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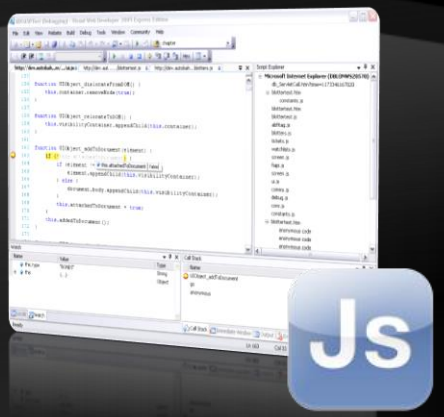

Classical OOP in JavaScript

The way of Object-oriented Ninja

Telerik Software Academy
Learning & Development Team
http://academy.telerik.com

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Object-oriented Design

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Object-oriented Programming

- OOP means that the application/program is constructed as a set of objects
  - Each object has its purpose
  - Each object can hold other objects
- JavaScript is prototype-oriented language
  - Uses prototypes to define its properties
  - Does not have definition for class or constructor
    - ECMAScript 1.6 introduces classes

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OOP in JavaScript

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OOP in JavaScript

- JavaScript is dynamic language
  - No such things as types and polymorphism
- JavaScript is also highly expressive language
  - Most things can be achieved in many ways
- That is why JavaScript has many ways to support OOP
  - Classical/Functional, Prototypal
  - Each has its advantages and drawbacks
  - Usage depends on the case

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Classical OOP

Classical OOP

- JavaScript uses functions to create objects
  - It has no definition for class or constructor
- Functions play the role of object constructors
  - Create/initiate object by calling the function with the "new" keyword

```
function Person(){}
var gosho = new Person(); //instance of Person
var maria = new Person(); //another instance of Person
```

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Creating Objects

- When using a function as an object constructor it is executed when called with new

```
function Person(){}
var personGosho = new Person(); //instance of Person
var personMaria = new Person(); //instance of Person
```

  - Each of the instances is independent
    - They have their own state and behavior
- Function constructors can take parameters to give instances different state

Creating Objects

- Function constructor with parameters
  - Just a regular function with parameters, invoked with new

```
function Person(name,age){
  console.log("Name: " + name + ", Age: " + age);
}
var personGosho = new Person("Georgi",23);
//logs:
//Name: Georgi, Age: 23
var personMaria = new Person("Maria",18);
//logs:
//Name: Maria, Age: 18
```

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Function Constructors

Live Demo

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Prototypes

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The prototype Object

- JavaScript is prototype-oriented programming language
  - Every object has a hidden property prototype
  - Its kind of its parent object
- Prototypes have properties available to all instances
  - The object type is the parent of all objects
    - Every object inherits object
    - All objects has `toString()` method

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The prototype Object (2)

- When adding properties to a prototype, all instances will have these properties

```
//adding a repeat method to the String type
String.prototype.repeat = function (count) {
  var str,
      pattern,
      i;
  pattern = String(this);
  if (!count) {
    return pattern;
  }
  str = '';
  for (i = 0; i < count; i += 1) {
    str += pattern;
  }
  return str;
};
```

The prototype Object (2)

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  return str;
};
```

Add method to all strings

The prototype Object (2)

- When adding properties to a prototype, all instances will have these properties

```
//adding a repeat method to the String type
String.prototype.repeat = function (count) {
  var str,
      pattern,
      i;
  pattern = String(this);
  if (!count) {
    return pattern;
  }
  str = '';
  for (i = 0; i < count; i += 1) {
    str += pattern;
  }
  return str;
};
```

Add method to all strings

Here this means the string

The prototype Object (2)

- When adding properties to a prototype, all instances will have these properties

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//adding a repeat method to the String type
String.prototype.repeat = function (count) {
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  }
  str = '';
  for (i = 0; i < count; i += 1) {
    str += pattern;
  }
  return str;
};
```

Add method to all strings

Here this means the string

```
//use it with:
'-'.repeat(25);
```

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Prototypes

Live Demo

Object Members

- Objects can also define custom state
  - Custom properties that only instances of this type have
- Use the keyword `this`
  - To attach properties to object

```
function Person(name,age){
  this.name = name;
  this.age = age;
}
var personMaria = new Person("Maria",18);
console.log(personMaria.name);
```

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Object Members (2)

