

INT201 Client-side

JavaScript History

- 1995 - JavaScript is a programming language that was created by Brendan Eich who was working for Netscape. mozilla
- 1997 - JavaScript 1.1 proposal was submitted to the European Computer Manufacturers Association (ECMA).

ECMAScript

- The formal specification of the JavaScript language specified in the document ECMA-262
- ES1, ES2, ES3, ... ESX are a different version of the ECMAScript specification มาตรฐานในการเขียน script

* Started from ES6, version of the ECMAScript start naming the versions based on the year of published specification, for example, ES2015 (ES6), ES2016 (ES7), ... ปัจจุบัน ES2020

JavaScript

ES6 (2009) is fully supported by most modern browser in early 2016

- Higher order iteration functions (map, reduce, filter, foreach);
- JSON support; JavaScript Obj
- Better reflection and object properties;

ES6 (ES2015) provide a greatly improved developer experience

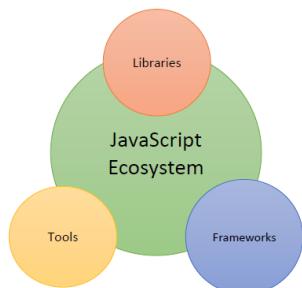
- Classes
- Modules
- Iterators
- Generators
- Promises
- Arrow functions

ES5 & ES6 เสริมให้ JS ทำงานด้วยร่องรอยของข้อมูลที่ได้
รองรับการเขียนแบบ functional programming
และทำให้การเขียนภาษาต้องง่ายขึ้น

From 2016 to 2019, a new edition of the ECMAScript standard was published each year, but the scope of changes was much smaller than the 5th or 6th editions

ES11 (ES2020), officially known as ECMAScript 2020, was published in June 2020

JavaScript Ecosystem



The different aspects of JavaScript

- Front-End: React, Angular, Vue.js, Svelte, jQuery
- Back-End: node.js Deno
- Web Framework: Express
- Mobile: React Native, Apache Cordova Ionic
- Desktop: Electron
- Database: MongoDB

Introduction to JavaScript

- JavaScript is the programming language of the web.
- The overwhelming majority of websites use JavaScript, and all modern web browsers on desktops, tablets, and phones

ກ່າວີ້ນ JS ຈະ power ຂອງເນັ້ນ ໄວເຕັມໃຈ browser ອີ້ນ ປຸ. ມານາເລືດ

- Over the last decade, Node.js has enabled JavaScript programming outside of web browsers, and the dramatic success of Node means that JavaScript is now also the most used programming language among software developers.
- JavaScript is completely different from the Java programming language.



DOM: The Document Object Model. Map out an entire page as a hierarchy of nodes JS can manipulate obj. ນີ້ແລ້ວຈະສຳເນົາ

BOM: The Browser Object Model. Deals with the browser window and frames ຮັບເທິງ obj. ຖ້າງໜຸນ browser ໃນ ex. history, location bar etc.

Chromium open source browser project

ເປັນ project ສຳເນົາ partner ຢ່າງ partner ສຳເນົາ open source ມີເຊົາ code base ທີ່ມີ browser ຢ່າງເກີນ

Web Browser

Chromium-based browser: Google Chrome Microsoft Edge Opera

ເປັນການ browser ລົດ { **Safari** is a graphical web browser developed by Apple, based on the WebKit engine.

{ **Mozilla Firefox**, or simply Firefox, is a free and open-source web browser developed by the Mozilla Foundation and its subsidiary, the Mozilla Corporation. Firefox uses the Gecko layout engine to render web pages.

Chrome V8

open source JavaScript engine project

Chrome V8: Google Chrome Microsoft Edge Opera

{ **JavaScriptCore**: A JavaScript interpreter and JIT originally derived from KJS. It is used in the WebKit project and applications such as **Safari**.

{ **SpiderMonkey**: A JavaScript engine in Mozilla Gecko applications, including **Firefox**.

high lv. ໂຄນ. ຕົກໄປປະຈຸບັນພາກເຄົ່າງ

JavaScript Development Environment

① run ຫຼື ↗
In Web Browser



② run ຫຼື
Outside Web Browser (based on Chrome V8 JavaScript Engine)

node Server side scripting ເຮັດວຽກ run ຫຼື browser ຈະມີມາ high lv. ໂຄນ.
Node.js: a JavaScript runtime built on Chrome's V8 JavaScript engine.
Deno: a simple, modern and secure runtime for JavaScript and TypeScript that uses Chrome's V8 and is built in Rust.

MyFirstScript.js

console.log("I am JavaScript.");

Demo JavaScript In and Outside Web Browser

index.html

```

<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Document</title>
    <script src="MyFirstScript.js"></script>
</head>
<body>
    <h1>Hello, This is my HTML page with JavaScript.</h1>
</body>
</html>
  
```

node ... ຖັນ vs ແກ້ໄຂ run ຣູ້ນ browser but if ຖັນ DOM & BOM ຕົວ run ຫຼື browser bec. ສຳນັກເຂົ້າໜຶ່ງ obj.

terminal

node

num

let num ปัจจุบันนี้

num = 3

num = 'INT201'

typeof(num) 'String'

num = 5

typeof(num) 'number'

: คือ key ที่ value

num = {id: 1, name: 'Panalee'} { } : obj.

num.email = 'panalee.fam@mail.kmutt.ac.th'

JavaScript Language Features

• Interpreted Language แปลงภาษา

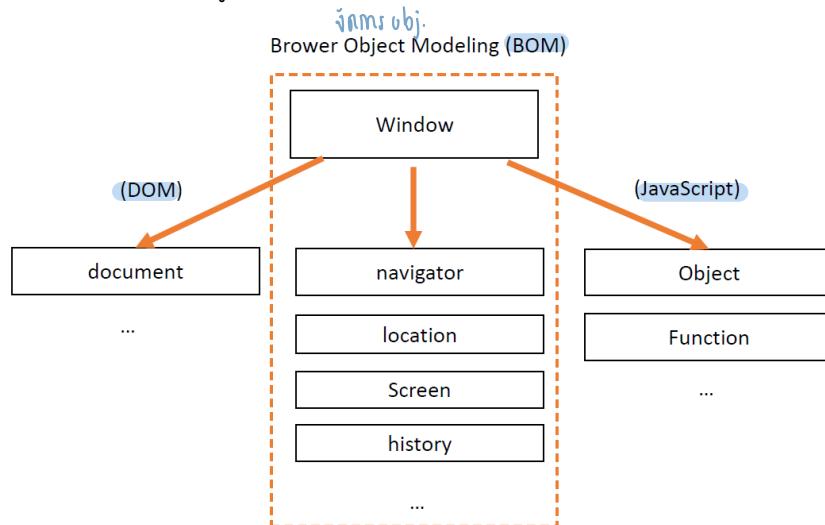
• Single Threaded, do one operation at one time ไม่ได้ทำ 2 ต่อตัว

• Dynamically and weakly typed language //02_TypesValuesVariables/script1.js

• Support Object Oriented Programming (Prototyped based)

คือ สิ่งที่มี type ของตัวเอง ได้อิสระ

The Window interface represents a window containing a DOM document. In a tabbed browser, each tab is represented by its own Window object.



