中山大學
SUN YAT-SEN UNIVERSITY

Lecture 07. Intermediate JavaScript

Modern Web Programming
(http://my.ss.sysu.edu.cn/wiki/display/WEB/ **supported by Deep Focus**)

School of Data and Computer Science, Sun Yat-sen University

Secrets of JavaScript

Part I Theories

Nested function

```
> var outter = function(){
    var a = 1;
    return function(){
      var b = 2;
      console.log("a: %s, b: %s", a, b);
    }
  }

  inner = outter();
  console.log("typeof inner: ", typeof inner);
  inner();
```

```
2016-10-19 10:41:37.763 typeof inner:  function
2016-10-19 10:41:37.763 a: 1, b: 2
```

Variable Scope

```
> var foo = "bar";
  (function () {
      console.log("Original value was " + foo);

      var foo = "foobar";

      console.log("New value is " + foo);
  })();
```

IIFE Imediately-Invoked Function Expression

?

```
2015-11-15 09:26:27.289 Original value was undefined
2015-11-15 09:26:27.289 New value is foobar
```

Variable Hoisting

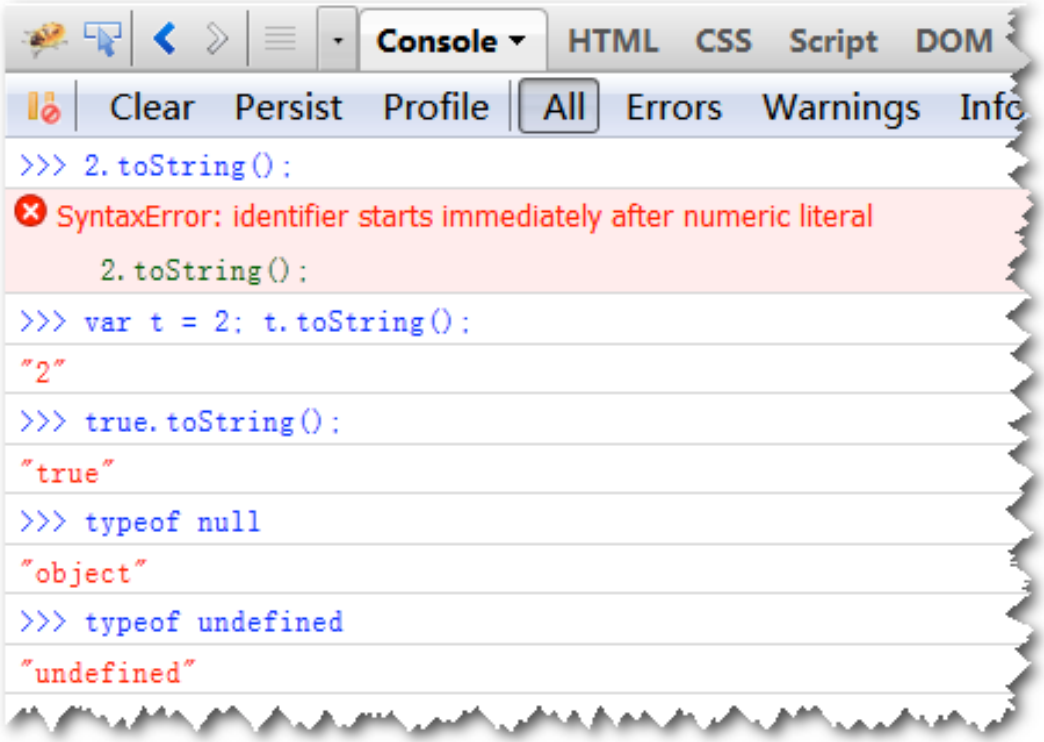
```
> var foo = "bar";
  (function () {
      var foo;

      console.log("Original value was " + foo);
      // Outputs: "Original value was undefined"

      foo = "foobar";

      console.log("New value is " + foo);
      // Outputs: "New value is foobar"
  })();
  console.log('foo: ' + foo);
```

```
2015-11-15 09:32:11.691 Original value was undefined
2015-11-15 09:32:11.691 New value is foobar
2015-11-15 09:32:11.691 foo: bar
```


instance
Variable
polymorphism
class
collaboration
object
software
messaging
objects
structure
software
self
reuse
abstraction
parent
objects
variable
collaboration
oop
messaging
derived
field
property
abstract
method
type
this
base
Self
program
parent
polymorphism
modularity
program
inheritance
code
oriented
field
final
structure
final
class
child
encapsulation
programming
base
abstract
oop
instance
encapsulation
method
reuse
abstraction
modularity
object

