CSI 3140 - LECTURE 04

JAVASCRIPT

OBJECTIVES

- Chapter 6-11
- Writing JavaScript
- Operators, conditions and looping constructs
  - if, if/else, switch
  - while, do/while
  - for, for/in
- null, true, false
- Java functions
- Arrays
- Objets

https://dart.dev/

https://clojurescript.org/

https://coffeescript.org/

https://www.typescriptlang.org/

https://en.wikipedia.org/wiki/VBScript

https://github.com/lumen/lumen

https://www.webcomponents.org/

https://webassembly.org/

https://en.wikipedia.org/wiki/ECMAScript

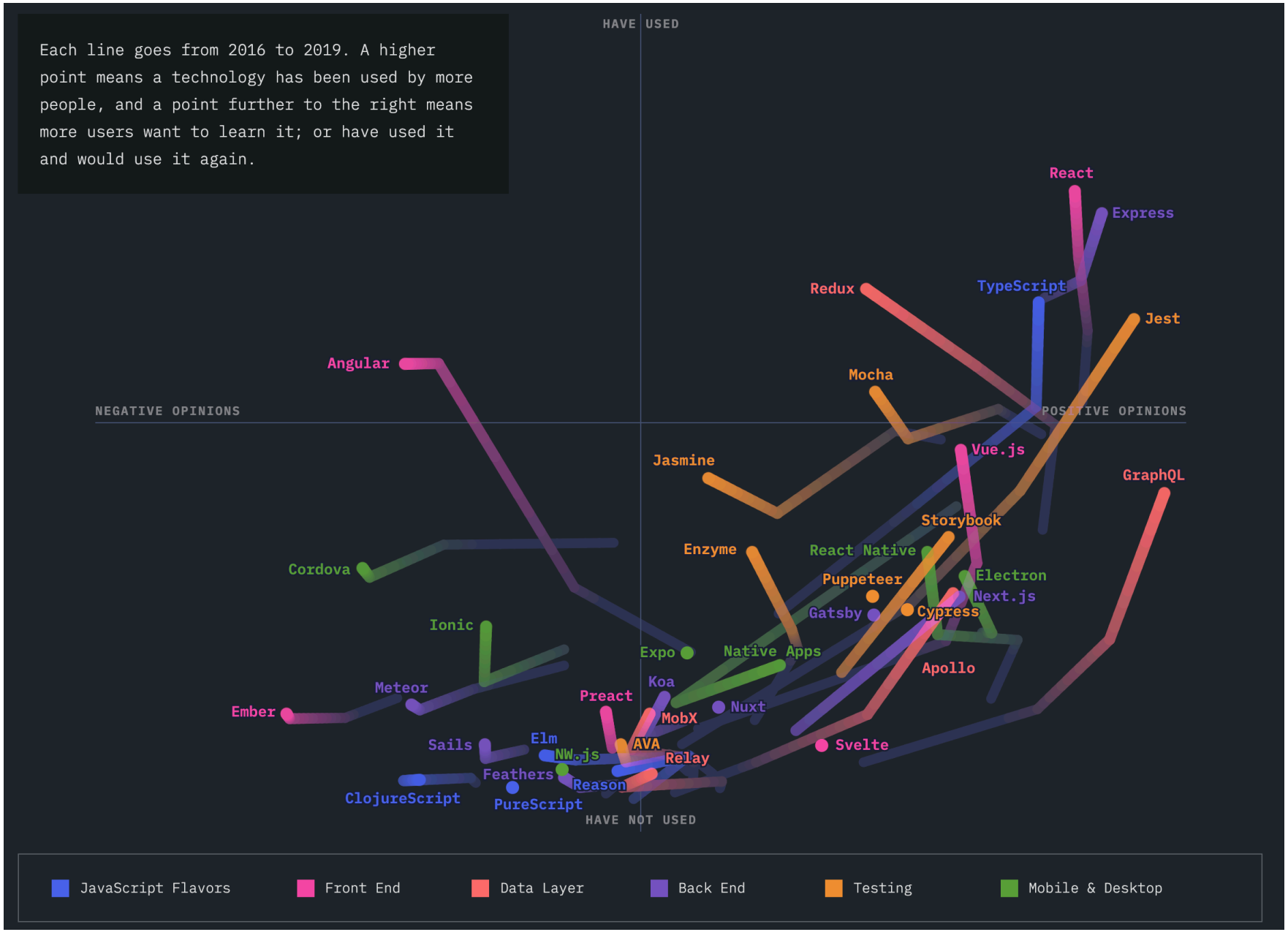
'b' + 'a' + + 'a' + 'a'

'b' + 'a' + + 'a' + 'a'

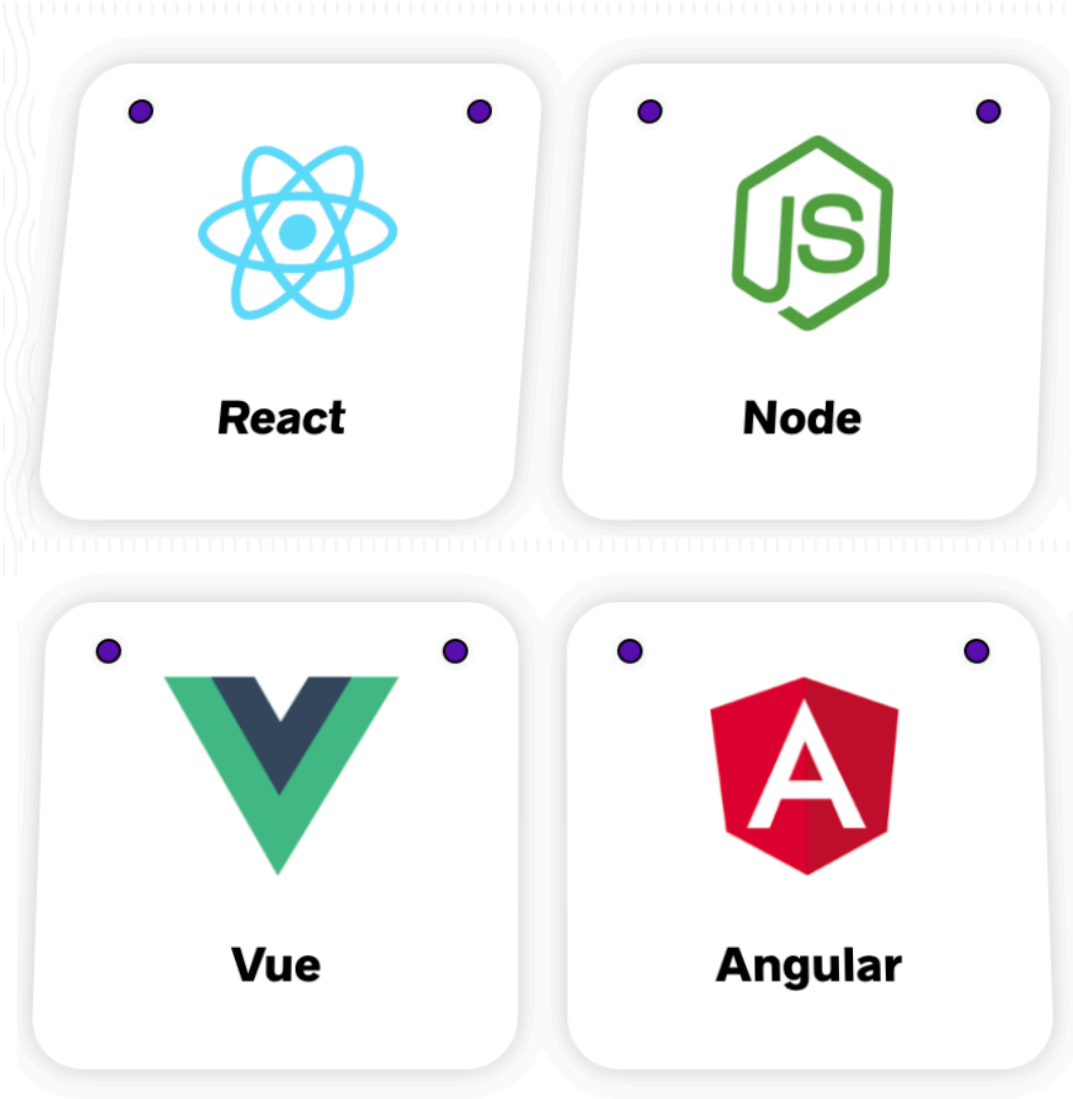
"baNaNa"


C#
JavaScript
Rust
C++
Python
TCCC

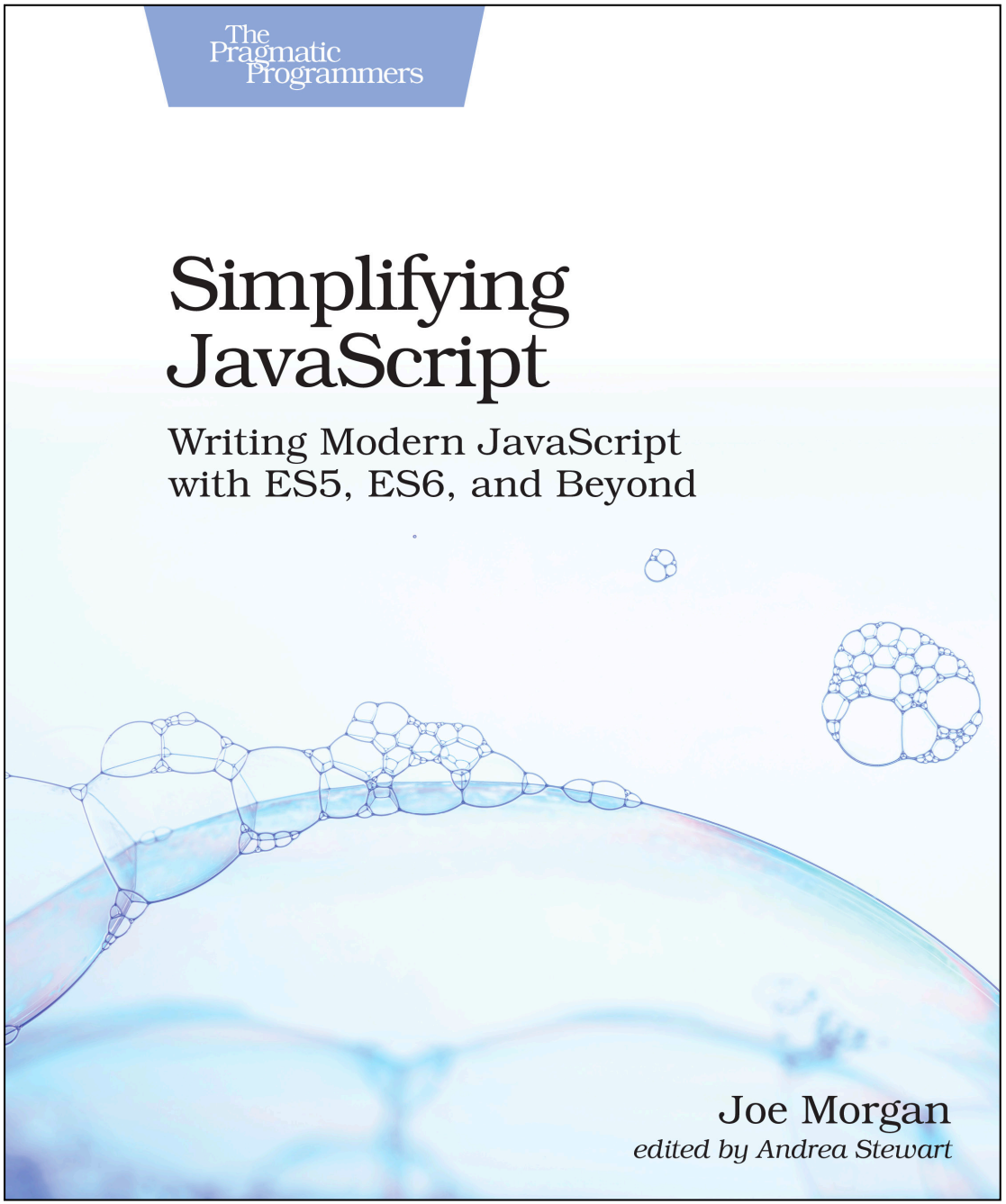
Version	Year
ECMAScript 1	June 1997
ECMAScript 2	June 1998
ECMAScript 3	December 1999
ECMAScript 5 (ES5)	December 2009
ECMAScript 2015 (ES6)	2015 (d'uh)
ECMAScript 2016	2016
...	...
ES.Next	



