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Responsive web. JavaScript

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TABLE OF CONTENTS

01

Responsive web & responsive design

Responsive web - mobile vs desktop

- Initially, web was desktop-only and then desktop-orientated, mobile was an afterthought
- Mobile browsers used to rearrange web page flow to fit in on their screens
  - Not that bad but not great, browsers rendered the pages differently
  - Alternatives: special mobile sites which didn't need to be re-arranged (e.g. m.sofascore 🌭)
- Mobile phones started having "insane" resolutions, e.g. 5" phone was "Full HD" like 32" TV
  - Solution: **viewport** of those phones is smaller, **CSS pixel isn't the same as physical pixel**
- Add viewport tag: `<meta name="viewport" content="width=device-width, initial-scale=1.0">`
  - More: https://www.w3schools.com/css/css_rwd_viewport.asp
- Deeper explanation: Viewport vs Screen Resolution, DPR vs PPI

Accessible web basics

- Can user redefine font size on a website to make it more readable for them?
  - YES, on a browser level! But, the website needs to be implemented in a particular way
- Elements sizing: different CSS units - absolute and relative
  - px (pixel) - absolute - **CSS pixels**
  - em - font-size relative to parent font-size; width, etc. relative to the font-size of the element
  - rem - relative to font-size of the root element (mostly to html tag)
- If root element has relative font-size like 100%, then it reads browser settings

Accessible web - what to use?

- Sizing in px, font-size in px
  - Complex layouts like Sofascore web page
  - Because of that viewport tag, zooming-in pages makes them accessible
- Sizing in px, font-size in rem
  - Layout is fixed, content is browser-resizable
- Sizing in rem, font-size in rem
  - Accessible simplish layouts
  - Everything is browser-resizable
  - Also works for complex layouts, but it's a bit harder

Responsive design

CSS Media

- Responsive design - page must look good on a large number of different devices
  - To consider different device capabilities - resolution, orientation, speed
  - Possibly different style rules by group
- Two strategies:
  - Progressive enhancement - “mobile first” - start with smaller screens and then handle wider devices
  - Graceful degradation - start with the best and largest devices, then handle all the problems

Responsive design

CSS Media

- Media queries - CSS checks for device capabilities
  - @media screen and (min-width: 400px) { ...will apply styles only on screens wider than 400px }
  - Much more than just screen size, e.g. @media (pointer: coarse|fine) {...} - link to docs
- Using viewport width and height in CSS: 100vh and 100vw - full viewport width and height
  - Great for desktop, a bit messy on mobile 😔
    - Problem: each browser handles disappearing toolbars and menus differently

Responsive design

CSS Media Breakpoints

- Media queries are usually not set at random screen sizes, but on few standardized values called media breakpoints
  - Standardized per site/development team/framework, not industry-wide
  - Bootstrap breakpoints
- Sofascore supports devices from 320px upwards
  - Lower resolutions work, but don’t look particularly great
- We’ll talk more about responsive design later

Responsive design

CSS Math Functions

- CSS supports 4 Math functions as values: calc, min, max, clamp
  - Practical Uses of CSS Math Functions: calc, clamp, min, max
  - e.g. setting main's min-height: calc(100vh - 30px)
    - We have a 30px header and the rest of the viewport should have content
  - Allows to dynamically calculate some value directly in CSS
    - Plain CSS is often faster than JS

