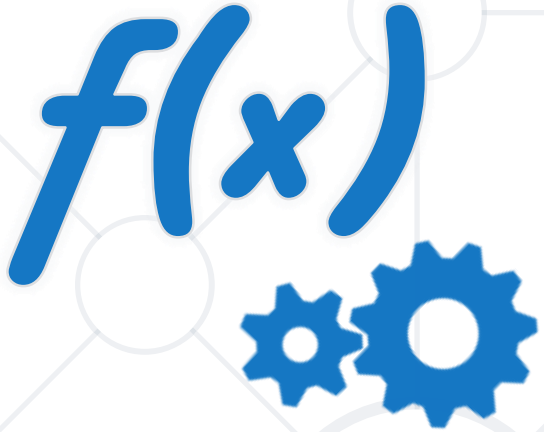
Advanced Functions

First-Class Functions, Function Expressions, IIFE, this, call, apply



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#JS-CORE

First Class Functions

Functions behaving like variables

First-Class Functions

A function can be passed as an **argument** to other function, can be **returned** by another function and can be **assigned** as a value to a variable.

- Assign a function to a **variable**

```
const write = function () {
  console.log("Hello, world!");
}

write();          // Hello, world!
```

First-Class Functions

- Pass a function as an **Argument**

```
function sayHello() {
  return "Hello, ";
}
function greeting (helloMessage, name) {
  console.log(helloMessage() + name);
}
greeting (sayHello, "JavaScript!");
//Hello, JavaScript!
```

Pass 'sayHello' as an argument to 'greeting' function

First-Class Functions

- Return a function

```
function sayHello() {
    return function() {
        console.log('Hello!');
    }
}
```

Higher-Order Functions

Take other **functions as argument** or **return a function** as result

```
const sayHello = function() {
  return function() {
     console.log("Hello!");
  }
}

const myFunc = sayHello();
myFunc();
//Hello!
```

Higher-Order Functions

The **filter()** method creates a new array with all elements that pass the test implemented by the provided function.

```
const words = ['JavaScript', 'programming', 'development', 'code'];

const result = words.filter(word => word.length > 6);

console.log(result);

// Expected output: Array["JavaScript", "programming", "development
```

Higher-Order Functions

The **map()** method creates a new array with the results of calling a provided function on every element in the calling array.

```
let arr = [4, 2, 1, 5];

const map1 = arr.map(x => x * 2);

console.log(map1);

//Expected output: Array [8, 4, 2, 10]
```

Higher-Order Functions

The **reduce()** method executes a **reducer** function on each member of the array resulting in a single output value.

```
const array1 = [1, 2, 3, 4];

const reducer = (acc, cur) => acc + cur;
// 1 + 2 + 3 + 4

console.log(array1.reduce(reducer));
// Expected output: 10

console.log([].reduce(reducer, 5));
// Expected output: 5
```

Problem: Aggregates

Write a JS program that uses a **reducer** function to **display** information about an **input array**.

```
2
3
10
5
```

```
Sum = 20
Min = 2
Max = 10
Product = 300
Join = 23105
```

```
5
-3
20
7
0.5
```

```
Sum = 29.5
Min = -3
Max = 20
Product = -1050
Join = 5-32070.5
```

Solution: Aggregates

```
function solution(arr) {
    console.log('Sum = ' + arr.reduce((a,b) => a + b));
    console.log('Min = ' + arr.reduce((a,b) => Math.min(a,b)));
    console.log('Max = ' + arr.reduce((a,b) => Math.max(a,b)));
    console.log('Product = ' + arr.reduce((a,b) => a * b));
    console.log('Join = ' + arr.reduce((a,b) => '' + a + b));
}
```

Check your solution here: https://judge.softuni.bg/Contests/1582

Currying

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Currying is the process of **breaking down** a function into a series of functions - each takes a **single** argument.

Takes three numbers as input

```
function sum3(a, b, c) {
    return a + b + c;
}
console.log(sum3(5,6,8);
// Expected output: 19
```

Takes one parameter and returns a function

```
function sum3(a) {
    return (b) => {
        return (c) => {
            return a + b + c;
        }
    }
}
console.log(sum3(5)(6)(8)); //19
```

Currying Usage

- **Function Composition** - Building new function from old function by passing arguments.
- **Memoization** - Functions that are called repeatedly with the same set of inputs but whose result is relatively expensive to produce.
- **Handle Errors** - Throwing functions and exiting immediately after an error.

Partial Application

- Converting a function with a **given number** of arguments into a function with **smaller number** of arguments
- Pass the **remaining parameters** when a final **result** is needed
  - The partially applied function can be **used multiple times**
- This helps write **reusable code** with **fewer bugs**

Set first parameter to 1

Same as increment operator (++)

```
f(x, y) = x + y
```

```
g(x) = f(1, x)
```

Currying vs Partial Application

- **Currying** always produces nested unary (1-ary) functions.
- **Partial** application produces functions of arbitrary number of arguments.
- Currying is **not** partial application. It can be implemented using partial application.

