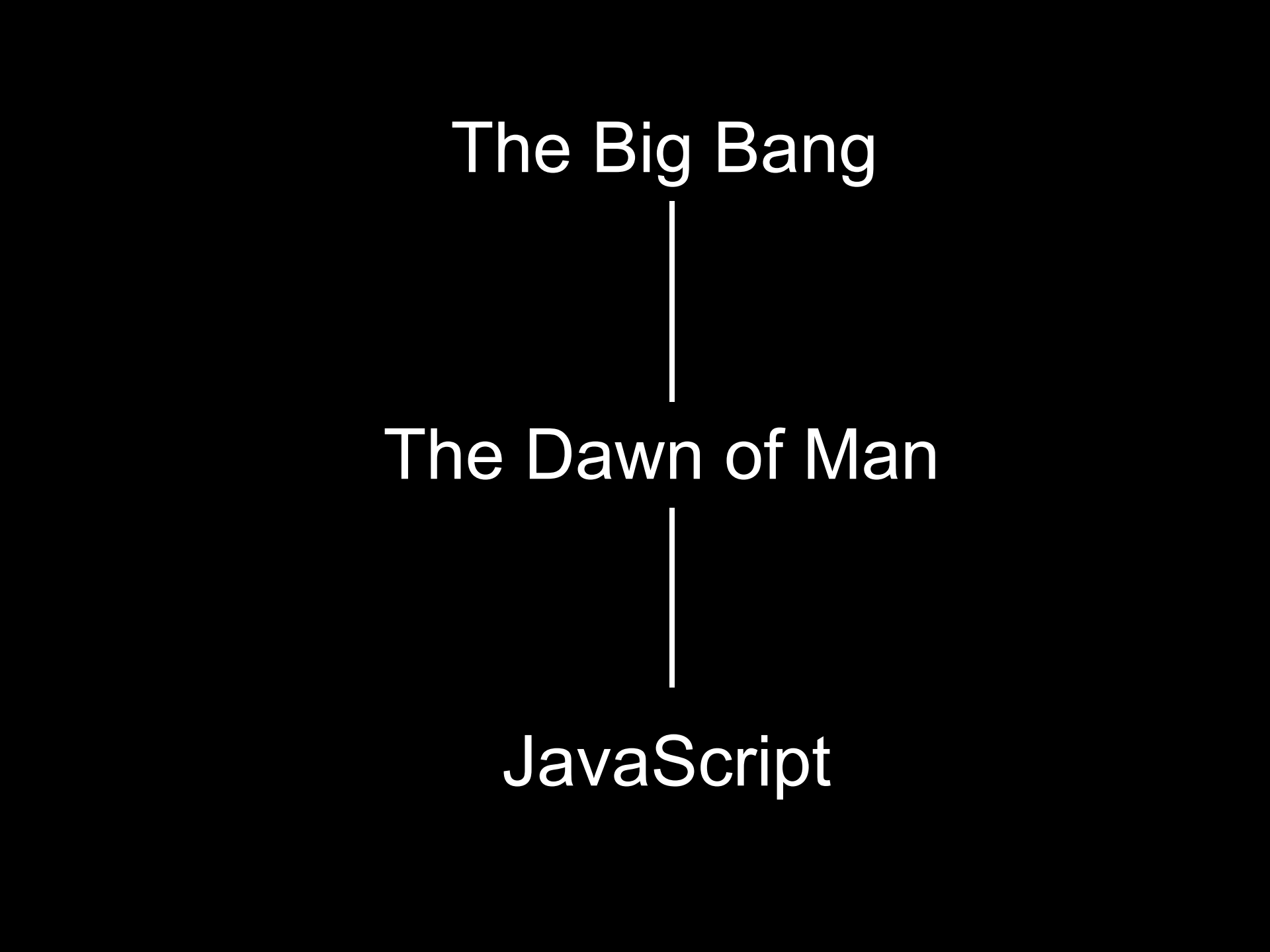