02

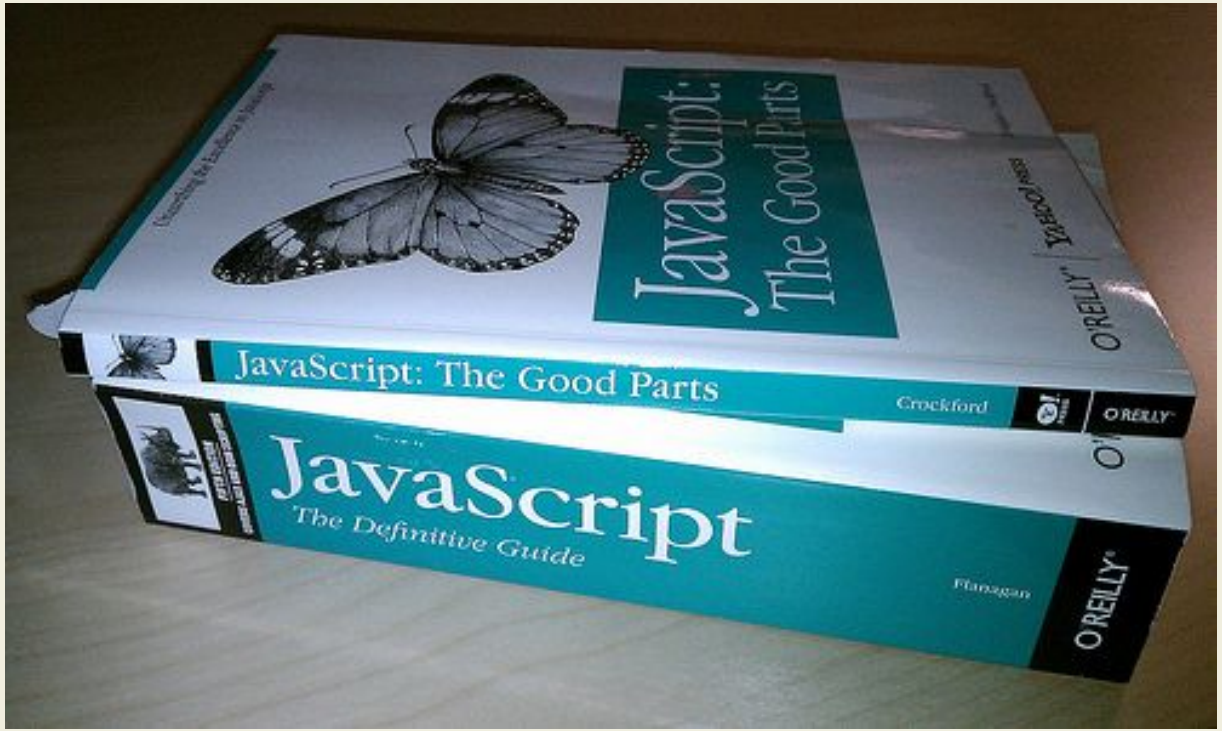
Javascript - Introduction and history

Literature

- Kyle Simpson: You don't know JS
- Douglas Crockford: JavaScript: The Good Parts

- “Java is to JavaScript as ham is to hamster” - Jeremy Keith, 2009

Literature


JavaScript: The Good Parts
Crockford
O'REILLY
JavaScript
The Definitive Guide
Flanagan
O'REILLY

Introduction

- Multi-paradigm language (Procedural, Object-Oriented, Functional)
  - Choice is on a programmer, the mix of concepts from multiple paradigms
- Backward compatible (not forward compatible)
  - Backward compatible -> old code can run on newer versions
  - We achieve forward compatibility in browser by transpiling new code for older browsers and using polyfills
- Implementation of the ECMAScript standard (TC39 Committee)
- Core technology of the Web

History

- 1994
  - Web pages are booming, Netscape Navigator is the most popular web browser
  - Pages are static, people want dynamic pages
- 1995
  - Companies tried embedding Java into browsers -> FAIL
  - Brendan Eich created LiveScript
  - LiveScript shipped as JavaScript in Netscape Navigator -> SUCCESS
  - Microsoft IE uses JScript -> reverse engineered JavaScript with all the quirks

History - rest

- ECMA standardization (1996.)
- Microsoft IE has 95% market cap -> standardized bugs from JScript
- Major improvements:
  - ECMA2009 (ES5)
  - ECMA2015 (ES6)

JavaScript engine

- Key part of a browser
- Runs JavaScript code
  - Compiles - JIT compiler
  - Optimizes
- V8 (Chrome & Node & Edge), SpiderMonkey (Firefox), Nitro (Safari)
  - All implement official specifications, but there may be differences in undefined behaviour