Problem: Currency Format

Your program will receive a function that **takes 4 parameters** and **returns** a formatted string.

Your task is to **return** another function that only takes **1 parameter** and returns the same formatted string.

```
let formatter = getDollarFormatter(formatCurrency);
formatter(5345); // $ 5345,00
```

Solution: Currency Format

- We take the initial **function as parameter**
- We **return a function** that takes only one parameter

```
function getDollarFormatter(formatter) {
  function dollarFormatter(value) {
      return formatter(',', '$', true, value);
  };
  return dollarFormatter;
}
```

Fix parameters

Return result of original function

Check your solution here: https://judge.softuni.bg/Contests/1582

Immediately-Invoked Function Expressions (IIFE)

What is IIFE?

Immediately-Invoked Function Expressions (IIFE)

- Define anonymous function expression
- Invoke it immediately after declaration

```
(function() { console.log("invoked!"); }());
```

```
(function() { console.log("invoked!"); })();
```

```
let iife = function() { console.log("invoked!"); }();
```

Functions Returning Functions

A **state** is preserved in the outer function, a.k.a. **closure**

```
let f = (function() {
  let counter = 0;
  return function() {
    console.log(++counter);
  }
})();
```

```
f(); // 1
f(); // 2
f(); // 3
f(); // 4
f(); // 5
f(); // 6
f(); // 7
```

Problem: Command Processor

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Write a JS program that keeps a string **inside it's context** and can execute different **commands** that modify or output the string on the console.

- **append(str)** - add **str** to the end of the internal string
- **removeStart(n)** - **remove** the **first n** characters from the string, **n** is an integer
- **removeEnd(n)** - **remove** the **last n** characters from the string, **n** is an integer
- **print** - **output** the stored string to the **console**

Solution: Command Processor

```
function solve(arr) {
    let closure = (function () {
        let str = '';
        return {
            append: (s) => str += s,
            removeStart: (n) => str = str.substring(n),
            removeEnd: (n) => str = str.substring(0, str.length - n),
            print: () => console.log(str)
        }
})();                                   // Continue on the next slide…
```

Solution: Command Processor

- We loop through **all** elements in the array.
- **Execute** the closure with the current values.

```
for (let st of arr) {
        let [comm, value] = st.split(' ');
        closure[comm](value);
  }
}
```

Check your solution here: https://judge.softuni.bg/Contests/1582

Function "this" Context

this, call, apply, bind

What is Function Context?

The **function context** is the object that "**owns**" the currently executed code

- Function context == "**this**" object
- Depends on how the function is invoked
  - Global invoke: **func()**
  - **object.function()**
  - **domElement.event()**
  - Using **call()** / **apply()** / **bind()**

The Function Context

```
function f() {
  console.log(this);
}
f(); // Window ("this" is the global context)
```

```
function f() {
  'use strict';
  console.log(this);
}
f(); // undefined ("this" is missing)
```

The Function Context with Object

```
function func() {
  console.log(this);
}

let obj = {
  name: 'Peter',
  f: func
};

obj.f(); // Object {name: "Peter"}
```

The Function Context for Objects

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```
let obj = {
  name: 'Todor',
  getName: function () {
    return this.name;  // "this" refers to "obj"
  }
};
console.log(obj.getName()); // Todor
```

```
function Car() {
  console.log(this);
}
let car = new Car(); // Car {}
```

The Function Context with Inner Function

```
function outer() {
  console.log(this); // Object {name: "Peter"}
  function inner() {
    console.log(this); // Window
  }
  inner();
}
let obj = { name: 'Peter', f: outer }
obj.f();
```

The Function Context with Arrow Function

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```
function outer() {
  let inner = () => console.log(this);
  inner();
}
let obj = {
  name: 'Peter',
  f: outer
};
obj.f(); // Object {name: "Peter"}
```

The Function Context for DOM Events

```
<button onclick="alert(this)">Click Me</button>
// Shows "[object HtmlButtonElement]" when clicked
```

```
<button onclick="f(this)">Click Me</button>
function f(btn) { alert(btn); };
// Shows "[object HtmlButtonElement]" when clicked
```

```
<button onclick="f()">Click Me</button>
function f() { alert(this); };
// Shows "[object Window]" when clicked
```

Avoided by using **addEventListener**

Changing the Context: Call

```
let sharePersonalInfo = function (){
    console.log(`Hello, my name is ${this.name}`.);
    console.log(`I'm a ${this.profession}.`);
}

let firstPerson = {name: "Peter", profession: "Fisherman"};
let secondPerson = {name: "George", profession: "Astronaut"};

// Continue on the next slide…
```

