JAVASCRIPT PITFALLS

Agenda

- Understand the major differences between JavaScript and popular static languages like C++/C#/Java
- Introduce best practices
- Pitfalls
- Bad parts

JavaScript is dynamic

- You don't specify the data type of a variable when you declare it
- The same variable can point to different data types
- We use var to declare a variable
- A variable has a scope
  - Global variables should be avoided (like in any other object oriented language)

```
var answer = 42;
answer = "Meaning of life";
```

Dynamic vs. Static

- Some studies show 15% bug reduction
  - http://ttendency.cs.ucl.ac.uk/projects/type_study/documents/type_study.pdf
- Some show no reduction
  - https://labs.ig.com/static-typing-promise
- All agree that static languages provide better development experience
  - Refactoring
  - Go to definition
  - Intelisense

Declaring Variables

- Case sensitive
- $ and _ are valid variable names
  - And common
- Cannot use reserved keywords
- Usually, camel case convention

```
$(function () {
    var res = _.map([1, 2, 3], function (num) {
        return num * 2;
    });
});
```

- Do you like above code ?

Implicit Variable Declaration

- You can write into a variable even when this variable was not declared before
- Don't do this !
- In this case a global variable is created

```
function () {
    global = 12;
    var local = "abc";
}

alert(local);
```

Disable bad behavior

- Implicit variable declaration is an old “feature” of JavaScript
- We don’t really want it
- Can we disable this feature for new code while keeping it for old code ?
- Yes, use strict mode

Automatic Initialization

- Like other modern programming languages, JavaScript supports automatic initialization
- The value of uninitialized variable is undefined
  - Not the same as null value

```
var num;

console.log(num == undefined);
```

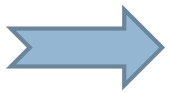
Undeclared Variable

- You cannot read a value of undeclared variable

```
try {
    if (xxx == 10) {
    }
}
catch (e) {
    console.log(e.message);
}
```

- You can ask for the typeof of an undeclared variable

```
console.log(typeof xxx);
```



Window is the Global Scope

- Every global variable is a property of a global object named window

```
var num = 10;
console.log(window.num); //prints 10

window.num = 11;
console.log(num); // prints 11
```

- Objects in JavaScript are dynamic → Global scope is dynamic ☺
  - See next slides about objects

Built-in types

- JavaScript supports only the following types:
  - number
  - boolean
  - string
  - function
  - object
  - undefined
- Given a variable you can use the keyword typeof to read it's runtime type

Built-in types


```
console.log(typeof 1); // number
console.log(typeof 1.2); // number
console.log(typeof "abc"); // string
console.log(typeof "abc"[0]); // string
console.log(typeof true); // boolean
console.log(typeof function () { }); // function
console.log(typeof {}); // object
console.log(typeof null); // object
console.log(typeof new Date()); // object
console.log(typeof window); // object
console.log(typeof undefined); // undefined
console.log(typeof blabla); // undefined
```

Value vs. Reference type

- Same concept as in Java/C#
- Built-in data types are grouped into
  - Reference types (object, array and function)
  - Value types (others …)
- A reference is implemented as a pointer
  - Points to an object that resides inside the heap
  - Many references can point to the same object
- A value can only copied
  - You cannot get the address of value

Number

- There is no distinction between integer and double
- All type of numbers are represented as 64bit floating point values
  - 10/3 = 3.3333 not 3
- parseInt can be used to parse a string into a number. In case of failure NaN is returned

```
var str = document.getElementById("firstName").value;
if (isNaN(parseInt(str))) {
    alert("Please enter a number");
}
```

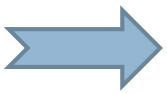
String (1)

- String contains any Unicode character
- No character type
  - str[0] is also a string !!!
- String literal can be expressed using “ or ‘

```
var str = "ABC";
var str = 'ABC';
```

