

EECS 368

Programming Language Paradigms

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Fall 2022

Reminders

- Assignment 2 due: 11:59 PM, Monday, September 19
- Assignment 3 due: 11:59 PM, Monday, October 3

Any Questions?

In-Class Problem Solution

- 6-(9-7) In-Class Problem Solution.pptx

Any Questions?

JavaScript Objects

Recall:

- A JavaScript object is an arbitrary collections of **properties**.
- One way to create an object is by using braces as an expression.
- Inside the braces, there is a list of properties separated by commas.
- Each property has a name followed by a colon and a value.

```
let day1 = {  
  squirrel: false,  
  events: ["work", "touched tree", "pizza", "running"]  
};  
console.log(day1.squirrel);  
// → false  
console.log(day1.events);  
// → Array(4) [ "work", "touched tree", "pizza", "running" ]
```

Methods

Recall:

- **Properties** that contain **functions** are called **methods**.

- Here is a simple **method**:

```
let rabbit = {};  
rabbit.speak = function(line) {  
  console.log(`The rabbit says '${line}'`); //Note the Template Literal here.  
};
```

```
rabbit.speak("I'm alive.");  
// → The rabbit says 'I'm alive.'
```

Recall:

When you write something inside `${}` in a Template Literal, its result will be computed, converted to a string, and included at that position.

this Keyword

- Usually a method needs to do something with the object it was called on.
- When a function is called as a method the binding called **this** in its body automatically points at the object that it was called on.

```
function speak(line) {  
  console.log(`The ${this.type} rabbit says '${line}'`);  
}  
let whiteRabbit = {type: "white", speak};  
let hungryRabbit = {type: "hungry", speak};  
  
whiteRabbit.speak("Oh my ears and whiskers, " +  
  "how late it's getting!");  
// → The white rabbit says 'Oh my ears and whiskers, how  
//   late it's getting!'  
hungryRabbit.speak("I could use a carrot right now.");  
// → The hungry rabbit says 'I could use a carrot right now.'
```

- Alternately, you can use the **call** method:
 - `speak.call(hungryRabbit, "I could use a carrot right now.");`
 - `// → The hungry rabbit says 'I could use a carrot right now.'`

this Keyword

- Arrow functions are different.
- They do not bind their own **this** but can see the **this** binding of the scope around them.
- Thus, you can do something like the following code, which references **this** from inside a local function:

```
function normalize() {  
  console.log(this.coords.map(n => n / this.length));  
}  
normalize.call({coords: [0, 2, 3], length: 5});  
// → [0, 0.4, 0.6]
```

