Internet Technologies

Introduction to JavaScript (Exercises)

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Involve JavaScript in web pages

```
<!DOCTYPE html>
<html>
  <head>
   <title>CS 425</title>
   <link rel="stylesheet" href="style.css" />
   <script src="script.js"></script>
  </head>
  <body>
   ... contents of the page...
  </body>
</html>
```

JavaScript execution

- There is **no "main method"**
  - The script file is executed from top to bottom.
- There's **no compilation** by the developer
  - JavaScript is compiled and executed on the fly by the browser

Same as Java/C++/C-style languages

- for-loops:

```
for (let i = 0; i < 5; i++) { ... }
```

- while-loops:

```
while (notFinished) { ... }
```

- comments:

```
// comment or /* comment */
```

- conditionals (if statements):

```
if (...) {
   ... }
else {
   ... }
```

Variables: `var`, `let`, `cons`

- Declare a variable in JS with one of three keywords:

```JS
// Function scope variable
var x = 15;
// Block* scope variable {}
let fruit = 'banana';
// Block scope constant; cannot be reassigned
const isHungry = true;
```

(*) A block is a group of 0 or more statements, **usually surrounded by curly braces**

- You do not have to declare the datatype of the variable before using it ("dynamically typed")

Variables best practices

- Use `const` whenever possible.
- If you need a variable to be reassignable, use `let`.
- Not doing so will result in global variables.
  - We want to avoid polluting the global namespace.
- **Avoid using var.**
  - You will see a ton of example code on the internet with `var` since `const` and `let` are relatively new.
  - However, `const` and `let` are well-supported, so there's no reason not to use them.
  - (This is also what the Google and AirBnB JavaScript Style Guides recommend.)

Aside: The internet has a ton of misinformation about JavaScript!

Including several "accepted" StackOverflow answers, tutorials, etc. Lots of stuff online is years out of date. Treat carefully.

Equality

- JavaScript's == and != are basically broken: they do an implicit type conversion before the comparison.

```
'' == '0'   // false
 '' == 0   // true
0 == '0'   // true
NaN == NaN   // false
 [''] == ''   // true
false == undefined   // false
  false == null   // false
null == undefined   // true
```

- Instead of fixing == and != , the ECMAScript standard kept existing behavior but added === and !==

```
'' === '0'   // false
 '' === 0   // false
0 === '0'   // false
NaN == NaN   // still weirdly false
 [''] === ''   // false
false === undefined   // false
  false === null   // false
null === undefined   // false
```

Always use === and !== and don't use == or !=

Functions

- One way of defining a JavaScript function is with the following syntax:

```JS
function name() {
   statement;
   statement;
   ...
   return ...
}
```

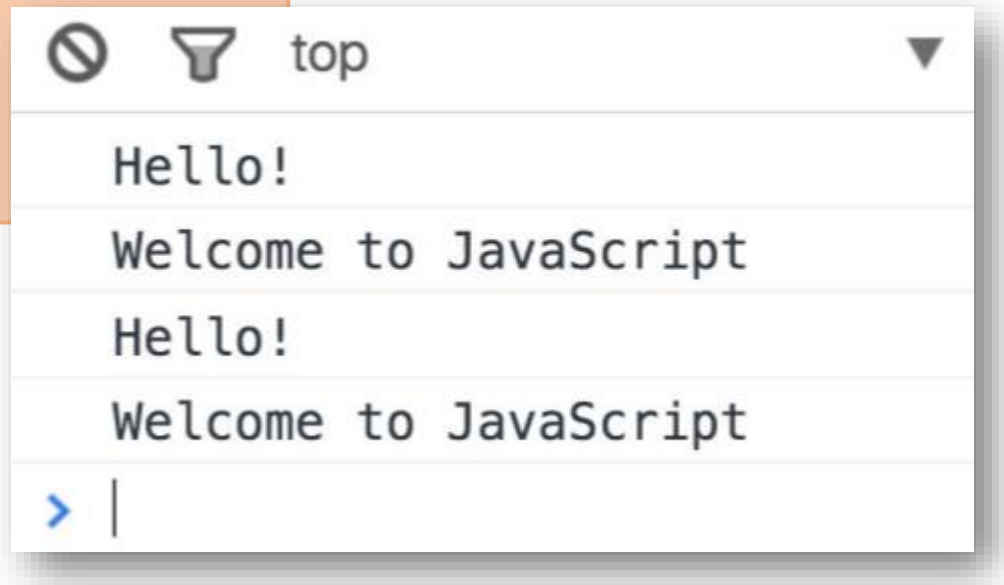
Function example

```
function hello() {
   console.log('Hello!');
   console.log('Welcome to JavaScript');
}

hello();
hello();
```

JS

Console output:



The browser "executes" the function definition first, but that just creates the hello function (and it doesn't run the hello function), similar to a variable declaration.

