



# Why is mutability such a pain in JavaScript?

<https://jit.team>

front.jit (29.03.2023)

# Today's agenda

- Motivation and real-life examples
- Pros and cons of immutability
- How to handle immutability in JS



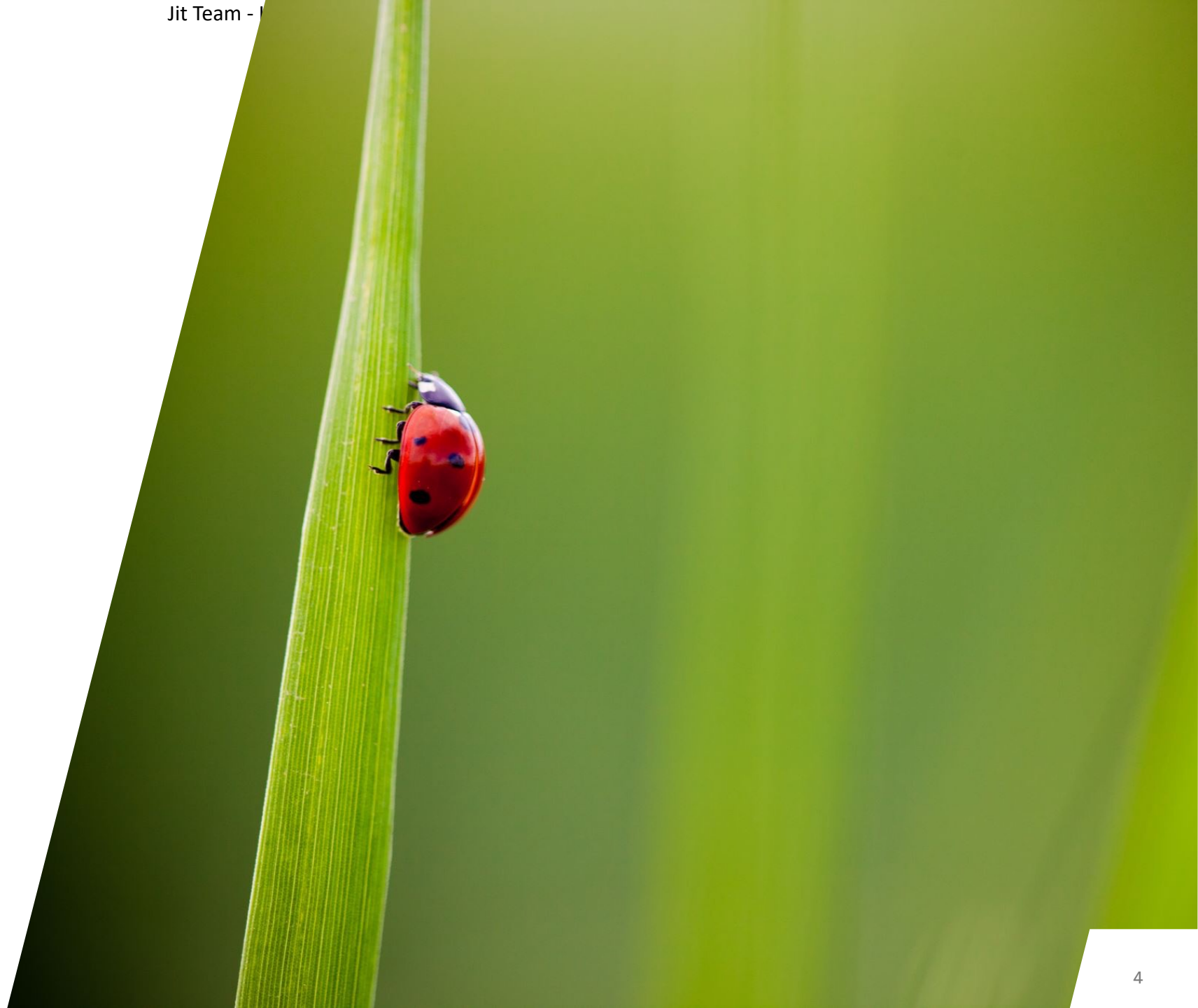
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- In Jit Team for 5 years 🤖
- Frontend (React/Next/Vue + 🎨)
- Mobile (🍏)
- Internal projects / mentoring 🎓 🎓
- Travel, drones, books, cars 🚀

# Motivation

- Bugs and hard debugging
- Discover problems quickly
- Ways to avoid accidental object mutations