- Strings are immutable
  - Allows for runtime optimization

```
var str = "ABC";
str[0] = "X";
```



str is still “ABC”

String (2)

- Should we use “ or ‘ when writing string literals?
  - Probably a matter of style
  - Programmers with C++\Java\C# background tend to use double quotes
  - Veteran Web Programmers tend to use single quote
- You should be aware of the following
  - JSON requires double quotes
  - HTML/XML attributes are usually expressed using double quotes
    - Therefore, when building XML fragments at runtime it is easier to use single quote for the whole string literal

String's useful methods

- charAt – Returns the character at the specified index
- charCodeAt – Returns the Unicode value
- indexOf – Returns the position
- match – Matching a regular expression
- trim – Removes whitespaces from both sides
- split – Splits a string into an array of substrings
- More …

Undefined

- A special data type
- Has only one value named undefined
- The value undefined is important concept in JavaScript
- You may encounter it during several scenarios
  - Uninitialized variable
  - A function without a return value
  - A function parameter that was not specified by the caller
  - A non existent object property
  - A non initialized array index

Comparison Operators

- JavaScript has both strict and abstract comparisons
- A strict comparison is only true if the operands are the same type
- Abstract comparison converts the operands to the same type before making the comparison

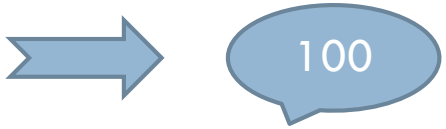
```
console.log(0 == false);
console.log(2 == "2");
console.log(undefined == null);
```

```
console.log(0 === false);
console.log(2 === "2");
console.log(undefined === null);
```

Data Type Conversion

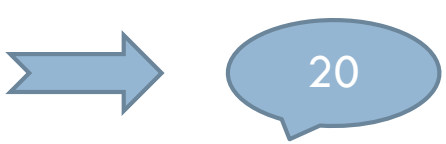
- Data types are converted automatically as needed during script execution
- Operator + may convert numeric values to strings

```
var num = 10;
alert(num + "0");
```



- Other operators may convert string values to numeric

```
var num = 10;
alert(num * "2");
```



Conversion Tricks

- Some JavaScript programmers use operators + and * to convert data types
- Convert string to number

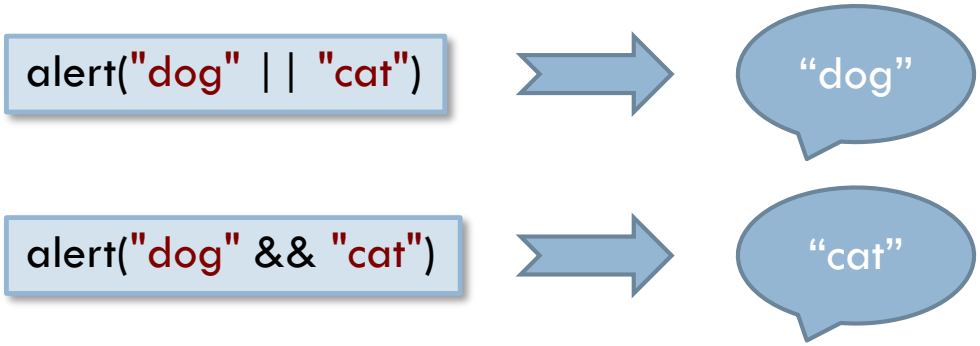
```
var str = document.getElementById("firstName").value;
if (isNaN(str * 1)) {
    alert("Please enter a number");
}
```

- Convert number to string

```
var num = 10;
console.log(num + "");
```

Logical Operators

- Typically used with Boolean values
  - In that case, they return a Boolean value
  - Behavior is consistent with other static programming languages (C++/Java/C#)
- May be used with non Boolean values
  - In that case, they return a non-Boolean value