Function example

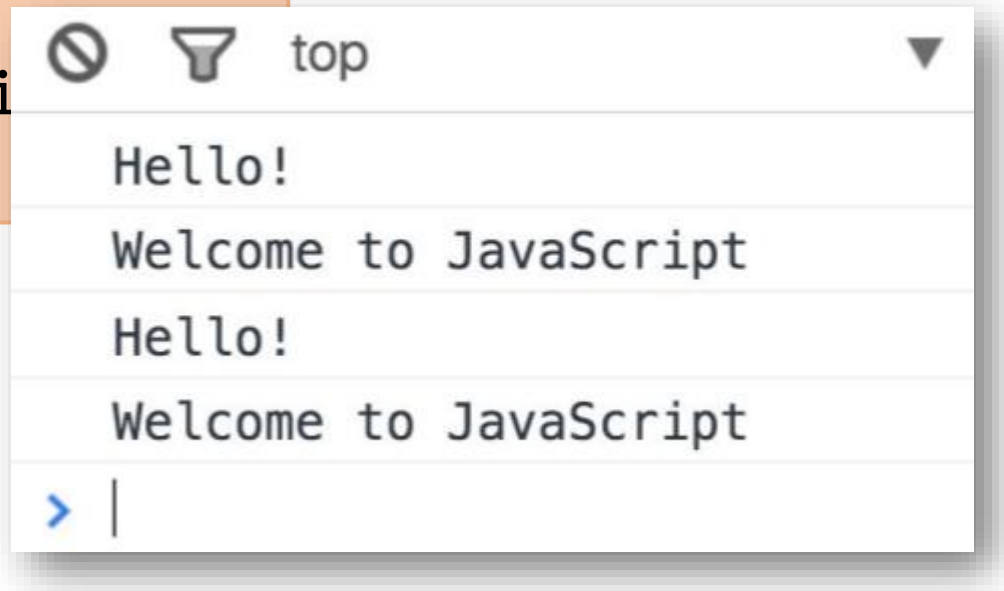
JavaScript Hoisting refers to **the process whereby the interpreter appears to move the declaration of functions, variables or classes to the top of their scope, prior to execution of the code.**

JS

```
hello();
hello();

function hello() {
   console.log('Hello!');
   console.log('Welcome to JavaScri
}
```

Console output:



- This works because function declarations are "hoisted" (mdn)
- Try not to rely on hoisting when coding. It gets bad.

Variable Hoisting

- Do you know what value will be printed in console if the following is executed as a JavaScript program?
- Undefined is for a variables that **has been declared** but has not yet been assigned a value. So, why undefined?

```
console.log(foo); // undefined
var foo = 10;
```

JS

is actually interpreted like this:

```
var foo; // foo is hoisted
console.log(foo);
foo = 10;
```

JS

Variable Hoisting

- Do you know what value will be alerted if the following is executed as a JavaScript program?

JS

```
var foo = 1;
function bar() {
   alert(foo); // undefined
   if (!foo) {
      var foo = 10;
   }
   alert(foo); // 10
}
bar();
```

JS

```
var foo = 1;
function bar() {
   var foo;      // declaration is hoisted
   alert(foo);   // var has function scope
   if (!foo) {
      foo = 10;
   }
   alert(foo);
}
bar();
```

When foo is re-declared, it overwrites the global foo.

Variable Hoisting

- Do you know what value will be alerted if the following is executed as a JavaScript program?