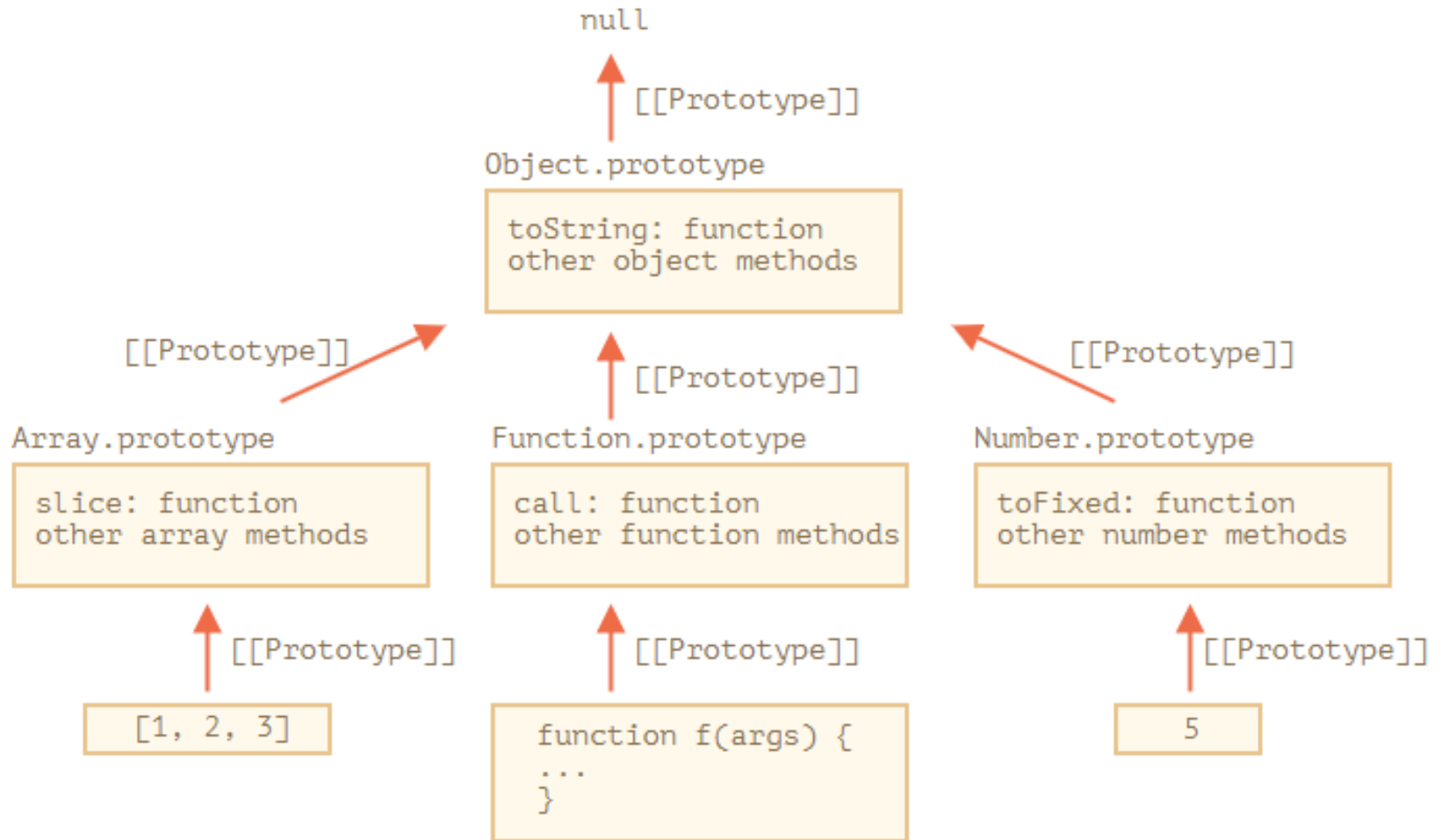
- If I had written the argument to map using the function keyword, the code wouldn't work.

Any Questions?

Prototypes

- In addition to their set of properties, most objects also have a **prototype**.
- A prototype is another object that is used as a fallback source of properties.
- When an object gets a request for a property that it does not have, its prototype will be searched for the property, then the prototype's prototype, and so on.
- This is **inheritance**.
- The prototype relations of JavaScript objects form a tree-shaped structure, and at the root of this structure sits **Object.prototype**.
- It provides a few methods that show up in all objects, such as `toString`, which converts an object to a string representation.
- **Function.prototype**, **Array.prototype**, and **Number.prototype** are built-in prototypes with their own set of default properties and methods.

Prototype Inheritance



Prototypes

- You can create your own prototypes with **Object.create**:

```
let protoRabbit = {  
  speak(line) {  
    console.log(`The ${this.type} rabbit says '${line}'`);  
  }  
};
```

```
let killerRabbit = Object.create(protoRabbit);  
killerRabbit.type = "killer";  
killerRabbit.speak("SKREEEE!");  
// → The killer rabbit says 'SKREEEE!'
```

- A property like **speak(line)** in an object expression is a shorthand way of defining a method.
- It creates a property called **speak** and gives it a function as its value.
- protoRabbit** acts as a container for the properties that are shared by all rabbits.
- killerRabbit** contains properties that apply only to itself (i.e., its type) and derives shared properties from its prototype, **protoRabbit**.

Prototypes

- Prototypes can also contain data properties:

```
let protoRabbit = {  
  city: 'Madrid'  
  speak(line) {  
    console.log(`The ${this.type} rabbit says '${line}'`);  
  }  
};
```

```
let killerRabbit = Object.create(protoRabbit);  
killerRabbit.type = "killer";  
killerRabbit.speak("SKREEEE!");  
// → The killer rabbit says 'SKREEEE!'  
killerRabbit.city  
// → 'Madrid'
```

Any Questions?