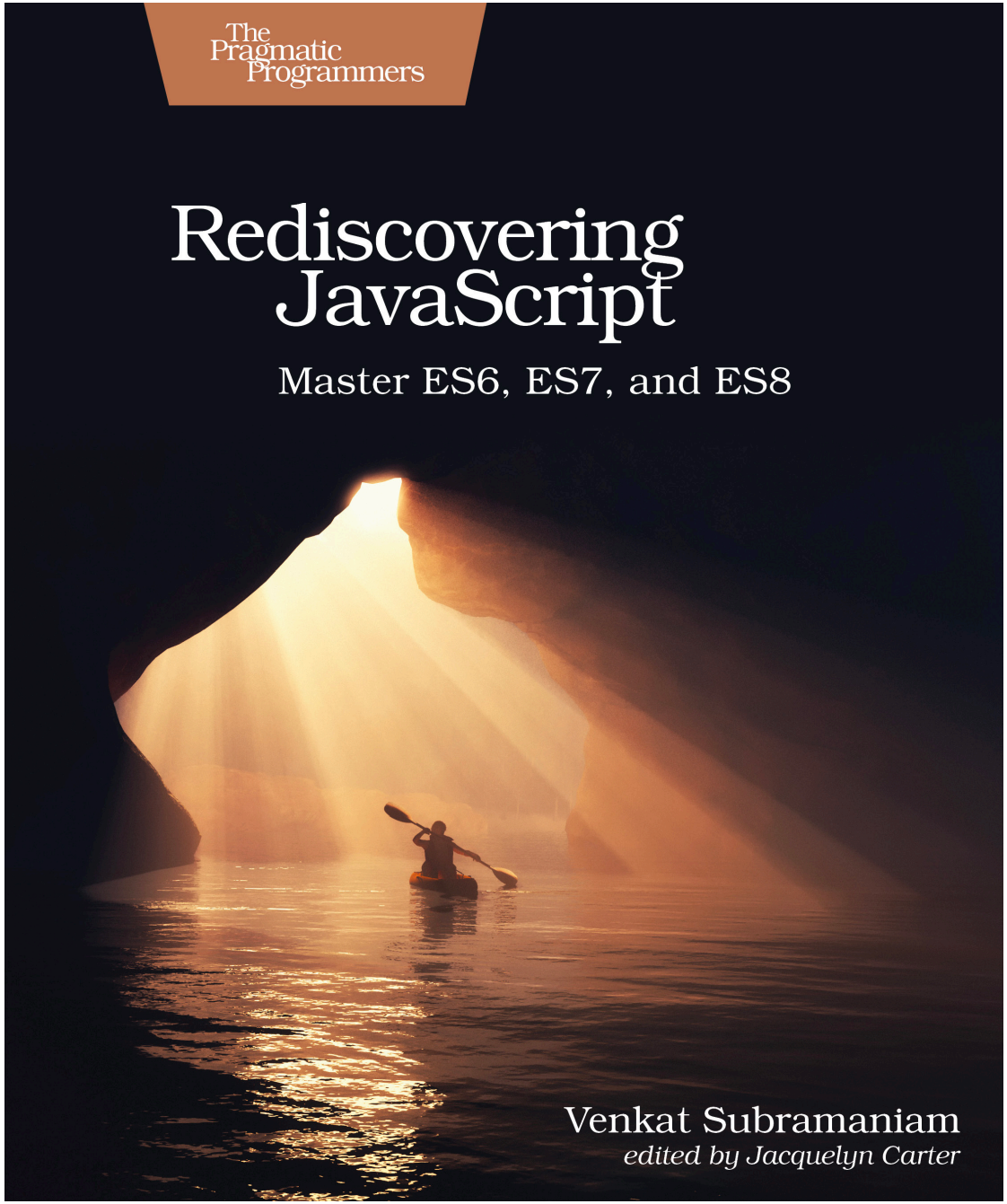
https://2019.stateofjs.com/overview/

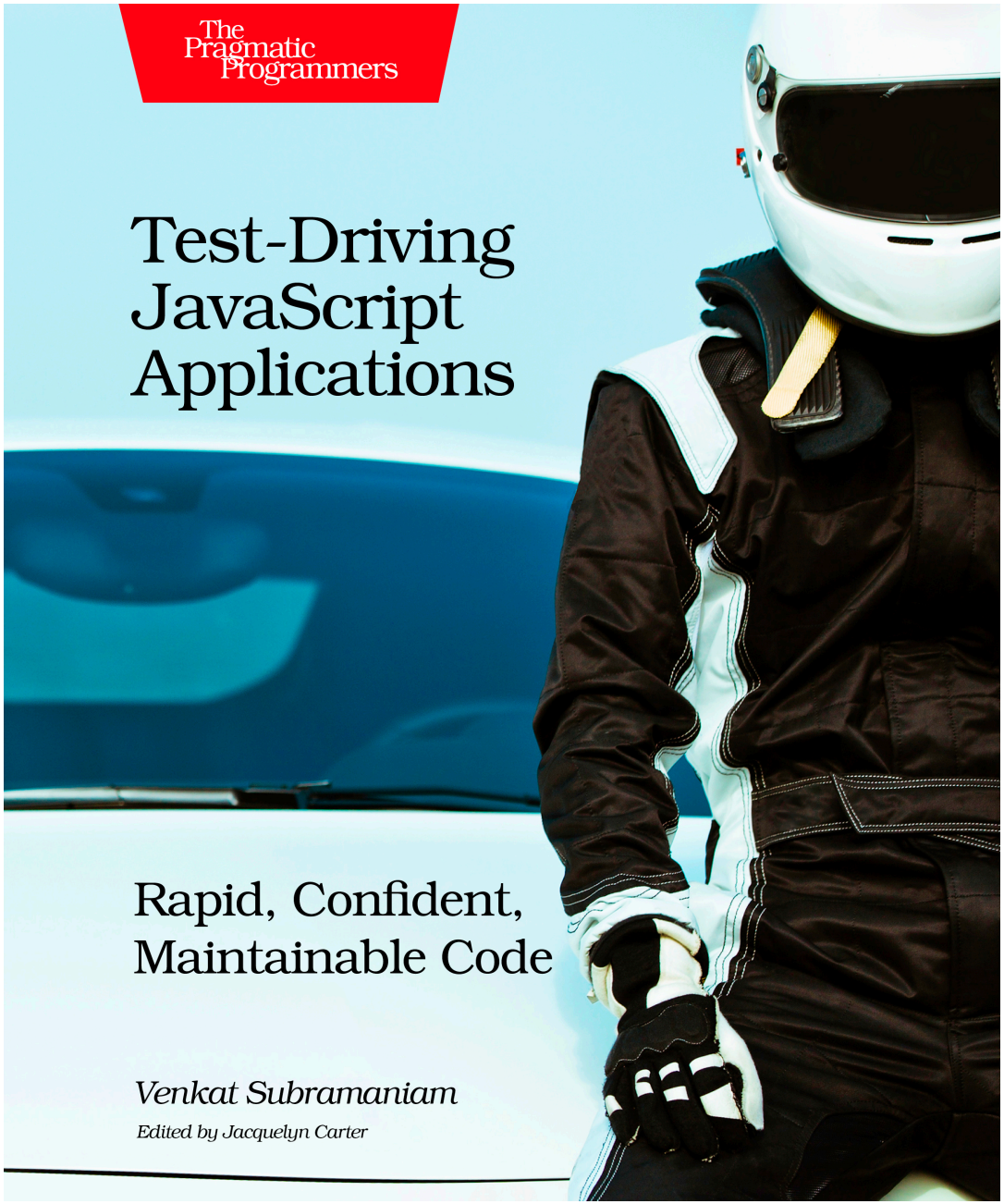


https://beginnerjavascript.com/



https://github.com/jsmapr1/simplifying-js


The Pragmatic Programmers
Rediscovering JavaScript
Master ES6, ES7, and ES8
Venkat Subramaniam
edited by Jacquelyn Carter


The Pragmatic Programmers
Test-Driving JavaScript Applications
Rapid, Confident, Maintainable Code
Venkat Subramaniam
Edited by Jacquelyn Carter

How do you write to the *screen*?

How do you write to the *screen*?

```
document.writeln("<p>Hi</p>")
```

How do you write to the *screen*?

```
document.writeln("<p>Hi</p>")
```

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Welcome</title>
  </head>
  <body>
    <script type="text/javascript">
      // Don't do this!
      document.writeln("<p>Welcome to HTML5!</p>");
    </script>
  </body>
</html>
```

Welcome to HTML5!

Inline scripts

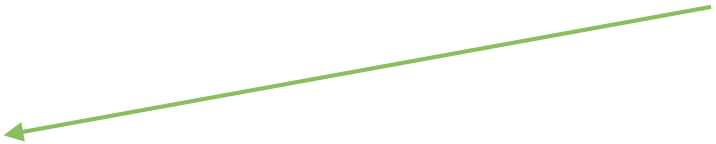
```
<script type="text/javascript">
  // Don't do this!
  document.writeln(
    "<p>Welcome to HTML5!</p>");
</script>
```

Again don't "writelin" in production

Welcome to HTML5!

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Welcome</title>
    <!-- Load your libraries at the top -->
    <script type="text/javascript" src="02_library.js"></script>
  </head>
  <body>

    <!-- And your event processing at the bottom -->
    <script type="text/javascript" src="02_events.js"></script>
  </body>
</html>
```

Use external files where possible



```
function helloWorld()
{
  document.writeln("<p>Welcome to HTML5!</p>");
}
```

External file is JavaScript, so do not mix in HTML

```
function helloWorld()
{
  document.writeln("<p>Welcome to HTML5!</p>");
}
```

Concatenate...

```
"Hi, " + name;
```

Templates...

```
`Hi, ${name}`;
```

CONCATENATING STRINGS

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">
      let buildTag = function(tagName, innerHTML) {
       return "<" + tagName + ">" + innerHTML + "</" + tagName + ">";
      }

      document.writeln(buildTag("p", "Welcome to HTML5"));
    </script>
  </body>
</html>
```

+ to concatenate strings

Variables can be assigned functions

Optional, but please use semi-colons for each declaration.

Use ***let*** or ***const*** or at least ***var*** to declare variables, otherwise they will be considered globals.