DOM: The Document Object Model

```

<html>
  <head>
    <title>Sample Page</title>
  </head>
  <body>
    <p>Hello World!</p>
  </body>
</html>

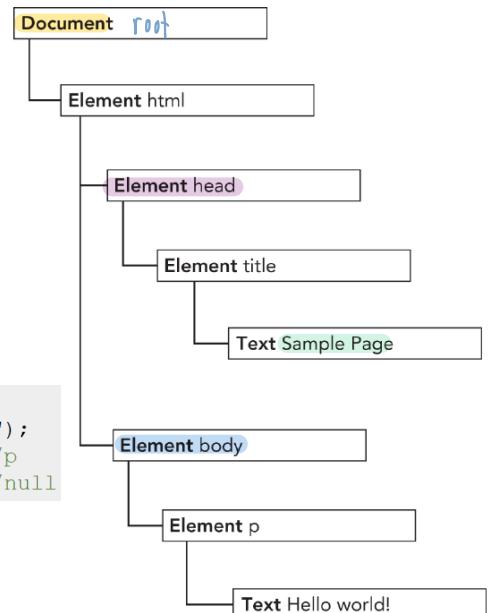
```

```

const paragraphs =
  document.getElementsByTagName("p");
alert(paragraphs[0].nodeName); //p
alert(paragraphs[0].nodeValue); //null
//01_BasicJS/script3.js

```

tree structure รูปแบบ node ต่อๆ กัน



Asynchronous vs. Synchronous Programming

task ที่เราต้องรอ

- **Synchronous** tasks are performed one at a time and only **when one is completed, the following is unblocked**. In other words, you need to wait for a task to finish to move to the next one.
- **Asynchronous** software design expands upon the concept by building code that allows a program to ask that a task be performed alongside the original task (or tasks), **without stopping to wait for the task to complete**. When the secondary task is completed, the original task is notified using an agreed-upon mechanism so that it knows the work is done, and that the result, if any, is available.

Asynchronous Callback Functions

function ที่ต้องรับ parameter

In JavaScript, a callback function is a function that is passed into another function as an argument.

This function can then be invoked during the execution of that higher order function. It function ที่รับ parameter

Javascript function ที่รับตัวแปร Data

```

console.log('Hello');
setTimeout(function () {
  console.log('JS');
}, 5000);
console.log('Bye bye');

```

// 01_BasicJS/script4.js

//Console

Hello

Bye bye

//until 5 seconds

JS

delay

Since, in JavaScript, functions are objects, functions can be passed as arguments.

setTimeout() executes a particular block of code once after a specified time has elapsed.

Higher-Order Functions

function ที่รับ / คืนค่าเป็น function ໄດ້

A "higher-order function" is a function that accepts functions as parameters and/or returns a function.

JavaScript Functions are **first-class citizens**

ประโยชน์ reuse ໄດ້ เจ็บນາຄ່າຄໍ່າໃຫຍ່ໄວ້ໄກ້ຕະລອດ

- be assigned to variables (and treated as a value)
- be passed as an argument of another function
- be returned as a value from another function

//1. store functions in variables

```
function add(n1, n2) {
  return n1 + n2
}
let sum = add

let addResult1 = add(10, 20)
let addResult2 = sum(10, 20)

console.log(`add result1: ${addResult1}`)
console.log(`add result2: ${addResult2}`)
```

//01_BasicJS/script2.js

```
//2. returned as a value from another function
function operator(n1, n2, fn) {
  return fn(n1, n2)
}

//3. Passing a function to another function
function multiply(n1, n2) {
  return n1 * n2
}

let addResult3 = operator(5, 3, add)
let multiplyResult = operator(5, 3, multiply)

console.log(`add result3 : ${addResult3}`)
console.log(`multiply result: ${multiplyResult}`)
```

Output
 console.log('Hello'); ① //Console
 setTimeout(function () {
 console.log('JS'); ③ //until 5 seconds
 }, 5000);
 console.log('Bye bye'); ② JS

console.log('Bye bye')

//Call Stack

console.log('Hello')
main()

//Call Stack

setTimeout(fn, delay)
main()

//Call Stack

setTimeout(fn, delay)
main()

with **single thread**, JavaScript
 Runtime cannot do a setTimeout
 while you are doing another code

//Call Stack

①
log('Hello')
main()

//Call Stack

setTimeout(fn, delay)
main()

//Call Stack

②
console.log('Bye bye')
main()

//Call Stack

③
console.log('JS')
fn

callback queue in callback func ຂອງເວັບໄຊ

//web APIs pushes the callback on to the
 callback queue when it's done
 fn

Event loop comes in on **concurrency**, look at the stack and look at the
 task callback queue. If the stack is empty it takes the first thing on the
 queue and pushes it on to the stack ↓ ໄໝ້ຕ້າງໆໃຈການການງານ ອ້າງສະຫງົບສະພາບ

Vanilla JavaScript is just plain or pure JavaScript without any additional libraries or framework

Types, Values, and Variables

Basic JavaScript Statements

- Semicolon in the end of statement is an optional

o let x=10; ຢູ່ມີ / ໃນໄດ້ກຳນົດ
 but ແກ້ວກຳທີ່ໄດ້

- o let y=20
- Statement can take up multiple lines.
- Comment
 - o //Single Line Comment
 - o /* ... */ Single or Multiple Lines Comment
- Console Printing ແກ້ວຂນ
 - o console.log(variable); ແກ້ວສັງນາໃຫ້ໄວ້

Reserved Words

ສຳເນົາທີ່ຈະເປັນ key word ທີ່ເປັນຄ່າສົ່ງ

| | | | | | | |
|----------|----------|---------|------------|--------|--------|-------|
| as | const | export | get | null | target | void |
| async | continue | extends | if | of | this | while |
| await | debugger | false | import | return | throw | with |
| break | default | finally | in | set | true | yield |
| case | delete | for | instanceof | static | try | catch |
| do | from | let | super | typeof | class | else |
| function | new | switch | var | | | |

Types

JavaScript types can be divided into **two** categories:

1. primitive types

ໄດ້ຕັ້ງ ການອະນຸມາດຕະກຳ

- number -including integer and floating-point numbers between -2^{53} to 2^{53}
- string text ຮ້າພະເພີ້ນ, char ອີ່ ' ' / " " ດີກໍາ
- boolean

Primitive value ຕ່ານັ້ນຈາກ ນັກຕ່າງໄປໄດ້ເລື່ອງ

- number
- string
- boolean
- null (special type) ໂມນຕ່າງໄລ້ໄດ້ຮັບ
- undefined (special type)
- symbol (special type) symbol = unistring (string ໄຟ້ສຳ)

2. object types

- An object (that is, a member of the type object) is a collection of properties where each property has a name and a value (either a primitive value or another object)
- a special kind of object, known as **an array**, that represents an ordered collection of numbered values

JavaScript Data Types: numbers, string, boolean , undefined, symbol, object ນຸ້ອຄອງກິບເປັນ

//02_TypesValuesVariables/script2.js

```
//output
type of myNum is number
type of myString is string
type of myBool is boolean
type of myUndefined is undefined
type of mySymbol is symbol
type of myNull is object
```

```
let myNum = 0;
console.log(`type of myNum is ${typeof myNum}`);

let myString = 'Good';
console.log(`type of myString is ${typeof myString}`);

let myBool = true;
console.log(`type of myBool is ${typeof myBool}`);

let myUndefined;
console.log(`type of myUndefined is ${typeof myUndefined}`);

let mySymbol = Symbol();
console.log(`type of mySymbol is ${typeof mySymbol}`);

let myNull = null;
console.log(`type of myNull is ${typeof myNull}`);

let myArr = [1, 2, 3];

console.log(`myArr Length: ${myArr.length}`);
console.log(`type of myArr is ${typeof myArr}`);

let myObj = {id: 1, task: 'grading exam'};

console.log(`#${JSON.stringify(myObj)}`);
console.log(`type of myObj is ${typeof myObj}`);
```

សំគាល់សំគាល់ អំពីវិនិច្ឆ័យ/ឯកតា Null and undefined មិនមែន absent value ទេ ដែលគឺជាបញ្ហា

- `null` is a language keyword that evaluates to a special value.
- `null` represent normal,expected absence of value and if there is no value, the value of variable can be set to `null`. If a variable is meant to later hold an object, it is recommended to initialize to `null`.
- Using the `typeof` operator on `null` returns the string "object" indicating that `null` can be thought of as a special object value that indicates "empty object pointer".
- JavaScript also has a second value that indicates absence of value. The `undefined` value represents **unexpected absence of value**, a deeper kind of absence.
 - the `value` of variables that have not been initialized
 - the `value` you get when you query the `value` of an object property or array element that does not exist.
 - `value` of functions that do not explicitly return a value
 - `value` of function `parameters` for which no argument is passed
- If you apply the `typeof` operator to the `undefined` value, it returns "undefined", indicating that this value is the sole member of a special type.