Everything in JS is an Object

- What is an object
- What is OOP



- 只有数字字面表达（number literal）和undefined不是对象

Everything in JS is an Object

- JavaScript语言中对象就是一个容器，容器包含了一系列属性（properties）。
- 每个属性都是一组名值对，属性名可以是任意字符串，包括空字符串，属性值可以是JavaScript中除undefined任何外合法的值。
- 当属性值为函数时，这个属性也称为对象的方法。
- JavaScript对象的最大特点就是其动态性（动态对象，dynamic object），一个对象可以在创建之后，动态地增加和删除属性和方法。

Object literal

源代码 9-1 对象字面表达（Object Literal）示例

```
var member = {
    name: '张三',
    age: 23,
    'goto': 'United States',
    say: function(){
        return this.name + '前往' + this['goto'];
    }
};

alert(member.age);          // 23
alert(member.say());        // 张三前往United States
```

Object literal

源代码 9-2 属性读取与更新示例

```
var member = {
    age: 23,
    'goto': 'United States',
};

alert(member.age);          // 23
alert(member['age']);       // 23
alert(member['goto']);      // United States
alert(member.goto);         // 语法错误！（某些JavaScript引擎能够执行）
```

源代码 9-3 安全读取和使用属性示例

```
var member = {
    age: 23,
    'goto': 'United States',
};

var name = member.name;                    // undefined
var name = member.name || '未知';          // '未知'
member.address.state                       // 抛出TypeError异常
member.address && member.address.state // undefined
```

Use of properties

源代码 9-4 更新和移除属性示例

```
var member = {
    age: 23,
    'goto': 'United States',
};

member.age = 34;
alert(member.age);          // 34
member.name = '李四';
alert(member.name);         // '李四'
delete member.name;
alert(member.name);         // undefined
```

JavaScript 动态对象（dynamic objects）：传统静态类型、强类型语言，如：C++、Java 等等，对象的类型固定，创建之后就不能改变增加或者删除其属性和方法。JavaScript 和很多动态类型、弱类型语言，如：ruby，python 等等，对象的类型不固定，都可以在对象创建后，灵活地增加和删除属性与方法。

Array literal

- Array is a special kind of object

源代码 9-6 数组字面表达示例

```
var a = ['a', 'b', 'c', 0, {name:'张三'}];
alert(typeof a);  // object
alert(a.length);  // 5
alert(a[4].name); // '张三'
```

JavaScript 的对象在使用中传递的都是引用，没有传值，即复制传递的方式。

源代码 9-5 更新和移除属性示例

```
var peter = {nickname: 'rabbit'};
var littlePeter = peter;
peter.nickname = 'bear';
alert(littlePeter.nickname);        // 'bear'
```

Function is also an Object

源代码 9-7 函数对象示例

```
var func = function(otherFunc){
    alert('func');
    otherFunc();
    return otherFunc;
};

var func2 = function(){
    alert('func2');
};

func.method = function(){
    alert('method of func');
};

var obj = {
    myFunc : func
};

var arr = [func, func2];

func.method();          // method of func
obj.myFunc(func2);      // func func2
arr[0](arr[1])();       // func func2 func2
```

Define a function

```
> function a(){}  <==>  var a = function a(){}

  var b = function(){}; // function expression

  var c = function d(){}; // function expression with named function
< undefined
> a.name
< "a"
> b.name
< ""
> c.name
< "d"
> d.name
✕ ▶ Uncaught ReferenceError: d is not defined(…)        VM1142:2
```

Function hoisting

```
> var a = function(){ // a的scope为global
    b = function c(){}; // b的scope为global, c的scope为a
    function d(){}; // d的scope为a
  };

  console.log(typeof a, typeof b, typeof c, typeof d, typeof e);

  a();

  console.log(typeof a, typeof b, typeof c, typeof d, typeof e);

  function e(){};
```

function hoisting

```
2015-11-15 09:57:03.761 function undefined undefined undefined function
2015-11-15 09:57:03.762 function function undefined undefined function
```

Function hoisting

```
> var a = function(){ // a的scope为global
    b = function c(){}; // b的scope为global, c的scope为a
    function d(){}; // d的scope为a
  };

  console.log(typeof a, typeof b, typeof c, typeof d, typeof e);

  a();

  console.log(typeof a, typeof b, typeof c, typeof d, typeof e);

  var f = function e(){};
```

function hoisting ??

```
2015-11-15 10:03:07.127 function undefined undefined undefined undefined
2015-11-15 10:03:07.128 function function undefined undefined undefined
```

function hoisting is **ONLY** for **declaration**, **NOT** for **expression**!