Changing the Context: Call

```
sharePersonalInfo.call(firstPerson);
// Hello, my name is Peter.
// I'm a Fisherman.

sharePersonalInfo.call(secondPerson);
// Hello, my name is George.
// I'm a Astronaut.
```

Changing the Context: Apply

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```
let firstPerson = {
    name: "Peter",
    prof: "Fisherman",
    shareInfo: function() {
        console.log(`${this.name} work as ${this.prof}`);
    }
};
let secondPerson = {name: "George", prof: "Astronaut"};
firstPerson.shareInfo.apply(secondPerson);
// George work as Astronaut
```

Changing the Context: Bind

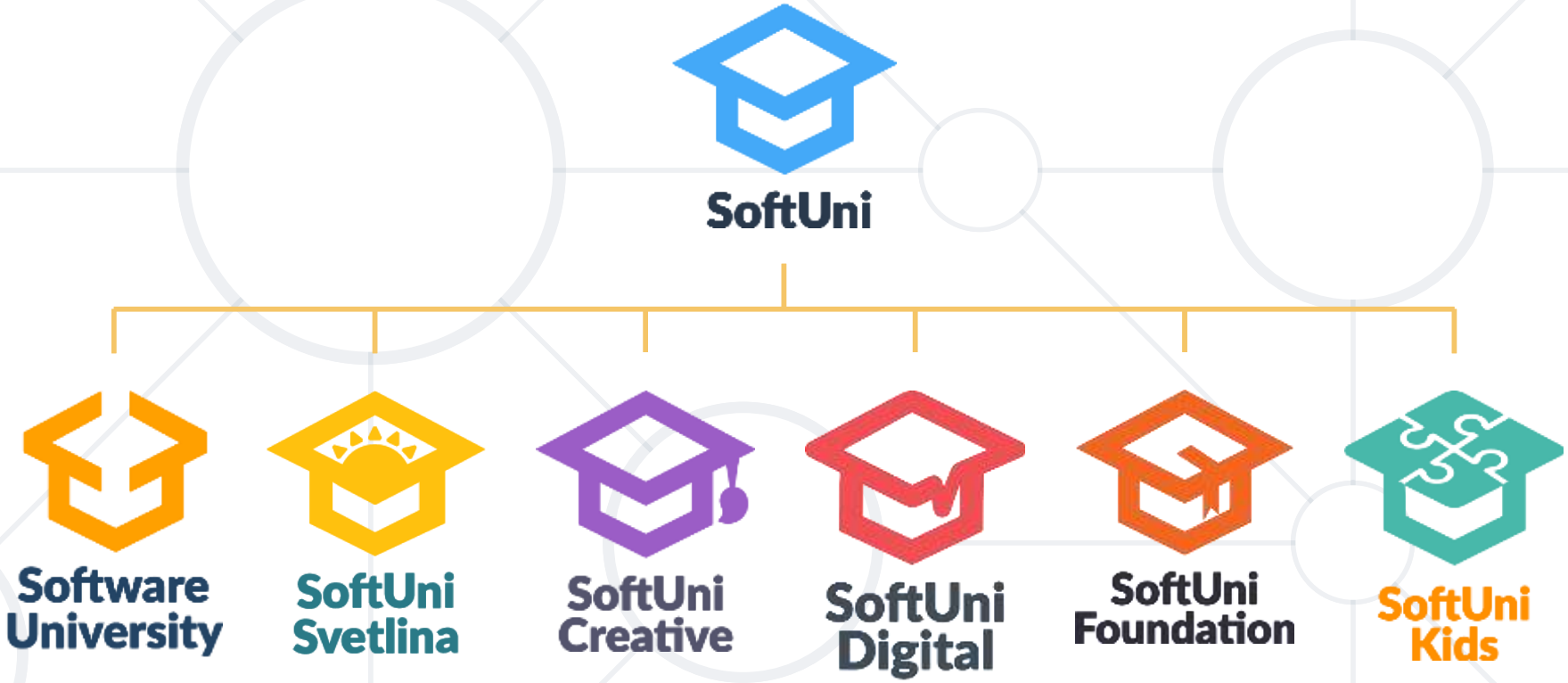
```
let module = {
  x: 42,
  getX: function() return this.x;
};
let unboundGetX = module.getX;
console.log(unboundGetX()); // undefined

let boundGetX = unboundGetX.bind(module);
console.log(boundGetX()); // 42
```

Live Exercises

Summary

- In JS, functions are objects (**first-class functions**)
- **IIFE** is immediately-invoked anonymous function
  - **Encapsulates** JS code + data (state)
- The **function context** "**this**" depends on how the function is invoked
  - Through object, as event-handler, inner function

Questions?



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