The following table summarizes the possible return values of `typeof`

| Type | Result |
|---|----------------------|
| <code>Undefined</code> | "undefined" |
| <code>Null</code> | "object" (see below) |
| <code>Boolean</code> | "boolean" |
| <code>Number</code> | "number" |
| <code>BIGINT</code> (new in ECMAScript 2020) | "bigint" |
| <code>String</code> | "string" |
| <code>Symbol</code> (new in ECMAScript 2015) ឬឱ្យឈ្មោះសំគាល់សំគាល់ | "symbol" |
| <code>Function</code> object (implements <code>[[Call]]</code> in ECMA-262 terms) | "function" |
| Any other object | "object" |

Literals

- `15` // The number twelve
- `1.5` // The number one point two
- `"Hello World"` // A string of text
- `'Hi'` // Another string
- back tip** • `"I' am a student", I said` // Another string
- `true` // A Boolean value
- `false` // The other Boolean value
- `null` // Absence of an object

ឲ្យដោលថា បានដឹងថា គឺជាបញ្ហាដែលបានរៀបចំឡើយ " / " នៅក្នុងកិច្ចការណ៍

Escape sequences can be used in JavaScript: `\n, \t, \\, \b, ...`

Identifiers ឈ្មោះសំគាល់សំគាល់

- **Identifiers** are used to name constants, variables, properties, functions, and classes and to provide labels for certain loops in JavaScript code.

- A JavaScript identifier **must begin with a letter, an underscore (_), or a dollar sign (\$)**. Subsequent characters can be letters, digits, underscores, or dollar signs. (Digits are not allowed as the first character so that JavaScript can easily distinguish identifiers from numbers.)
- JavaScript is a **case-sensitive language**. This means that language keywords, variables, function names, and any other identifiers must always be typed with a consistent capitalization of letters.

let, var, const variables

- One of the features that came with ES 6 is the addition of `let` and `const`, which can be used for variable declarations.
- `var` declarations are **globally scoped or function/locally scoped**.
- The scope is global when a `var` variable is declared outside a function. This means that any variable that is declared with `var` outside a function block is available for use in the whole window.
- All variables and functions declared globally with `var` **become properties and methods of the window object**.
- `var` is function scoped when it is declared within a function. This means that it is available and can be accessed only within that function.

var Variables

// 01_BasicJS/ script5.js

```
//greeting is globally scope, it exists outside a function
var greeting = 'Hey';

//var variables can be re-declared and updated
var greeting = 'Ho Ho';
greeting = 'H'; → update
function greeter() {
  //msg is function scoped, we cannot access the variable msg outside of a function
  var msg = 'hello';
}

// console.log(msg); //error: msg is not defined
console.log(greeting);
```

↑ សេចក្តីពង្រាយ ពេលបង្កើត
↑ សេចក្តីពង្រាយ ពេលបញ្ចូន

var variables can be re-declared and updated

This means that we can do this within the same scope and won't get an error.

```
var year = 'leap';
if (year === 'leap')
  var greeting = 'Hey 366 days'; //re-declared
console.log(greeting);
```

↑ ការរក

it becomes a problem when you do not realize that a variable `greeting` has already been defined before.

let variables

នគរណ៍នូវ Var នៃ ការក្លែងឱ្យការងារ

- let is now preferred for variable declaration.
- JavaScript block of code is bounded by `{}`. A block lives in curly braces. Anything within curly braces is a block.
- let is **block scoped**, a variable declared in a block with let is only available for use within that block.
- Let **can be updated but not re-declared**.

let can be updated but not re-declared.

// 01_BasicJS/ script 6.js

if the same variable is defined in different scopes, there will be no error. This is because both instances are treated as different variables since they have different scopes.

```
/*let variables*/
//greeting is block scope
let greeting = 'Hey';
//let variables cannot be re-declared, only can be updated
greeting = 'Ho Ho';
function greeter() {
  //msg is function scoped, we cannot access the variable msg outside of a function
  let msg = 'hello';
}
// console.log(msg); //error: msg is not defined
console.log(greeting);
↑ សេចក្តីពង្រាយ

let year = 'leap';
if (year === 'leap')
  greeting = 'Hey 366 days';
console.log(greeting);
```

infunction

```
let greeting = 'Hey';
greeting = 'Ho Ho';
function greeter() {
  if (list) {
    let greeting = 'Good morning'; ↑ តិច redeclared
    console.log(`greeting in function is ${greeting}`);
  }
}
greeter(); console.log(greeting); //Ho Ho
```

↑ តិចក្នុងការងារ

const သိမ်းတွေ

- Variables declared with the const maintain constant values.
- const declarations share some similarities with let declarations.
- Like let declarations, const declarations can only be accessed within the block they were declared.
- const cannot be updated or re-declared
- Every const declaration, therefore, must be initialized at the time of declaration.

```
/*const variables*/
const greeting = 'Hey'; // စိတ်အားပေါ်တဲ့ မှတ်ယူမယ်
//const variables cannot be re-declared
// const greeting = 'Ho Ho';
//const variables cannot be updated
// greeting = 'Hi Hi';
```

//01_BasicJS/script 7.js

မှတ်ယူမယ် controlStructures file P.10

JavaScript string

၁။ လျှော့ဝှက် value မှာ return a string မှာ function

- The JavaScript type for representing text is the string.
- A string is an immutable ordered sequence of 16-bit values.
- JavaScript's strings (and its arrays) use zero-based indexing: the first 16-bit value is at position 0, the second at position 1, and so on.
- The empty string is the string of length 0.
- JavaScript does not have a special type that represents a single element of a string. To represent a single 16-bit value, simply use a string that has a length of 1.

```
let msg = 'JS'
msg JS
msg.length 2
msg.charAt(msg.length -1) JS
msg.toLowerCase() JS
```

msg.substring(1,2) S

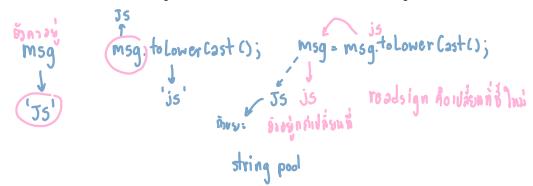
Template Literals

```
let name = 'Umaporn';
let greeting = `Hello ${name}`;
```

expression
... world`

```
console.log("Hello"+msg) Hellojs
(`Hello, 'section' ${msg}`) Hello, 'section'js
(`Hello, ${msg}`) Hello
... world` World
```

ဒီမှာ ဒဲ တော်ကဲမှုများများ



string pool

- This is more than just another string literal syntax, however, because these template literals can include arbitrary JavaScript expressions.
- Everything between the \${ } is interpreted as a **JavaScript expression**.
- Everything outside the curly braces is **normal string literal text**.
- The final value of a string literal in backticks is computed by
 - evaluating any included expressions,
 - converting the values of those expressions to strings and
 - combining those computed strings with the literal characters within the backticks

- $\{x+y\}$ operation (arithmetic/logical) and operands (x,y)
- $\{\text{let value} = x+y\}$ correct to $\text{let value} = \{x+y\}$
- Simple expression → complicated exp

```
console.log('Hello ${msg}') Hello js
+1') Hello js1
$1000') Hello 1000
{true && false}') Hello false
{msg.charAt(1)}) Hello s
```

- (Boolean exp) ? (true) expression : (false) expression
- $x > y$? $\text{let value} = x+y$: $\text{let value} = x-y$
- ✓ $\text{let value} = x>y$? $x+y$: $x-y$

Explicit Conversions မှုပေါ်အားပေါ်

- Although JavaScript performs many type conversions automatically, you may sometimes need to perform an explicit conversion, or you may prefer to make the conversions explicit to keep your code clearer.
- The simplest way to perform an explicit type conversion is to use the **Boolean()**, **Number()**, and **String()** functions:

```
//Explicit Conversions
Number('3'); // 3 String → Number
String(false); // "false" Boolean → string
Boolean([]); // true
```

How values convert from one type to another in JavaScript?

implicit convert မှုပေါ်အားပေါ်

```
1 + ' objects'; // "1 objects": Number 1 converts to a string
'5' * '4'; // 20: both strings convert to numbers
let n = 'y' + 1; // n == NaN; string "y" can't convert to a number
```

JavaScript implicit type conversions

ကုန်အားပေါ်အားပေါ် 1 "2" - 1 Number("2") - 1

၅ အားပေါ်အားပေါ် ထဲမှာ မြတ်မည်

implicit = manual ဆုံးတော်ယူရမည်ပေးစီ x+y

implicit = auto ဆုံးတော်ယူရမည် x+y³

The primitive-to-primitive conversions shown in the table are relatively straightforward but Object-to-primitive conversion is somewhat more complicated.