# Example: Reference vs value equality

```
JS index.js x
1 const x = 10;
2 const y = 20;
3
4 var object1 = { x: 10, y: 20 };
5 var object2 = { x: 10, y: 20 };
6
7 // reference equality
8 console.log("object1 == object2", object1 == object2);
9 console.log("object1 === object2", object1 === object2);
10
11 // value equality
12 console.log("object1.x == x", object1.x == x);
13 console.log("object1.x === x", object1.x === x);
```

Console 0 Problems 3

Console was cleared

object1 == object2 false

object1 === object2 false

object1.x == x true

object1.x === x true

<https://codesandbox.io/s/js-reference-vs-value-equality-zb2rdt?file=/src/index.js>



# Example: Object mutation

```
1 document.querySelector("#app header").innerHTML = `  
2 <h1>JS - object mutation</h1>  
3 `;  
4  
5 const car = { manufacture: "VW" };  
6 const sameCar = car;  
7 const newCar = { ...car };  
8  
9 sameCar.manufacture = "BMW";  
10  
11 document.querySelector("#app section").innerHTML = `

12 Car: ${car.manufacture},  
13 Same car: ${sameCar.manufacture},  
14 New car: ${newCar.manufacture}  
15 </p>`;


```

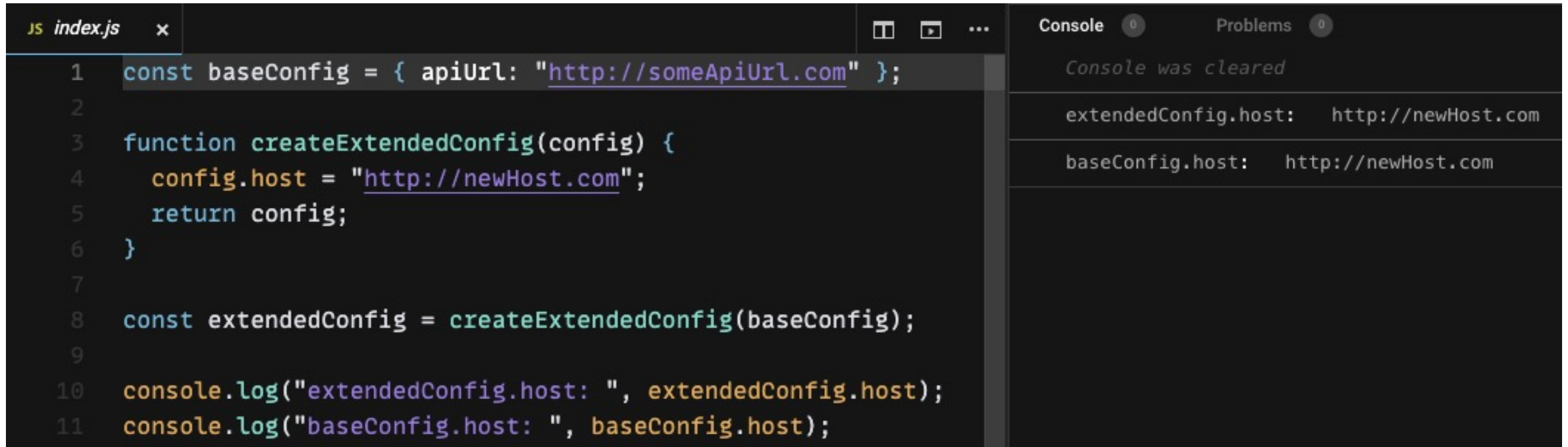
< > ↺ https://vcv37l.csb.app/

## JS - object mutation

Car: BMW, Same car: BMW, New car: VW

<https://codesandbox.io/s/js-object-mutation-vcv37l?file=/src/index.js>

# Example: Object mutation (from function)



The screenshot shows a code editor with a file named `index.js`. The code defines a base configuration object, a function to create an extended configuration, and then calls the function to create an extended configuration from the base. Finally, it logs both configurations to the console.

```
1 const baseConfig = { apiUrl: "http://someApiUrl.com" };
2
3 function createExtendedConfig(config) {
4   config.host = "http://newHost.com";
5   return config;
6 }
7
8 const extendedConfig = createExtendedConfig(baseConfig);
9
10 console.log("extendedConfig.host: ", extendedConfig.host);
11 console.log("baseConfig.host: ", baseConfig.host);
```

The console output shows the following messages:

```
Console 0 Problems 0
Console was cleared
extendedConfig.host: http://newHost.com
baseConfig.host: http://newHost.com
```

<https://codesandbox.io/s/js-object-mutation-from-function-k2uyen?file=/src/index.js>

