OOP Using JavaScript

Some of the slides are based on JavaScript course from Telerik
http://downloads.academy.telerik.com/svn/school-academy/

Outline

- JavaScript OOP
  - Object Literal using JSON
  - Classical OOP
  - Prototype-oriented OOP
- Inheritance and Polymorphism

JavaScript OOP

Properties & Methods

JavaScript OOP

- JavaScript is designed on a simple object-based paradigm
  - An object is a collection of properties
- An object property is association between a name and a value
  - A value of property can be either a **variable** (e.g., a number or a string) or a **method** (function)
- Lots of predefined objects available in JS
  - Math, document, window, etc…
- Objects can be created by the developer

JS Objects

- Objects are containers for
  - Properties - Data
  - Methods - Behaviors
- In JS an object is a dynamic collection of properties
  - Every property has a key string that is unique within that object.
- Classes and objects can be altered during the execution of a program

OOP in JavaScript

JavaScript has 3 ways to create an objects:

- **Object Literal**: create an object using JSON
- **Classical OOP**: create a class then instantiate objects from the class
- **Prototype-oriented OOP**: create objects from other objects
  - Creates new copies of objects from an existing object (the **prototype**)
  - Code reuse done by **cloning**

e.g, `var fiona = Object.create(shrek);`

Object Literal using JSON

Create an Object Literal using JSON

```
var person = {
    firstName: 'Samir',
    lastName: 'Saghir',
    height: 54,
    name : function() {
      return this.firstName + ' ' + this.lastName;
    }
};

//Two ways to access the object properties
console.log(person['height'] === person.height);

console.log(person.name());
```

Creating an object using {} or new Object()

- Another way to create an object is to use the built-in **`Object`** data type or simply assigning **{}** to the variable

```
var joha = {}; //or new Object();
joha.name = "Juha Nasreddin";
joha.grade = 8;

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

Get, set and delete

- **get**

  object.name

  object[expression]

- **set**

  object.name = value;

  object[expression] = value;

- **delete**

  delete object.name

  delete object[expression]

JSON.stringify and JSON.parse

```
/* Serialise the object to a string in JSON
  format -- only attributes getr serialised */

var jsonString = JSON.stringify(person);
console.log(jsonString);


//Deserialise a JSON string to an object
//Create an object from a string!

var personObject = JSON.parse(jsonString);
console.log(personObject);
```

- More info https://developer.mozilla.org/en-US/docs/JSON

Classical OOP

Defining a Class with Constructors

- A new JavaScript class is defined by creating a function (serving as constructor)
  - Functions play the role of object constructors
  - Create/initiate object by calling the function with the "**new**" keyword
  - Function constructors can take parameters to give instances different state

