

This is related to [CoderDost Course on Advance JavaScript](#)

1. Scope and Closure

- We have 3 types of variable in JavaScript ***var***, ***let*** and ***const***
-  ***var*** is the old one, and should not be used now in any case. As it has many issues with creating scopes
 - why it is still there ?
- Also there are 4 kinds of scope in Javascript - *Block Scope*, *Global Scope*, *Function Scope*, *Module Scope*

Block scope & Global Scope

The **scope** is the current context of execution in which *values* and expressions are "visible" [MDN](#)

Global Scope : Any variable/expression which is written outside - i.e. not inside any functions, blocks etc. This is shared across files.

let

- this creates a *block scope*
- *re-declaration* in NOT allowed (in same scope)
- *re-assignment* is allowed

```
{ // block scope
  let x = 0;
  let y = 0;
  console.log(x); // 0
  let x = 1; // Error
}

{
  let x = 1;
  let y = 1;
  x = 2;
  console.log(x); // 2
}

console.log(x); // Error in Global Scope
```

Temporal Dead Zone(TDZ) : the area in which a variable is not accessible. Temporal because it depends on time of execution not position

```
{
  // TDZ starts
  const say = () => console.log(msg); // hi

  let msg = 'hi';
  say();
}
```

const

- this creates a *block scope*
- *re-declaration* is NOT allowed
- *re-assignment* is NOT allowed
- must be assigned at declaration time.

```
{
  const x; //Error
  const y=0;
}

{
  const x=1;
  x=2 // Error
}

console.log(x); // Error
```

Variable Shadowing

```
let x = 0 // shadowed variable
{
  let x = 1;
```

```
console.log(x)
}

}
```

var

- it doesn't have any block scope, and can be *re-declared*
- it only had *function scope*
- *var* are *hoisted*, so they can be used before the declaration

```
var x = 1;
var x = 2; // valid
```

```
console.log(y) // valid
var y = 3
```

```
z=4
console.log(z) // valid
var z;
```

NOTE : You should NOT use **var** now ❌

let vs var

```
for(let i=0;i<5;i++){
  setTimeout(
    ()=>console.log(i),
    1000)
} // prints 0,1,2,3,4
```

```
for(var i=0;i<5;i++){
  setTimeout(
    ()=>console.log(i),
    1000)
} // prints 5,5,5,5,5
```

Module scope

In modern javascript, a file can be considered as module, where we use *export* and *import* syntax to use variable across files. We

```
<script src="index.js" type="module"></script>
```

```
export { someVar, someFunc }
```

```
import { someVar} from './app.js'
```

global Object

- The global Object is the variable **window** in case of browser. This helps you to use variables across the scopes. Also, it is the **this** value for global functions
 - window.alert
 - window.Promise
- In non-browser environment, **window** doesn't exist. but other global objects exist.
- **var** affects this global obejct, also **function** declarations.

```
function sayHi(){
  console.log(this) // this will refer to window
}
```

```
// Strict mode can change this behaviour;
`use strict`
```

```
function sayHi(){
    console.log(window) // this is a better way of code
}
```

function scope

- it is created upon execution a function

```
function sayHi(name){
    return name;
}

sayHi() // this call will create a function scope

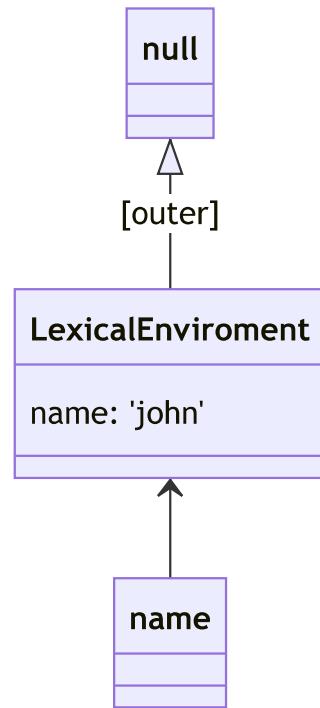
sayHi() // this call will create another function scope
```