Scope

源代码 9-9 JavaSript 嵌套作用域示例

```
function outter(){
    var outterName = 'outter name';
    var inner = function(){
        alert(outterName);    // outter name
        var innerName = 'inner name';
    };
    inner();
    alert(innerName); // ReferenceError: innerName is not defined
}

outter();
```

- var 局部；无 var 全局
- 局部为function block scope

Duration

源代码 9-11 JavaScript 词法作用域（lexical scope）示例

```
function outter(){
    var secret = 'secret';
  inner = function(){
    alert(secret);
  };
    inner();
}
outter(); // secret
inner(); // secret
```

词法作用域是 JavaScript 构造闭包（closure）的基础，参考 f)闭包。

arguments, caller, callee

源代码 9-12 arguments 参数示例

```
var sum = function () {
    var i, sum = 0;
    for (i = 0; i < arguments.length
        sum += arguments[i];
    }
    return sum;
};
```

```
> function add(a, b){};
  function addThree(a, b, c){};
  console.log(add.length);
  console.log(addThree.length);
  2015-11-15 10:35:54.366 2
  2015-11-15 10:35:54.366 3
```

```
> function a(){
    console.log("callee:", arguments.callee);
    console.log("caller:", arguments.callee.caller);
  }
  function b(){a();}
< undefined
> b();
  2015-11-15 14:45:38.539 callee: function a(){
    console.log("callee:", arguments.callee);
    console.log("caller:", arguments.callee.caller);
  }
  2015-11-15 14:45:38.539 caller: function b(){a();}
```

4 kinds of function invoking

- 普通函数
- 方法(method)调用
- 构造子
- 应用(apply、call)调用

Constructor

源代码 9-13 函数构造子示例

```
var Foo = function(){
    this.name = 'foo';
}

var result = Foo();                 // 普通函数
alert(result);                      // undefined
alert(name);                        // foo
var result = new Foo();             // 构造子
alert(result);                      // Object
alert(result.name);                 // foo
```

Constructor

```
> var Foo = function(){ this.name = 'foo'};
  bar = new Foo;
< Foo {name: "foo"}
> bar.constructor === Foo
< true
> bar instanceof Foo
< true
```

call , apply

源代码 9-17 函数应用（apply、call）模式调用示例

```
var sayHello = function(message, to){
    alert(this.name + ' says ' + message + ' to ' + to);
};
var peter = {name: 'peter'};
var name = 'global';
sayHello.apply(this, ['hello', 'Marry']);  //global says hello to Marry
sayHello.apply(peter, ['hello', 'Marry']);// peter says hello to Marry
sayHello.call(this, 'hello', 'Marry'); // global says hello to Marry
sayHello.call(peter, 'hello', 'Marry');// peter says hello to Marry
```

4 kinds of function invoking

表 9-1 4 种调用方式的对比

调用模式	this	无 return 时的返回值
函数模式	顶层对象（在浏览器中执行时为 window）	undefined
方法模式	当前对象（方法从属的对象，即成员操作符“.”的左侧）	undefined
构造子模式	正在构造的对象	this（构造好的对象）
应用模式	第一个参数	undefined


Closure

Closure

- 闭包(**closure**)指函数和函数所能访问的函数体外部局部变量构成的组合
- 闭包中的函数称为闭包函数,闭包函数能够访问的函数体外部局部变量称为闭包变量
- JavaScript 的scope和duration使得闭包，自然、容易、强大

源代码 9-18 闭包（closure）示例

IIFE

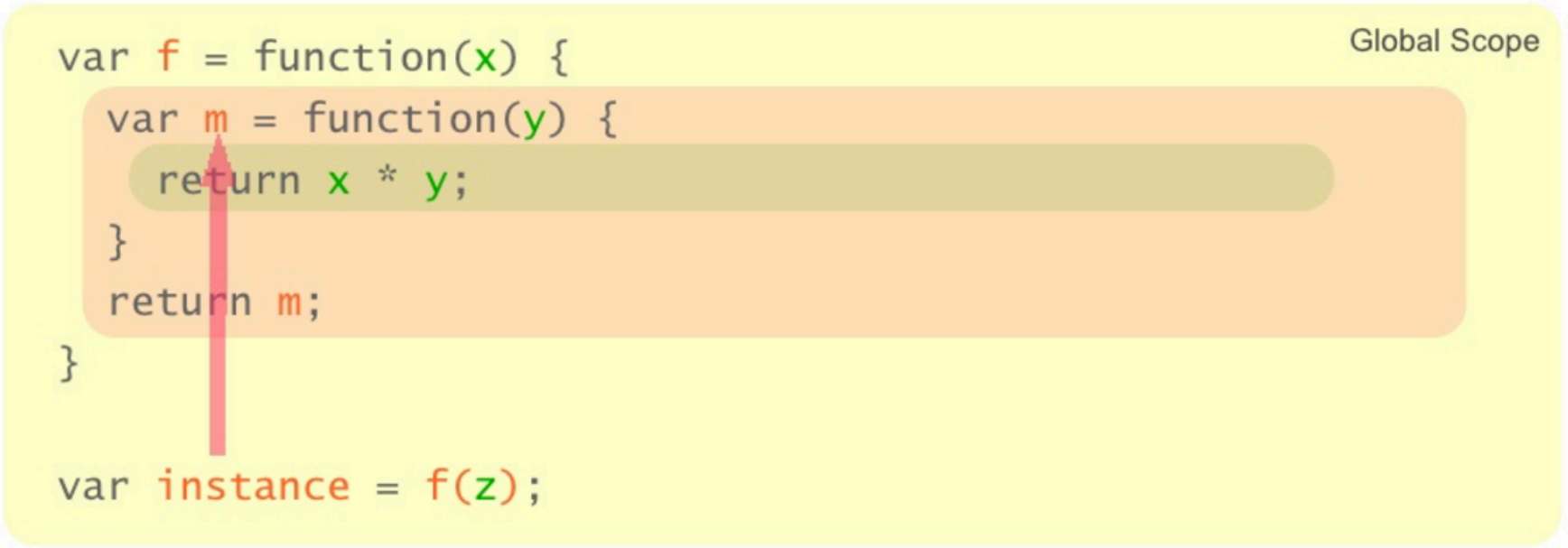
```
var counter = function(){
    var amount = 0;
    return function(){
        return amount++;
    };
}();

alert(counter()); // 0
alert(counter()); // 1
alert(counter()); // 2
```