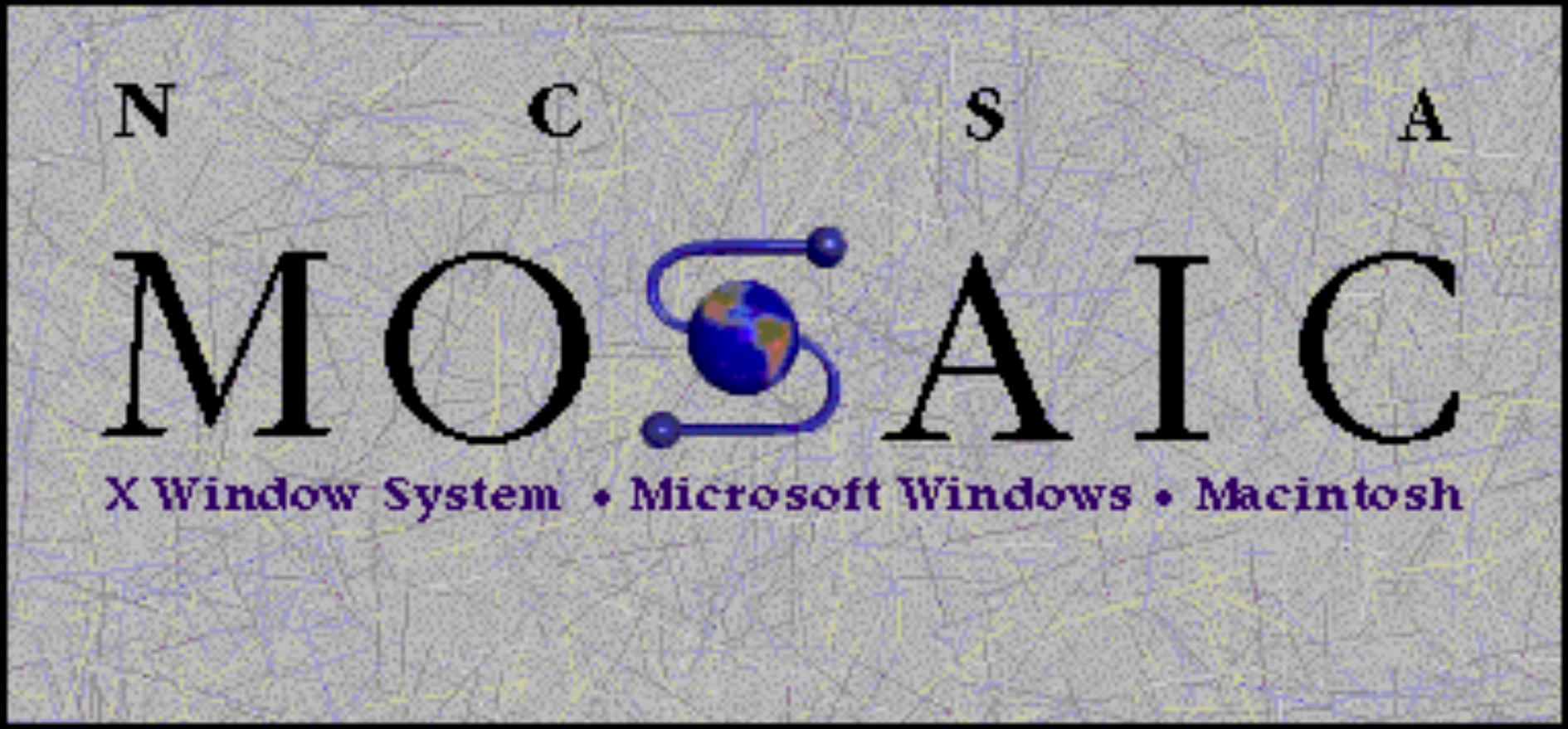
Chapter 2