```
let buildTag = function(tagName, innerHTML) {
  return "<"
    + tagName
    + ">"
    + innerHTML
    + "</" + tagName + ">";
}

document.writeln(
  buildTag(
    "p",
    "Welcome to HTML5"
  )
);
```

Re-write using templates

```
function(tagName, innerHTML) {
  return "<"
    + tagName
    + ">"
    + innerHTML
    + "</" + tagName + ">";
}
```

Re-write using templates

```
function(tagName, innerHTML) {
  return `<${tagName}>${innerHTML}
</${tagName}>`;
}
```

```
var letters = "OK";
var snake_case = "OK, but unconventional";
var $beCareful = "OK, conflicts with jQuery";
var numbers1 = "OK, but not at the start";
// 133t -> not OK, cannot start with a number
```

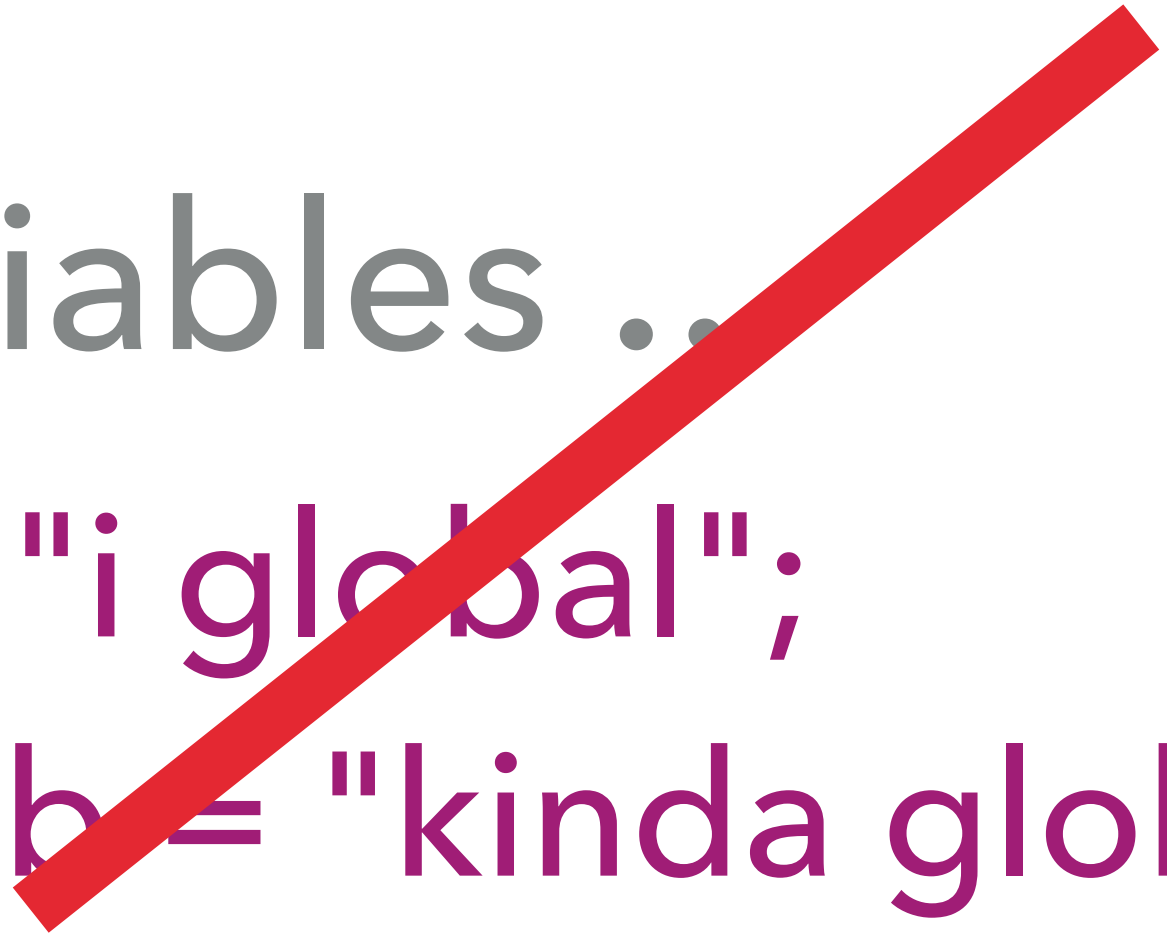
Variables ...

Variables ...

```
a = "i global";
var b = "kinda global";
```

Variables ..

```
a = "i global";
var b = "kinda global";
```



Variables ...

```
let a = "local";
const b = "somewhat can’t change";
```

Calculate the total cost of a $100 milkshake (13% tax)

Calculate the total cost of a $100 milkshake (13% tax)

```
const tax_rate = 0.13;
const total_cost = 100 * (1 + tax_rate);
```

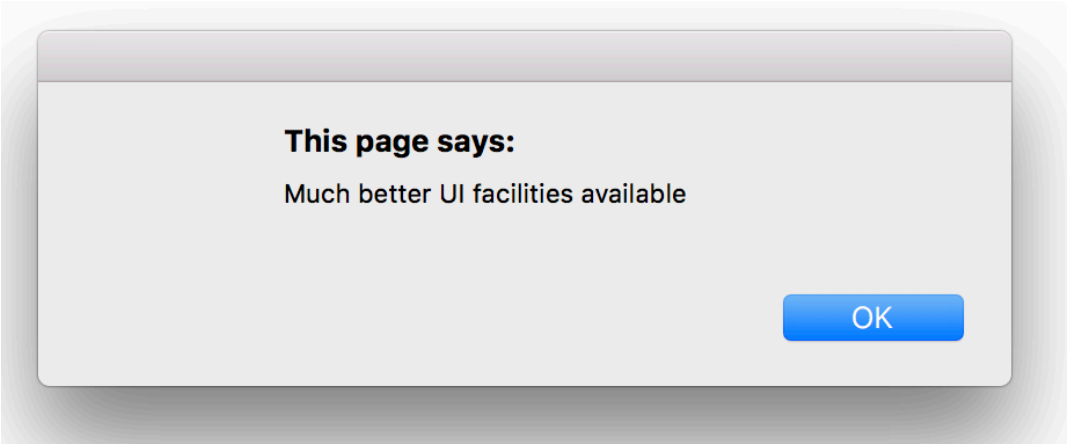
Calculate the shopping chart total, that includes a $100 milkshake (13% tax)

Calculate the shopping chart total, that includes a $100 milkshake (13% tax)

```
const tax_rate = 0.13;
let total_cost = 0;

...

total_cost += 100 * (1 + tax_rate);
```

ALERT

```
window.alert(
   "Much better UI facilities available"
);
```

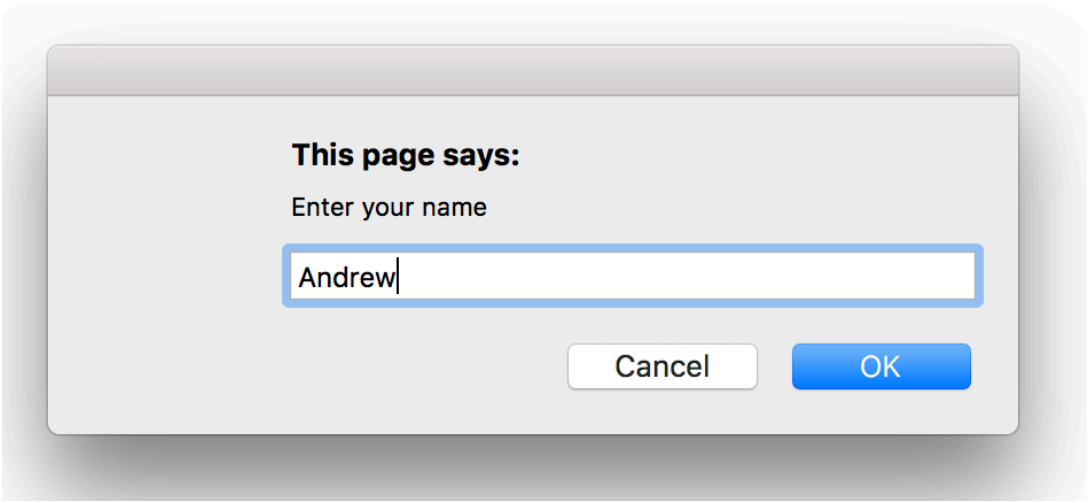


Escape Character

```
document.writeln("<p>Normal \"Escape\" with Slash \\</p>");
document.writeln('<p>Or use \' to build your string when you want "');
document.writeln("<pre>One\n\tTwo</pre>");
```

PROMPT

```
// Don't use!
var name = window.prompt("Enter your name");
document.writeln("<h1>Hello " + name + "</h1>");
```



```
var a;
isNull("a (new var)", a);

a = null;
isNull("a (assigned null)", a);

a = "";
isNull("a (assigned empty string)", a);

delete a;
isNull("a (deleted)", a);
```

```
var a;
isNull("a (new var)", a);

a = null;
isNull("a (assigned null)", a);

a = "";
isNull("a (assigned empty string)", a);

delete a;
isNull("a (deleted)", a);
```

a (new var) is null

a (assigned null) is null

a (assigned empty string) is NOT null; value is []

a (deleted) is NOT null; value is []

```
var a = 10;
var b = 15;
var sum = a + b;
document.writeln("As integers: " + a + " + " + b + " = " + sum);

document.writeln("<br>");

a = "10";
b = "15";
sum = a + b;
document.writeln("As strings: " + a + " + " + b + " = " + sum);
```

```
var a = 10;
var b = 15;
var sum = a + b;
document.writeln("As integers: " + a + " + " + b + " = " + sum);

document.writeln("<br>");

a = "10";
b = "15";
sum = a + b;
document.writeln("As strings: " + a + " + " + b + " = " + sum);
```

As integers: 10 + 15 = 25

As strings: 10 + 15 = 1015

```
document.writeln("<pre>");
document.writeln("ADD:  10 + 5 = " + (10 + 5) + "\n");
document.writeln("SUB:  10 - 5 = " + (10 - 5) + "\n");
document.writeln("MULT: 10 * 5 = " + (10 * 5) + "\n");
document.writeln("DIV: 10 / 5 = " + (10 / 5) + "\n");
document.writeln("REM: 11 % 5 = " + (11 % 5) + "\n");
document.writeln("</pre>");
```

IF CONDITION

```
var date = new Date();
if (date.getHours == 11) {
  document.writeln("Current time is 11 o'clock\n");
} else {
  document.writeln("Current time ("+ date +") is NOT 11 o'clock\n");
}
```

An object to get information about the current time

Current time (Sat Jan 07 2017 19:05:01 GMT-0500 (EST)) is NOT 11 o'clock

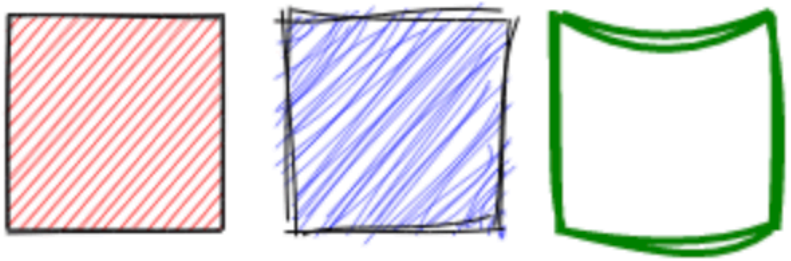
MOMENT.JS