Array

- Array is created using the following syntax
  - []
  - new Array

Preferred

```
var arr = [];
var arr = [1,2,3];
```

Less common

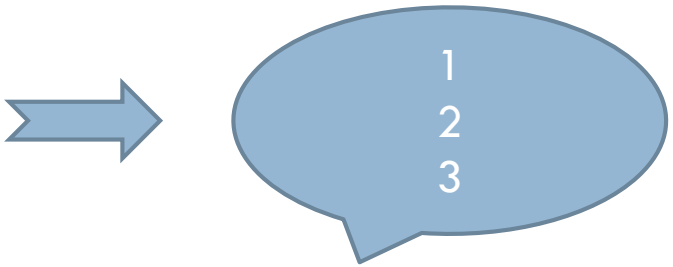
```
var arr = new Array();
var arr = new Array(10); // length is 10
var arr = new Array(10, 2); // length is 2
```

Iterating an Array

- Straight forward
- Use a running index and the length property

```
var arr = [1, 2, 3];

for (var i = 0; i < arr.length; i++) {
    console.log(arr[i]);
}
```



Array is dynamic

- New elements can be added/deleted at runtime
  - In contrast to static languages
- The property length is automatically being updated

```
var arr = [];
arr.push(10); // add last
arr.pop(); // remove last
arr.splice(arr.length-1, 1); // remove last
arr[10] = 10; // never throws an exception
arr.length = 2; // resize
arr.shift(); // remove first
arr.splice(0, 1); // remove first
```

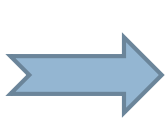
Useful Array's Methods

- concat - Joins two or more arrays, and returns a copy of the joined arrays
- indexOf - Search the array for an element and returns its position
- join - Joins all elements of an array into a string
- sort - Sorts the elements of an array
- toString - Converts an array to a string, and returns the result

Object

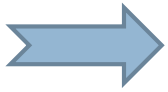
- A container of keys and values
- The key must be of type string
- Has built-in methods
- Creating empty object is easy

```
var obj = {};
alert(typeof obj);
```



Less common

```
var obj = new Object();
alert(typeof obj);
```



Initializing an Object

- An object can be initialized at declaration
- A.K.A object literal syntax (the basis for JSON)

```
var obj = {
    id: 123,
    name: "Udi",
    email: "udi@gmail.com"
};
```

Less common

```
var obj = {
    "id": 123,
    "name": "Udi",
    "email": "udi@gmail.com"
};
```

Object is dynamic

- Properties can be added/removed after creation

```
var obj = {};
obj.name = "Ori";
obj["name"] = "Ori";
```

- Removing a property

```
delete obj["name"];
delete obj.name;
```

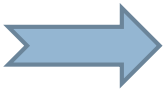
- Accessing non existent property yields the value undefined

Object Content

- The for…in statement allows you to iterate over all object's properties

```
var obj = {
    "id": 123,
    "name": "Roni",
    "email": "roni@gmail.com"
};

for (var key in obj) {
    var value = obj[key];
    console.log(key + " = " + value);
}
```



```
id = 123
name = roni
email = roni@gmail.com
```

Object's built-in methods

- hasOwnProperty - Returns a Boolean indicating whether an object contains the specified property as a direct property of that object and not inherited through the prototype chain
- toString - Returns a string representation of the object
- valueOf - Returns the primitive value of the specified object
- More …

Array is an Object

- You can act on a array is if it was an object (it is !)
- Not recommended
- What is the expected output?

```
var arr = [1, 2, 3];
arr.name = "Ori";

for (var i = 0; i < arr.length; i++) {
    console.log(arr[i]);
}

for (var key in arr) {
    console.log(arr[key]);
}
```

Function

- More than just a method …
  - The basic for advanced JavaScript techniques
- Declaring a function

```
function add(num1, num2) {
    return num1 + num2;
}
```

- Calling a function is also straightforward

```
var res = add(num1, num2);
```

Pass by value

- JavaScript only supports “pass by value” mechanism
- The parameter being sent to a function is copied
  - Whether it is a reference or a value

```
var str = "ABC";

function modify(str) {
    str = "XXX";
}

console.log(str);
```

Where to declare variables ?