And Then There Was JavaScript


The Big Bang
The Dawn of Man
JavaScript

The First Important Discovery of the 21st Century

JavaScript has good parts.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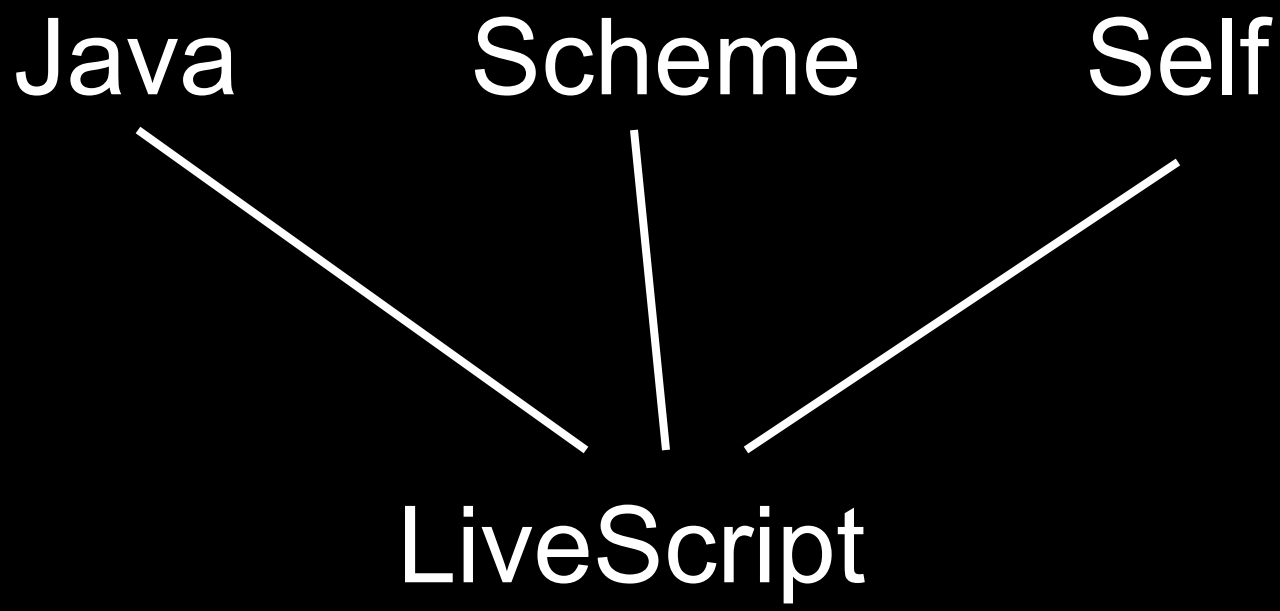