```
<!DOCTYPE html>
<html>
  <head>
    <script src="moment.js"></script>
  </head>
  <body>
    <script type="text/javascript">
      var showDate = function(prefix, m) {
        document.writeln(prefix + ": " + m.format('MMMM Do YYYY, h:mm:ss a') + "<br>");
      }

      var today = moment();
      showDate("NOW", today);
      showDate("LAST WEEK", today.subtract(1, 'weeks'));
      showDate("TOMORROW", today.add(1, 'day'));
    </script>
  </body>
</html>
```

NOW: January 7th 2017, 7:49:45 pm
LAST WEEK: December 31st 2016, 7:49:45 pm
TOMORROW: January 1st 2017, 7:49:45 pm

ROUGH.JS

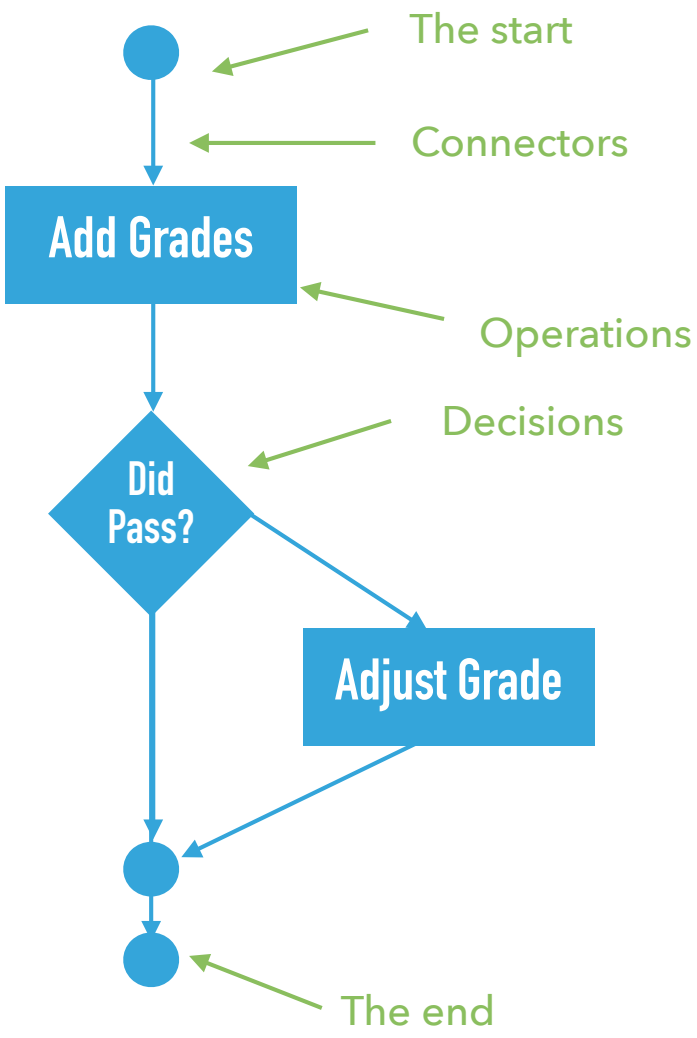
Sketching style



```
rc.rectangle(15, 15, 80, 80, { roughness: 0.5, fill: 'red' });
rc.rectangle(120, 15, 80, 80, { roughness: 2.8, fill: 'blue' });
rc.rectangle(220, 15, 80, 80, { bowing: 6, stroke: 'green', strokeWidth: 3 });
```

https://roughjs.com/posts/release-4.0/

FLOWCHART




```
grade = homeworkMark + midtermMark + finalMark;
```

```
if (grade < 50)
```

```
grade = (midtermMark + finalMark)/65*100;
```

JavaScript Reserved Words

break	case	catch	continue	default
delete	do	else	false	finally
for	function	if	in	instanceof
new	null	return	switch	this
throw	true	try	typeof	var
void	while	with	let	

All predicates that return
“truthy” go into the truth block

```
if (grade >= 90) {
  console.log("A+");
}
```

Practical to have more than just **FALSE** be considered as a "falsey" value

```
if (false) {
  err();
} else {
  console.log("false is falsey");
}
```

```
if ("") {
  err();
} else {
  console.log("Empty string is falsey");
}
```

```
if (0) {
  err();
} else {
  console.log("0 (and -0) integers are falsey");
}
```

```
if (null) {
  err();
} else {
  console.log("null falsey");
}
```

```
if (undefined) {
  err();
} else {
  console.log("undefined falsey");
}
```

```
if (NaN) {
   err();
} else {
   console.log("NaN falsey");
}
```

If you are not “falsey”, it means you are “truthy”

```
if ("0") {
 console.log("Is true?");
} else {
  console.log("Or false");
}
```

Only FALSE evaluates true for false === false

```
if (false === 0) {
 console.log("Is true?");
} else {
  console.log("Or false");
}
```

IF / ELSE

```
if (grade >= 90) {
  console.log("A+");
} else {
  console.log("You received " + grade);
}
```

IF / ELSE "SHORTHAND"

Many declarations on one line

```
var a, b;

b = null;
a = b ? b : "99";
console.log(a);

b = "101";
a = b ? b : "99";
console.log(a);

// NOT SUPPORTED IN JavaScript
// b = null;
// a = b ?: "99";
// console.log(a);
```

```
if (b) {
  a = b;
} else {
  a = "99";
}
```

99

101

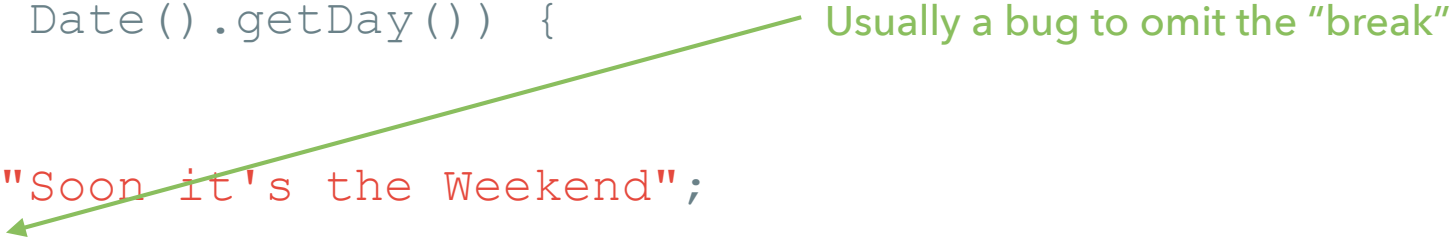
Be careful of bringing short cuts from other languages

IF / ELSE IF / ELSE

```
if (grade >= 90) {
  console.log("A+");
} else if (grade >= 85) {
  console.log("A");
} else if (grade >= 80) {
  console.log("A-");
} else if (grade >= 75) {
  console.log("B+");
} else if (grade >= 70) {
  console.log("B");
} else if (grade >= 65) {
  console.log("C+");
} else if (grade >= 60) {
  console.log("C");
} else if (grade >= 55) {
  console.log("D+");
} else if (grade >= 50) {
  console.log("D");
} else {
  console.log("E");
}
```

SWITCH

```
var text = null;
switch (new Date().getDay()) {
  case 4:
  case 5:
    text = "Soon it's the Weekend";
    break;
  case 0:
  case 6:
    text = "It is Weekend";
    break;
  default:
    text = "Looking forward to the Weekend";
}
console.log(text);
```



"BETTER" SWITCH

```
function weekendThoughts(date) {
  switch (date.getDay()) {
    case 4:
    case 5:
      return "Soon it's the Weekend";
    case 0:
    case 6:
      return "It is Weekend";
    default:
      return "Looking forward to the Weekend";
  }
}

var text = weekendThoughts(new Date());
console.log(text);
```

Better design to move switch to a separate function

More testable to allow inputs, otherwise it will take you "all week" to test the behaviour

While

Controlled repetition based on a predicate
(We know it will do 5 loops – 0, 3, 6, 9, 12)

```
let i = 0;
while (i < 10) {
  i += 3;
}
console.log("The value of i is " + i);
```

The value of i is 12.

Do / while

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">
      var level = 0;
      do {
        level += 1;
        document.writeln("<h"+ level +">Welcome to HTML5!</h"+ level +">");
      } while (level < 6);
    </script>
  </body>
</html>
```

Use do/while when you always want to enter the loop at least once

FOR

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">
      for (var level = 1; level < 7; level++) {
        document.writeln("<h"+ level +">Welcome to HTML5!</h"+ level +">");
      }
    </script>
  </body>
</html>
```

Control variable

Guard for when to loop

Increment the control variable

BREAK / CONTINUE

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">

      var countBy = 18;
      var maxNum = 100;
      var count = 0;
      document.writeln("Counting by " + countBy + " up to a max of " + maxNum);
      while (true) {
        count += 1;
        if (count > maxNum) {
          break;
        } else if (count % countBy != 0) {
          continue;
        } else {
          document.writeln("<li>" + count + "</li>");
        }
      }
    </script>
  </body>
</html>
```

Infinite loop

Stop looping

Stop this loop, but continue looping

Counting by 18 up to a max of 100

- 18
- 36
- 54
- 72
- 90

PARSEINT

Convert a string to a int

Check for “Not a Number”

```
var rawInput = "89";

var grade = parseInt(rawInput);

if (isNaN(grade)){
  console.log("Unable to process grade " + rawInput);
} else {
  grade += 3;
  console.log("After the 3% bonus, your grade is now " + grade);
}
```

ASSIGNMENT

```
var c;

c = 10;
c += 3;
console.log("C is " + c);

c = 10;
c -= 3;
console.log("C is " + c);

c = 10;
c *= 3;
console.log("C is " + c);

c = 10;
c /= 5;
console.log("C is " + c);
```

c = c + 3

c = c - 3

c = c * 3

c = c / 3

C is 13

C is 7

C is 30

C is 2

INCREMENTATION

Inc by one before evaluating < 3

```
i = 0
while (++i < 3) {}
console.log("++i loop, i is now " + i);

i = 0
while (i++ < 3) {}
console.log("i++ loop, i is now " + i);
```

Inc by one after evaluation < 3

++i loop, i is now 3

i++ loop, i is now 4

Same for decrement (--i or i--)

MATH.POW

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">
      var answer = Math.pow(3, 2);
      document.writeln("3^2 = " + answer);
    </script>
  </body>
</html>
```

3^2 = 9

LOGICAL OPERATORS

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">

      var a = "OK";
      var b = "";

      if (a) {
        document.writeln("a is TRUE<br>");
      } else {
        document.writeln("a is FALSE<br>");
      }

      if (b) {
        document.writeln("b is TRUE<br>");
      } else {
        document.writeln("b is FALSE<br>");
      }

      if (a && b) {
        document.writeln("a && b is TRUE<br>");
      } else {
        document.writeln("a && b is FALSE<br>");
      }

      if (a || b) {
        document.writeln("a || b is TRUE<br>");
      } else {
        document.writeln("a || b is FALSE<br>");
      }

      if (!a) {
        document.writeln("!a is TRUE<br>");
      } else {
        document.writeln("!a is FALSE<br>");
      }

      if (!b) {
        document.writeln("!b is TRUE<br>");
      } else {
        document.writeln("!b is FALSE<br>");
      }

    </script>
  </body>
</html>
```

a is TRUE
b is FALSE
a && b is FALSE
a || b is TRUE
!a is FALSE
!b is TRUE

CASTING TO BOOLEAN

```
<!DOCTYPE html>
<html>
  <body>
    <script type="text/javascript">

      var a = "OK";
      var b = "";

      if (!!a) {
        document.writeln("!!a is TRUE<br>");
      } else {
        document.writeln("!!a is FALSE<br>");
      }

      if (!!a == a) {
        document.writeln("!!a == a is TRUE<br>");
      } else {
        document.writeln("!!a == a is FALSE<br>");
      }

      if (!!b == b) {
        document.writeln("!!b == b is TRUE<br>");
      } else {
        document.writeln("!!b == b is FALSE<br>");
      }

      if (!!a === true) {
        document.writeln("!!a === true is TRUE<br>");
      } else {
        document.writeln("!!a === true is FALSE<br>");
      }

      if (!!b === false) {
        document.writeln("!!b === false is TRUE<br>");
      } else {
        document.writeln("!!b === false is FALSE<br>");
      }

    </script>
  </body>
</html>
```

!!a is TRUE
!!a == a is FALSE
!!b == b is TRUE
!!a === true is TRUE
!!b === false is TRUE

JavaScript Teacher
@js_tut

Array methods you should know:
[].map()
[].filter()
[].reduce() – sometimes used to calculate shopping cart total
[].some() – returns if at least one item matches condition
[].flat()
[].flatMap()
[].every()
[].sort() – used this one to create tables sorted by column