# Example: Date object mutation

```
1 document.querySelector("#app header").innerHTML = `  
2 <h1>JS - date mutation</h1>  
3 `;  
4  
5 const date = new Date();  
6 const sameDate = date;  
7 const newDate = new Date(date);  
8  
9 sameDate.setFullYear(2100);  
10 newDate.setFullYear(3100);  
11  
12 document.querySelector("#app section").innerHTML = `

13 Year: ${date.getFullYear()},  
14 Same Year: ${sameDate.getFullYear()},  
15 New Year: ${newDate.getFullYear()}  
16 </p>`;


```



<https://codesandbox.io/s/js-date-mutation-mhkflp?file=/src/index.js>



# Pros & cons of immutability

- But before, what is data immutability?
- Simpler programming and debugging
- Immutable data is slower than mutable
- DOM rendering, database quering etc. is even much slower
- Being aware of working with reference and values data types
- Being aware of working with shallow and deep comparision
- It matters in "reactive" frameworks like React.js, Vue.js...

# How to handle immutability in JS

- Reduce the usage of mutative functions like **push**, **unshift** or **splice**
- Use shallow-copying functions like **map**, **filter** or **reduce**
- `const` vs `Object.freeze()` (runtime)
- **readonly** - Typescript modifier (compile-time only)
- Immer.js, immutable.js
- React: **useDeepCompare**, **shouldComponentUpdate** (memo)
- Pure Function
- Deep & shallow clone methods...

# Shallow clone methods

- Object.assign(), spread operator



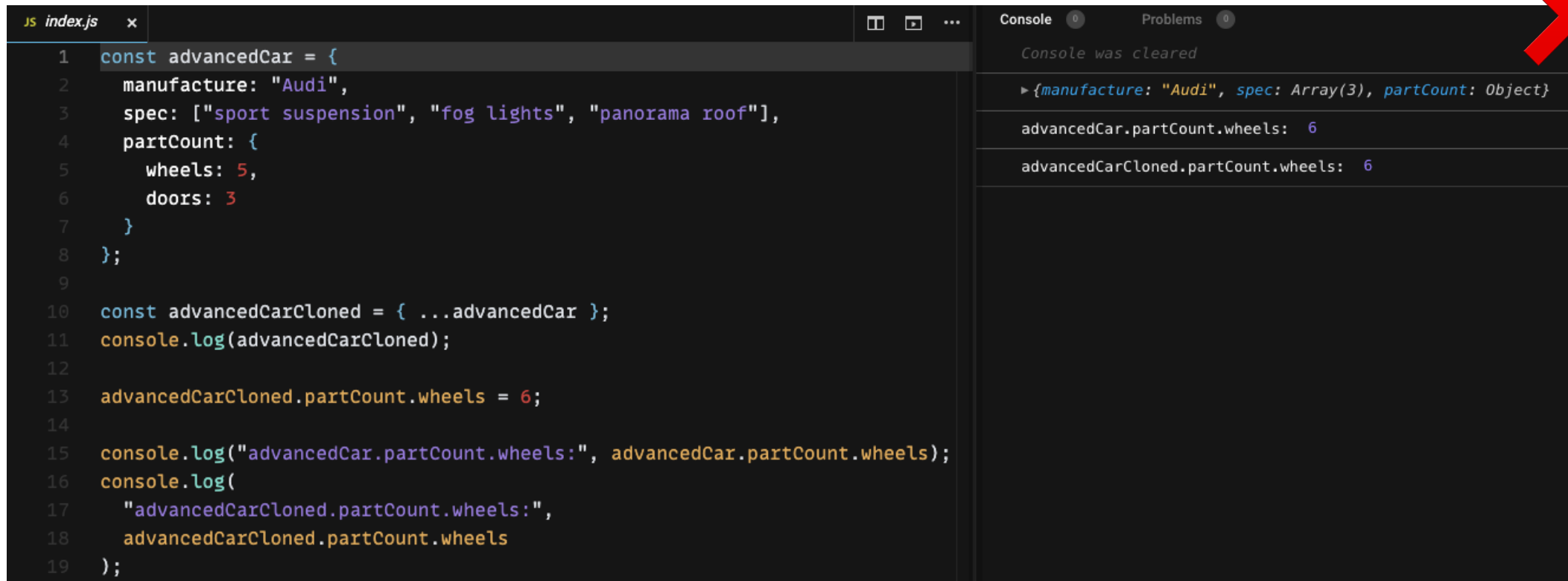
```
const game = {  
  title: "God of War",  
}  
// works fine since there is no nested object  
const gameCopy = {...game}
```



```
const game = {  
  title: "God of War",  
  date: new Date(2022),  
  genre: ["Action", "RPG"]  
}  
  
const gameCopy = {...game}  
  
gameCopy.genre.push("Fighting")  
  
gameCopy.date.setTime(2023)  
  
// game.genre will be the same array as gameCopy  
// game.date will be modified
```