03

Syntax, objects and functions

JavaScript Basics

- C like syntax (if, switch, while)
  - Dynamically typed
- Types (typeof operator):
  - Primitive: number, boolean, string, undefined
  - Complex: object, null, function
- Variables:
  - var - function scope, reassignable
  - let - block scope, reassignable
  - const - block scope, cannot be reassigned
- Semicolons - it’s complicated
  - At Sofascore, we prefer not to use them

Hello world example - helloWorld.js

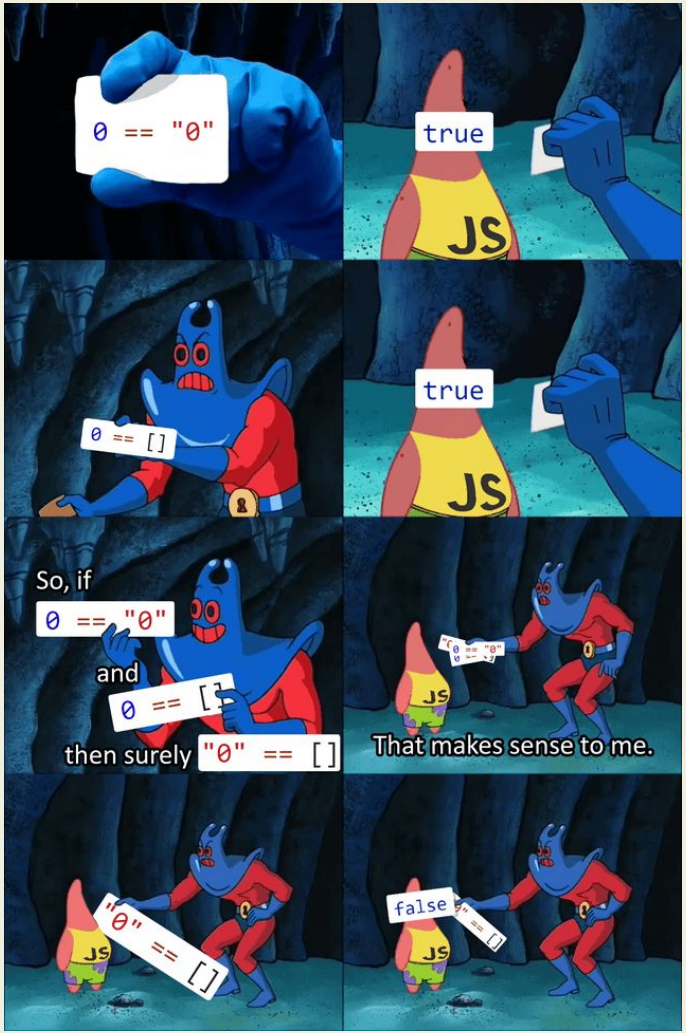
Semicolons example - asi.js

Types example - types.js

Type Coercion

- Process of converting a value from one type to another
- Happens implicitly during comparison using ==
  - Implemented that way in initial version to make life easier for developers
- Comparison using === was added later
- **Always use triple equal**
  - Or at least be certain that double equal works

Type Coercion



Explanation

Plus operator

- Used for:
  - Concatenating strings
  - Adding numbers
- If arguments are number and string -> coerce number to a string

```
2 + 4 // 6
'Sofa' + 'score' // Sofascore
2 + 4 + 'score' // 6score
'Sofa' + 2 + 4 // Sofa24
```

Objects

- Most important structure in JavaScript
  - Collection of named values
  - Values can be of any type (even function)
    - Functions can be stored in variables
- **MUTABLE**
  - Adding or changing the property of an object doesn't change object (its reference stays the same) -> IMPORTANT for React (how state updates and why props changing is bad)
- Creation:
  - new Object
  - Object.create
  - { foo: 'bar' } -> most used