12:25 PM · Jan 15, 2020 · Twitter Web App

```
let entity = {};
entity.balance = 0.0;
entity.fees = 1.00;

function applyTransaction(delta) {
  entity.balance = entity.balance
    + delta
    - entity.fees;
}

applyTransaction(10);
```

```
let entity = {};
entity.balance = 0.0;
entity.fees = 1.00;

entity.showBalance = function() {
  document.writeln(`Balance ${this.balance}<br>`);
}

entity.showBalance();
```

```
var BankAccount = (function () {
   let entity = {};
   entity.balance = 0.0;
   return entity;
}());

BankAccount.blance;
```

```
var BankAccount = (function () {
  var entity = {};
  entity.balance = 0.0;
  entity.fees = 1.00;

  function applyTransaction(delta) {
    entity.balance = entity.balance + delta - entity.fees;
  }

  entity.showBalance = function() {
    document.writeln("Balance " + this.balance + "<br />");
  }

  entity.deposit = function(amount) {
    document.writeln("Deposit " + amount + "<br />");
    applyTransaction(amount);
    this.showBalance();
    return this.balance;
  }

  entity.withdraw = function(amount) {
    document.writeln("Withdraw " + amount + "<br />");
    applyTransaction(-1 * amount);
    this.showBalance();
    return this.balance;
  }

  return entity;
}());

BankAccount.showBalance();
BankAccount.deposit(100.0);
BankAccount.withdraw(10.0);
```

A module is just a variable with properties (which can be data or functions, named “methods”)

Module properties

Private function

Public methods of the module

Don't do this, just for demonstration

A closure that we immediately call

```
var BankAccount = (function () {
  var entity = {};
  entity.balance = 0.0;
  entity.fees = 1.00;

  function applyTransaction(delta) {
    entity.balance = entity.balance + delta - entity.fees;
  }

  entity.showBalance = function() {
    document.writeln("Balance " + this.balance + "<br />");
  }

  entity.deposit = function(amount) {
    document.writeln("Deposit " + amount + "<br />");
    applyTransaction(amount);
    this.showBalance();
    return this.balance;
  }

  entity.withdraw = function(amount) {
    document.writeln("Withdraw " + amount + "<br />");
    applyTransaction(-1 * amount);
    this.showBalance();
    return this.balance;
  }

  return entity;
}());

BankAccount.showBalance();
BankAccount.deposit(100.0);
BankAccount.withdraw(10.0);
```

Balance 0

Deposit 100

Balance 99

Withdraw 10

Balance 88

"Old" module as an input

```
var Math = (function (module) {
  module.inc = function(num) {
    return num + 1;
  }
  return module;
}(Math))
```

Pass in the existing module in the closure.

```
document.writeln(`Math.inc(7) = ${Math.inc(7)}<br>`);
```

AUGMENTATION (MONKEY PATCHING)

```
var Math = (function (module) {
  module.inc = function(num) {
    return num + 1;
  }
  return module;
}(Math))

document.writeln(`Math.inc(7) = ${Math.inc(7)}<br>`);
```

Math.inc(7) = 8

AUGMENTATION (MONKEY PATCHING)

```
function factorial(n) {
  if (n < 0) {
    return;
  } else if (n == 0) {
    return 1;
  } else {
    return n * factorial(n - 1);
  }
}

function showFactorial(n) {
  var answer = factorial(n);
  document.writeln(`${n} != ${answer}<br>`);
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(2);
showFactorial(3);
showFactorial(4);
```

Return "nothing" **undefined**

Return a value

Return at the "end" of the function

```
function factorial(n) {
  if (n < 0) {
    return;
  } else if (n == 0) {
    return 1;
  } else {
    return n * factorial(n - 1);
  }
}

function showFactorial(n) {
  var answer = factorial(n);
  document.writeln(`${n} != ${answer}<br>`)
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(2);
showFactorial(3);
showFactorial(4);
```

-10! = undefined

0! = 1

1! = 1

2! = 2

3! = 6

4! = 24

```
function beCareful() {
  x = 99;
}

function buggyInc(y) {
  return x + 1;
}

beCareful();
var answer = buggyInc(35);

document.writeln(`buggyInc(35) = ${answer}<br>`);
```

```
function beCareful() {
  x = 99;
}

function buggyInc(y) {
  return x + 1;
}

beCcareful();
var answer = buggyInc(35);

document.writeln(`buggyInc(35) = ${answer}<br>`);
```

buggyInc(35) = 100

```
var Dice = (function() {
  var entity = {
    "history": []
  };

  entity.roll = function() {
    var nextValue = Math.floor(1 + Math.random() * 6);
    this.history.push(nextValue);
    return nextValue;
  }

  entity.showHistory = function() {
    if (this.history.length == 0) {
      document.writeln("<br>No die has been thrown yet.<br>");
    } else {
      document.writeln("<br>Dice rolls ("+ this.history.length +")<br>");
      for (var i = 0, len = this.history.length; i < len; i++) {
        document.writeln("<li>" + this.history[i] + "</li>");
      }
    }
  }

  return entity;
}());

Dice.showHistory();

Dice.roll();
Dice.roll();
Dice.roll();

Dice.showHistory();
```

Return a random number between 0 (inclusive) and 1 (exclusive):

Truncate any value

No die has been thrown yet.

Dice rolls (3)

- 3
- 1
- 1

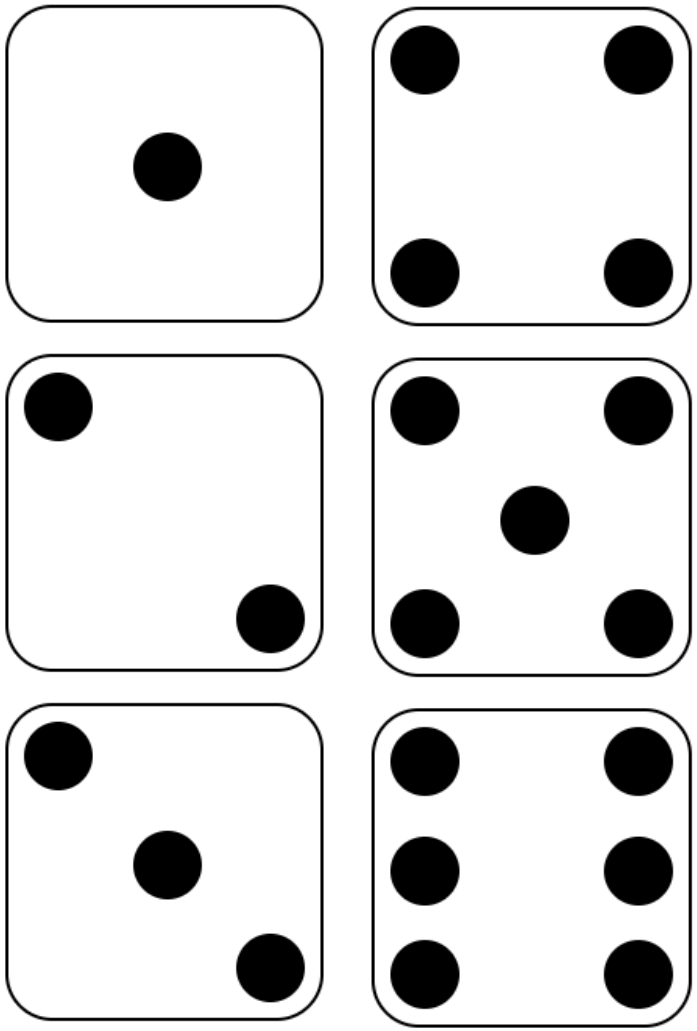
```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Welcome</title>
    <style>
      .dice {
        margin: 10px;
        position: relative;
        width: 100px;
        height: 100px;
        border: 1px solid black;
        border-radius: 15px;
      }

      .dice .middle {
        position: absolute;
        top: 40px;
        left: 40px;
      }

      .dot {
        border: 1px solid black;
        background-color: black;
        border-radius: 50%;
        width: 20px;
        height: 20px;
      }

    </style>
  </head>
  <body>

    <div class="dice" />
      <div class="middle"><div class="dot"></div></div>
    </div>

  </body>
</html>
```

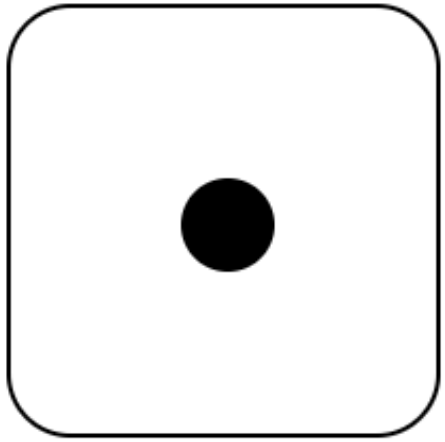
Die borders

Absolute is "relative" to the parent, when the parent is "relative"

Position of the point

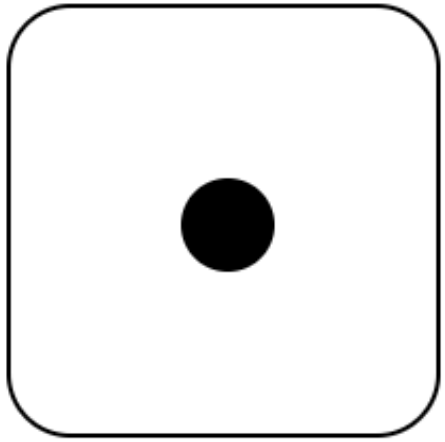
Black dot





Roll

History

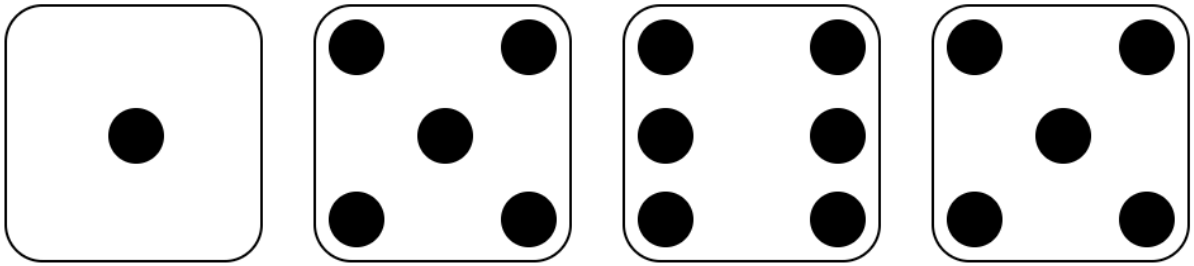


Roll

Roll

History

History



```
var roller = document.getElementById("roller");
var rollHistory = document.getElementById("rollHistory");
```

When someone clicks the button, the "onclick" event / function is executed

```
roller.onclick = function() {
  var nextValue = Dice.roll();
  var nextHtml = Dice.showDie("die01", nextValue);
  rollHistory.innerHTML +=
    `<div class="dice-container">${nextHtml}</div>`;
}

Dice.showDie("die01", 1);
```

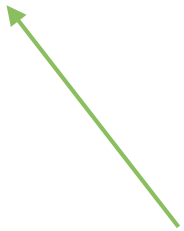
Safer to start running the event configuration when the page is ready

```
window.addEventListener("load", start, false);

function start() {

  var roller = document.getElementById("roller");
  var rollHistory = document.getElementById("rollHistory");

  roller.addEventListener(
    "click",
    function () {
      var nextValue = Dice.roll();
      var nextHtml = Dice.showDie("die01", nextValue);
      rollHistory.innerHTML += `<div class="dice-container">${nextHtml}</div>`;
    },
    false);

  Dice.showDie("die01", 1);
}
```

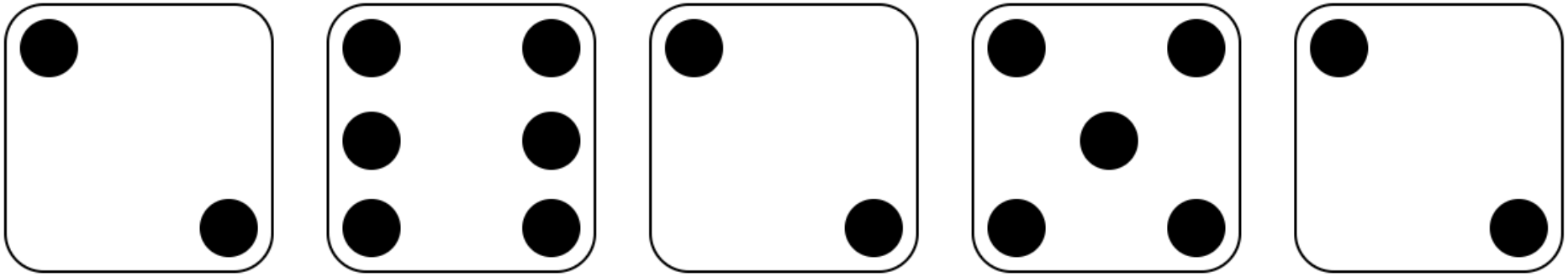
Can be applied to any DOM element.