```
function Student(name, grade)
{
    this.name = name;
    this.grade = grade;
}
var juha = new Student("Juha Nasreddin", 8);
var abbas = new Student("Abbas Ibn Firnas",9 );
var samir = new Student("Samir Saghir",6);
```

Class Members

- Use the keyword **this** to attach properties to object
- Property values can be either variables or functions (i.e., methods)
- **this** contains the instance of the object that is initialized with the function constructor

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

Here this means the Person object

this

- `this` is available everywhere where there is JavaScript
  - Yet it has a different meaning
- This can have two different values
  - **Global scope** (i.e. window)
    - When outside a object scope
  - **A concrete object**
    - When using the new operator

Prototype-oriented OOP

Prototypal OOP

- JavaScript is **prototype-oriented** programming language
- Prototypal Inheritance enables creating objects from other objects (instead of creating them from classes)
  - Instead of creating classes, you **make prototype objects**, and then use the **Object.create**(…) to make new instances that inherit form the prototype object
  - Customize the new objects by adding new properties and methods
- We don't need classes to make lots of similar objects. **Objects inherit from objects!**

Prototypal OOP

- Create an object template then 'clone it' into another object
  - Create an object from another object!

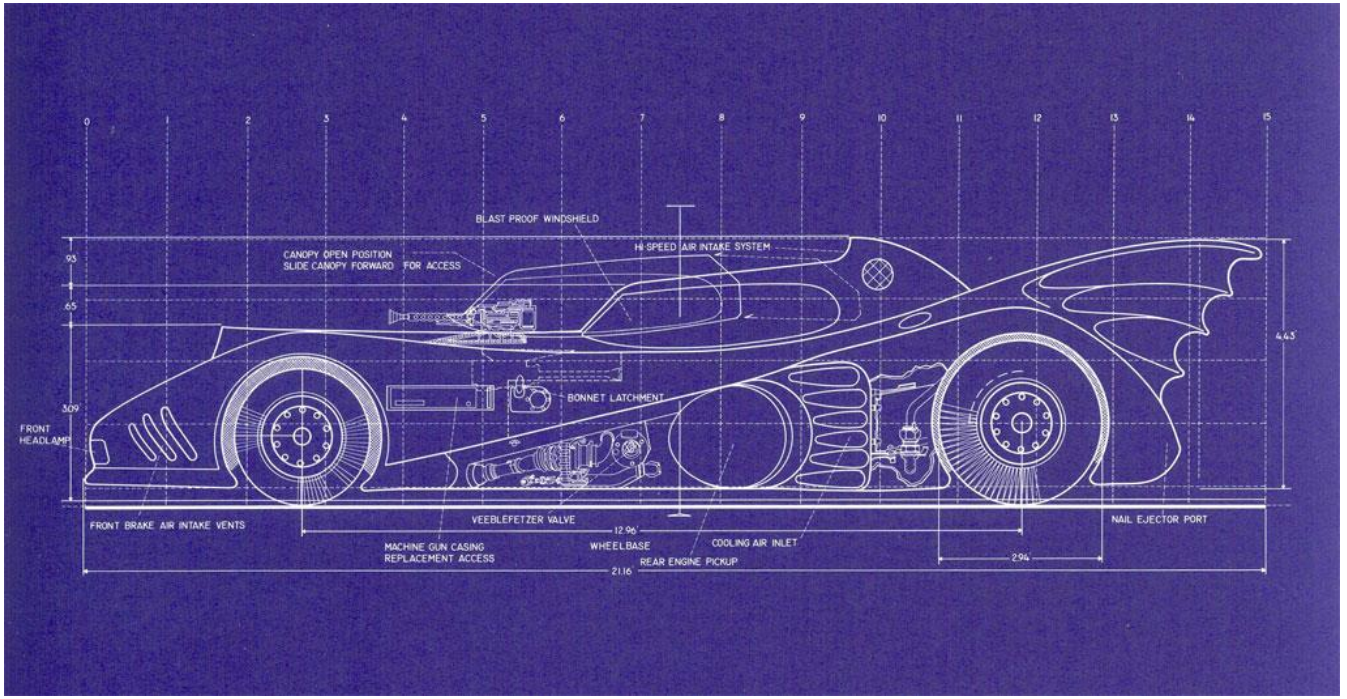
```
var Organism = Object.create(Object.prototype);
var Animal = Object.create(Organism);
var Mammal = Object.create(Animal);
var Dog = Object.create(Mammal);
var Spot = Object.create(Dog);

Dog.numLegs = 4;
Dog.speak = function() {
        return 'woof, woof!';
};
```

Demo @ http://www.youtube.com/watch?v=giJV6boOLxU

Inheritance and Polymorphism

Back



- Every object has a **prototype** property that allows you to add properties and methods to a class + it can be used to implement **inheritance**

Prototype is used to extend classes

- We can use the `prototype` object to add custom properties / methods to classes
  - That is reflected on all instances of the class
  - Simply reference the keyword **`prototype`** on the object before adding the custom property

See prototype-object.html

```
function Circle() {
}
Circle.prototype.pi = 3.14159;
Circle.prototype.radius = 5;
Circle.prototype.calculateArea = function () {
  return this.pi * this.radius * 2;
}
var circle = new Circle();
var area = circle.calculateArea();
alert(area);  // 31.4159
```

Using prototype object to Add Functionality to Build-in Classes

- Dynamically add a function to a built-in class at runtime using the **prototype** object:

```
//adding a method to arrays to sum their number elements
Array.prototype.sum = function(){
  var sum = 0;
  for(var i in this){
    if(typeof this[i] === "number"){
      sum += this[i];
    }
  }
  return sum;
}

var numbers = [1,2,3,4,5];
console.log(numbers.sum());   //logs 15
```

Attaching a method to the Array class

Here this means the array

Inheritance in Classical OOP

- Inheritance is a way to extend the functionality of an object, into another object
  - E.g., Student inherits Person
- In JavaScript Inheritance **is achieved by setting the prototype of the derived type to an instance of the super type**

```
function Person(fname, lname) {}
function Student(fname, lname, gpa) {}
Student.prototype = new Person();
```

- Now all instances of type Student are also of type Person and have Person functionality

```
var student = new Student("Abbas", "Ibn Firnas", 3.9);
```

Inheritance Example

- To inherit from a class in JavaScript you should set the **prototype** object of the subclass to an instance of the superclass:

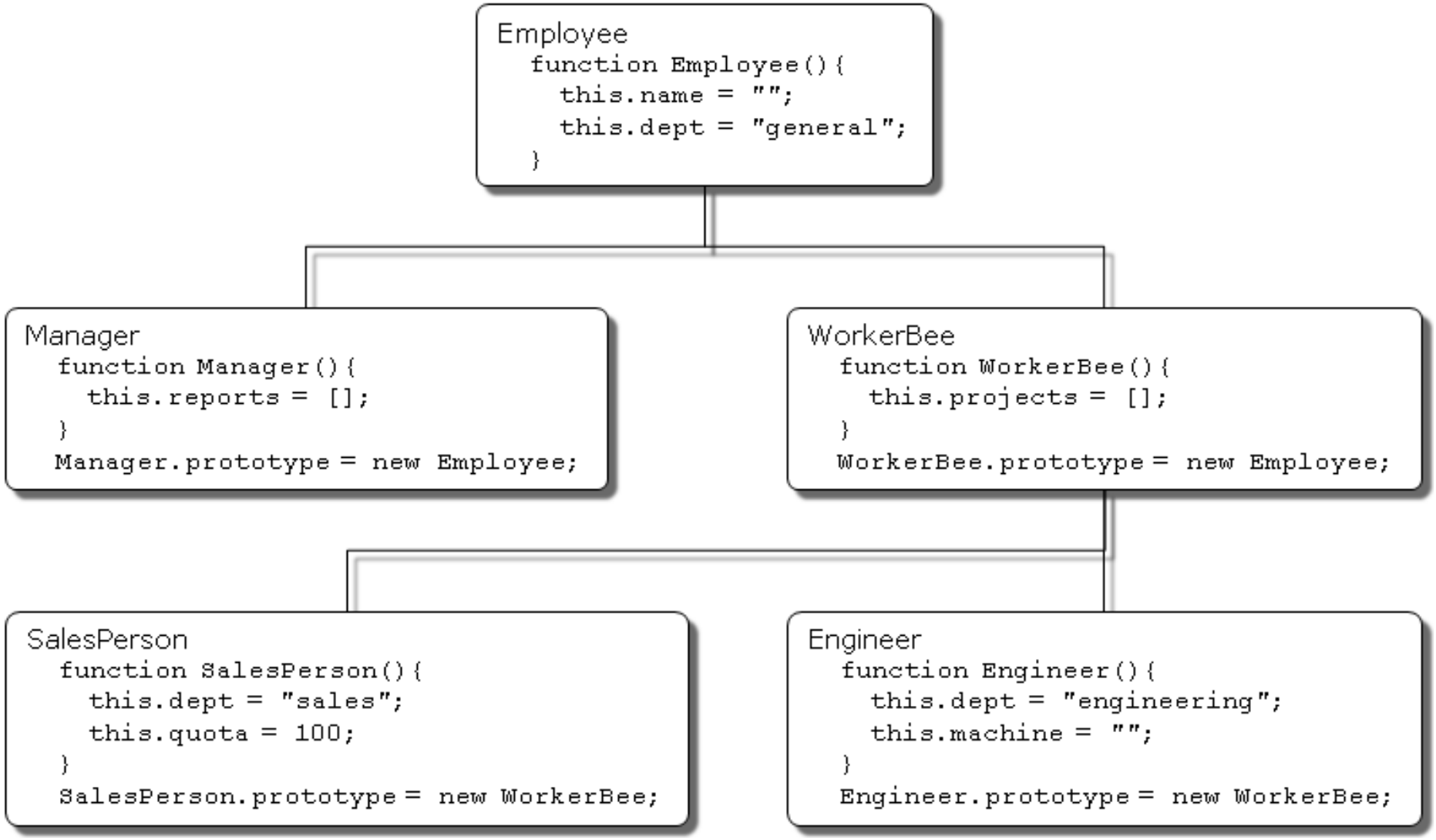
inheritance.html