A simple closure

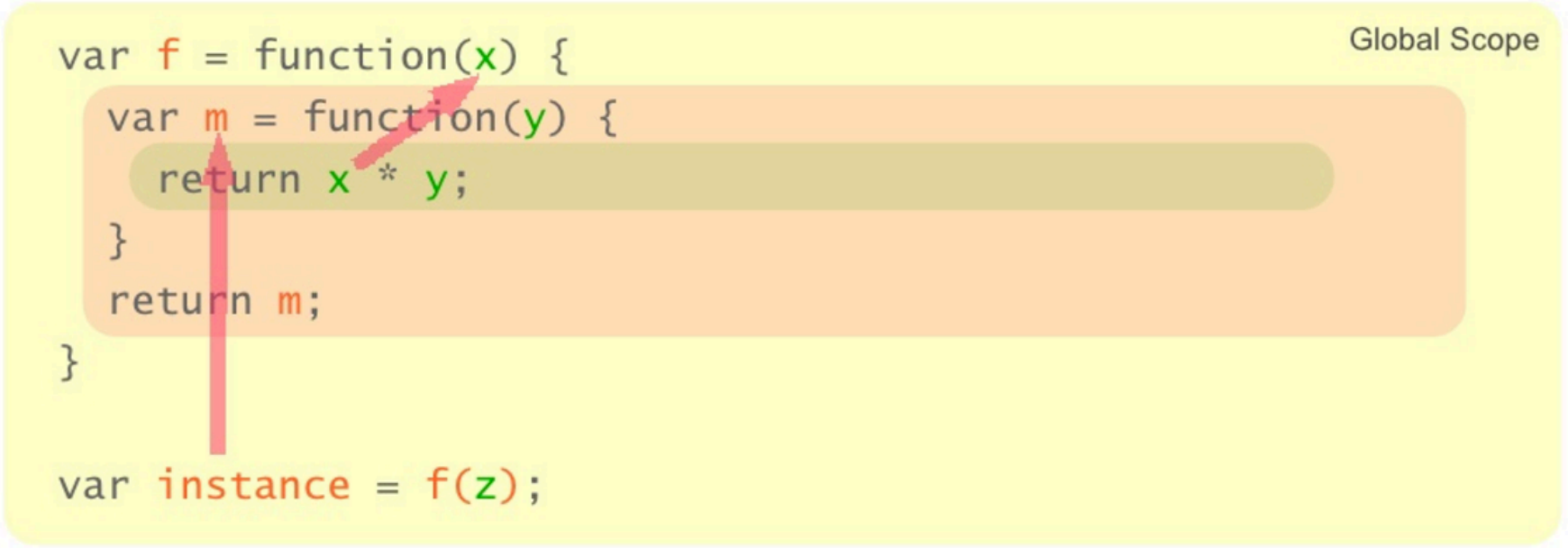
Global Scope

```
var f = function(x) {
  var m = function(y) {
    return x * y;
  }
  return m;
}

var instance = f(z);
```