Can be a function name, or the direct function

```
roller.onclick = function() {
   ...
}
```



But direct calls are generally better



Roll

```
window.onload = function()
{
  var roller = document.getElementById("roller");
  roller.addEventListener(
    "click",
    function () {
      Dice.showDie("die01", Dice.roll());
      Dice.showDie("die02", Dice.roll());
      Dice.showDie("die03", Dice.roll());
      Dice.showDie("die04", Dice.roll());
      Dice.showDie("die05", Dice.roll());
    },
    false);

  Dice.showDie("die01", 0);
  Dice.showDie("die02", 0);
  Dice.showDie("die03", 0);
  Dice.showDie("die04", 0);
  Dice.showDie("die05", 0);
}
```

Roll

```
var Dice = (function() {
  var entity = { "min": 1, "max": 6, "history": [] };

  entity.roll = function() {
    var nextValue = Math.floor(this.min + Math.random() * this.max);
    this.history.push(nextValue);
    return nextValue;
  }

  function htmlDie(num) {
    var html = '<div class="dice" />';
    var pos = positions(num);

    if (Array.isArray(pos)) {
      for (var i = 0, len = pos.length; i < len; i++) {
        html += htmlDot(pos[i]);
      }
    } else {
        html += '<div class="middle">'+ num +'</div></div>'
    }

    html += '</div>';
    return html;
  }

  function htmlDot(position) {
    return '<div class="'+ position +'"><div class="dot"></div></div>';
  }

  function positions(num) {
    switch (num) {
      case 0: return [];
      case 1: return [“middle"];
      ...
      default: return num;

    }
  }

  return entity;
}());
```

Store the min and max values.

Random number between min and max

If we can “draw” the dice face, do it

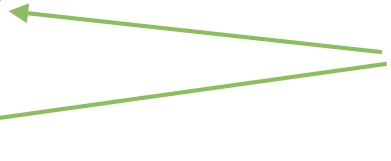
Otherwise print the number

For a large number, simply return itself instead of the position of the points

```
x = "GlobalX";
var y = "QuasiGlobalY";

function showY() {
  var y = "ScopedY"
  var p = "ScopedP"
  document.writeln("=== start showY =====<br>");
  document.writeln("x = " + x + "<br>");
  document.writeln("y = " + y + "<br>");
  document.writeln("p = " + p + "<br>");
  if (typeof(z) != "undefined") {
    document.writeln("z = " + z + "<br>");
  } else {
    document.writeln("z is undefined<br>");
  }
  document.writeln("=== end showY =====<br>");
}

function addZ()
{
  z = "AlsoGlobalZ";
}

showY();
addZ();
document.writeln("=== start main =====<br>");
document.writeln("x = " + x + "<br>");
document.writeln("y = " + y + "<br>");
document.writeln("z = " + z + "<br>");
if (typeof(p) != "undefined") {
  document.writeln("p = " + p + "<br>");
} else {
  document.writeln("p is undefined<br>");
}
document.writeln("=== end main =====<br>");
showY();
```

"x" is globale

"y" and "p" are local to the function



"z" is global

```
x = "GlobalX";
var y = "QuasiGlobalY";

function showY() {
  var y = "ScopedY"
  var p = "ScopedP"
  document.writeln("=== start showY =====<br>");
  document.writeln("x = " + x + "<br>");
  document.writeln("y = " + y + "<br>");
  document.writeln("p = " + p + "<br>");
  if (typeof(z) != "undefined") {
    document.writeln("z = " + z + "<br>");
  } else {
    document.writeln("z is undefined<br>");
  }
  document.writeln("=== end showY =====<br>");
}

function addZ()
{
  z = "AlsoGlobalZ";
}

showY();
addZ();
document.writeln("=== start main =====<br>");
document.writeln("x = " + x + "<br>");
document.writeln("y = " + y + "<br>");
document.writeln("z = " + z + "<br>");
if (typeof(p) != "undefined") {
  document.writeln("p = " + p + "<br>");
} else {
  document.writeln("p is undefined<br>");
}
document.writeln("=== end main =====<br>");
showY();
```

"x" is globale

"y" and "p" are local to the function

"z" is global

```
=== start showY =====
x = GlobalX
y = ScopedY
p = ScopedP
z is undefined
=== end showY =====
=== start main =====
x = GlobalX
y = QuasiGlobalY
z = AlsoGlobalZ
p is undefined
=== end main =====
=== start showY =====
x = GlobalX
y = ScopedY
p = ScopedP
z = AlsoGlobalZ
=== end showY =====
```

```
function showIsFinite(input)
{
  if (isFinite(input)) {
    document.writeln("Yes, ["+ input +"] is finite<br>");
  } else {
    document.writeln("No, ["+ input +"] is not finite<br>");
  }
}

showIsFinite(null);
showIsFinite(10);
showIsFinite(NaN);
showIsFinite(Number.POSITIVE_INFINITY);
showIsFinite(Number.NEGATIVE_INFINITY);
showIsFinite(Number.BLAH);
```

```
function showIsFinite(input)
{
  if (isFinite(input)) {
    document.writeln("Yes, ["+ input +"] is finite<br>");
  } else {
    document.writeln("No, ["+ input +"] is not finite<br>");
  }
}

showIsFinite(null);
showIsFinite(10);
showIsFinite(NaN);
showIsFinite(Number.POSITIVE_INFINITY);
showIsFinite(Number.NEGATIVE_INFINITY);
showIsFinite(Number.BLAH);
```

Yes, [null] is finite

Yes, [10] is finite

No, [NaN] is not finite

No, [Infinity] is not finite

No, [-Infinity] is not finite

No, [undefined] is not finite

```
function showIsNaN(input)
{
  if (isNaN(input)) {
    document.writeln("Yes, ["+ input +"] is NaN (not a number)<br>");
  } else {
    document.writeln("No, ["+ input +"] is not NaN (it's not not a number)<br>");
  }
}

showIsNaN(parseInt("abc"));
showIsNaN("abc");
showIsNaN(1/0);
showIsNaN(-1/0);
showIsNaN(10);
```

```
function showIsNaN(input)
{
  if (isNaN(input)) {
    document.writeln("Yes, ["+ input +"] is NaN (not a number)<br>");
  } else {
    document.writeln("No, ["+ input +"] is not NaN (it's not not a number)<br>");
  }
}

showIsNaN(parseInt("abc"));
showIsNaN("abc");
showIsNaN(1/0);
showIsNaN(-1/0);
showIsNaN(10);
```

Yes, [NaN] is NaN (not a number)

Yes, [abc] is NaN (not a number)

No, [Infinity] is not NaN (it's not not a number)

No, [-Infinity] is not NaN (it's not not a number)

No, [10] is not NaN (it's not not a number)

```
function factorial(n) {
  document.writeln("factorial("+ n +")<br>");
  if (n < 0) {
    document.writeln("> invalid input ["+ n +"]<br>");
    return;
  } else if (n == 0) {
    document.writeln("> base case 0! = 1<br>");
    return 1;
  } else {
    document.writeln("> recursive case "+ n +"! = "+ n +" * ("+ n +"-1)!<br>");
    return n * factorial(n - 1);
  }
}

function showFactorial(n) {
  document.writeln("<br>CALCULATING " + n +"! ... <br>");
  var answer = factorial(n);
  document.writeln("ANSWER " + answer + "<br>");
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(2);
showFactorial(3);
showFactorial(4);
```

Recursion is elegant, but ...

Usually it takes more time and memory

```
function factorial(n) {
  document.writeln("factorial("+ n +")<br>");
  if (n < 0) {
    document.writeln("> invalid input ["+ n +"]<br>");
    return;
  } else if (n == 0) {
    document.writeln("> base case 0! = 1<br>");
    return 1;
  } else {
    document.writeln("> recursive case "+ n +"! = "+ n +" * ("+ n +"-1)!<br>");
    return n * factorial(n - 1);
  }
}

function showFactorial(n) {
  document.writeln("<br>CALCULATING " + n +"! ... <br>")
  var answer = factorial(n);
  document.writeln("ANSWER " + answer + "<br>");
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(2);
showFactorial(3);
showFactorial(4);
```

CALCULATING 4! ...
factorial(4)
> recursive case 4! = 4 * (4-1)!
factorial(3)
> recursive case 3! = 3 * (3-1)!
factorial(2)
> recursive case 2! = 2 * (2-1)!
factorial(1)
> recursive case 1! = 1 * (1-1)!
factorial(0)
> base case 0! = 1
ANSWER 24

```
var fibonacci = (function () {
    var memo = [0, 1];
    var fib = function (n) {
        var result = memo[n];
        if (typeof(result) !== 'number') {
            result = fib(n-1) + fib(n-2);
            memo[n] = result;
        }
        return result;
    };
    return fib;
}());

function showFibonacci(n) {
  var answer = fibonacci(n);
  document.writeln(
    `fibonacci(${n} = ${answer}<br>`);
}

showFibonacci(0);
showFibonacci(1);
showFibonacci(2);
showFibonacci(3);
showFibonacci(4);
showFibonacci(5);
showFibonacci(6);
```

Fib (x) is always the same (no side effects) so we can cache the results (memoize).

```
var fibonacci = (function () {
    var memo = [0, 1];
    var fib = function (n) {
        var result = memo[n];
        if (typeof(result) !== 'number') {
            result = fib(n-1) + fib(n-2);
            memo[n] = result;
        }
        return result;
    };
    return fib;
}());

function showFibonacci(n) {
  var answer = fibonacci(n);
  document.writeln(
    `fibonacci(${n} = ${answer}<br>`);
}

showFibonacci(0);
showFibonacci(1);
showFibonacci(2);
showFibonacci(3);
showFibonacci(4);
showFibonacci(5);
showFibonacci(6);
```

fibonacci(0) = 0

fibonacci(1) = 1

fibonacci(2) = 1

fibonacci(3) = 2

fibonacci(4) = 3

fibonacci(5) = 5

fibonacci(6) = 8

```
var memoizer = function (formula) {
  var memo = [];
  var recur = function (n) {
    var result = memo[n];
    if (typeof result == 'undefined') {
      result = formula(recur, n);
      memo[n] = result;
    }
    return result;
  };
  return recur;
};

var factorial = memoizer(function (recur, n) {
  document.writeln("factorial("+ n +")<br>");
  if (n < 0) {
    document.writeln("> invalid input ["+ n +"]<br>");
    return;
  } else if (n == 0) {
    document.writeln("> base case 0! = 1<br>");
    return 1;
  } else {
    document.writeln("> recursive case "+ n +"! = "+ n +" * ("+ n +"-1)!<br>");
    return n * recur(n - 1);
  }
});

function showFactorial(n) {
  document.writeln("<br>CALCULATING " + n +"! ... <br>");
  var answer = factorial(n);
  document.writeln("ANSWER " + answer + "<br>");
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(4);
showFactorial(2);
showFactorial(3);
```

But we get the cached values "for free"

Same implementation

```
var memoizer = function (formula) {
  var memo = [];
  var recur = function (n) {
    var result = memo[n];
    if (typeof result == 'undefined') {
      result = formula(recur, n);
      memo[n] = result;
    }
    return result;
  };
  return recur;
};

var factorial = memoizer(function (recur, n) {
  document.writeln("factorial("+ n +")<br>");
  if (n < 0) {
    document.writeln("> invalid input ["+ n +"]<br>");
    return;
  } else if (n == 0) {
    document.writeln("> base case 0! = 1<br>");
    return 1;
  } else {
    document.writeln("> recursive case "+ n +"! = "+ n +" * ("+ n +"-1)!<br>");
    return n * recur(n - 1);
  }
});

function showFactorial(n) {
  document.writeln("<br>CALCULATING " + n +"! ... <br>");
  var answer = factorial(n);
  document.writeln("ANSWER " + answer + "<br>");
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(4);
showFactorial(2);
showFactorial(3);
```

CALCULATING 4! ...

factorial(4)

> recursive case 4! = 4 * (4-1)!

factorial(3)

> recursive case 3! = 3 * (3-1)!

factorial(2)

> recursive case 2! = 2 * (2-1)!