```
function Person(name) {
  this.name = name;
  this.talk = function () {
    alert("Hi! I am " + this.name);
  }
}

function Student(name, grade) {
  this.name = name;
  this.grade = grade;
}

Student.prototype = new Person();
```

This way we say that the Student class will have all the functionality of the Person class



- Further details @ https://developer.mozilla.org/en-US/docs/Web/JavaScript/Guide/Details_of_the_Object_Model

Reusing the parent Constructor

- To reuse the parent constructor you can use **`apply`** or **`call`** function

```
function Person(name, age){
        this.name = name; this.age = age;
}
function Student(name, age, grade){
  Person.apply(this, arguments); //Person.call(this, name, age);
  this.grade = grade;
}
Student.prototype = new Person();
Student.prototype.constructor = Student;
```

Polymorphism in JavaScript

- **Polymorphism** = ability to take more than one form (objects have more than one type)
  - A class can be used through its parent interface
  - A child class may override some of the behavior of the parent class
  - Refer to ***polymorphism.html*** example for further details

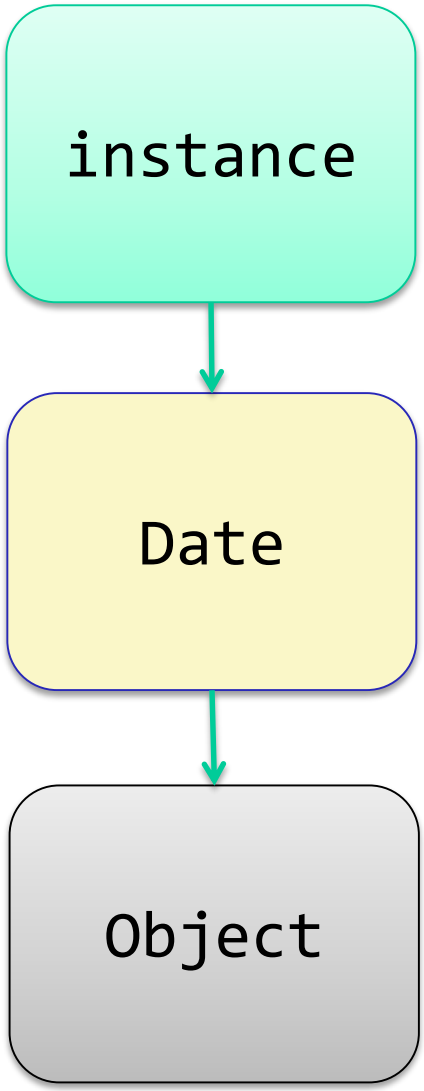
```
Student.prototype = new Person();
Teacher.prototype = new Person();
 var people = [new Teacher("Joha", "Math"),
               new Student("Samir", 3.5),
               new Person("Salaheddine")];
for(var index in people) {
        people[index].saySalam();
}
```

The Prototype Chain

- Objects in JavaScript can have only a single prototype
  - Their prototype also has a prototype, etc…
  - This is called the **prototype chain**
- When a property is called on an object
  - This object is searched for the property
  - If the object does not contain such property, its prototype is checked for the property, etc…
  - If a null prototype is reached, the result is undefined

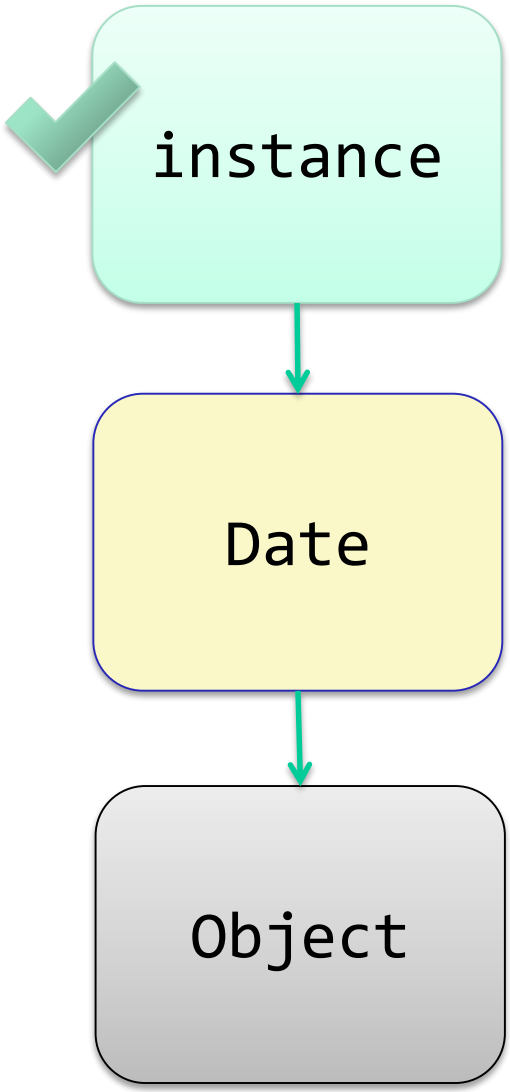
Property lookup chain