//examples of implicit type conversions

`x + ""` // String(x)

`+x` // Number(x)

`x-0` // Number(x)

`!!x` // Boolean(x)

//02_TypesValuesVariables/script5.js

| Value | toString | toNumber | toBoolean |
|-------------------------------|-------------|----------|-----------|
| undefined | "undefined" | NaN | false |
| null | "null" | 0 | false |
| true | "true" | 1 | |
| false | "false" | 0 | |
| "" (empty string) | 0 | | false |
| "1.2" (nonempty, numeric) | 1.2 | true | |
| "one" (nonempty, non-numeric) | NaN | true | |
| 0 | "0" | false | |
| -0 | "0" | false | |
| 1 (finite, non-zero) | "1" | true | |
| Infinity | "Infinity" | true | |
| -Infinity | "-Infinity" | true | |
| NaN | "NaN" | false | |
| [] (empty array) | 0 | true | |
| "" | | | |

Control Structures

JavaScript Operators

//02_TypesValuesVariables/script4.js

Operator precedence and associativity specify the order in which operations are performed in a complex expression.

- Increment and Decrement
 `++` `--`
- Invert Boolean value
 `!`
- Type of operand
 `typeof`
- Arithmetic operators
 `*` `/` `%` `+` `-`
- Relational operators
 `<` `<=` `>` `>=`
- Equality operators
 `==` `!=` (non strict equality)
 `===` `!==` (strict equality)
- Logical operators
 `&&` `||`
- Conditional operators
 `?:`
- Assignment operators
 `+=` `-=` `*=` `/=` `%=`

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การ轉換ที่ไม่ถูกต้อง

Conversions and Equality

//02_TypesValuesVariables/script5.js

```
null == undefined // true: These two values are treated as equal.
"0" == 0      // true: String converts to a number before comparing.
0 == false    // true: Boolean converts to number before comparing.
"0" == false  // true: Both operands convert to 0 before comparing.

// If change from == to strict equality ===, the results are all FALSE!
```

- JavaScript has two operators that test whether two values are equal.
- The "strict equality operator,"`==`, does not consider its operands to be equal if they are not of the same type.
- But because JavaScript is so flexible with type conversions, it also defines the`==`operator with a flexible definition of equality.

Equality with type conversion

The equality operator `==` is like the strict equality operator, but it is less strict. If the values of the two operands are not the same type, it attempts some type conversions and tries the comparison again:

- If the two values have the same type, test them for strict equality as described previously. If they are strictly equal, they are equal. If they are not strictly equal, they are not equal.

- If the **two values do not have the same type**, the **`==` operator may still consider them equal**. It uses the following rules and type conversions to check for equality:
 - If **one value is null and the other is undefined**, they are **equal**.
 - If **one value is a number and the other is a string**, convert the string to a number and try the comparison again, using the converted value.
 - If either value is **true**, convert it to **1** and try the comparison again. If either value is **false**, convert it to **0** and try the comparison again.
 - Any other combinations of values are not equal.

//02_TypesValuesVariables/script4.js

```
//Arithmetic operators
console.log(5 + 2); // => 7: addition
console.log(5 - 2); // => 3: subtraction
console.log(5 * 2); // => 10: multiplication
console.log(5 / 2); // => 2.5: division

// JavaScript defines some shorthand arithmetic operators
let count = 0; // Define a variable
count++; // Increment the variable
count--; // Decrement the variable
count += 3; // Add 3: same as count = count + 3;
count *= 2; // Multiply by 2: same as count = count * 2;
console.log(`count = ${count}`); // => 6: variable names are expressions

//conditional operator
let result = count > 5 ? 'count > 5' : 'count<=5';
console.log(`result = ${result}`);

//== and != non-strict equality
//If the two operands are different types, interpreter attempts to convert them to suitable type.
console.log(`15 == '15' ${15 == '15'}`); //true

//== and !== strict equality without type conversion
console.log(`15 === '15' ${15 === '15'}`); //false

//logical operators
// && (and), || (or), ! (not)

console.log(`5 < '10' && '1' > 5 is ${5 < '10' && '1' > 5}`); //false

console.log(`5 < '10' || '1' > 5 is ${5 < '10' || '1' > 5}`); //true
console.log(`!(0) is ${!0}`); //true
```

Aimauño ?, 98 implicit function ?

- `1 == true` true, `Number()` convert `true` to `1`
- * • `"1" == []` false, `Number([]) == Number("1")`
- `"1" == 1` true, `Number("1")`
- * • `1 == null` false, `Number(null)`
- * • `"1" == undefined` false, `Number(undefined) = NaN`
- `typeof(null)` 'object'
- `null == 0` false • `typeof([])` 'object'
- `"0" == []` false • `0 == []` true

array obj.

Object

JavaScript String

இலக்கும் string

'B' < 'a' given atly code
65 < 97

$$'A' - 'Z' = 65 - 90$$

$$'a' - 'z' = 97 - 122$$

- Strings can be compared with the standard `==` equality and `!=` inequality operators
- two strings are equal if and only if they consist of exactly the same sequence of 16-bit values.
- Strings can also be compared with the `<`, `<=`, `>`, and `>=` operators. String comparison is done simply by comparing the 16-bit values.
- To determine the length of a string—the number of 16-bit values it contains—use the `length` property of the string: `str.length`

//02_TypesValuesVariables/script3.js

```
let str1 = 'Hello';
let str2 = 'hello';
console.log(`str1 === str2 is ${str1 === str2}`);
console.log(`str1 < str2 is ${str1 < str2}`);
console.log(`str1 > str2 is ${str1 > str2}`);
console.log(`str1.length = ${str1.length}`);
console.log(`str1.toLowerCase === str2.toLowerCase is ${str1.toLowerCase() === str2.toLowerCase()}`);
console.log(`str1.toLowerCase === str2.toLowerCase is ${str1.toLowerCase() === str2.toLowerCase()}`);
console.log(`str1.charAt(str1.length-1) = ${str1.charAt(str1.length - 1)}');
```

//output

```
str1 === str2 is false
str1 < str2 is true
str1 > str2 is false
str1.length = 5
str1.toLowerCase === str2.toLowerCase is true
str1.charAt(str1.length-1) = o
```

ເລື່ອງທີ່ມີ value
ເລື່ອງທີ່ມີ address ຂອງ obj.

Comparing Primitives vs Objects

- Primitives are also compared by value:** two values are the same only if they have the same value.
- Objects are not compared by value: two distinct objects are not equal even if they have the same properties and values.
- Objects** are sometimes called **reference types** to distinguish them from JavaScript's primitive types
- we say that objects are compared by reference: two object values are the same if and only if they refer to the same underlying object.

```
//02_TypesValuesVariables/script2.js
```

```
let myObj = {
  id: 1,
  task: 'grading exam'
};

let myObj2 = {
  id: 1,
  task: 'grading exam'
};

newObj = myObj;
console.log(`newObj === myObj is ${newObj === myObj}`);
console.log(`myObj1 === myObj2 is ${myObj1 === myObj2}`);

```

myObj: ↓
 myObj2: ↓
 id = 1
 task = xxx

//output
 newObj === myObj is true
 myObj1 === myObj2 is false

↑ address ດີනີ້
 JAVA: obj.