A simple closure



A simple closure



A simple closure

Global Scope

```
var f = function(x) {
  var m = function(y) {
    return x * y;
  }
  return m;
}
var myDouble = f(2);
var myTreble = f(3);

alert (myDouble(10))  // 20
alert (myTreble(10))  // 30
```

```
.....
    <ol>
        <li>第一项</li>
        <li>第二项</li>
        <li>第三项</li>
        <li>第四项</li>
    </ol>
.....

window.onload = function(){
  var lis = document.getElementsByTagName('li');
  for (var i = 0; i < lis.length; i++) {
    lis[i].onclick = function(){
            alert(i);
    }
  }
}
```

this problem

源代码 9-15 this 丢失问题示例

```
var peter = {name: 'peter'};
var name = 'global';
var sayHello = function(){
    var helper = function(){
        alert(this.name + ' says hello');
    };
    helper();
};
peter.greeting = sayHello;

peter.greeting(); // global says hello (应该是peter says hello)
```

that for this

源代码 9-16 使用 that 模式修复 this 丢失问题示例

```
var peter = {name: 'peter'};
var name = 'global';
var sayHello = function(){
    var that = this;
    var helper = function(){
        alert(that.name + ' says hello');
    };
    helper();
};
peter.greeting = sayHello;

peter.greeting(); // peter says hello
```

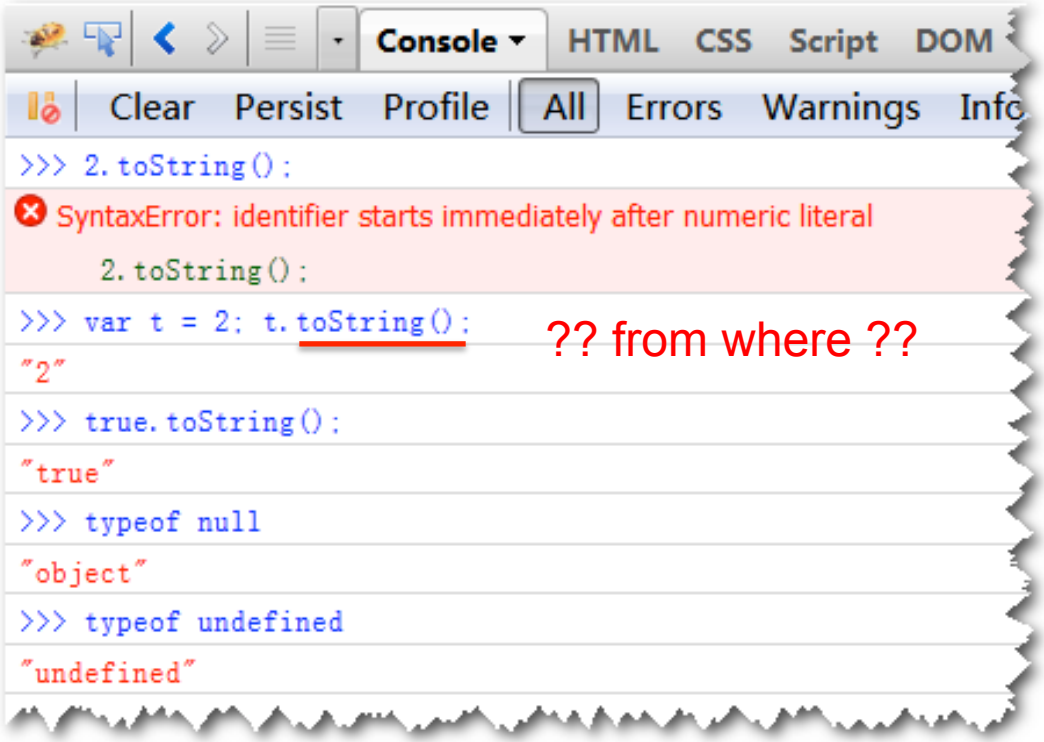
Quiz

```
1  var counter = function(){
2      var amount = 0;
3      return function(){
4          return amount++;
5      }
6  }
7
8  var c1 = counter();
9  var c2 = counter();
10
11 c1(); // 0
12 c1(); // 1
13 c2(); // ?
```


PROTOTYPE

Everything in JS is an Object

- What is an object
- What is OOP



- 只有数字字面表达（number literal）和undefined不是对象

Prototype

```
a = {};
console.log(typeof a.b);
console.log(typeof a.toString);
console.log(typeof a.__proto__);
```