Lexical Environment

- Every variable in JavaScript (within global / block / or function) has a reference to an object-like data called *Lexical environment*. This object (kind of object) serves as the basis of search for value of variable.

```
let name = 'john'
console.log(name)
```

Lexical Environment (Global variable)

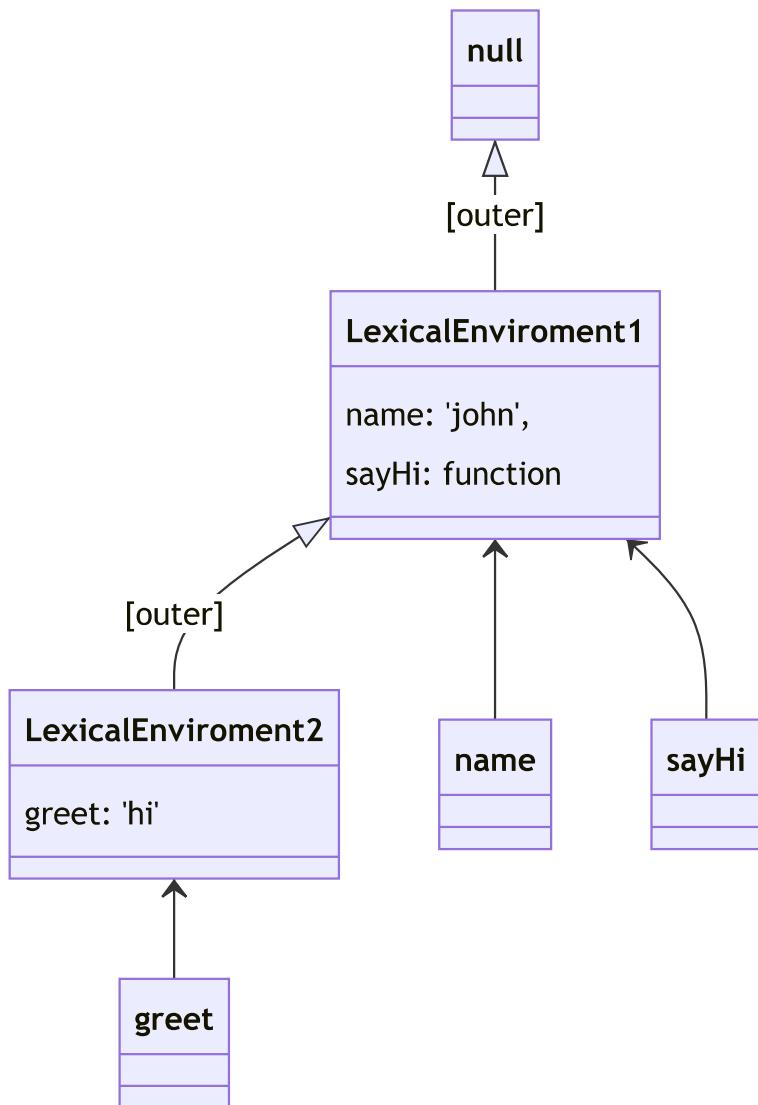


```
let name = 'john';

function sayHi(){
  let greet = "hi"
  console.log(greet)
}

sayHi()
console.log(name, sayHi)
```

Lexical Environment (functions)



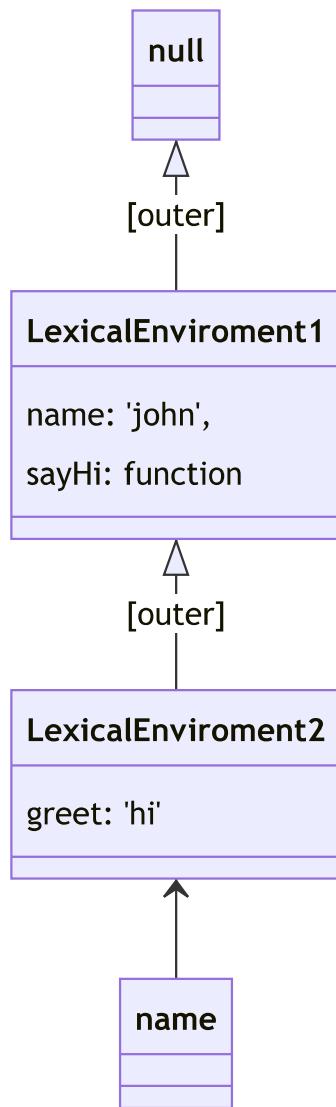
```

let name = 'john';

function sayHi(){
  let greet = "hi"
  console.log(name)
}

sayHi()
  
