

Lecture 8: ECMAScript 2015 (ES6)



Building Modern Web Applications – CPEN400A

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What is ES6?

1. **What is ES6?**
2. Object-oriented Programming
3. Functional Programming



What is ES6?

- JavaScript specifications are maintained by an international organization - ECMA International
 - ECMA-262 & ISO/IEC-22275
 - ECMAScript is a **living and evolving standard**
 - Goal is to **standardize JS**, as different browser vendors implement different versions: JavaScript, JScript, ActionScript, etc.
 - Current latest edition (as of 2019) is ES10
 - ES5 has been the longest serving standard and still the most prevalent
 - ES6 has gained a lot of momentum and becoming mainstream



ES5 vs ES6

- ES5 still has quirks that create confusion among users
 - Prototypal inheritance
 - Semantics of keywords like: `var`, `this`
- ES6 introduces many useful features
 - Syntactic sugar for commonly used code patterns
 - Better support for object-oriented programming
 - Better support for functional programming
- Good coverage of ES6 features can be found at:
 - <http://es6-features.org>
 - <https://github.com/lukehoban/es6features>
- In this class we will focus on a subset of the ES6 features



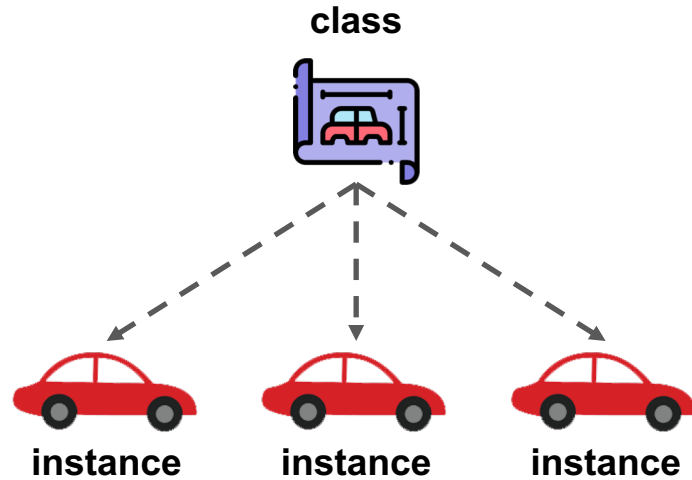
Object-oriented Programming

1. What is ES6?
- 2. Object-oriented Programming**
3. Functional Programming

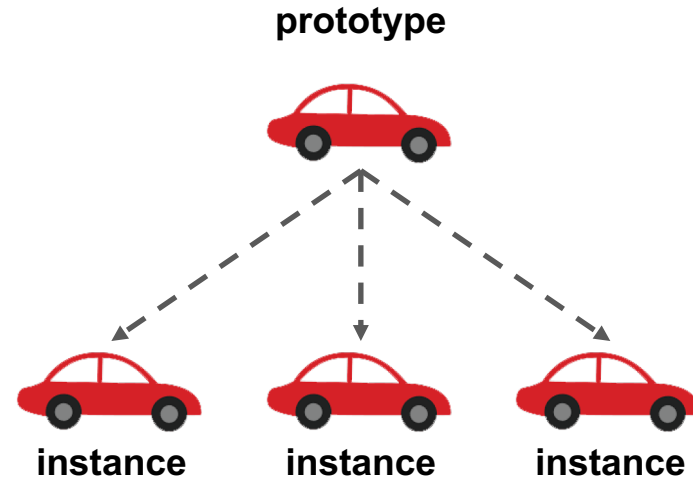


Object-oriented Programming

Object-oriented



Prototypal



Object-oriented Programming

- JavaScript is still prototypal at its core
- Prototypes can emulate OOP patterns
 - However, it is syntactically and semantically different
- ES6 introduces the `class` keyword to support OOP



Object-oriented Programming

New keywords introduced in this chapter

- `class` : ES6 keyword for declaring a Class
- `constructor` : for defining the constructor function for a class
- `extends` : ES6 keyword for extending/inheriting from a Class
- `super` : ES6 keyword for referencing the superclass