Constructors

- JavaScript's **prototype** can be interpreted as a somewhat informal object-oriented **class**.
- A **class** defines the shape of an object: What methods and properties it has.
- As does a JavaScript prototype.
- Recall, in object-oriented-programming an **object** is an instance of a **class** created by a **constructor**.
- In JavaScript, an **object** is an instance of a **prototype** created by **Object.create**.
- Thus, **Object.create** is a **constructor**.
- JavaScript also treats a function call with the keyword **new** in front of it as a **constructor**.

```
function Rabbit(type) {  
  this.type = type;  
}  
Rabbit.prototype.speak = function(line) {  
  console.log(`The ${this.type} rabbit says '${line}'`);  
};
```

```
let weirdRabbit = new Rabbit("weird");  
console.log(weirdRabbit.speak("Hello World!"))
```

```
// → The weird rabbit says 'Hello World!'
```

By convention, the **names of constructors** are capitalized so that they can easily be distinguished from other functions.

Class Notation

- In 2015, JavaScript introduced an easier way to create classes with the **class** keyword:

```
class Rabbit {  
  constructor(type) {  
    this.type = type;  
  }  
  speak(line) {  
    console.log(`The ${this.type} rabbit says '${line}'`);  
  }  
}
```

```
let killerRabbit = new Rabbit("killer");  
console.log(killerRabbit.speak("Hello World!"))  
// → The killer rabbit says 'Hello World!'
```

Class Notation

- Class declarations currently allow only methods.
- This can be somewhat inconvenient when you want to save a non-function value in there.
- The next version of the language will probably improve this.
- For now, you can create such properties by directly manipulating the prototype after you've defined the class.
- Like **function**, **class** can be used both in statements and in expressions.
- When used as an expression, it doesn't define a binding but just produces the constructor as a value.

```
let object = new class { getWord() { return "hello"; } };  
console.log(object.getWord());  
// → hello
```

Any Questions?

Adding or Overriding Object Properties

- You can **add a property** to an object, whether it is present in the prototype or not.
- If there was already a property with the same name in the prototype, this **property will be overwritten**.
- Overriding properties that exist in a prototype can be a useful thing to do.
- Overriding can be used to express exceptional properties in instances of a more generic class of objects, ...
- ... while letting the nonexceptional objects take a standard value from their prototype.

```
//Adding a property  
Rabbit.prototype.teeth = "small";  
console.log(killerRabbit.teeth);  
// → small
```

```
//Overriding a property  
killerRabbit.teeth = "long, sharp, and  
bloody";  
console.log(killerRabbit.teeth);  
// → long, sharp, and bloody  
console.log(blackRabbit.teeth);  
// → small  
console.log(Rabbit.prototype.teeth);  
// → small
```

JavaScript Polymorphism

- The polymorphism is a core concept of an object-oriented paradigm that provides a way to perform a single action in different forms.
- It provides an ability to call the same method on different JavaScript objects.

```
Rabbit.prototype.toString = function() {  
  return `a ${this.type} rabbit`;  
};
```

```
console.log(blackRabbit.toString());  
// → a black rabbit
```

Any Questions?

Summary

- When a function is called as a method the binding called **this** in its body automatically points at the object that it was called on.
- In addition to their set of properties, most objects also have a prototype.
- A prototype is another object that is used as a fallback source of properties.
- JavaScript's prototype can be interpreted as a somewhat informal object-oriented class.
- The **new** key word can be used as a constructor to create a new instance of a prototype.
- There's a **class** notation that provides a clear way to define a constructor and its prototype.
- JavaScript also supports:
 - Adding or Overriding Object Properties
 - Polymorphism – overriding object methods

Any Questions?

In-Class Problem

- Use polymorphism to change the Rabbit class, so that this code:
`let killerRabbit = new Rabbit("killer");`
`killerRabbit.speak("Hello World!");`
- prints out:
The rabbit of type killer says 'Hello World!'
- Do not re-write the existing Rabbit class.

```
class Rabbit {  
  constructor(type) {  
    this.type = type;  
  }  
  speak(line) {  
    console.log(`The ${this.type} rabbit says '${line}'`);  
  }  
}
```