Java
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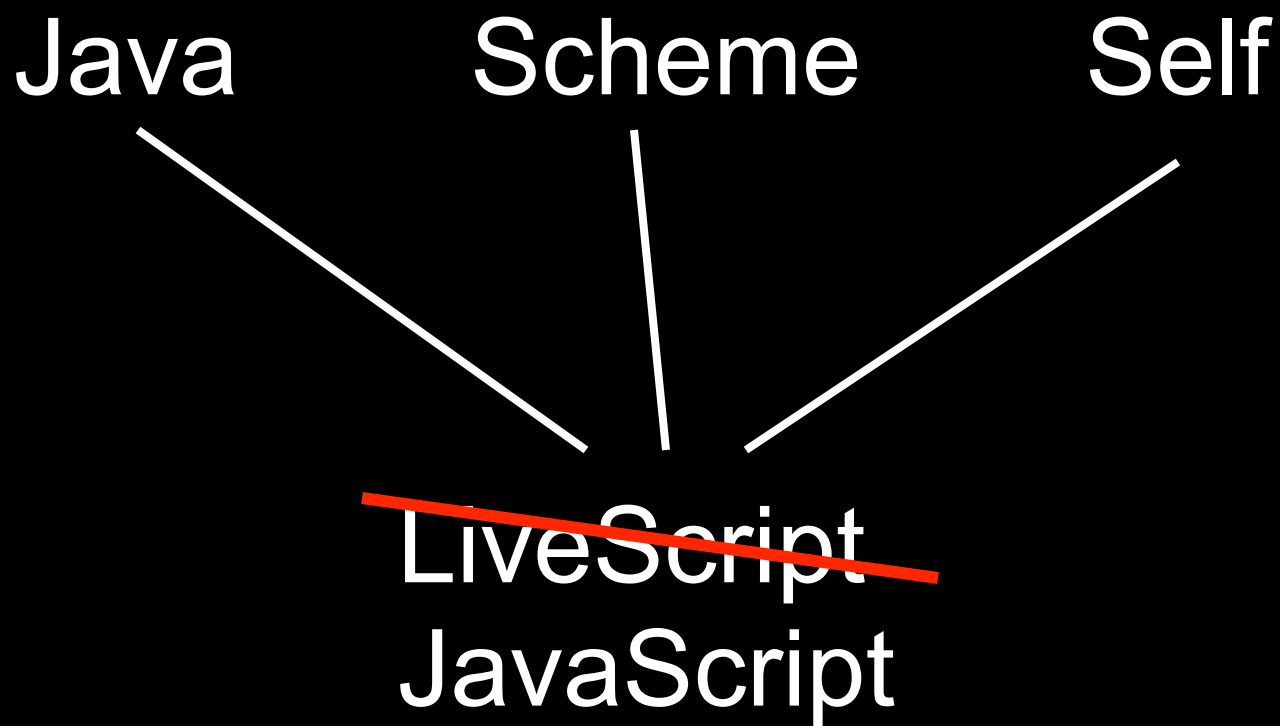
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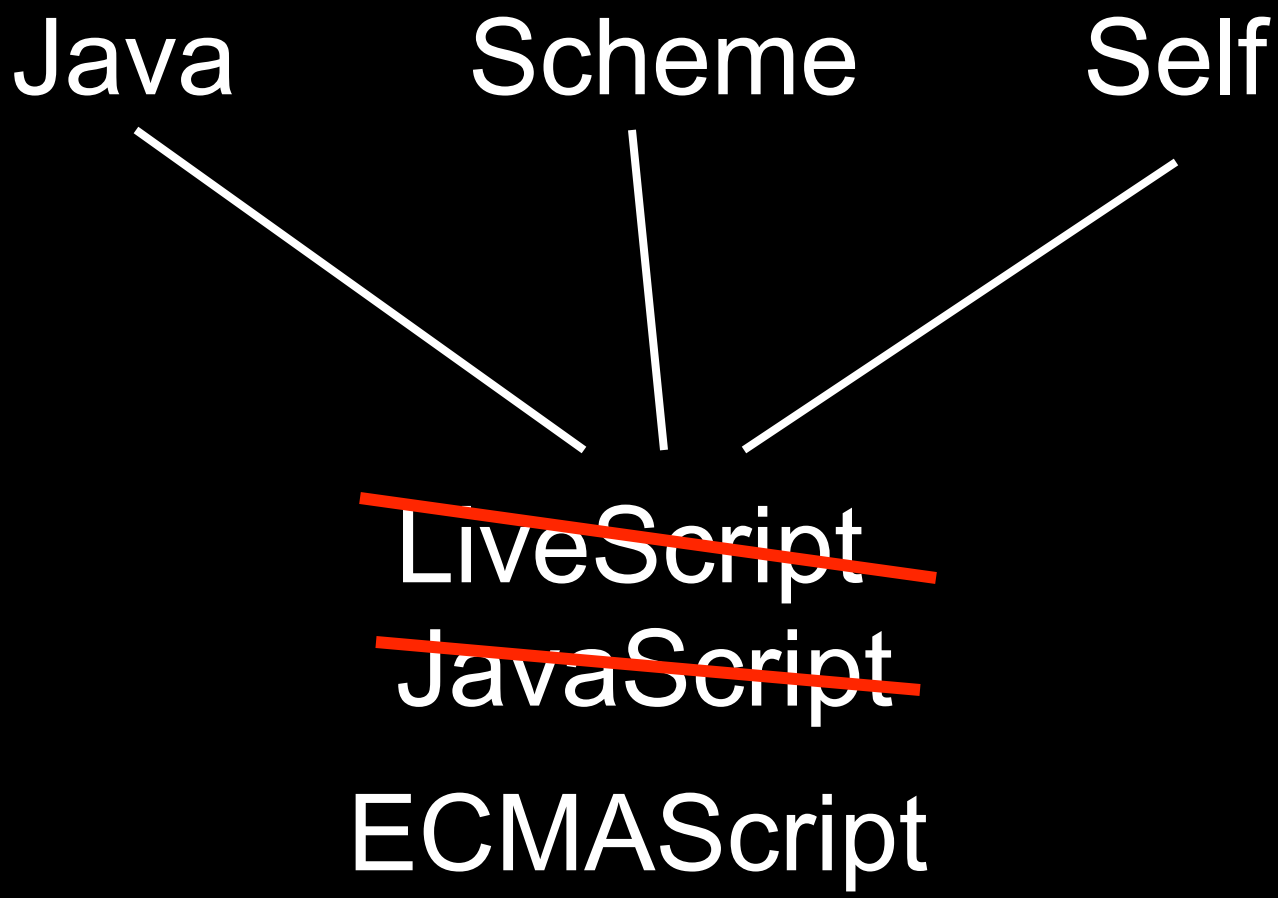
Java
Scheme
Self
LiveScript
JavaScript
ECMAScript