ANSWER 24

CALCULATING 2! ...

ANSWER 2

CALCULATING 3! ...

ANSWER 6

```
function factorial(n) {
  document.writeln("factorial("+ n +")<br>");
  if (n < 0) {
    return;
  } else {
    var runningTotal = 1;
    for (var i = n; i > 0; i--) {
      runningTotal *= i;
    }
    return runningTotal;
  }
}

function showFactorial(n) {
  document.writeln("<br>CALCULATING " + n +"! ... <br>");
  var answer = factorial(n);
  document.writeln("ANSWER " + answer + "<br>");
}

showFactorial(-10);
showFactorial(0);
showFactorial(1);
showFactorial(2);
showFactorial(3);
showFactorial(4);
```

Any recursive solution can be resolved in a non-recursive manner (aka iteratively)

But you can't use memoization as easily

```
function showArray(name, arr)
{
  var output = "Array "+ name +" ["+ arr.length+"] is [";
  for (var i=0, len = arr.length; i < len; i++) {
    output += arr[i] + ", ";
  }
  output += "]<br>";
  document.writeln(output);
}

var a = new Array(1, 2, 3);
var b = [1, 2, 3];
var c = [];
var d = new Array(3);
var e = [,,,];
c.push(1);
c.push(2);
c.push(3);

showArray("a", a);
showArray("b", b);
showArray("c", c);
showArray("d", d);
showArray("e", e);
```

Array object

Initialise with values 1,2,3

Simplified constructor

Un tableau vide

Please note, an array of size 3, NOT an array of size one with a “3” in it

Push elements into an array

```
function showArray(name, arr)
{
  var output = "Array "+ name +" ["+ arr.length+"] is [";
  for (var i=0, len = arr.length; i < len; i++) {
    output += arr[i] + ", ";
  }
  output += "]<br>";
  document.writeln(output);
}

var a = new Array(1, 2, 3);
var b = [1, 2, 3];
var c = [];
var d = new Array(3);
var e = [,,,];
c.push(1);
c.push(2);
c.push(3);

showArray("a", a);
showArray("b", b);
showArray("c", c);
showArray("d", d);
showArray("e", e);
```

Array a [3] is [1, 2, 3,]

Array b [3] is [1, 2, 3,]

Array c [3] is [1, 2, 3,]

Array d [3] is [undefined, undefined, undefined,]

Array e [3] is [undefined, undefined, undefined,]

Pre-calculate the length to avoid the call every time

```
var arr = ["apples", "bananas", "carrots"];

document.writeln("<h3>Method 1</h3>");
for (var i=0, len = arr.length; i < len; i++) {
  document.writeln("["+ i +"] = " + arr[i] + "<br>");
}
```

Avoid for / in, it is much slower than a simple one for the loop

```
document.writeln("<h3>Method 2</h3>");
for (var i in arr) {
  document.writeln("["+ i +"] = " + arr[i] + "<br>");
}
```

The second argument (element index) is optional

```
document.writeln("<h3>Method 3 (slow)</h3>");
arr.forEach(function (ele, i /* optional */){
  document.writeln("["+ i +"] = " + ele + "<br>");
})
```

```
var arr = ["apples", "bananas", "carrots"];

document.writeln("<h3>Method 1</h3>");
for (var i=0, len = arr.length; i < len; i++) {
  document.writeln("["+ i +"] = " + arr[i] + "<br>");
}

document.writeln("<h3>Method 2</h3>");
for (var i in arr) {
  document.writeln("["+ i +"] = " + arr[i] + "<br>");
}

document.writeln("<h3>Method 3 (slow)</h3>");
arr.forEach(function (ele, i /* optional */){
  document.writeln("["+ i +"] = " + ele + "<br>");
})
```

Method 1

[0] = apples
[1] = bananas
[2] = carrots

Method 2

[0] = apples
[1] = bananas
[2] = carrots

Method 3 (slow)

[0] = apples
[1] = bananas
[2] = carrots

```
function show(name, o)
{
  document.writeln(name + " = " + o + "<br>");
}

function changeInt(i)
{
  i += 1;
}

function changeString(str)
{
  str += " a change";
}

function changeBoolean(b)
{
  b = !b;
}

var x;

x = 99;
show("x before", x);
changeInt(x);
show("x after", x);

x = "abc";
show("x before", x);
changeString(x);
show("x after", x);

x = true;
show("x before", x);
changeBoolean(x);
show("x after", x);
```

```
function show(name, o)
{
  document.writeln(name + " = " + o + "<br>");
}

function changeInt(i)
{
  i += 1;
}

function changeString(str)
{
  str += " a change";
}

function changeBoolean(b)
{
  b = !b;
}

var x;

x = 99;
show("x before", x);
changeInt(x);
show("x after", x);

x = "abc";
show("x before", x);
changeString(x);
show("x after", x);

x = true;
show("x before", x);
changeBoolean(x);
show("x after", x);
```

x before = 99

x after = 99

x before = abc

x after = abc

x before = true

x after = true

```
function show(name, o)
{
  document.writeln(name + " = " + o + "<br>");
}

function showObj(name, o)
{
  document.writeln(name + " = " + o.name + ", "+ o.colour +"<br>");
}

function changeArray(arr)
{
  arr[0] = "candy";
  arr.push("oranges");
}

function changeObject(o)
{
  o.name = "James";
  o.colour = "green";
}

var x;

x = ["apples"];
show("x before", x);
changeArray(x);
show("x after", x);

x = {"name": "Andrew"};
showObj("x before", x);
changeObject(x);
showObj("x after", x);
```


Similar to Java, objects and arrays are passed by reference

```
function show(name, o)
{
  document.writeln(name + " = " + o + "<br>");
}

function showObj(name, o)
{
  document.writeln(name + " = " + o.name + ", "+ o.colour +"<br>");
}

function changeArray(arr)
{
  arr[0] = "candy";
  arr.push("oranges");
}

function changeObject(o)
{
  o.name = "James";
  o.colour = "green";
}

var x;

x = ["apples"];
show("x before", x);
changeArray(x);
show("x after", x);

x = {"name": "Andrew"};
showObj("x before", x);
changeObject(x);
showObj("x after", x);
```

x before = apples

x after = candy, oranges

x before = Andrew, undefined

x after = James, green

```
var arr = ["apples", "oranges", "carrots"];

document.writeln(arr.join() + "<br>");

document.writeln(arr.join("&#9786;") + "<br>");
```

The default separator is a comma (without spaces)

Can be changed

```
var arr = ["apples", "oranges", "carrots"];

document.writeln(arr.join() + "<br>");

document.writeln(arr.join("&#9786;") + "<br>");
```

apples,oranges,carrots

apples ☺ oranges ☺ carrots

```
var arr = ["monkey", "apple", "zealot"];
document.writeln(arr.sort().join(", ") + "<br>");

var arr = [40, 8, 320];
document.writeln(arr.sort().join(", ") + "<br>");
```

Not what you expect

```
var arr = ["monkey", "apple", "zealot"];
document.writeln(arr.sort().join(", ") + "<br>");

var arr = [40, 8, 320];
document.writeln(arr.sort().join(", ") + "<br>");
```

apple, monkey, zealot

320, 40, 8

Sort algorithm based on strings
("4" <"8", therefore "40" <"8")

```
var arr = [40, 8, 40, 320];

arr.sort(function (a, b){
  return a - b;
})

document.writeln(arr.join(", ") + "<br>");
```

You can pass (as a function) a comparator

It returns three “types” of values:

If “a” is **before** “b”, returns a **negative** number

If “a” is **after** “b”, returns a **positive** number

If they are the **same**, return **0**

```
var arr = [40, 8, 40, 320];

arr.sort(function (a, b){
  return a - b;
})

document.writeln(arr.join(", ") + "<br>");
```

8, 40, 40, 320

```
function show(name, ele, index)
{
  document.writeln(name + " of " + ele + " is " + index + "<br>");
}

var arr = [40, 8, 40, 320, 40, 57];

show("indexOf(40)", 40, arr.indexOf(40));
show("lastIndexOf(40)", 40, arr.lastIndexOf(40));
show("indexOf(8)", 8, arr.indexOf(8));
show("lastIndexOf(8)", 8, arr.lastIndexOf(8));
show("indexOf(40, 1)", 40, arr.indexOf(40, 1));
show("lastIndexOf(40, 1)", 40, arr.lastIndexOf(40, 1));
show("lastIndexOf(40, 3)", 40, arr.lastIndexOf(40, 3));
show("indexOf(40, 5)", 40, arr.indexOf(40, 5));
show("indexOf(40,99)", 40, arr.indexOf(40,99));
```

The index of “40” in the table

The last index of “40” in the table

Optional starting offset

Returns -1 if the offset is out of range or if the value is not found

Think of the "lastIndexOf" as the "indexOf", but in the opposite direction

indexOf(40) of 40 is 0

lastIndexOf(40) of 40 is 4

indexOf(8) of 8 is 1

lastIndexOf(8) of 8 is 1

indexOf(40,1) of 40 is 2

lastIndexOf(40,1) of 40 is 0

lastIndexOf(40,3) of 40 is 2

indexOf(40,99) of 40 is -1

Arrays of any number of dimensions

But instead, use a more appropriate data structure

```
var arr = [
   ["Andrew", 41],
   ["Hayden", 9],
   ["Ayana", 41],
   ["August", 6]
];
```

If same age, by name

```
arr.sort(function(a,b){
   if (a[1] == b[1]) {
      return a[0].localeCompare(b[0]);
   } else {
      return b[1] - a[1];
   }
})

document.writeln(arr.join("<br>"));
```

First sort by age

Andrew,38

Ayana,38

Hayden,6

August,4

A global object named Math

```
Math.abs(-1);
Math.floor(38.9);
Math.ceil(12.2);
Math.round(14.49);
Math.max(-2, 4);
Math.min(-2, 4);
Math.PI;
```

Several functions are available, such as rounding numbers

```
Math.abs(-1);
Math.floor(38.9);
Math.ceil(12.2);
Math.round(14.49);
Math.max(-2, 4);
Math.min(-2, 4);
Math.PI;
```

Math.abs(-1) = 1

Math.floor(38.9) = 38

Math.ceil(12.2) = 13

Math.round(14.49) = 14

Math.max(-2, 4) = 4

Math.min(-2, 4) = -2

Math.PI = 3.141592653589793

A string is also an object with methods

```
"this course rocks".charAt(2);
"this course rocks".charCodeAt(2);
"this course".concat(" is just ok").replace("just ok", "rocks");
"this course is just ok".replace("just ok", "awesome actually");
"this course is just ok".split(" ");
"STOP YELLING".toLowerCase();
"I said pardon?".toUpperCase();
"Off by one errors".substring(0,9);
```

Read the API documents carefully to know the meaning of the arguments (for example the index or length)

```
"this course rocks".charAt(2);
"this course rocks".charCodeAt(2);
"this course".concat(" is just ok").replace("just ok", "rocks");
"this course is just ok".replace("just ok", "awesome actually");
"this course is just ok".split(" ");
"STOP YELLING".toLowerCase();
"I said pardon?".toUpperCase();
"Off by one errors".substring(0,9);
```

"this course rocks".charAt(2) = i

"this course rocks".charCodeAt(2) = 105

"this course".concat(" is just ok").replace("just ok", "rocks") = this course is rocks

"this course is just ok".replace("just ok", "awesome actually") = this course is awesome actually

"this course is just ok".split(" ") = this,course,is,just,ok

"STOP YELLING".toLowerCase() = stop yelling

"I said pardon?".toUpperCase() = I SAID PARDON?