- Property values can be either variables or functions
  - Functions are called methods

```
function Person(name,age){
  this.name = name;
  this.age = age;
  this.sayHello = function(){
    console.log("My name is " + this.name +
                " and I am " + this.age + "-years old");
  }
}
var maria = new Person("Maria",18);
maria.sayHello();
```

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Object Members

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Attaching Methods

- Attaching methods inside the object constructor is a tricky operation
  - Its is slow
  - Every object has a function with the same functionality, yet different instance
  - Having the function constructor

```
function Person(name, age){
  this.introduce = function(){
    return 'Name: ' + name +
           ', Age: ' + age;
  };
}
```

Attaching Methods

- Attaching methods inside the object constructor is a tricky operation
  - Its is slow
  - Every object has a function with the same functionality, yet different instance
  - Having the function constructor

```
function Person(name, age){
  this.introduce = function(){
    return 'Name: ' + name +
           ', Age: ' + age;
  };
}
```

And the code

```
var p1 = new Person();
var p2 = new Person();
console.log (p1 === p2);
```

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Attaching Methods

- Attaching methods inside the object constructor is a tricky operation
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function Person(name, age){
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  };
}
```

And the code

```
var p1 = new Person();
var p2 = new Person();
console.log (p1 === p2);
```

Logs 'false'

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Different Method Instances

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Better Method Attachment

- Instead of attaching the methods to this in the constructor

```
function Person(name,age){
  //…
  this.sayHello = function(){
    //…
  }
}
```

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Better Method Attachment

- Instead of attaching the methods to this in the constructor

```
function Person(name,age){
  //…
  this.sayHello = function(){
    //…
  }
}
```

- Attach them to the prototype of the constructor

```
function Person(name,age){
}
Person.prototype.sayHello =
          function(){
            //…
          }
```

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Better Method Attachment

- Instead of attaching the methods to this in the constructor

```
function Person(name,age){
  //…
  this.sayHello = function(){
    //…
  }
}
```

- Attach them to the prototype of the constructor

```
function Person(name,age){
}
Person.prototype.sayHello =
          function(){
            //…
          }
```

- And each method is created exactly once

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Attaching Methods to the Prototype

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Pros and Cons When Attaching Methods

- Attaching to this
- Attaching to prototype

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages ✓
- Attaching to prototype

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages ✓
- Attaching to prototype
  - Using JavaScript as it is meant ✓

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages ✓
- Attaching to prototype
  - Using JavaScript as it is meant ✓

JavaScript is NO other language

It should be treated like a first class language

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages ✓
  - Hidden data ✓
- Attaching to prototype
  - Using JavaScript as it is meant ✓

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages 
  - Hidden data 
- Attaching to prototype
  - Using JavaScript as it is meant 
  - No hidden data 

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages 
  - Hidden data 
- Attaching to prototype
  - Using JavaScript as it is meant 
  - No hidden data 

Hidden data is not such a big problem

Prefix "hidden" data with _(underscore) and be done with it

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages 
  - Hidden data 
  - Not good performance 
- Attaching to prototype
  - Using JavaScript as it is meant 
  - No hidden data 

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages 
  - Hidden data 
  - Not good performance 
- Attaching to prototype
  - Using JavaScript as it is meant 
  - No hidden data 
  - A way better performance 

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Pros and Cons When Attaching Methods

- Attaching to this
  - Code closer to other languages 
  - Hidden data 
  - Not good performance 
- Attaching to prototype
  - Using JavaScript as it is meant 
  - No hidden data 
  - A way better performance 

Performance is a big deal!

It should be taken into serious consideration

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The this Object

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The this Object

- this is a special kind of object
  - It is available everywhere in JavaScript
    - Yet it has a different meaning
- The this object can have two different values
  - The parent scope
    - The value of this of the containing scope
    - If none of the parents is object, its value is window
  - A concrete object
    - When using the new operator

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this in Function Scope

- When executed over a function, without the new operator
  - this refers to the parent scope

```
function Person(name) {
  this.name = name;
  this.getName = function getPersonName() {
    return this.name;
  }
}
var p = new Person("Gosho");
var getName = p.getName;
console.log(p.getName()); //Gosho
console.log(getName()); //undefined
```

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this in Function Scope

- When executed over a function, without the new operator
  - this refers to the parent scope