And two distinct arrays are not equal even if they have the same elements in the same order:

```
let a = [];
let b = a;
b[0] = 1;
let c = [1];
console.log(`a === b is ${a === b}`);
console.log(`b == c is ${b == c}`);

```

//02_TypesValuesVariables/script3.js

//output
 a === b is true
 b == c is false

a: ↓
 b: ↓
 c: ↓
 1 | 1 | 1 |

↑ obj. ດັບກັນຫຼືກຳເນົາກັນ
 JAVA: array

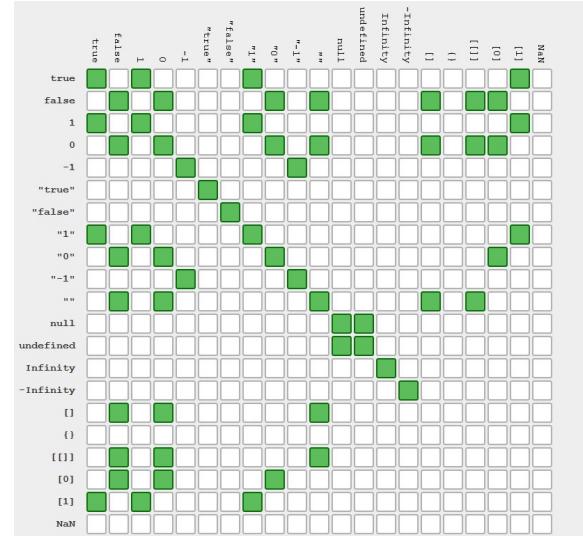
Conditionals - if/else

use a statement block {} to combine multiple statements into one

```
if (expression)
  statement
```

```
if (expression)
  statement1
else
  statement2
```

```
if (expression1) {
  // Execute code block #1
}
else if (expression2) {
  // Execute code block #2
}
else if (expression3) {
  // Execute code block #3
}
else {
  // If all else fails, execute block #4
}
```



Conditionals - switch

The matching case is determined using the `==` identity operator, not the `==`=equality operator, so the expressions must match without any type conversion.

```
switch(n) {
  case 1: // Start here if n == 1
    // Execute code block #1.
    break; // Stop here
  case 2: // Start here if n == 2
    // Execute code block #2.
    break; // Stop here
  case 3:
    // Start here if n == 3 // Execute code block #3.
    break; // Stop here
  default:
    // If all else fails... // Execute code block #4.
    break; // Stop here
}
```

```
switch(expression) {
  statements
}
```

Loop - while/do while

```
while (expression)
    statement
```

```
let count = 0;
while(count < 10) {
    console.log(count);
    count++;
}
```

```
do
    statement
while (expression);
```

```
let count = 0;
do {
    console.log(count);
    count++;
} while (count < 10);
```

Loop - for

The **for** statement simplifies loops that follow a common pattern.

```
for(initialize ; test ; increment)
    statement
```

```
for(let i = 0, len = data.length; i < len; i++)
    console.log(data[i]);
```

The **for/of** loop works with *iterable* objects, arrays, strings, sets, and maps are iterable:

```
for(variable of iterableObject)
    statement
```

```
let data = [1, 2, 3, 4, 5, 6, 7, 8, 9]
let sum = 0;
for(let element of data) {
    sum += element;
}
console.log(`sum = ${sum}`); //sum=45
```

The **for/in** statement loops through the property names of a specified object

```
for (variable in object)
    statement
```

```
for(let property in object) {
    console.log(property); //print property name
    console.log (object[property]); //print value of each property
}
```

แบบฝึกหัด 1 เขียนโปรแกรมเพื่อแสดงรายศักราชที่ตรงกับปีที่กำหนดไว้ โดยมีชั้งหมอด 12 ราศี ซึ่งแทนโดยสัตว์ประเภทต่าง ๆ ตัวอย่างเช่น ปี 1900 % 12 จะมีค่า 4 ซึ่งจะแทนด้วยราศีพิทุน

- 0: monkey
- 1: rooster
- 2: dog
- 3: pig
- 4: rat
- 5: ox
- 6: tiger
- 7: rabbit
- 8: dragon
- 9: snake
- 10: horse
- 11: sheep



https://www.hisgo.com/us/destination-japan/blog/japanese_horoscope.html

แบบฝึกหัดที่ 4 ให้เขียนโปรแกรมเพื่อทำเมนูให้เลือกับการจัดการ Text String ให้ทดสอบโดยใช้ String อ่านน้อย 3 กรอบที่แตกต่างกัน

- ให้เขียน Function เพื่อแสดงเมนูให้เลือกในการจัดการ String
 - 1: Reverse String
 - 2: Replace Vowels with '''
 - 3: Count Vowels in String
- ตัวอย่างเช่น “Hello World”
 - กด 1 ได้ “dlroW olleH”
 - กด 2 ได้ “Hlll W*Wld”
 - กด 3 ได้ 3

JavaScript Objects

let obj = { ... } *สร้าง obj.*

34:00 - 1.20.00

set var key ให้ value

- ECMAScript objects as hash tables: nothing more than a grouping of name-value pairs where the **value** may be **data or a function**. *เข้าถึง / บันทึก data ໄດ້ກໍາໄລເວັບໄຊ hashcode*
- An **object** is an **unordered collection of properties**
- An object is a **composite value**: it aggregates multiple values (primitive values or other objects) and allows you to store and retrieve those values by name.
- **Property names** are usually **Strings** or can also be **Symbols**.
- No object may have two properties with the same name. *ໄປສົນທະນາໄດ້*
- JavaScript objects are **dynamic**—properties can usually be added and deleted
- It is possible to create an instance of an “**implicit**” class without the need to actually create the class.

1.31.00 - 2.15.00

obj. can *ແກ່ໄປໄຫວ້ອມຂອງ*

JavaScript Object Examples

```
//Simple Object
let student = {
  name: 'Bob',
  age: 32,
  gender: 'male',
```

```
//Object Value is array
let profile = {
  id: 123,
  interests: [ 'music', 'skiing' ]
```

```
//Aggregated Object
let book = { isbn: 123456789,
  title: "JavaScript",
  author: {
    firstname: "Umaporn",
    lastname: "Sup"
  }
};
```

Object Passing to functions by reference

วัสดุใน obj. ไม่

Objects are **mutable** and manipulated by reference rather than by value.

```
//04_Objects/script2.js
let point = { x:10, y: 20 };
let newPoint = point;
newPoint.x = 30;
console.log (point) // {x:30, y:20};
```



Understanding Objects

```
//create object without class
//The function distance does not care
//whether the arguments are an instance of the class Point
  formal parameter
function distance(p1, p2) {
  console.log(typeof p1); //object
  console.log(typeof p2); //object
  // ** - The exponentiation assignment operator
  return Math.sqrt((p1.x - p2.x) ** 2 + (p1.y - p2.y) ** 2);
}

console.log(distance({ x: 1, y: 1 }, { x: 2, y: 2 })); //1.4142135623730951
  actual parameter
```

shorthand Object Methods

- When function is defined as a property of an object, we call that function a method
- Prior to ES6

```
let square = {
  area: function() { return this.side * this.side; },
  side: 10
};
square.area() //=>100
```

- In ES6, the object literal syntax has been extended to allow a shortcut where the function keyword and the colon are omitted,

```
let square = {
  area () { return this.side * this.side; },
  side: 10
};
square.area() //=>100
```

Understanding Object Creation

- Simplest form with **object literals**, object literal is a comma-separated list of {name: value} pairs.

```
let point = {x:10, y: 20};
```