```

Lexical Environment (functions)



Hoisting

The movement of *variable declaration* to top of scope - before execution

- *function declarations* are properly hoisted (value accessible)
- *var* is hoisted.

```
let name = 'john';
```

```
sayHi() // valid
```

```
function sayHi(){  
  let greet = "hi"
```

```

    console.log(name)
}

sayHello() // error
let sayHello = function(){
    console.log(name)
}

```

Temporal Dead Zone(TDZ) :

```

let x = 1;

{
    console.log(x) // Reference error
    let x = 2;
}

```

Closures

- we can create nested functions in JavaScript

```

function createUser(name){
    let greeting = 'Hi '
    function greet(){
        return greeting + name + ' is Created';
    }
    return greet()
}

createUser('john') // Hi john is created;

```

- Now more useful work is if we can return the `greet` function itself.

```

function createUser(name){
  let greeting = 'Hi '
  function greet(){
    return greeting + name + ' is Created';
  }
  return greet // returned just definition of function
}

let welcomeJohn = createUser('john')
welcomeJohn() // Hi john is created;

```

- This is **Closure**
 - *welcomeJohn* function definition has access
 - to outer **params** (*name*) which came from *createUser* function
 - also any other "variables" declared inside *createUser* will also be accessible to this *welcomeJohn*

Example

```

function initCounter() {
  let count = 0;
  return function () {
    count++;
  };
}

let counter = initCounter();
counter() // 0
counter() // 1

let counter1 = initCounter();
counter1() // 0
counter1() // 1

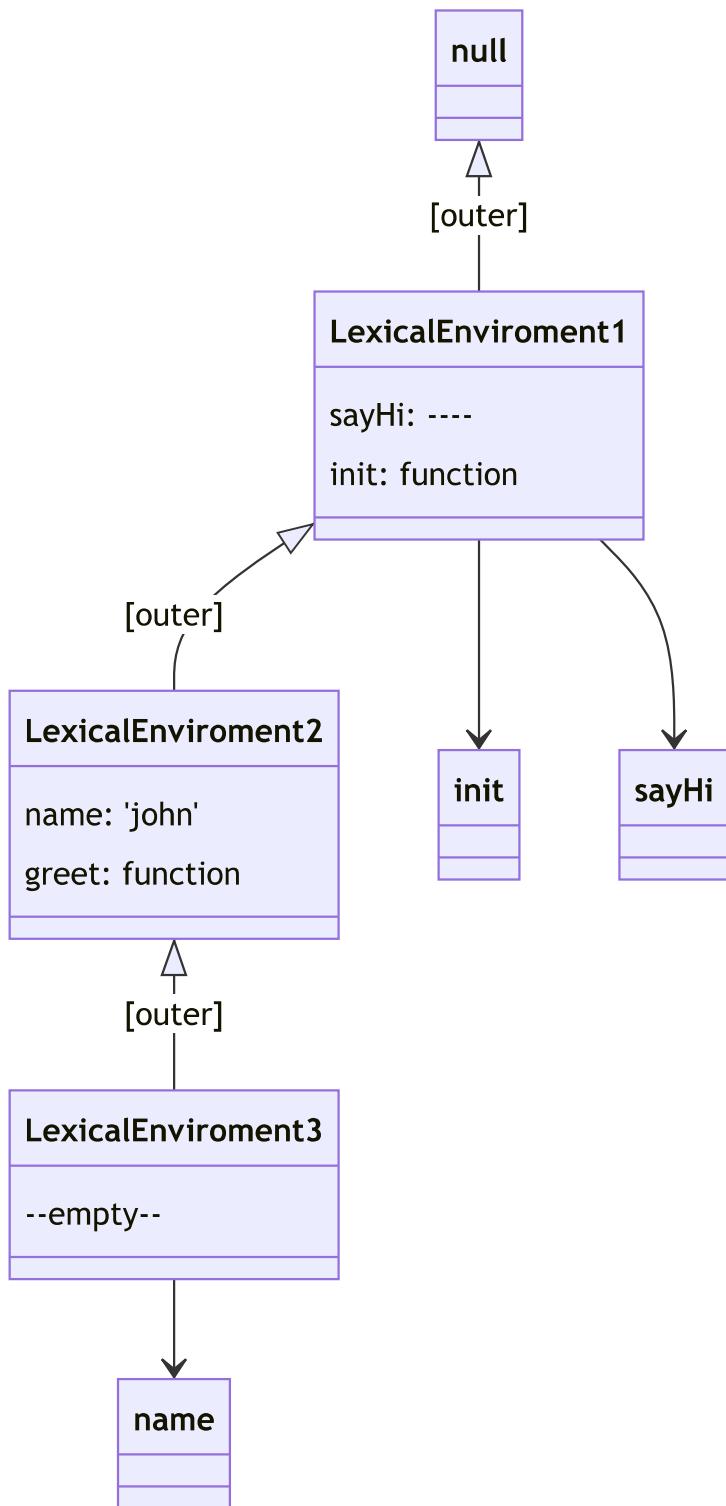
```