"Off by one errors".substring(0,9) = Off by on


```
"three blind mice".indexOf("blind");
"three seeing mice".indexOf("blind");
"there are these things in the woods".lastIndexOf("the");
"there are these things in the woods".indexOf("the");
"there are these things in the woods".indexOf("the", 1);
"there are these things in the woods".indexOf("the", 11);
"there are these things in the woods".indexOf("the", 27);
"there are these things in the woods".lastIndexOf("the", 9);
"there are these things in the woods".lastIndexOf("the", 25);
```

```
"three blind mice".indexOf("blind");
"three seeing mice".indexOf("blind");
"there are these things in the woods".lastIndexOf("the");
"there are these things in the woods".indexOf("the");
"there are these things in the woods".indexOf("the", 1);
"there are these things in the woods".indexOf("the", 11);
"there are these things in the woods".indexOf("the", 27);
"there are these things in the woods".lastIndexOf("the", 9);
"there are these things in the woods".lastIndexOf("the", 25);
```

"three blind mice".indexOf("blind") = 6

"three seeing mice".indexOf("blind") = -1

"there are these things in the woods".lastIndexOf("the") = 26

"there are these things in the woods".indexOf("the") = 0

"there are these things in the woods".indexOf("the", 1) = 10

"there are these things in the woods".indexOf("the", 11) = 26

"there are these things in the woods".indexOf("the", 27) = -1

"there are these things in the woods".lastIndexOf("the", 9) = 0

"there are these things in the woods".lastIndexOf("the", 25) = 10

Returns an array, using the parameter to delimit the string

Comma, by default

```
"three blind mice".split(" ");
"three;blind;mice".split(";");
"three,blind,mice".split();
```

Create a smaller string between the start and end index

```
"abcdefghijklmnopqrstuvwxyz".substring(0);
"abcdefghijklmnopqrstuvwxyz".substring(0, 5);
"abcdefghijklmnopqrstuvwxyz".substring(1, 5);
"abcdefghijklmnopqrstuvwxyz".substring(12);
"abcdefghijklmnopqrstuvwxyz".substring(12, 99);
```

The final index is optional

If the end of the string is before the last index of the string itself, returns to the end of the string

```
"three blind mice".split(" ");
"three;blind;mice".split(";");
"three,blind,mice".split();

"abcdefghijklmnopqrstuvwxyz".substring(0);
"abcdefghijklmnopqrstuvwxyz".substring(0, 5);
"abcdefghijklmnopqrstuvwxyz".substring(1, 5);
"abcdefghijklmnopqrstuvwxyz".substring(12);
"abcdefghijklmnopqrstuvwxyz".substring(12, 99);
```

"three blind mice".split(" ") = three,blind,mice

"three;blind;mice".split(";") = three,blind,mice

"three,blind,mice".split() = three,blind,mice

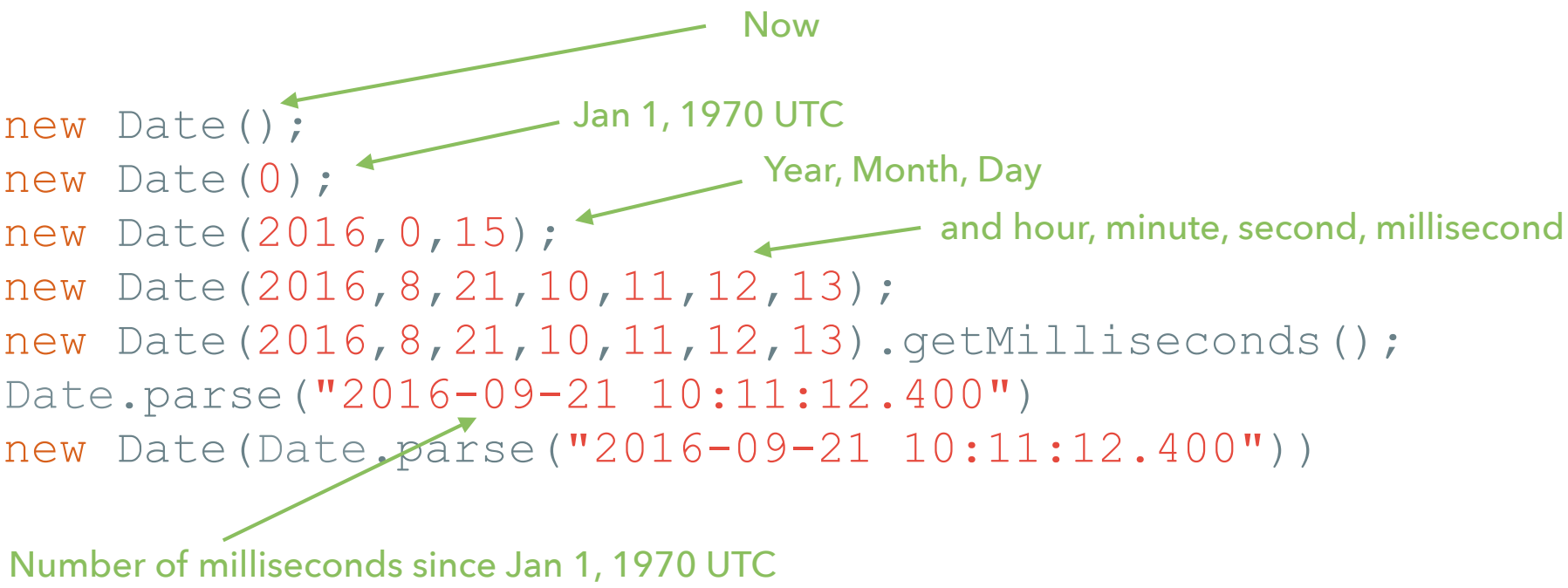
"abcdefghijklmnopqrstuvwxyz".substring(0) = abcdefghijklmnopqrstuvwxyz

"abcdefghijklmnopqrstuvwxyz".substring(0, 5) = abcde

"abcdefghijklmnopqrstuvwxyz".substring(1, 5) = bcde

"abcdefghijklmnopqrstuvwxyz".substring(12) = mnopqrstuvwxyz

"abcdefghijklmnopqrstuvwxyz".substring(12, 99) = mnopqrstuvwxyz


Now
Jan 1, 1970 UTC
Year, Month, Day
and hour, minute, second, millisecond
new Date();
new Date(0);
new Date(2016,0,15);
new Date(2016,8,21,10,11,12,13);
new Date(2016,8,21,10,11,12,13).getMilliseconds();
Date.parse("2016-09-21 10:11:12.400")
new Date(Date.parse("2016-09-21 10:11:12.400"))
Number of milliseconds since Jan 1, 1970 UTC

```
new Date();
new Date(0);
new Date(2016,0,15);
new Date(2016,8,21,10,11,12,13);
new Date(2016,8,21,10,11,12,13).getMilliseconds();
Date.parse("2016-09-21 10:11:12.400")
new Date(Date.parse("2016-09-21 10:11:12.400"))
```

new Date() = Sun Jan 15 2017 09:58:09 GMT-0500 (EST)

new Date(0) = Wed Dec 31 1969 19:00:00 GMT-0500 (EST)

new Date(2016,0,15) = Fri Jan 15 2016 00:00:00 GMT-0500 (EST)

new Date(2016,8,21,10,11,12,13) = Wed Sep 21 2016 10:11:12 GMT-0400 (EDT)

new Date(2016,8,21,10,11,12,13).getMilliseconds() = 13

Date.parse("2016-09-21 10:11:12.400") = 1474467072400

new Date(Date.parse("2016-09-21 10:11:12.400")) = Wed Sep 21 2016 10:11:12 GMT-0400 (EDT)

```
new Date();
(new Date()).getFullYear();
(new Date()).getUTCFullYear();
(new Date()).getMonth();
(new Date()).getDate();
(new Date()).getDay();
(new Date()).getHours();
(new Date()).getUTCHours();
(new Date()).getMinutes();
(new Date()).getSeconds();
(new Date()).getMilliseconds();
(new Date()).getTime();
(new Date()).getTimezoneOffset();
new Date((new Date()).setMinutes(59));
```

Every getX has a getUTCX

Months of the year (0-12)

Days of the months (1-31)

Days of the week (0 - 6)
Sunday to Saturday

In minutes

Every getX has a setX

new Date() = Sun Jan 15 2017 10:10:52 GMT-0500 (EST)

(new Date()).getFullYear() = 2017

(new Date()).getUTCFullYear() = 2017

(new Date()).getMonth() = 0

(new Date()).getDate() = 15

(new Date()).getDay() = 0

(new Date()).getHours() = 10

(new Date()).getUTCHours() = 15

(new Date()).getMinutes() = 10

(new Date()).getSeconds() = 52

(new Date()).getMilliseconds() = 962

(new Date()).getTime() = 1484493052962

(new Date()).getTimezoneOffset() = 300

new Date((new Date()).setMinutes(59)) = Sun Jan 15 2017 10:59:52 GMT-0500 (EST)

```
new Date();
(new Date()).getFullYear();
(new Date()).getUTCFullYear();
(new Date()).getMonth();
(new Date()).getDate();
(new Date()).getDay();
(new Date()).getHours();
(new Date()).getUTCHours();
(new Date()).getMinutes();
(new Date()).getSeconds();
(new Date()).getMilliseconds();
(new Date()).getTime();
(new Date()).getTimezoneOffset();
new Date((new Date()).setMinutes(59));
```

new Date() = Sun Jan 15 2017 10:10:52 GMT-0500 (EST)

(new Date()).getFullYear() = 2017

(new Date()).getUTCFullYear() = 2017

(new Date()).getMonth() = 0

(new Date()).getDate() = 15

(new Date()).getDay() = 0

(new Date()).getHours() = 10

(new Date()).getUTCHours() = 15

(new Date()).getMinutes() = 10

(new Date()).getSeconds() = 52

(new Date()).getMilliseconds() = 962

(new Date()).getTime() = 1484493052962

(new Date()).getTimezoneOffset() = 300

new Date((new Date()).setMinutes(59)) =
Sun Jan 15 2017 10:59:52 GMT-0500 (EST)

```
new Boolean(true);
new Boolean("James");
new Boolean("0");

new Boolean(false);
new Boolean(0);
new Boolean("");
new Boolean();
new Boolean(null);
new Boolean(NaN);
new Boolean(undefined);
```

"0" est vrai

0 est faux

new Boolean(true) = true

new Boolean("James") = true

new Boolean("0") = true

new Boolean(false) = false

new Boolean(0) = false

new Boolean("") = false

new Boolean() = false

new Boolean(null) = false

new Boolean(NaN) = false

new Boolean(undefined) = false

```
new Number(10)
Number.MAX_VALUE
Number.MIN_VALUE
Number.NaN
Number.NEGATIVE_INFINITY
Number.POSITIVE_INFINITY
```

Don't do this

Some constants available, the greatest value is NaN ("Not a Number")

```
new Number(10)
Number.MAX_VALUE
Number.MIN_VALUE
Number.NaN
Number.NEGATIVE_INFINITY
Number.POSITIVE_INFINITY
```

new Number(10) = 10

Number.MAX_VALUE = 1.7976931348623157e+308

Number.MIN_VALUE = 5e-324

Number.NaN = NaN

Number.NEGATIVE_INFINITY = -Infinity

Number.POSITIVE_INFINITY = Infinity

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