2. with the **new** operator. Objects created using the new keyword and a constructor invocation use the value of the prototype property of the constructor function as their prototype.

```
let person = new Object(); //เริ่มต้นไปที่ค่าของ attribute
let a = new Array();
let p = new Point();
in inheritant
```

3. with the **Object.create()** function. Creates a new object, with specified prototypes.

```
let o = Object.create({x: 1, y: 2});
let p = Object.create(o);
console.log(p.x); //1
console.log(p.y); //2
```

Understanding Object Creation

| | |
|--|--|
| <pre>//new Object() let person = new Object(); person.name = "Adam"; person.age = 29; person.greeting = function(){ console.log("Hello" + person.name); }; //{ name: 'Adam', age: 29, greeting: [Function] }</pre> | <pre>//Object Literal let person={}; //no property console.log(typeof person) //object</pre> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <pre>let person = { name: "Adam", //property key: value age: 29, greeting(){ //property function console.log("Hello" + person.name); } };</pre> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <pre>//both can call greeting() function person.greeting();</pre> </div> <div style="margin-top: 10px; color: green;"> <p>Hello, Adam</p> </div> |
|--|--|

Object literals

- The easiest way to create an object is to include an object literal in your JavaScript code.
- In its simplest form, an object literal is a comma-separated list of colon-separated **name: value** pairs, enclosed within curly braces {}.
- A **property name** is a JavaScript identifier or a string literal.
- A **property value** is any JavaScript expression; the value of the expression (it may be a primitive value or an object value) becomes the value of the property

Object literal Examples

```
let empty={};
let point = {x:0, y:0};
let p2={x: point.x, y: point.y+1};
let book = {① key: "string"
② "main title": "JavaScript", //These property names include spaces
  "sub-title": "The Definitive Guide", //and hyphens, so use string literals
  for: "all audiences",
① author:{② Identifier domains
    firstname: "David",
    Surname: "Flanagan"
  }
};
```

Getting, Setting , Creating Object Properties

- To obtain the value of a property, use the dot(.) or square bracket([]) operators

```

let book = {
  isbn: 123456789,
  title: "JavaScript",
  author: {
    firstname: "Umaporn",
    lastname: "Sup"
  }
};

object.property
object["property"]

```

- with the[] array notation, the name of the property is expressed as a string.
- Strings are JavaScript data types, so they can be manipulated and created while a program is running.

```

//getting object property
console.log(book.isbn);
console.log(book["title"]);
Console.log(book['author']['firstname'])
//setting object property
book.author.firstname = "Uma";
//create new object property
book["publishedYear"] = 2000;
//or book.publishedYear = 2000;

//console.log(book)
{
  isbn: 123456789,
  title: 'JavaScript',
  author: {firstname: 'Uma', lastname: 'Sup'},
  publishedYear: 2000
}

```

Create class and constructor functions (ES6)

```
//Recommendation to wrapping property and function within a single unit
//A class can be composed of the class's constructor method, instance methods, getters, setters, and static class methods.
```

```

class Rectangle{
  constructor(width, height){ //invoke by new operator
    // Everything added to 'this' will exist on each individual instance
    this._width=width;
    this._height=height;
  }
  // Everything defined in the class body is defined on the class prototype object and
  // sharing between instances.
  area(){
    return this._width*this._height;
  }
}

```

```

let rec1=new Rectangle (2, 3);
console.log(rec1.area()); //6

```

```

class Rectangle {
  constructor(width, height) {
    this._width = width;
    this._height = height;
  }
  area() {
    return this._width * this._height;
  }
  get width() {
    return this._width;
  }
  set width(newWidth) {
    this._width = newWidth;
  }
  get height() {
    return this._height;
  }
  set height(newHeight) {
    this._height = newHeight;
  }
  toString(){
    return "width = "+this._width + ", height = "+this._height +
    ", area = " + this.area();
  }
}

```

```
//create object with Function Constructor Pattern (ES5)
//It is also possible to define custom constructors, in the form of a function,
//that define properties and methods for your own type of object.
//By convention, constructor functions always begin with an uppercase letter,
//whereas non constructor functions begin with a lowercase letter.
```

//04 Objects/script4.js

```

function Person(name, age, job){
  this.name = name;
  this.age = age;
  this.job = job;
  this.sayName = function() {
    console.log(this.name);
  };
}

let person1 = new Person("Pot", 40, "Tester");
let person2 = new Person("Joe", 20, "Doctor");

person1.sayName(); // "Pot"
person2.sayName(); // "Joe"

```

Constructor
ไม่ใช้ class

Any function that is called with the **new** operator acts as a constructor, whereas any function called without it acts just as you would expect a normal function call to act.

ใช้ new คือ class

```

Person.prototype.greeting = function () {
  return `Hello, ${this.name}`;
};

console.log(person1.greeting());

```

Object Prototypes

- **Prototypes** are the mechanism by which JavaScript objects inherit features from one another.
- **JavaScript** is often described as a prototype-based language—to provide inheritance, objects can have a prototype object, which acts as a template object that it inherits methods and properties from.

Prototype Chaining

ในส่วนของ object

Object > Rectangle > Square

- ECMA-262 describes **prototype chaining** as the primary method of **Inheritance** in ECMAScript.
- The object created by `new Object()` or **Object literal** inherit from `Object.prototype`
- Similarly, the object created by `new Array()` uses `Array.prototype` as its prototype, and the object created by `new Date()` uses `Date.prototype` as its prototype.
- `Date.prototype` inherits properties from `Object.prototype`, so a `Date` object created by `new Date()` inherits properties from both `Date.prototype` and `Object.prototype`.
- This linked series of prototype objects is known as a **prototype chain**.
- JavaScript objects have a set of "**own properties**" and they also inherit a set of properties from their prototype object.

```
let o = {};           // o inherits object methods from Object.prototype
o.x = 1;             // and it now has an own property x.
let p = Object.create(o); // p inherits properties from o and Object.prototype
p.y = 2;             // and has an own property y.
let q = Object.create(p); // q inherits properties from p, o, and Object.prototype
q.z = 3;             // and has an own property z.
let f = q.toString(); // toString is inherited from Object.prototype
q.x + q.y           // => 3; x and y are inherited from o and p
```

`prototypeObj.isPrototypeOf(object)`

object - the object whose prototype chain will be searched. Return a Boolean indicating whether the calling object lies in the prototype chain of the specified object.

```
//define our own class and
//constructor functions
class Rectangle{
  constructor(width, height){
    this._width=width;
    this._height=height;
  }
  area(){
    return this._width*this._height;
  }
}
let rec1=new Rectangle(2, 3);
console.log(rec1.area()); //6
```

```
//create object with Object.create()
let square = Object.create(rec1);
square.perimeter = function() {
  return 4 * this.width;
}
console.log(square.width); //2
console.log(square.height); //3
console.log(square.area()); //6
console.log(square.perimeter()); //8
console.log(Object.prototype.isPrototypeOf(rec1)); //true
console.log(Rectangle.prototype.isPrototypeOf(square)); //true
console.log(Object.prototype.isPrototypeOf(square)); //true
```

How to Compare Objects in JavaScript

1. Referential equality: `==`, `===`, `Object.is()`
2. Manual comparison of properties' values.
3. Shallow Equality check the properties' values for equality.