ECMAScript

- 1999 Third Edition ES3
- 2009 Fifth Edition ES5
  - Default
  - Strict

- For the short term, work in the intersection of ES3 and ES5/Strict
- For the long term, work with ES5/Strict.
- Avoid ES5/Default.

Where do Bad Parts come from?

- Legacy
- Good Intentions
- Haste

- For the most part, the bad parts can be avoided.
- The problem with the bad parts isn't that they are useless.

Objects

An object is a dynamic collection of properties.

Every property has a key string that is unique within that object.

Get, set, and delete

- get
  object.name
  object[expression]

- set
  object.name = value;
  object[expression] = value;

- delete
  delete object.name
  delete object[expression]

Object literals

- An expressive notation for creating objects.

```
var my_object = {foo: bar};

var my_object = Object.defineProperties(
        Object.create(Object.prototype), {
    foo: {
        value: bar,
        writeable: true,
        enumerable: true,
        configurable: true
    }
});
```

Classes v Prototypes

Working with prototypes

- Make an object that you like.
- Create new instances that inherit from that object.
- Customize the new objects.

- Taxonomy and classification are not necessary.

Delegation

Differential Inheritance

new prefix operator

```
function new(func, args) {
    var that = Object.create(func.prototype),
        result = func.apply(that, args);
    return (typeof result === 'object' &&
        result) || that;
}
```

JavaScript didn’t get it quite right

```
function bump_count(word) {
    if (word_count[word]) {
       word_count[word] += 1;
    } else {
       word_count[word] = 1;
    }
}
```

- Accidental collisions:
  Fails when `word === 'constructor'`

JavaScript didn’t get it quite right

```
function bump_count(word) {
    if (typeof word_count[word] ===
            'number') {
        word_count[word] += 1;
    } else {
        word_count[word] = 1;
    }
}
```

The `for in` problem

- Functions inherited from a prototype are included in the `for in` enumeration.

```
for (name in object) {
    if (object.hasOwnProperty(name) {
        …
    }
}
```

- This can fail if an object has a `hasOwnProperty` property.

The `for in` problem

- Functions inherited from a prototype are included in the `for in` enumeration.

```
for (name in object) {
    if (Object.prototype
        .hasOwnProperty
        .call(object, name)) {
            ...
    }
}
```

Keys must be strings

Automatic type coercion.

Object and …

- Number
- Boolean
- String
- Array
- Date
- RegExp
- Function

Number

Numbers

- Only one number type

  No integer types

- 64-bit floating point
- IEEE-754 (aka “`Double`”)

Good that we don't have `int`

```
a > 0
b > 0

c = a + b;
```

- **Possible results:**

```
c < a
c < b
```

Number literals

```
.01024e4
1.024e+3
  10.24E2
102.4E+1
1024.e0
1024.00
  1024
10240e-1
```

Associative Law does not hold

```
(a + b) + c === a + (b + c)
```

- Produces `false` for some values of `a`, `b`, `c`.

- Integers under 9007199254740992 (9 quadrillion) are ok.

9007199254740992 ===

```
(a + 1) - 1 === a
```

Can be false.