JS

```
var foo = 1;
function bar() {
   alert(foo); // 1
   if (!foo) {
      let foo = 10;
   }
   alert(foo); // 1
}
bar();
```

- Let has block scope is not hoisted outside of its block
- foo has the value of 1 inside function (from the global foo assignment)
- Condition within the if statement is true, foo is assigned the value 10 within the block
- Outside the if statement block, foo maintains its global value

Arrays

- Arrays are Object types used to create lists of data.

```JS
// Creates an empty list
let list = [];
let groceries = ['milk', 'cocoa puffs'];
groceries[1] = 'kix';
```

  - 0-based indexing
  - Mutable (can be modified in the same memory location)
  - Can check size via length property (not function)

Arrays – Iterating through array

- You can use the familiar for-loop to iterate through a list:

```JS
let groceries = ['milk', 'cocoa puffs', 'tea'];
for (let i = 0; i < groceries.length; i++) {
   console.log(groceries[i]);
}
```

- Or use a for-each loop via `for...of` (mdn):
  (intuition: **for** each item **of** the groceries list)

```JS
let groceries = ['milk', 'cocoa puffs', 'tea'];
for (let item of groceries) {
   console.log(item);
}
```

```
let arr = [5,10,15];
let len = arr.length;      // array length: 3
arr[1];                    // second element of the array (index starts at 0): 10
arr.push(1);               // adds new item(s) to the end: [5,10,15,1]
arr.push(2,3);             // [5,10,15,1,2,3]
arr.pop();                 // removes last item and returns it's value, [5,10,15,1,2]
arr.shift();               // removes first element and returns it's value, [10,15,1,2]
arr.unshift(0);            // adds new item(s) to beginning, [0,10,15,1,2]
arr.reverse();             // reverses the array in place, [2,1,15,10,0]
arr.concat([9,8]);         // merges 2 or more arrays.Arrays unmodified. Returns new array: [2,1,15,10,0,9,8]
arr.slice(2,4);            // returns a copy of a portion of an array into a new array: [15,10]
arr.find(function check(i) { return i >= 5; });
                           // returns the value of the first element in array that pass test: 15
arr.findIndex(function check(i) { return i >= 5; });
                           // returns the index of the first element in array that pass test: 2
arr.filter(function check(i) { return i >= 5; });
                           // creates new array with every element in array that pass test: [15,10,9,8]
arr.indexOf(0)             // Search the array for an element and returns its position
arr.splice(start[, deleteCount[, item1[, item2[, ...]]]]);
                           // changes content by removing /or adding elements. start=Index at which to start
changing, deleteCount=number of array elements to remove, item1=element(s) to add
arr.splice(2,1,4,6);   // removes one element from index 2 and adds 4,6 in the same index [2,1,4,6,10,0,9,8]
delete arr[1];             // delete but not removes the element: [2,,4,6,10,0,9,8]. Use splice instead.
[5,10,15,1,2,3].sort();    // sort the elements of array in Unicode code point order: [1,10,15,2,3,5]
[5,10,15,1,2,3].sort(function compFunc(a,b) { return a-b; });
                           // For first iteration a=5 and b=10. If compFunc(a,b) > 0 : sort b to an index
                           // lower than a, else(<0 or ===0) the two elements will not change indexes
```

Objects

- Every JavaScript object is a collection of property-value pairs.
- Objects can be initialized using `new Object()`, `Object.create()`, or using the literal notation (initializer notation).
- An object initializer is a comma-delimited list of zero or more pairs of property names and associated values of an object, enclosed in curly braces {} as shown below:

JS

```
// Creates an empty object
const prices = {};
// Non empty object
const scores = { 'peach': 100, 'mario': 88, 'luigi': 91 };
```

Objects literal notation

```JS
// Creates an empty object
const prices = {};
// Non empty object
const scores = { 'peach': 100, 'mario': 88, 'luigi': 91 };
```

- There are two ways to access the value of a property:

1. `objectName[property]` `Ex: console.log(scores['peach']); // 100`
2. `objectName.property` (for string keys) `Ex: console.log(scores.peach);`

Objects – Adding property

- To add a property to an object, name the property and give it a value:

```JS
const scores = { peach: 100, mario: 88, luigi: 91 };
scores.toad = 72;
let name = 'super';
scores[name] = 102;
console.log(scores);
```

```
▶ {peach: 100, mario: 88, luigi: 91, toad: 72, super: 102}
```

Objects – Deleting property

- To remove a property to an object, use delete:

```JS
const scores = { peach: 100, mario: 88, luigi: 91 };
scores.toad = 72;
let name = 'super';
scores[name] = 102;
delete scores.peach;
console.log(scores);
```

```
▶ {mario: 88, luigi: 91, toad: 72, super: 102}
```

Objects – Iterating through object

- Iterate through a map using a for...in loop (mdn):
  (intuition: **for** each key **in** the object)

```JS
for (key in object) {
   // … do something with object[key]
}

for (let name in scores) {
   console.log(name + ' got ' + scores[name]);
}
```

You can't use `for...in` on lists; only on object types
You can't use `for...of` on objects; only on list types

Objects – How to transfer between client-server?