```
function Person(name) {
  this.name = name;
  this.getName = function getPersonName() {
    return this.name;
  }
}
var p = new Person("Gosho");
var getName = p.getName;
console.log(p.getName()); //Gosho
console.log(getName()); //undefined
```

Here this means the Person object

this in Function Scope

- When executed over a function, without the new operator
  - this refers to the parent scope

```
function Person(name) {
  this.name = name;
  this.getName = function getPersonName() {
    return this.name;
  }
}
var p = new Person("Gosho");
var getName = p.getName;
console.log(p.getName()); //Gosho
console.log(getName()); //undefined
```

Here this means the Person object

Here this means its parent scope (window)

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The this function object

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Function Constructors

- JavaScript cannot limit function to be used only as constructors
  - JavaScript was meant for a simple UI purposes

```
function Person(name) {
  var self = this;
  self.name = name;
  self.getName = function getPersonName() {
    return self.name;
  }
}
var p = Person("Peter");
```

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Function Constructors

- JavaScript cannot limit function to be used only as constructors
  - JavaScript was meant for a simple UI purposes

```
function Person(name) {
  var self = this;
  self.name = name;
  self.getName = function getPersonName() {
    return self.name;
  }
}
var p = Person("Peter");
```

What will be the value of `this`?

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Function Constructors (2)

- The only way to mark something as contructor is to name it PascalCase
  - And hope that the user of you code will be so nice to call PascalCase-named functions with new

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Invoking Function Constructors Without new

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Function Constructor Fix

- John Resig (jQuery) designed a simple way to check if the function is not used as constructor:

```
function Person(name, age) {
  if (!(this instanceof arguments.callee)) {
    return new Person(name, age);
  }
  this._name = name;
  this._age = age;
}
```

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Function Constructor Fix

- John Resig (jQuery) designed a simple way to check if the function is not used as constructor:

```
function Person(name, age) {
  if (!(this instanceof arguments.callee)) {
    return new Person(name, age);
  }
  this._name = name;
  this._age = age;
}
```

If this is not of type the function call the function with new

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John Resig Constructor Fix

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Function Constructors with Modules

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Constructors with Modules

- Function constructors can be put inside a module
  - Introduces a better abstraction of the code
  - Allows to hide constants and functions
- In JavaScript functions are first-class objects, so they can be easily returned by a module

```
var Person = (function () {
  function Person(name) {
    //…
  }
  Person.prototype.walk = function (distance){ /*...*/ };
  return Person;
}());
```

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Function Constructors with Modules

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Hidden functions

What to do when we want to hide something?

Hidden Funcitons

- When a function constructor is wrapped inside a module:
  - The module can contain hidden functions
  - The function constructor can use these hidden functions
- Yet, to use these functions as object methods, we should use `apply` or `call`

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Hidden Functions: Example

- Using hidden functions

```
var Rect = (function () {
  function validatePosition() {
    //…
  }
  function Rect(x, y, width, height) {
    var isPositionValid = validatePosition.call(this);
    if (!isPositionValid) {
      throw new Error('Invalid Rect position');
    }
  }

  Rect.prototype = { /* … */};
  return Rect;
}());
```

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Hidden Functions: Example

- Using hidden functions

```
var Rect = (function () {
  function validatePosition() {
    //…
  }
  function Rect(x, y, width, height) {
    var isPositionValid = validatePosition.call(this);
    if (!isPositionValid) {
      throw new Error('Invalid Rect position');
    }
  }

  Rect.prototype = { /* … */};
  return Rect;
}());
```

This is not exposed from the module

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Hidden Functions: Example

- Using hidden functions

```
var Rect = (function () {
  function validatePosition() {
    //…
  }
  function Rect(x, y, width, height) {
    var isPositionValid = validatePosition.call(this);
    if (!isPositionValid) {
      throw new Error('Invalid Rec
    }
  }

  Rect.prototype = { /* … */};
  return Rect;
}());
```

This is not exposed from the module

Use call() to invoke the function over this

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Hidden Functions

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Homework

1. Create a module for drawing shapes using Canvas. Implement the following shapes:
   - Rect, by given position (X, Y) and size (Width, Height)
   - Circle, by given center position (X, Y) and radius (R)
   - Line, by given from (X1, Y1) and to (X2, Y2) positions