```
1  var instance = new Date();
2  instance.foo = function() { alert("bar"); };
3
4  instance.foo();
5  instance.getTime();
6  instance.hasOwnProperty("foo");
7
8
9
10
11
12
```



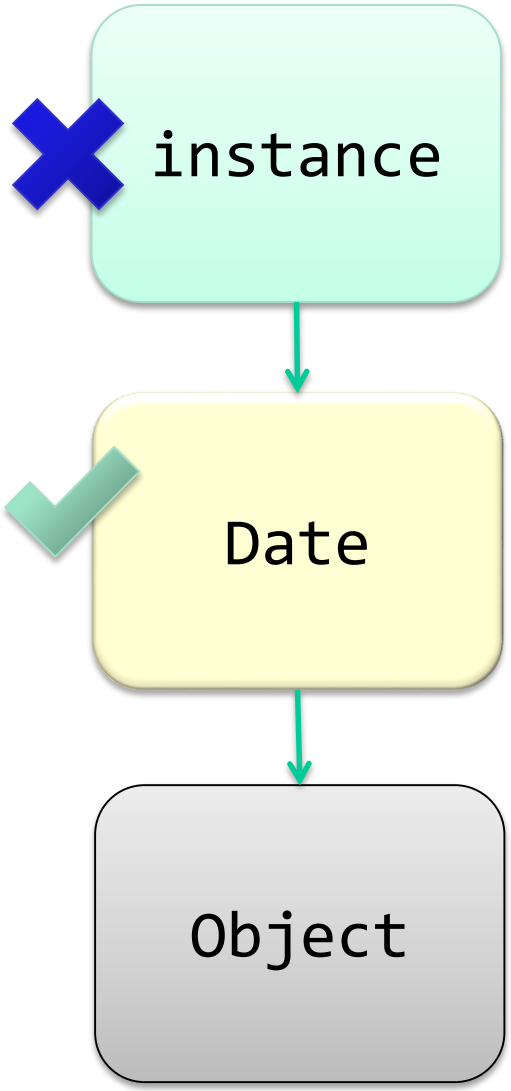
Property lookup chain (look up instance.foo)

```
1  var instance = new Date();
2  instance.foo = function() { alert("bar"); };
3
4  instance.foo();
5  instance.getTime();
6  instance.hasOwnProperty("foo");
7
8
9
10
11
12
```



Property lookup chain (lookup instance.getTime)

```
1  var instance = new Date();
2  instance.foo = function() { alert("bar"); };
3
4  instance.foo();
5  instance.getTime();
6  instance.hasOwnProperty("foo");
7
8
9
10
11
12
```



Property lookup chain (look up instance.hasOwnProperty)

```
1  var instance = new Date();
2  instance.foo = function() { alert("bar"); };
3
4  instance.foo();
5  instance.getTime();
6  instance.hasOwnProperty("foo");
7
8
9
10
11
12
```