- Strings are lightweight and therefore very useful when transporting data.
  - Convert list (arrays) or objects to Strings
  - JavaScript Object Notation (JSON) is a standard text-based format for representing structured data based on JavaScript object syntax
- A JavaScript object can be easily converted to a JSON string using `JSON.stringify()` function
- JSON string can easily converted to JavaScript object using `JSON.parse()`

JS

```
const obj = {firstname : "Sam", lastname : "Shark", age : 41};
const jsonObj = JSON.stringify(obj);
console.log(jsonObj);
```

```
"{"firstname":"Sam","lastname":"Shark","age":41}"
```

Object to JSON – Examples

```
let contacts = {};
contacts["name"] = "Timothy";
contacts["age"] = 35;
contacts["address"] = {};
contacts["address"]["street"] = "1 Main St";
contacts["address"]["city"] = "Montreal";
contacts["interests"] = [];
contacts["interests"][0] = "cooking";
contacts["interests"][1] = "biking";
```

Create the whole JavaScript object once OR Create the JavaScript object as data become available

JS

```
let contacts = {
   name :"Timothy",
   age : 35,
   address : {
      street : "1 Main St",
      city : "Montreal"
   },
   interests:["cooking", "biking"]
};
```

```
let contacts = {};
contacts.name = "Timothy";
contacts.age = 35;
contacts.address = {};
contacts.address.street = "1 Main St";
contacts.address.city = "Montreal";
contacts.interests = [];
contacts.interests[0] = "cooking";
contacts.interests[1] = "biking";
```

The same

```
jsonStr = JSON.stringify(contacts);
```

```
"{"name":"Timothy","age":35,"address":{"street":"1 Main St","city":"Montreal"},"interests":["cooking","biking"]}"
```

```
conObj = JSON.parse(jsonStr);
```

JSON.parse()

- When using the `JSON.parse()` on a JSON derived from an array, the method will return a JavaScript array, instead of a JavaScript object.

JS

```
const text = '[ "Ford", "BMW", "Audi", "Fiat" ]';
const obj = JSON.parse(text);
console.log(obj);
```

```
["Ford", "BMW", "Audi", "Fiat"]
```

- Date objects are not allowed in JSON. If you need to include a date, write it as a string. You can convert it back into a date object later:

JS

```
var text = '{ "name":"John", "birth":"1986-12-14", "city":"New York"}';
var obj = JSON.parse(text);
obj.birth = new Date(obj.birth);
```

Exercises

1. Write JavaScript source code to parse the JSON string shown below and log, i.e. print using console.log(), the name and age of the person.

JSON string:

```
{
    "name": "Alice",
    "age": 28,
    "city": "New York"
}
```

Program output

```
Name: Alice
Age: 28
```

To execute a JavaScript file in VSCode, open terminal and run the command (NodeJS needed to be installed – see Lab1):
node file.js
Alternatively, use an online JavaScript editor.

Exercises

2. Write JavaScript source code to convert the given user data object to a JSON string and log it.

Object:

```
const userData = {
    name: "Bob",
    age: 30,
    city: "Los Angeles"
};
```

Program output

```
{"name":"Bob","age":30,"city
":"Los Angeles"}
```

Exercises

3. Write JavaScript source code to parse the following JSON string and access the city and postal code from the nested address object.

JSON string:

```
{
    "name": "Charlie",
    "address": {
        "city": "Paris",
        "postalCode": "75001"
    }
}
```

Program output

```
City: Paris
Postal Code: 75001
```

Exercises

4. Write JavaScript source code to parse the given JSON array string and log the names of all users.

JSON Array string:

```
[
  {"name": "David"},
  {"name": "Emma"},
  {"name": "Frank"}
]
```

Program output

```
Name: David
Name: Emma
Name: Frank
```

Exercises

5. Write JavaScript source code to filter the given JSON array and create new array that includes only users with an age greater than 25 and log the result (hint: can be done using for loops or an appropriate function in slide 16)

JSON Array string:

```
[
  {"name": "Jack", "age": 30},
  {"name": "Kelly", "age": 22},
  {"name": "Leo", "age": 28}
]
```

Program output

```
[ { name: 'Jack', age: 30 },
{ name: 'Leo', age: 28 } ]
```