# Shallow clone methods

- Object.assign(), spread operator



```
1 const advancedCar = {
2   manufacture: "Audi",
3   spec: ["sport suspension", "fog lights", "panorama roof"],
4   partCount: {
5     wheels: 5,
6     doors: 3
7   }
8 };
9
10 const advancedCarCloned = { ...advancedCar };
11 console.log(advancedCarCloned);
12
13 advancedCarCloned.partCount.wheels = 6;
14
15 console.log("advancedCar.partCount.wheels:", advancedCar.partCount.wheels);
16 console.log(
17   "advancedCarCloned.partCount.wheels:",
18   advancedCarCloned.partCount.wheels
19 );
```

Console

Console was cleared

► {manufacture: "Audi", spec: Array(3), partCount: Object}

advancedCar.partCount.wheels: 6

advancedCarCloned.partCount.wheels: 6

<https://codesandbox.io/s/js-shallow-merge-ow7jgq?file=/src/index.js>

# Shallow clone methods: JSON api

- JSON.stringify(), JSON.parse()
- Basic objects, arrays, primitives

```
let ingredients_list = ["noodles", { list: ["eggs", "flour", "water"] }];
let ingredients_list_deepcopy = JSON.parse(JSON.stringify(ingredients_list));

// Change the value of the 'list' property in ingredients_list_deepcopy.
ingredients_list_deepcopy[1].list = ["rice flour", "water"];
// The 'list' property does not change in ingredients_list.
console.log(ingredients_list[1].list);
// Array(3) [ "eggs", "flour", "water" ]
```



⚠ Functions, Symbols, objects that represent HTML, recursive data... cannot be serialized

# Shallow clone methods: JSON api

- JSON.stringify(), JSON.parse()
- Basic objects, arrays, primitives



```
const game = {
  title: "God of War",
  date: new Date(2022),
  genre: ["Action", "RPG"]
}

const gameCopy = Object.assign({}, game)

// {
//   "title": "God of War",
//   "date": "1970-01-01T00:00:02.022Z",
//   "genre": [
//     "Action",
//     "RPG"
//   ]
// }
```

⚠ Functions, Symbols, objects that represent HTML, recursive data... cannot be serialized



# Deep clone methods: structuredClone

- Original values to be transferred rather than cloned to the new object.
- It's browser (or Javascript runtime) feature rather than JavaScript language itself (window)

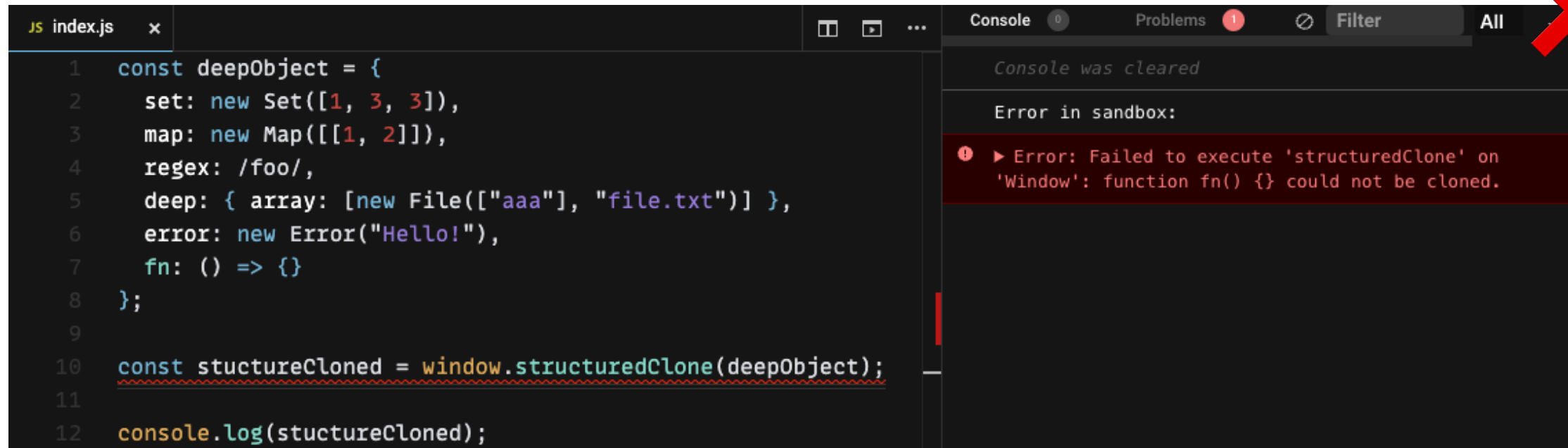


```
// Create an object with a value and a circular reference to itself.  
const original = { name: "MDN" };  
original.itself = original;  
  
// Clone it  
const clone = structuredClone(original);  
  
console.assert(clone !== original); // the objects are not the same (not same identity)  
console.assert(clone.name === "MDN"); // they do have the same values  
console.assert(clone.itself === clone); // and the circular reference is preserved
```