NOTE : so whenever you have a function which wants to preserve a value over many calls - it's a time for closure.

Lexical Environment

```
function init() {  
  let name = 'john';  
  
  function greet() {  
    console.log(name)  
  }  
  return greet;  
}  
  
let sayHi = init();  
  
sayHi();
```

Lexical Environment (functions)



Real life example 1

```
function initCounter(id) {
  let count = 0;
```

```

        return function () {
            count++;
            document.getElementById(id).innerText = count;
        };
    }
    let count = 10;
    let counter1 = initCounter('btnCount1');
    let counter2 = initCounter('btnCount2');

// here `btn1` and `btn2` are id of HTML buttons.

```

```

<button onclick="counter1()">1</button>
<p id="btnCount1"></p>
<button onclick="counter2()">2</button>
<p id="btnCount2"></p>

```

Real life example 2

```

function initAddString(inputId, outputId) {
    let str = '';
    return function () {
        str += ' ' + document.getElementById(inputId).value;
        document.getElementById(inputId).value = '';
        document.getElementById(outputId).innerText = str;
    };
}

let strAdder1 = initAddString('text1', 'text-output1');
let strAdder2 = initAddString('text2', 'text-output2');

```

```

<input type="text" id="text1">
<button onclick="strAdder1()">Add String</button>
<p id="text-output1"></p>

<input type="text" id="text2">

```

```
<button onclick="strAdder2()">Add String</button>
<p id="text-output2"></p>
```

IIFE - Immediately Invoked Function Expression

- this practice was popular due to `var`.
- Immediately invoking a function avoids - re-declaration of variables inside it

```
// Immediately invoked function expressions
(function(){
    var x = 1; // this var is now protected
})()

(function(a){
    var x = a; // this var is now protected
})(2)
```

Currying

```
function sum(a){
    return function(b){
        return function(c){
            console.log(a,b,c)
            return a+b+c
        }
    }
}

let add = a => b => c => a+b+c

let log = time => type => msg => `At ${time.toLocaleString()}: severity ${type}`

log(new Date())('error')('power not sufficient')
```

```

let logNow = log(new Date())

logNow('warning')('temp high')

let logErrorNow = log(new Date())('error')

logErrorNow('unknown error')

function op(operation) {
  return function (a) {
    return function (b) {
      return operation === 'add' ? a + b : a - b;
    };
  };
}

const add3 = op('add')(3);
const sub3 = op('sub')(3);
const add = op('add');

add3(6);
sub3(6);
add(1)(2);