Object-oriented Programming

Object-oriented

```
1 class Car {  
2     constructor (name, power=1){  
3         this.name = name;  
4         this.power = power;  
5         this.velocity = 0;  
6     }  
7     accelerate (fuel){  
8         this.velocity  
9         += fuel * this.power;  
10    }  
11 }  
12 var myCar = new Car("Smart");  
13 myCar.accelerate(10);  
14
```

Prototypal



Object-oriented Programming

Object-oriented

```
1 class Car {
2   constructor (name, power=1){
3     this.name = name;
4     this.power = power;
5     this.velocity = 0;
6   }
7   accelerate (fuel){
8     this.velocity
9       += fuel * this.power;
10  }
11 }
12 var myCar = new Car("Smart");
13 myCar.accelerate(10);
14
```

Prototypal

```
1 function Car (name, power=1){
2   this.name = name;
3   this.power = power;
4   this.velocity = 0;
5 };
6 Car.prototype.accelerate
7   = function(fuel){
8     this.velocity
9       += fuel * this.power;
10  };
11
12 var myCar = new Car("Smart");
13 myCar.accelerate(10);
14
```



Class Activity: Defining a Class



[lectures/lecture-8/activity1.js](https://github.com/lectures/lecture-8/activity1.js)

- Define a class named “Thing” and implement the following:
 - The constructor accepts a single argument `id`, and initializes 2 instance properties `id` and `live`. The property `id` is set to the argument `id` and `live` is set to `false`
 - `printStatus` method, printing in the format “{id} [on|off]” using `console.log`
 - `powerOn` method, setting `live` property to `true`
 - `powerOff` method, setting `live` property to `false`



```
1 class Thing {
2   // To implement
3 }
4
5 var thing = new Thing("thing-0");
6 thing.printStatus();    // prints: thing-0 (off)
7 thing.powerOn();
8 thing.printStatus();    // prints: thing-0 (on)
```

Object-oriented Programming

extends and super keyword

```
1 class RacingCar extends Car {  
2     constructor (name){  
3         super(name, 3.5);  
4     }  
5  
6     turbo (fuel){  
7         this.velocity += fuel * this.power * 1.5;  
8     }  
9  
10 }  
11  
12  
13  
14
```



Object-oriented Programming

extends and super keyword

```
1 class RacingCar extends Car {  
2     constructor (name){  
3         super(name, 3.5);  
4     }  
5  
6     turbo (fuel){  
7         this.velocity += fuel * this.power * 1.5;  
8     }  
9  
10 }  
11  
12 var superCar = new RacingCar("F1");  
13 superCar.accelerate(10);  
14 superCar.turbo(5);
```



Class Activity: Inheritance



[lectures/lecture-8/activity2.js](https://github.com/lectures/lecture-8/activity2.js)



- Implement the classes `Sensor` and `Actuator`, which inherits from the `Thing` class from the previous activity
 - `Sensor` and `Actuator` should, in addition to calling the superclass constructor, initialize a property `value` to `null`
 - `Sensor` should have its own method `readValue`. If `live` is `true`, it should set the `value` property to a random value and return it. Else, it should return `null`
 - `Actuator` should have its own method `writeValue`, taking in a single argument `val`. If `live` is `true`, it should set the `value` property to `val`. Else, it should do nothing
 - Override the `printStatus` method as below:
 - For `Sensors`, it should print in the format “`{id} [on|off] -> {value}`”
 - For `Actuators`, it should print in the format “`{id} [on|off] <- {value}`”

Functional Programming

1. What is ES6?
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Functional Programming

- JavaScript supports functional programming
- When used appropriately, **functions** can implement pure functions
 - Except it is not actually a pure function
 - Keywords like **this**, **arguments** make JavaScript functions impure
- ES6 introduces **arrow functions** to support real functional programming



Functional Programming

- Arrow functions are **not replacements** for ES5 functions
- Arrow functions are **anonymous functions**
- `this` and `arguments` inside arrow functions are lexically bound



Functional Programming

- Arrow functions are **not replacements** for ES5 functions
- Arrow functions are **anonymous functions**
- `this` and `arguments` inside arrow functions are lexically bound



Syntax Example:

```
1 (radius, height) => {  
2   return radius * radius * Math.PI * height;  
3 }  
4  
5 (radius, height) => (radius * radius * Math.PI * height);
```

