      break; // breaks out of loop and ends
game.
    }
  }
game.sayToHuman("Game Over!");
```

Here we are using the `continue` statement to force the flow of control to the top of the loop. We are also using the `break` statement to break out of the infinite loop, letting us do other things after the player has 'died'.

Do..While Loop

There is another kind of loop, a **Do..While** loop. Why? well, sometimes you need a loop to go at least once, no matter what and continue until the condition on the loop becomes false. These are used only occasionally, and only in very specific situations.

```
let x = 0;

do {
  console.log(x);
  x++;
}
while (x < 5);
```

For Loop

The **for** loop is more complex, but it's also the most commonly used loop.

```
for (begin; condition; step) {

  // execute the code statements
  // in the loop body

}
```

Here's one where we go from 1 to 5.

```
for(let j = 1; j < 6; j++){  
    // loop body code  
    console.log(j);  
}  
// print  
1  
2  
3  
4  
5
```

Notice how there are THREE parts to the loop's mechanism.

- `begin j = 1` Executes once upon entering the loop.
- `condition j < 6` Checked before every loop iteration. If false, the loop stops.
- `body console.log()` Runs again and again while the condition is true.
- `step j++` Executes after the body on each iteration.

Break

```
for(let p = 1; p < 6; p++){  
    if(p == 4){  
        break;  
    }  
    console.log("Loop " + p + " times");  
}
```

Jumps out of the loop when `p` is equal to 4



- Print from 10 to 1 with a for loop and a while loop (hint use decrement)
- Write a loop that prints 1 - 5 but break out at 3



Stretch Goal: S/he who dares wins!

- Create an array of donuts
- Loop through the array of donuts and print them

Solution

```
for(let x = 0; x < donuts.length; x++){  
  console.log(donuts[x]);  
}
```

Break Statement

Normally, a loop exits when its condition becomes false. But we can force the exit at any time using the special **break** statement.

```
while (true) {  
  
    let cmd = +prompt("Enter a command", '');  
  
    if (cmd == "exit") break;  
  
    execute(command);  
}  
console.log("Exiting.")
```

Here are asking the user to type in a command. If the command is "exit", then quit the loop and output "Exiting", and end the program. Otherwise, execute the command and go around to the top of the loop and ask for another command.

Continue Statement

The continue statement doesn't stop the whole loop. Instead, it stops the current iteration and forces the loop to start a new one (if the condition allows).

We can use it if we're done with the current iteration and would like to move on to the next one. This loops prints odd number less than 10.

```
for (let i = 0; i < 10; i++) {  
  
    // if true, skip the remaining part of the body  
    // will only be true if the number is even  
    if (i % 2 == 0) continue;  
  
    console.log(i); // prints 1, then 3, 5, 7, 9  
}
```

What's interesting here is the use of the remainder operator (%) to see if a number is odd. Here the expression (i % 2) is zero if the number is even, it not the number must be odd. You want to remember this trick, how to find odd or even numbers. It's common programming problem that you will get asked. The continue statement starts the loop over, not letting the console.log to print out the number when it's even. === Return statement

need to know about functions and calls.

Functions in JavaScript

A function is a block of code designed to perform a particular task. Functions get executed when invoked

Functions let you avoid duplicating code and organize your code.

Functions are invoked when:

- An event occurs (when a user clicks a button)
- It is invoked (called) from JavaScript code

JS Function Syntax

```
function | NameOfFunction | (Parameters){  
  //Logic goes here  
}  
//-----  
function myFunction(parameter1, parameter2) {  
  return parameter1 * parameter2;  
}
```

Creating and using a function


```
function greetUser(username) {  
  console.log( "Hello " + username);  
}
```

```
//calling/Invoking the function  
greetUser("Mike Jones");
```

Function Return

Once JavaScript reaches a return statement, the function will stop executing

Functions often compute a return value. The return value is "returned" back to the "caller"

```
function greetUser(username) {  
  return "Hello " + username;  
}  
console.log(greetUser("Welcome back, Mike  
Jones"));  
// function returns a string to be printed on  
console
```

Function Parameters

```
function printReceipt(price, productName, tax) {  
  //this method has 3 parameters  
}
```



- Create a function called zipCoder
- Your function takes one parameter of type number
- Your function checks and does the following
- If parameter is divisible by 3. Print Zip
- If parameter is divisible by 5. Print Coder
- If parameter is divisible by 3 and 5. Print ZipCoder Phew...Finally
- Call the method and pass in 45 as your parameter

Function ZipCoder

```
function zipCoder(aNumber) {  
  if (aNumber % 15 == 0) console.log("ZipCoder");  
  else if (aNumber % 3 == 0) console.log("Zip");  
  else if (aNumber % 5 == 0) console.log("Coder");  
}  
zipCoder(45); // -> ZipCoder
```

Modules

modules. (more needed)

Objects

There are eight data types in JavaScript. Seven of them are called “primitive”, because their values contain only a single thing (be it a string or a number or whatever).

In contrast, **objects** are used to store keyed collections of various data and more complex entities. In JavaScript, objects penetrate almost every aspect of the language. So we must understand them first before going in-depth anywhere else.

An object can be created with figure brackets {...} with an optional list of properties. A property is a “key: value” pair, where key is a string (also called a “property name”), and value can be anything.

We can imagine an object as a cabinet with signed files. Every piece of data is stored in its file by the key. It’s easy to find a file by its name or add/remove a file.

(more needed)