Decimal fractions are approximate

```
a = 0.1;
b = 0.2;
c = 0.3;

(a + b) + c === a + (b + c)
false
```

Number methods

- toExponential
- toFixed
- toLocaleString
- toPrecision
- toString
- valueOf

Number methods

```
if (!Number.prototype.trunc) {
    Number.prototype.trunc =
      function trunc(number) {
        return number >= 0
            ? Math.floor(number)
            : Math.ceil(number);
    };
}
```

Numbers are first class objects

- A number can be stored in a variable.
- A number can be passed as a parameter.
- A number can be returned from a function.
- A number can be stored in an object.

- A number can have methods.

Math object

- abs
- acos
- asin
- atan
- atan2
- ceil
- cos
- exp
- floor
- log
- max
- min
- pow
- random
- round
- sin
- sqrt
- tan

Math object

- E
- LN10
- LN2
- LOG10E
- LOG2E
- PI
- SQRT1_2
- SQRT2

```
function log2(x) {
    return Math.LOG2E *
        Math.log(x);
}
```

`NaN`

- Special number: Not a Number
- Result of undefined or erroneous operations
- Toxic: any arithmetic operation with **`NaN`** as an input will have **`NaN`** as a result
- **`NaN`** is not equal to anything, including **`NaN`**
- **`NaN === NaN`** is **`false`**
- **`NaN !== NaN`** is **`true`**

```
x = x + 1
```

Mathematic nonsense.

$$x = x + 1$$

Infinity

```
x = x + 1
```

Infinity

Number.MAX_VALUE

```
x = x + 1
```

Infinity

Number.MAX_VALUE

9007199254740992

```
x = x + 1
```

But not `NaN`

because `NaN === NaN` is `false`

```
x = x + 1
```

But not `NaN`

because `NaN === NaN` is `false`

`NaN !== NaN` is `true`!

Boolean

`true`

`false`

String

Strings

- A sequence of 0 or more 16-bit Unicode characters
  - UCS-2, not quite UTF-16
  - No awareness of surrogate pairs
- No separate character type
  - Characters are represented as strings with length of 1
- Strings are immutable
- Similar strings are equal (`===`)
- String literals can use single or double quotes with \ escapement.
- Use `"` for external strings.
- Use `'` for internal strings and characters.

+

+ can concatenate or add.

```
'$' + '1' + '2' === '$12'
```

```
'$'.concat('1').concat('2')
```

Convert a number to a string

- Use number's method (`toString`)
- Use `String` function

```
str = num.toString();
str = String(num);
```

Convert a string to a number

- Use the Number function.
- Use the + prefix operator.
- Use the `parseInt` function.

```
num = Number(str);
num = +str;
```

parseInt function

```
parseInt(str, 10)
```

- Converts the value into a number.
- It stops at the first non-digit character.

```
parseInt("12em") === 12
```

- The radix (10) should always be used.

```
parseInt("08") === 0
parseInt("08", 10) === 8
```

String `length`

- string.`length`

- The `length` property determines the number of 16-bit characters in a string.
- Extended characters are counted as 2.

String methods

- charAt
- charCodeAt
- compareLocale
- concat
- indexOf
- lastIndexOf
- localeCompare
- match
- replace
- search
- slice
- split
- substring
- toLocaleLowerCase
- toLocaleUpperCase
- toLowerCase
- toString
- toUpperCase
- trim
- valueOf

trim

```
if (typeof String.prototype.trim !==
        'function') {
    String.prototype.trim = function () {
        return this.replace(
            /^\s*(\S*(\s+\S+)*)\s*$/,
            "$1");
    };
}
```

supplant

```
var template = '<table border="{border}">' +
    '<tr><th>Last</th><td>{last}</td></tr>' +
    '<tr><th>First</th><td>{first}</td></tr>' +
    '</table>';

var data = {
    first: "Carl",
    last: "Hollywood",
    border: 2
};

mydiv.innerHTML = template.supplant(data);
```

supplant

```
if (typeof String.prototype.supplant !==
        'function') {
    String.prototype.supplant = function (o) {
        return this.replace(/{([^{}]*)}/g,
            function (a, b) {
                var r = o[b];
                return typeof r === 'string' ?
                    r : a;
            });
    };
}
```