Referential equality

- Both are the same object means both object point to the same object instances.
- Three ways to compare objects:

| Memory Address | Variable Value |
|----------------|----------------|
| 1100 (num1) | 10 |
| 1101 | |
| 1102 | |
| 1103 (num2) | 10 |
| ... | |
| 1104 (num) | 10 |

```
let num1 = 10;
let num2 = num1;
doSomething(num2);
function doSomething(num) {
  //num=num2
  num = 20;
}
num1==num2 // 10==10
```

- The strict equality operator `==`
- The loose equality operator `==`
- `Object.is()` function

```
//Object Comparing
let student = { id: 1, name: "Joe" };
let newStudent = { id: 2, name: "Joe" };
let oldStudent = { id: 1, name: "Joe" };
let alumniStudent = student;
```

```
if (student == alumniStudent) { //true
  console.log("student equals to alumni student by ==");
  //student equals to alumni student by ==
}
if (student == newStudent) { //false
  console.log("student equals alumni student by ==");
}
if (student === alumniStudent) { //true
  console.log("student strictly equals to alumni student");
  //student strictly equals to alumni student.
}

if (student === newStudent) { //false
  console.log("student strictly equals to new student by ==");
}
```

```
//Object Comparing
let student = { id: 1, name: "Joe" };
let newStudent = { id: 2, name: "Joe" };
let oldStudent = { id: 1, name: "Joe" };
let alumniStudent = student;
```

*/*The `Object.is()` method determines whether two values are the same value without type conversion. Both the same object means both object have same reference*/*

```
if (Object.is(student, alumniStudent)) { //true
  console.log("student equals to alumni student by Object.is()");
  //student equals to alumni student by Object.is()
}
if (Object.is(student, newStudent)) { //false
  console.log("student equals to new student by Object.is()");
}

if (Object.is(student, oldStudent)) { //false
  console.log("student equals to old student by Object.is()");
}
```

| Memory Address | Variable Value |
|--------------------|-------------------------|
| 1100 (per1) | FF00 |
| 1101 | 1 |
| 1102 (per2) | FF00 |
| 1103 (per3) | EEEE |
| ... | |
| 11EE (p) local var | FF00 |
| ... | |
| FF00 | { id: 3, name: 'Mary' } |

//04_Objects/script3.js

```
let per1 = { id: 1, name: 'Joe' };
let per2 = per1;

doSomething(per2);

function doSomething(p) { //p=per2
  p.name = 'Mary';
}

console.log(per1);
console.log(per2);
per2.id = 3;
console.log(per1);
Console.log(per2);
per2==per1 //FF00==FF00
let per3={id:1, name: 'Joe'}
per3==per2 //EEEE==FF00
```

Manual Comparison

A manual comparison of properties' values.

//04_Objects/script3.js

```
//compare properties manually
function isStudentEqual(object1, object2) {
  return object1.id === object2.id;  // ပေါ်စောင့်ခဲ့မယ့်လိုအပ်
}
```

ဖြော်ပေးထို့မျှ သူ၏ object

```
console.log(isStudentEqual(student, oldStudent)); //true
console.log(isStudentEqual(student, alumniStudent)); //true
```

Shallow Equality

ဖော်ပေးထို့မျှ ပေါ်စောင့်ခဲ့မယ့်လိုအပ်

Deep Equality

ဖြော်ပေးထို့မျှ ပေါ်စောင့်ခဲ့မယ့်လိုအပ်

return an array of key property

`Object.keys(obj)`

//04_Objects/script3.js

`obj` - the object of which the enumerable's own properties are to be returned. Return an array of strings that represent all the enumerable properties of the given object.

```
//3. Shallow Equality
let book1 = {
  isbn: 123456789,
  title: "JavaScript",
};

let book2 = {
  isbn: 123456789,
  title: "JavaScript",
};
```

```
function shallowEquality(object1, object2){
  const keys1=Object.keys(object1);
  const keys2=Object.keys(object2);

  if(keys1.length !== keys2.length){
    return false;
  }
  for(let key of keys1){
    if(object1[key] !== object2[key] ){
      return false;
    }
  }
  return true;
}
```

กู๊บ book1 กู๊บ book2 ถ้า key properties ไม่เท่ากัน?
ไม่เท่ากันค่าทั้งหมด properties

```
console.log("shallow equality: " + shallowEquality(book1, book2)); //true
```

JSON – JavaScript Object Notation

<https://www.borntodev.com/2020/02/28/what-is-json/>

ตัวอย่างภาษา JSON แบบ JS

- JavaScript Object Notation (JSON) is a standard text-based format for representing structured data based on JavaScript object syntax.
- It is commonly used for transmitting data in web applications (e.g., sending some data from the server to the client, so it can be displayed on a web page, or vice versa).
- Even though it closely resembles JavaScript object literal syntax, it can be used independently from JavaScript, and many programming environments feature the ability to read (parse) and generate JSON.
- A JSON string can be stored in its own file, which is basically just a text file with an extension of .json, and a MIME type of application/json.

JSON structure

`JSON.stringify()`
`JSON.parse()`

- JSON is a string whose format very much resembles JavaScript object literal format.
- JSON requires double quotes to be used around strings and property names. Single quotes are not valid other than surrounding the entire JSON string.
- You can include the same basic data types inside JSON as you can in a standard JavaScript object — strings, numbers, arrays, booleans, and other object literals.
- JSON is purely a string with a specified data format — It contains only properties, no methods.
- We can also convert arrays to/from JSON.

```
{
  "squadName": "Super hero squad",
  "homeTown": "Metro City",
  "formed": 2016,
  "secretBase": "Super tower",
  "active": true,
  "members": [
    {
      "name": "Molecule Man",
      "age": 29,
      "secretIdentity": "Dan Jukes",
      "powers": [
        "Radiation resistance",
        "Turning tiny",
        "Radiation blast"
      ],
      "name": "Madame Uppercut",
      "age": 39,
      "secretIdentity": "Jane Wilson",
      "powers": [
        "Million tonne punch",
        "Damage resistance",
        "Superhuman reflexes"
      ],
      "name": "Eternal Flame",
      "age": 1000000,
      "secretIdentity": "Unknown",
      "powers": [
        "Immortality",
        "Heat Immunity",
        "Inferno",
        "Teleportation",
        "Interdimensional travel"
      ]
    }
  ]
}
```

JavaScript Arrays

Learn > L5.js

Arrays

- An array is an ordered collection of values. JavaScript arrays are objects.
- Each value is called an element, and each element has a numeric position in the array, known as its index (zero-based index).

In collection n'mj type n'w'k

- JavaScript arrays are **untyped**: an array element may be of **any type**, and different elements of the same array **may be of different types**.
- Array elements** may even be **objects or other arrays**, which allows you to create complex data structures such as arrays of objects and arrays of arrays.
- JavaScript arrays are **dynamic**: they grow or shrink as needed, and there is **no need to declare a fixed size** for the array when you create it or to reallocate it when the size changes.
- Every JavaScript array has a **length** property.

Creating Arrays //05_Arrays/script2.js

1. Array literals
2. The ... spread operator on an iterable object
3. The `Array()` constructor
4. The `Array.of()` and `Array.from()` factory methods

1. Array literals

- The simplest way to create an array is with an array literal, which is simply a comma separated list of array elements within square brackets

//05_Arrays/script1.js

```
let arr1 = [10, 'in progress', true];
let arr2 = [15, 30, 42];

let students = [
  { id: 1, name: 'Ann' },
  { id: 2, name: 'Peter' },
  { id: 3, name: 'Mary' }
];

let colors = [
  ['pink', 'red'],
  ['yellow', 'orange', 'brown']
];
```

2. The ... spread operator on an iterable object

- In ES6 and later, you can use the "spread operator," ..., to include the elements of one array within an array

literal:

```
let a = [1, 2, 3];
let b = [0, ...a, 4]; // b == [0, 1, 2, 3, 4]
```

- The three dots "spread" the array so that its elements become elements within the array literal that is being created.
- The spread operator is a convenient way to create a (shallow) copy of an array:

//05_Arrays/script2.js

```
let c = [5, 10, 15];
let d = [...c];
d[0] = 10;
console.log(`d: ${d}`); //d: 10,10,15
console.log(`c[0]: ${c[0]}`); //5
console.log(`d[0]: ${d[0]}`); //10
```

- Modifying the copy does not change the original

3. The Array() Constructor

- Call it with **no arguments**:

```
let a = new Array();
```

- Call it with a single numeric argument, which **specifies a length**:

```
let a = new Array(10);
```