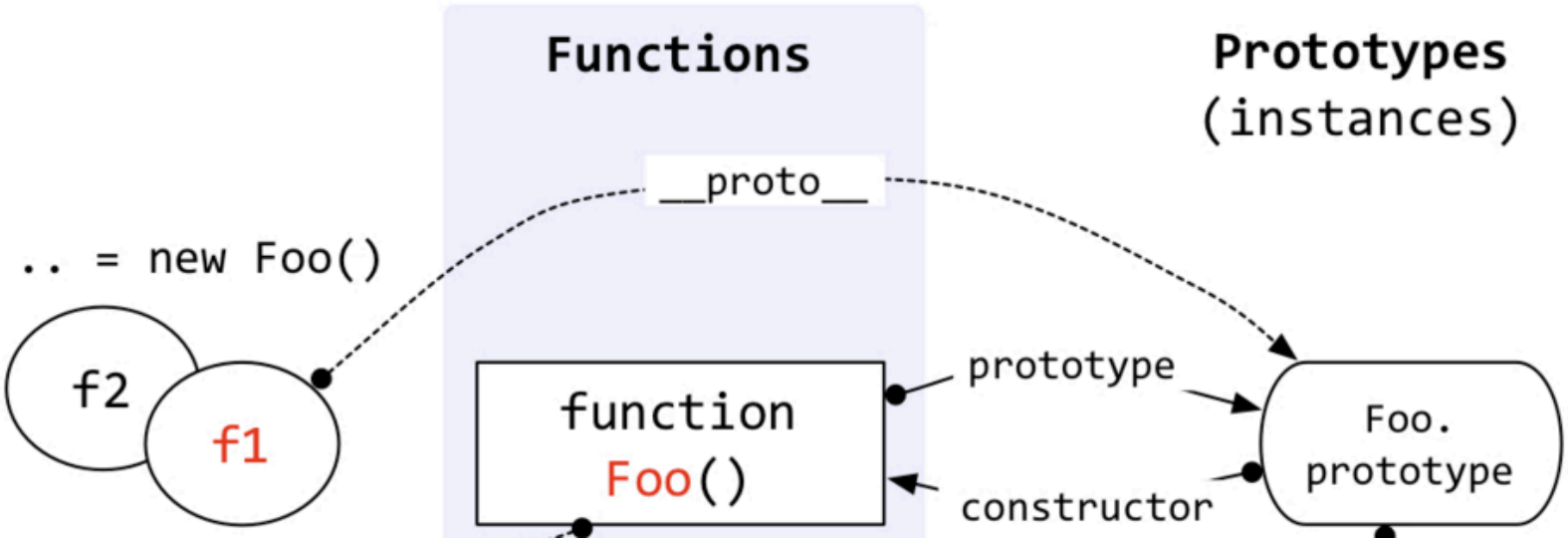
```
2015-11-15 10:26:33.002 undefined
2015-11-15 10:26:33.002 function
2015-11-15 10:26:33.003 object
```

where's it from?

what the hell it is?

Prototype

JavaScript Object Layout [Hursh Jain/mollypages.org]

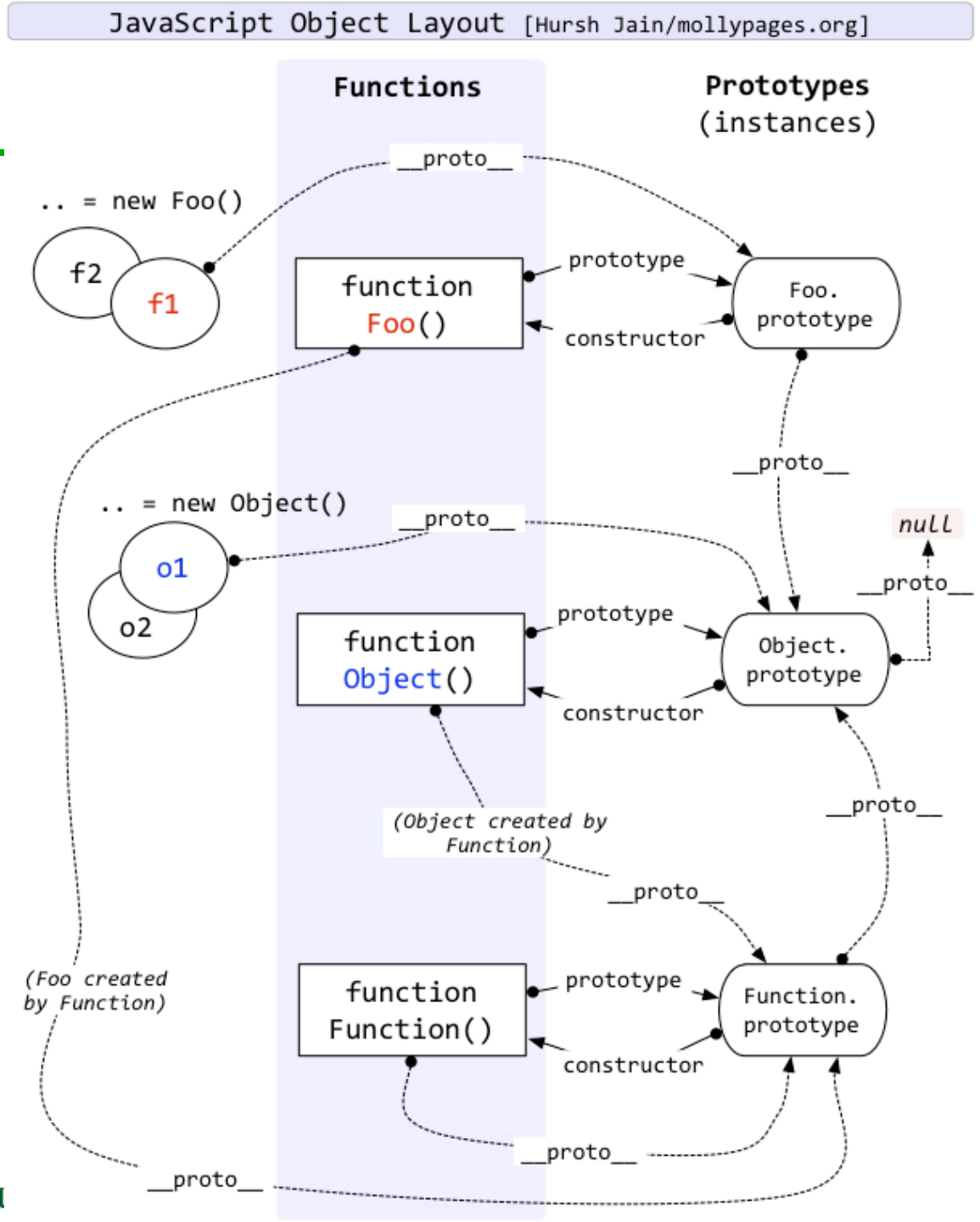



```
> function Foo(name){this.name = na
  Foo.prototype.b = function(){cons
  f1 = new Foo('first');
  f2 = new Foo('second');
  f1.b();
  f2.b();
  2015-11-15 11:01:52.256 name:   f
  2015-11-15 11:01:52.256 name:   se
```

```
f1.b == f2.b
true
f1.__proto__ == f1.constructor.prototype
true
f1.hasOwnProperty('name')
true
f1.hasOwnProperty('b')
false
```