Array

Arrays

- **`Array`** inherits from **`Object`**.
- Indexes are converted to strings and used as names for retrieving values.
- Very efficient for sparse arrays.
- Not very efficient in most other cases.
- One advantage: No need to provide a length or type when creating an array.

length

- Arrays, unlike objects, have a special **length** property.
- It is always 1 larger than the highest integer subscript.
- It allows use of the traditional **for** statement.

```
for (i = 0; i < a.length; i += 1) {
    ...
}
```

- Do not use **for in** with arrays

Array Literals

- An array literal uses `[]`
- It can contain any number of expressions, separated by commas

```
myList = ['oats', 'peas', 'beans'];
```

- New items can be appended

```
myList[myList.length] = 'barley';
```

- The dot notation should not be used with arrays.

Array methods

- concat
- every
- filter
- forEach
- indexOf
- join
- lastIndexOf
- map
- pop
- push
- reduce
- reduceRight
- reverse
- shift
- slice
- some
- splice
- toLocaleString
- toString
- unshift

sort

```
var n = [4, 8, 15, 16, 23, 42];
n.sort();
// n is [15, 16, 23, 4, 42, 8]
```

Deleting Elements

```
delete array[number]
```

- Removes the element, but leaves a hole in the numbering.

```
array.splice(number, 1)
```

- Removes the element and renumbers all the following elements.

Deleting Elements

```
myArray = ['a', 'b', 'c', 'd'];

delete myArray[1];

// ['a', undefined, 'c', 'd']

myArray.splice(1, 1);

// ['a', 'c', 'd']
```

Arrays v Objects

- Use objects when the names are arbitrary strings.
- Use arrays when the names are sequential integers.
- Don't get confused by the term Associative Array.

Date

The `Date` function is based on Java's Date class.

It was not Y2K ready.

RegExp

```
/\/(\\[^\x00-\x1f]|\[(\\[^\x00-\x1f]|[^\x00-\x1f\\\/])*\]|[^\x00-\x1f\\\/\[])+\/[gim]*/
```

Function

All values are objects

Except `null` and `undefined`.

`null`

A value that isn't anything

`undefined`

- A value that isn't even that.
- The default value for variables and parameters.
- The value of missing members in objects.

typeof

- The `typeof` prefix operator returns a string identifying the type of a value.

type	`typeof`
object	`'object'`
function	`'function'`
array	`'object'`
number	`'number'`
string	`'string'`
boolean	`'boolean'`
`null`	`'object'`
`undefined`	`'undefined'`

Array.isArray

```
alert(Array.isArray([]));   // true


if (typeof Array.isArray !== 'function') {
    Array.isArray = function (value) {
        return Object.prototype
            .toString.apply(value) ===
                '[object Array]';
    };
}
```

Falsy values

- `false`
- `null`
- `undefined`
- `""` (empty string)
- `0`
- `NaN`

- **All other values (including all objects) are truthy.**

`"0"` `"false"`

Loosely Typed

- Any of these types can be stored in an variable, or passed as a parameter to any function.
- The language is not untyped.

Reference

- Objects can be passed as arguments to functions, and can be returned by functions
  - Objects are passed by reference.
  - Objects are not passed by value.
- The `===` operator compares object references, not values
  - `true` only if both operands are the same object

C

- JavaScript is syntactically a C family language
- It differs from C mainly in its type system, which allows functions to be values

Identifiers

- Starts with a letter or _ or **$**
- Followed by zero or more letters, digits, _ or **$**
- By convention, all variables, parameters, members, and function names start with lower case
- Except for constructor functions which start with upper case
- Initial _ should be reserved for implementations
- **$** should be reserved for machines.