⚠ The same serialization issues like JSON.stringify()

# Deep clone methods: structuredClone

- Original values to be transferred rather than cloned to the new object.
- It's browser (or Javascript runtime) feature rather than JavaScript language itself (window)



The screenshot shows a code editor with a file named `index.js`. The code defines a `deepObject` with various properties including a `Set`, a `Map`, a `regex`, a nested object `deep` containing a `File` and an `Error`, and an arrow function `fn`. It then attempts to clone this object using `window.structuredClone(deepObject)` and logs the result. The console on the right shows an error: "Error in sandbox: Error: Failed to execute 'structuredClone' on 'Window': function fn() {} could not be cloned." A large red 'X' is drawn over the console area.

```
1 const deepObject = {
2   set: new Set([1, 3, 3]),
3   map: new Map([[1, 2]]),
4   regex: /foo/,
5   deep: { array: [new File(["aaa"], "file.txt")] },
6   error: new Error("Hello!"),
7   fn: () => {}
8 };
9
10 const stuctureCloned = window.structuredClone(deepObject);
11
12 console.log(stuctureCloned);
```

Console: 0 Problems: 1 Filter All

Console was cleared

Error in sandbox:


! Error: Failed to execute 'structuredClone' on 'Window': function fn() {} could not be cloned.

⚠ The same serialization issues like `JSON.stringify()`

<https://codesandbox.io/s/js-window-structuredclone-xkt0i7>

# Deep clone methods: external libraries

- Lodash (`_cloneDeep`), Ramda
- Structural sharing
- Bundle size



```
JS index.js x [Icons] ...  
1  const cloneDeep = require("lodash.clonedeep");  
2  
3  const deepObject = {  
4    set: new Set([1, 3, 3]),  
5    map: new Map([[1, 2]]),  
6    regex: /foo/,  
7    deep: { array: [new File(["aaa"], "file.txt")] },  
8    error: new Error("Hello!"),  
9    fn: () => {}  
10 };  
11  
12 const newDeepObject = cloneDeep(deepObject);  
13  
14 console.log(newDeepObject);
```

Console 0 Problems 0

Console was cleared

```
▼ {set: Set, map: Map, regex: /foo/  
  ▼ set: Set  
    0: 1  
    1: 3  
  ▼ map: Map  
    1: 2  
    regex: /foo/  
  ▼ deep: Object  
    ► array: Array(1)  
    error: ► Error: Hello!  
  ▼ fn: f fn() {}  
    ► <constructor>: "Function"
```

# Conclusions

- Bugs & debugging: Working with immutable data prevents the developers to avoid accidental changes
- Performance impact: DOM renders is much slower than using immutable data
- Shallow (vs. Deep) comparison is a better performant so it's a default solution for React, Redux etc.
- „Immutable libraries such as Immer can employ structural sharing, which effectively returns a new object that reuses much of the existing object being copied from”



# References

- [https://developer.mozilla.org/en-US/docs/Glossary/Shallow\\_copy](https://developer.mozilla.org/en-US/docs/Glossary/Shallow_copy)
- [https://developer.mozilla.org/en-US/docs/Glossary/Deep\\_copy](https://developer.mozilla.org/en-US/docs/Glossary/Deep_copy)
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- <https://blog.klipse.tech/javascript/2021/02/26/structural-sharing-in-javascript.html>
- <https://javascript.plainenglish.io/deep-clone-objects-the-right-way-in-javascript-a7ded9d23860>
- <https://monsterlessons-academy.com/posts/mutable-and-immutable-data-in-javascript>
- <https://www.builder.io/blog/structured-clone>