Prototype

- __proto__, 缺属性去那儿找
- __proto__指向构造子的prototype
- 构造子的prototype用constructor反指构造子
- 构造子的prototype也是object，也有自己的构造子
- 形成了__proto__链条



Part II Applications

Information hiding

- private/secret by closure

```
> var count = function(){
    var secretAmount = 0;
    count = function(n){ if (!count.isEnough()) secretAmount += n;
  };
    count.isEnough = function(){ return secretAmount >= 2;};
    count.reset = function(){ return secretAmount = 0;}
    return count;
  }();
```

```
> count.isEnough()
< false
> count(1)
< undefined
> count.isEnough()
< false
> count(1)
< undefined
> count.isEnough()
< true
> secretAmount
✕ ▶ Uncaught ReferenceError: secretAmount is not defined(…)
> count.secretAmount
< undefined
```

Code reuse

```
> var tom = {name: 'tom', greet: function(){console.log("I am", this.name)}};

  var mike = {name: 'mike', greet: tom.greet}

  tom.greet();
  mike.greet();
  2015-11-16 16:25:08.496 I am tom
  2015-11-16 16:25:08.497 I am mike


> [].forEach
< function forEach() { [native code] }
> 'abc'.forEach
< undefined
> Array.prototype.forEach.call('abc', function(c){console.log(c);});
  2015-11-15 12:06:48.572 a
  2015-11-15 12:06:48.572 b
  2015-11-15 12:06:48.572 c
```

Code reuse

```
function Animal(name){this.name = name;};
Animal.prototype.sleep = function(){console.log(this.name + ' is sleeping.');};

function Dog(name, age){this.age = age; Animal.call(this, name);};
Dog.prototype = new Animal;
Dog.prototype.constructor = Dog;

var ace = new Dog('Ace', 2);
ace.sleep();
console.log("name: ", ace.name, " age: ", ace.age);

var bob = new Dog('Bob', 5);
bob.sleep();
console.log("name: ", bob.name, " age: ", bob.age);
```

```
2015-11-15 11:57:08.014 Ace is sleeping.
2015-11-15 11:57:08.014 name:  Ace  age:  2
2015-11-15 11:57:08.014 Bob is sleeping.
2015-11-15 11:57:08.014 name:  Bob  age:  5
```

Functional Programming

源代码 9-22 Memoization 示例

```
----------------------  原始fibonacci  ----------------------
var fibonacci = function(n){
  return n < 2 ? n : fibonacci(n - 1) + fibonacci(n - 2);
};

for (var i = 0; i <= 10; i += 1) {
  document.writeln('// ' + i + ': ' + fibonacci(i));
}   // fibonacci被调用452次
```