Functional Programming



- Pure functions

- Always returns the same value given the same arguments
- Have no side effects like mutating an external object (e.g., I/O, network resource, variables outside of its scope)
- Examples:
 - area of circle, distance between 2 points in 3-dimensional space

- Impure functions

- Might depend on an external context
- Might change an external object
- Examples:
 - `Date.now()`
 - `console.log()`

Functional Programming

Regular ES5 Function

```
1 var f = function (g, x, y){  
2   var gx = g(x);  
3   var gy = g(y);  
4   var result = gx + gy;  
5   return result;  
6 }
```

ES6 Arrow Function

```
1 var f = (g, x, y)=> {  
2   var gx = g(x);  
3   var gy = g(y);  
4   var result = gx + gy;  
5   return result;  
6 };
```



Functional Programming

Regular ES5 Function

```
1 var f = function (g, x, y){  
2   return g(x) + g(y);  
3 }  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14
```

ES6 Arrow Function

```
1 var f = (g, x, y) => (g(x) + g(y));  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14
```



Functional Programming

Regular ES5 Function

```
1 var u = function(f){  
2   return function(x){  
3     return f(x, u(f));  
4   }  
5 }
```

ES6 Arrow Function

```
1 var u = f=> x=> f(x, u(f));  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14
```



Class Activity: Rewriting Code with Arrow Functions



[lectures/lecture-8/activity3.js](#)



```
1  var fib = function(n){  
2    if (n > 1) return fib(n-1) + fib(n-2);  
3    else return 1;  
4  }  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14
```

Class Activity: Rewriting Code with Arrow Functions

Solution



[lectures/lecture-6/activity3.js](https://github.com/UBC-CS/lectures/lecture-6/activity3.js)



```
1  var fib = function(n){
2      if (n > 1) return fib(n-1) + fib(n-2);
3      else return 1;
4  }
5
6  var fib = n=> (n > 1 ? fib(n-1) + fib(n-2) : 1);
7
8
9
10
11
12
13
14
```


Functional Programming

- Arrow Function usage scenario

```
1  class Timer {  
2    constructor () {  
3      this.seconds = 0;  
4      this.reference = null;  
5    }  
6    start () {  
7      this.reference = setInterval(function() {  
8        this.seconds += 1;  
9      }, 1000);  
10   }  
11   stop () {  
12     clearInterval(this.reference);  
13   }  
14 }
```



Functional Programming

- Arrow Function usage scenario

```
1 class Timer {  
2   constructor () {  
3     this.seconds = 0;  
4     this.reference = null;  
5   }  
6   start () {  
7     var self = this;  
8     this.reference = setInterval(function () {  
9       self.seconds += 1;  
10    }, 1000);  
11  }  
12  stop () {  
13    clearInterval(this.reference);  
14  }  
15 }
```



Functional Programming

- Arrow Function usage scenario

```
1 class Timer {  
2   constructor () {  
3     this.seconds = 0;  
4     this.reference = null;  
5   }  
6   start () {  
7     this.reference = setInterval(() => {  
8       this.seconds += 1;  
9     }, 1000);  
10  }  
11  stop () {  
12    clearInterval(this.reference);  
13  }  
14 }
```



Class Activity: Rewriting Code with Arrow Functions

Find the problem in the following code and fix it



[lectures/lecture-6/activity4.js](https://github.com/lectures/lecture-6/activity4.js)



```
1 class User {  
2   constructor (username){  
3     this.id = username;  
4   }  
5  
6   readAllSensors (things){  
7     var mine = things.filter(function(thing){  
8       return (thing.owner === this.id && thing instanceof Sensor);  
9     });  
10    // ... more code  
11  }  
12 }  
13  
14
```

Class Activity: Rewriting Code with Arrow Functions

Solution

```
1 class User {  
2   constructor (username){  
3     this.id = username;  
4   }  
5  
6   readAllSensors (things){  
7     var mine = things.filter(thing =>  
8       (thing.owner === this.id && thing instanceof Sensor));  
9     // ... more code  
10  }  
11 }  
12  
13  
14
```



Functional Programming

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