This

- Reference to an object it belongs to
- Used in functions, to access properties of an owner (similar to Java)
  - Java methods have this as a reference to an instance on which method is called
  - In JavaScript, functions have this
    - If global function is called (without owner), this refers to the global object (window, global)
  - Try to play with whatIsThis.js example
- Making your code dependent on value of global *this* can lead to bugs, we rarely use it in modern React (modern React is mostly functional components)

Functions

- Can be pictured as Object
  - can have properties and methods, even have object prototype (e.g. console.log instanceof Object is true)
- Function Declaration
  - function doSomething() { ... }
- Function Expression
  - const doSomething = function() { ... }
- Arrow functions
  - const return2024 = () => 2024
  - function and return can be avoided
  - no this

Function arguments example - functionArgs.js

04

Prototype inheritance, closure and classes

Prototype inheritance

- Mechanism by which JS objects inherit features
- Prototype chain -> chain of prototypes for an object (all accessible)
    - Prototype chain -> list of inherited prototypes starting from more specific to more general. If an object doesn't have property or function then look in its prototype. If a more specific prototype doesn't contain searched property or function, go into the next, more generic prototype, ...
    - All prototypes end with object prototype -> "Object is the king in JavaScript"
    - instanceof operator tests if an object has some prototype in its chain (e.g. function is an instance of an object)
- Most OO languages -> class inheritance
- constructor method is called with new keyword

Prototype inheritance advantage over class inheritance

- Additional methods can be added to existing prototypes
  - e.g. we can add a method to Array prototype
  - This is how polyfills work
- Closest comparable language feature are *extension methods* in C#

Prototypes example - prototypes.js

Classes

- Classes are type of functions in JS
- Cleaner and more familiar syntax
  - constructor function
  - static methods
  - extends and super
- Classes are actually functions -> functions are objects -> all classes can be written as objects
- Class syntax is similar to other OO languages (Java)
- Classes can have getters and setters too (get and set keywords)

Classes example - classes.js

Hoisting

- Process of moving all **DECLARATIONS** to the top of a file
  - Declarations are hoisted (var x), not definitions (x = 'X')
- Hoisted:
  - Function declarations (function() {...})
  - var variables
- Not Hoisted:
  - Function expressions (const a = () => {})
  - const and let variables
  - classes

Hoisting example - hoisting.js

Closure

- Functions are bundled with references to the surrounding state (Lexical Environment)
- Inner function can access outer function scope **even after** outer function has finished its execution
- Makes encapsulation possible

Closure example - closure.js

05

JavaScript design

JavaScript Design

- Single-threaded -> no threading and standard parallelization for developers
  - Has only one thread, which is often called *Main thread*
- Concurrent
  - Based on *event loop*
  - one operation can progress without waiting for another operation to finish if the thread is available
  - (e.g. JS will not wait for an HTTP request to finish and JS will run next line of a script).
- Event loop -> collects, processes, executes sub-tasks (asynchronous code) and makes concurrency possible.
  - EXCELLENT TALK ABOUT EVENT LOOP

JavaScript Runtime

- Semantics that JavaScript engines implement and optimize
  - parts that should be implemented by JavaScript engines (e.g. V8)
- Defines how JavaScript should run
- Contains heap and call stack
  - as in other languages, a heap is used for memory allocation (e.g. this is where variables are stored, etc.)
  - stack stores information about active functions (it keeps track of the script flow)
- Call stack answers questions:
  - where is the script currently (which function)
  - where should the script return after the current function
  - what variables are currently in the scope

JavaScript design

Blocking

- Happens when some function on the call stack(main thread) is taking too long (> 200ms) to execute so others can't execute
- Direct consequence of the single-threaded runtime design
  - Only one thing can run at a time on a call stack
  - Others are blocked
- JavaScript handles blocking and non-blocking functions
- Developers should avoid blocking synchronous code whenever possible
  - BUT: Writing 100% non-blocking code is impossible
- Non-blocking code usually executes in "background" (it uses other browser resources - networking, I/O operations, ...) and calls the function with the result once it has finished
  - These functions are called **callbacks**.

Blocking code example - blocking.html, nonBlocking.js

Thank you for your attention!

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