Functional Programming

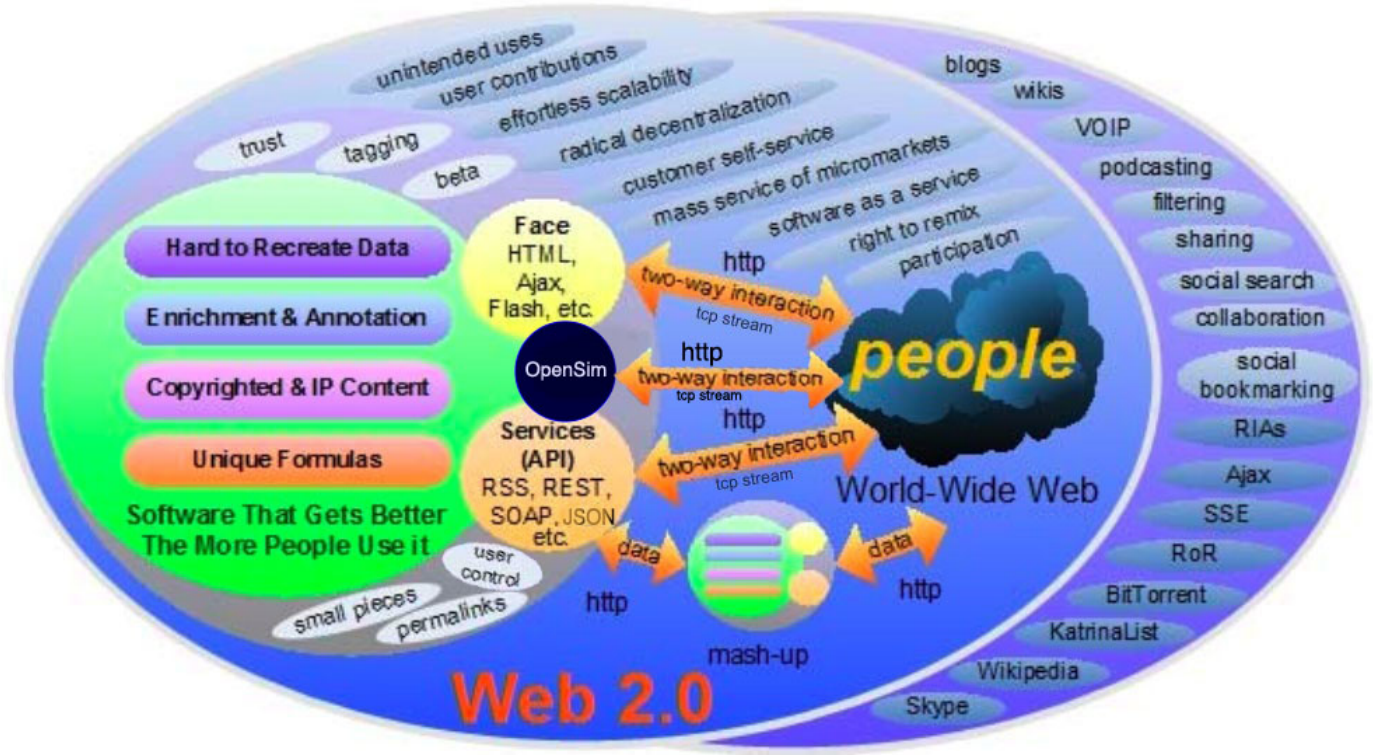
```
-------------------- Memoization fibonacci ------------------
var fibonacci = function(){
  var memo = [0, 1];
  var fib = function(n){
    var result = memo[n];
    if (typeof result !== 'number') {
      result = fib(n - 1) + fib(n - 2);
      memo[n] = result;
    }
    return result;
  };
  return fib;
}();

for (var i = 0; i <= 10; i += 1) {
  document.writeln('// ' + i + ': ' + fibonacci(i));
}   // fibonacci被调用29次
```

Functional Programming

源代码 9-23 Memoization 示例

```
------------------------- memoizer -------------------------
var memoizer = function(memo, fundamental){
  var shell = function(n){
    var result = memo[n];
    if (typeof result !== 'number') {
      result = fundamental(shell, n);
      memo[n] = result;
    }
    return result;
  };
  return shell;
};

--------------------- memoizer fibonacci函数 -----------------
var fibonacci = memoizer([0, 1], function(shell, n){
  return shell(n - 1) + shell(n - 2);
});

---------------------- memoizer阶乘函数 ----------------------
var factorial = memoizer([1, 1], function(shell, n){
  return n * shell(n - 1);
});
```

Thank you!


unintended uses
user contributions
effortless scalability
radical decentralization
customer self-service
mass service of micromarkets
software as a service
right to remix
participation
trust
tagging
beta
blogs
wikis
VOIP
podcasting
filtering
sharing
social search
collaboration
social bookmarking
RIAs
Ajax
SSE
RoR
BitTorrent
KatrinaList
Wikipedia
Skype
Hard to Recreate Data
Enrichment & Annotation
Copyrighted & IP Content
Unique Formulas
Software That Gets Better The More People Use it
Face
HTML, Ajax, Flash, etc.
OpenSim
Services (API)
RSS, REST, SOAP, JSON etc.
http
two-way interaction
tcp stream
people
World-Wide Web
user control
small pieces
permalinks
data
mash-up
Web 2.0