Comments

```
// slashslash line comment

/*
    slashstar
    block
    comment
*/
```

Operators

- Arithmetic
  `+  -  *  /  %`
- Comparison
  `==  !=  <  >  <=  >=`
- Logical
  `&&  ||  !`
- Bitwise
  `&  |  ^  >>  >>>  <<`

  Ternary
  `?:`

+

- Addition and concatenation
- If both operands are numbers,

  then

    add them

  else

    convert them both to strings
    concatenate them

```
'$' + 3 + 4 = '$34'
```

+

Unary operator can convert strings to numbers

```
+"42" = 42
```

Also

```
Number("42") = 42
```

Also

```
parseInt("42", 10) = 42
```

```
+"3" + (+"4") = 7
```

/

- Division of two integers can produce a non-integer result
  - `10 / 3 = 3.3333333333333335`

%

- The remainder operator, not the modulo operator.

```
-1 % 8    // -1, not 7
```

== !=

- Equal and not equal
- These operators can do type coercion
- It is always better to use === and !==, which do not do type coercion.

Evils of type coercion

- `'' == '0'` // false
- `0 == ''` // true
- `0 == '0'` // true

- `false == 'false'` // false
- `false == '0'` // true

- `false == undefined` // false
- `false == null` // false
- `null == undefined` // true

- `' \t\r\n ' == 0` // true

&&

- The guard operator, aka *logical and*
- If first operand is truthy
  then result is second operand
  else result is first operand
- It can be used to avoid null references

```
if (a) {
   return a.member;
} else {
   return a;
}
```

- can be written as

```
return a && a.member;
```

||

- The default operator, aka *logical or*
- If first operand is truthy
  then result is first operand
  else result is second operand
- It can be used to fill in default values.

```
var last = input || nr_items;
```

- (If `input` is truthy, then `last` is input, otherwise set `last` to `nr_items`.)
- May not work as expected if the first operand is a number, because 0 is falsy.

!

- Prefix *logical not* operator.
- If the operand is truthy, the result is **`false`**. Otherwise, the result is **`true`**.
- `!!` produces booleans.

Bitwise

`&` `|` `^` `>>` `>>>` `<<`

- The bitwise operators convert the operand to a 32-bit signed integer, and turn the result back into 64-bit floating point.

Statements

- *expression*
- `if`
- `switch`
- `while`
- `do`
- `for`
- `break`
- `continue`
- `return`
- `try/throw`

Break statement

- Statements can have labels.
- Break statements can refer to those labels.

```
loop: for (;;) {
    …
        if (…) {
            break loop;
        }
    …
}
```

For statement

- Iterate through all of the elements of an array:

```
for (i = 0; i < array.length; i += 1) {

        // within the loop,
        // i is the index of the current member
        // array[i] is the current element

}
```

For in statement

- Iterate through all of the members of an object:

```
for (name in object) {
    if (object.hasOwnProperty(name)) {

        // within the loop,
        // name is the key of current member
        // object[name] is the current value

    }
}
```

Switch statement

- Multiway branch.
- The switch value does not need to a number. It can be a string.
- The case values can be expressions.
- Danger: Cases fall through to the next case unless a disruptive statement like **`break`** ends the case.

Switch statement

```
switch (expression) {
case ';':
case ',':
case '.':
    punctuation();
    break;
default:
    noneOfTheAbove();
}
```

Throw statement

```
throw new Error(reason);

throw {
    name: exceptionName,
    message: reason
};
```

Try statement

```
try {
    ...
} catch (e) {
    switch (e.name) {
    case 'Error':
        ...
        break;
    default:
        throw e;
    }
}
```

Try Statement

- The JavaScript implementation can produce these exception names:

```
'Error'
'EvalError'
'RangeError'
'SyntaxError'
'TypeError'
'URIError'
```

Next time:

Act III

Function the Ultimate

With statement

- Intended as a convenient short-hand
- Ambiguous
- Error-prone
- Don't use it

```
with (o) {
    foo = koda;
}
```

- `o.foo = koda;`
- `o.foo = o.koda;`
- `foo = koda;`
- `foo = o.koda;`

With statement

```
if ('foo' in o) {
  o.foo = 'koda' in
    foo ? o.koda :
    koda;
} else {
  foo = 'koda' in
    foo ? o.koda :
    koda;
}
```

```
with (o) {
    foo = koda;
}
```

- `o.foo = koda;`
- `o.foo = o.koda;`
- `foo = koda;`
- `foo = o.koda;`