- Explicitly **specify two or more array elements** or a **single non-numeric element for the array**:

```
let a = new Array(3, 2, 1, "testing");
```

ตั้ง 3 ถึง 2 ค่า / มากกว่า 3 ค่า ให้ 1 ค่า ใน array

4. The Array.of() and Array.from() factory methods

- The Array() constructor **cannot be used to create** an array with a single numeric element.
- In ES6, the **Array.of()** function addresses this problem: it is a factory method that creates and returns a new array, using its argument values (regardless of how many of them there are) as the array elements:

//05_Arrays/script2.js

```
Array.of()           // => []; returns empty array with no arguments
Array.of(5)         // => [5]; create arrays with a single numeric argument
Array.of(1,2,3)     // => [1, 2, 3]
```

- Array.from** is another array factory method introduced in ES 6.
- It expects an iterable or array like object as its first argument and returns a new array that contains the elements of that object.
- With an iterable argument, **Array.from (iterable)** works like the spread operator [... iterable] does. It is also a simple way to make a copy of an array:

//05_Arrays/script2.js

```
let j = Array.of(1, 2, 3);
let k = Array.from(j); //k: 1,2,3
```

Reading and Writing Array Elements

- You access an element of an array using the **[]** operator.
- An arbitrary expression that has a non negative integer value should be inside the brackets.
- You can use this syntax to both read and write the value of an element of an array. Thus, the following are all legal JavaScript statements:

```
let a = ["hello"];
let value = a[0];           // Read element 0
a[1] = 3.5;                // Write element 1
let i = 2;
a[i] = 3;                  // Write element 2
a[i + 1] = "world";        // Write element 3
a[a[i]] = a[0];            // Read elements 0 and 3, write element 3
```

Adding and Deleting Array Elements

//05_Arrays/script4.js

```
let arrList = []; // Start with an empty array.
arrList[0] = 10; // add elements to it.
arrList[1] = 20; // add elements to it.
arrList[2] = 'ten'; // add elements to it.
delete arrList[1]; // delete element at index 1
arrList.length //length=3
```

Note that using **delete** on an array element does **not alter the length property and does not shift elements with higher indexes down to fill in the gap** that is left by the deleted property.

//result
[10, <1 empty item>, 'ten'] ลิสต์ตัวที่ถูกลบออก แต่ length ยังคงไว้

Iterating Arrays

- As of ES 6, the easiest way to loop through each of the elements of an array (or any iterable object) is with the **for/of** loop

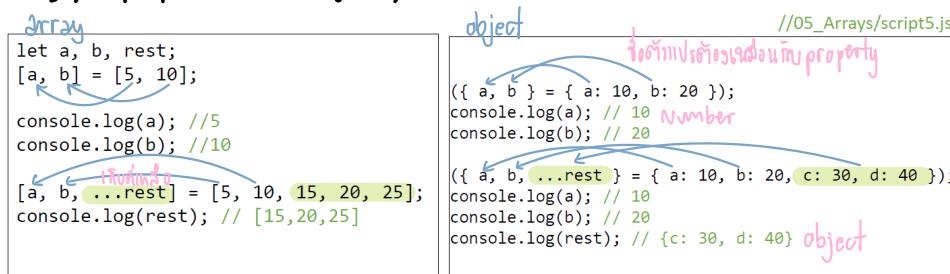
```
//05_Arrays/script3.js
let letters = [...'Hello world']; //spread array of characters
let msg = '';
for (let ch of letters) {
  msg += ch + ', ';
}
console.log(msg);
```

//result

H, e, l, l, o, , w, o, r, l, d,

destructuring assignment ក្រឹតចំណាំ > 1 ព័ត៌មានចាប់ផ្តើម

- The **destructuring assignment** syntax is a JavaScript expression that makes it possible to **unpack values from arrays, or properties from objects, into distinct variables.**



Iterating Arrays (with index of each array element)

- If you want to use a **for/of** loop for an array and **need to know the index** of each array element, use the **entries()** method of the array, along with destructuring assignment.

```
//05_Arrays/script3.js
let letters = [...'Hello world'];
let value = '';
for (let [index, letter] of letters.entries()) {
  if (index % 2 === 0) value += letter; // letters at even indexes
}
console.log(`value: ${value}`); // "Hlowrd"
```

The **entries()** method returns a new **Array Iterator** object that contains the key/value pairs for each index in the array

Array Methods

Array Iterator Methods: iterator methods loop over the elements of an array

- forEach()** iterates through an array, invoking a function you specify for each element
- map()** passes each element of the array on which it is invoked to the function you specify and returns an array containing the values returned by your function.
- filter()** returns an array containing a subset of the elements of the array on which it is invoked.
- find()** returns the matching element, If no matching element is found, find() returns undefined
- findIndex()** returns the index of the matching element. If no matching element is found, If no matching element is found, find() returns -1
- every()** and **some()** they apply a predicate function you specify to the elements of the array, then return true or false.
- reduce()** combine the elements of an array, using the function you specify, to produce a single value.

Stack and queue methods add and remove array elements to and from the beginning and the end of an array.

- **push()** appends one or more new elements to the end of an array and returns the new length of the array.
- **pop()** deletes the last element of an array, decrements the array length, and returns the value that it removed.
- **unshift()** adds an element or elements to the beginning of the array, shifts the existing array elements up to higher indexes to make room, and returns the new length of the array.
- **shift()** removes and returns the first element of the array, shifting all subsequent elements down one place to occupy the newly vacant space at the start of the array.

Subarray methods are for extracting, deleting, inserting, filling, and copying contiguous regions of a larger array.

- **slice()** returns a slice, or subarray, of the specified array. Its two arguments specify the start and end of the slice to be returned.
- **splice()** a general-purpose method for inserting or removing elements from an array.
- **fill()** sets the elements of an array, or a slice of an array, to a specified value. It mutates the array it is called on, and also returns the modified array:

Searching and sorting methods are for locating elements within an array and for sorting the elements of an array.

- **indexOf()** search an array for an element with a specified value and return the index of the first such element found, or -1 if none is found.
- **includes()** takes a single argument and returns true if the array contains that value or false otherwise. It does not tell you the index of the value, only whether it exists.
- **sort()** sorts the elements of an array in place and returns the sorted array.
- **reverse()** reverses the order of the elements of an array and returns the reversed array.

Array to String Conversions

- **join()** converts all the elements of an array to strings and concatenates them, returning the resulting string.

Function Expressions

Function expression

```
const getRectangleArea = function(width, height) {
    return width * height;
};
```

Named function expression

```
let fact = function factorial(n) {
    console.log(n);
    if (n <= 1) {
        return 1;
    }
    return n * factorial(n - 1);
};

fact(5); //120
```

| |
|---|
| //No param () => expression |
| // One param param => expression |
| // Multiple param (param1, paramN) => expression |
| // Multiline statements param1 => { statement1; ... statementN; } (param1, paramN) => { statement1; ... statementN; } |

Arrow Function Expressions

- is a compact alternative to a traditional function expression but is limited and can't be used in all situations.

| |
|---|
| // Traditional Function (no arguments) let a = 4; let b = 2; function (){ return a + b + 100; } // Arrow Function let a = 4; let b = 2; (() => a + b + 100); |
|---|

Comparing traditional functions to arrow functions

```
// Traditional Function (one argument)
function (a){
    return a + 100;
}

// Arrow Function Break Down
// 1. Remove the word "function" and place arrow
// between the argument and opening body bracket
(a)=> {
    return a + 100;
}

// 2. Remove the body braces and word "return" --
// the return is implied.
(a)=> a + 100;

// 3. Remove the argument parentheses
a => a + 100;
```

```
// Traditional Function (multiple arguments)
function (a, b){
    return a + b + 100;
}

// Arrow Function
(a, b) => a + b + 100;

// Traditional Function (multiline statements)
function (a, b){
    let chuck=42;
    return a + b + chuck;
}

// Arrow Function
(a, b) => {
    let chuck=42;
    a + b + chuck;
}
```