- A variable is accessibly inside its surrounding function
- Even before point of declaration
- Therefore many JavaScript programmers declare all variables at the beginning of the method

```
var num = 11;

function doSomething() {
    console.log(num);
    var num = 10;
}

doSomething();
```

Overloading

- JavaScript does not support Overloading
- Last method wins
- You can simulate it

```
var ERR = "ERR";
var WRN = "WRN";
var MSG = "MSG";

function log(type, message) {
    if (message == undefined) {
        message = type;
        type = MSG;
    }

    console.log(type + " " + message);
}
```

```
log(ERR, "Internal Error");
log("Connecting to server");
```

Function – The Dark Side

- A function is an object

```
function f() {
    var num = 10;
}

f.num = 10;
```

- Has built-in properties and methods

```
function f(input) {
    console.log(f.name); // the name of the method
    console.log(f.length); // number of parameters
    console.log(f.toString()); //function source code
    console.log(f.arguments); // available only during execution
    console.log(f.caller.name); // available only during execution
}
```

Function – Indirect Invocation

- A function can be invoked using special syntax

```
function f(name) {
    console.log("Hello " + name);
}

f.call({}, "Ori");
f.apply({}, ["Ori"]);
```

- Although not intuitive, above syntax is quite common
- Mainly, when doing Object Oriented JavaScript

Function creates a Scope

- Function creates a new scope which is isolated from outer scope
- Outer scope cannot access local variables of a function

```
var num = 20;

function f() {
    var num = 10;

    console.log(num); // yields 10
}

f();

console.log(f.num); // yields undefined
```

Closure

- Inner function may access the local variables of the outer function
  - Even after outer function completes execution
- Allows us to simulate stateful function

```
function getCounter() {
    var num = 0;
    function f() {
        ++num;
        console.log("Num is " + num);
    }
    return f;
}
```

```
var counter = getCounter();
counter();
counter();
```

Function inside an Object

- An object can contain functions

```
var obj = {
    id: 123,
    dump: function() {
        console.log("dumping: " + this.id);
    }
};

obj.dump();
```

- Feels like OOP
- The keyword this is used for accessing other properties (see next slide)

The this keyword

- Available only inside a function
- Points to the object that this function is being invoked on

```
var obj = {
    id: 123,
    dump: function() {
        console.log(this.id);
    }
};

obj.dump();
```

- Global function points to the window object

Apply & Call - Recap

- You can control the value of this using apply and call methods

```
var obj = {
    id: 123
};

function dump() {
    console.log(this.id);
}

dump.call(obj);
```

Self Executing Function

- A function can declared without a name
- Since no name exist no one can invoked it
- Except the code that declared it
- A.K.A self executing function

```
(function () {
    //  External code has no access to these variables
    var url = "http://www.google.com";
    var productKey = "ABC";
})();
```

Sending Parameters

- Think about the $ sign
- Usually it points to jQuery global object
- But how can we ensure that?
  - There might be a case were additional 3rd party library overrides it

```
(function ($) {
    $.ajax({
        url: "www.google.com",
        type: "GET",
    });
})(jQuery);
```

Module Pattern

- Arrange your JavaScript code into modules
- Each module is surrounded with self executing function thus hiding all local variables and functions
- Peek the ones that should be public (sparsely)

```
var Server = (function () {
    var baseUrl = "http://www.google.com";

    function httpGet(relativeUrl) {
        $.ajax(…);
    }

    return {
        httpGet: httpGet,
    };
})();
```

Summary

- JavaScript is simple but powerful
  - Small amount of built-in types
  - Implicit conversion
  - No character data type
  - No integer data type
- Function is the basis for advanced JavaScript coding
- Arrange your code into modules