```

2. Objects

Basic behaviours

Reference Copying

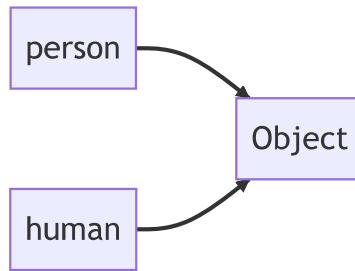
- Variable value is not copied in case of object/arrays

```

let person = {name: 'john'}
let human = person;

```

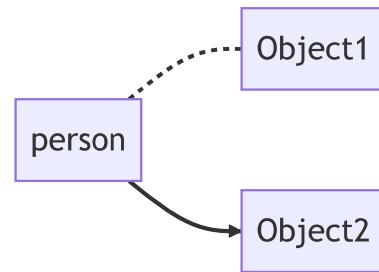
Reference are point to same value



```

let person = {name:'john'} // Object1
person = {name:'wick'}; // Object2
  
```

Reference can be changed for a variable (Garbage collection of Object1)



- it's better to use `const` always, and whenever you must need to re-assign change it to `let`

```

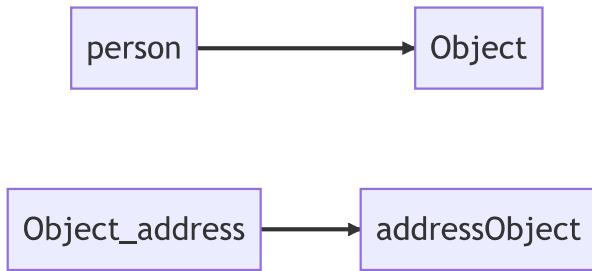
const person = {name:'john'} // Object1
person = {name:'wick'}; // ERROR
  
```

Nested Objects

```

let person = {
  name: 'John',
  address: { city: 'delhi', state: 'delhi' },
};
  
```

Object properties can point to other objects



```

let addressObject = { city: 'delhi', state: 'delhi' }

let person = {
  name: 'John',
  address: addressObject
};
  
```

Copying objects

Shallow Copy

Many methods can be used to *copy* object without old reference

1. **Object.assign()**

```

let person = {name:'john'}
let newPerson = Object.assign({}, person)
  
```

2. **Spread Operator[...]**

```

let person = {name:'john'}
let newPerson = {...person}
  
```

But problem which these is they just create a copy of *properties* of that object , but not creating a copy of their references also.

```
let addressObject = { city: 'delhi', state: 'delhi' }
```

```
let person = {
  name: 'John',
  address: addressObject
};
```

```
let newPerson = Object.assign({}, person)
person === newPerson; // false
person.address === newPerson.address // true
```

Deep Copy

This is a hard problem to solve in past as there can be multiple level of nested objects and there can be references to functions etc also. few methods which are there:

1. **JSON.stringify and JSON.parse** : this method utilizes the fact that every JSON can be converted to a string value (exception of methods/functions)

```
let addressObject = { city: 'delhi', state: 'delhi' }
```

```
let person = {
  name: 'John',
  address: addressObject
};
```

```
let str = JSON.stringify(person)
let jsonObject = JSON.parse(str);
```

2. **structuredClone** : Browser API which work even for circular references (but functions not supported)

```
let addressObject = { city: 'delhi', state: 'delhi' }
```

```
let person = {
```

```

    name: 'John',
    address: addressObject,
};

person.me = person

let newPerson = structuredClone(person);

```

"this" and Methods

- we can also define *function* as value to properties of object. These will be called *methods*. Methods are just functions but, it means they have been called in "reference" on an Object.

```

let person = {
  name: 'john',
  sayHi: function(){
    return "hi";
  }
}

person.sayHi() // hi

```

- methods can also access the *properties* and other *methods* of same object. To do this we use *this*

```

let person = {
  name: 'john',
  sayHi: function(){
    return "hi " + this.name;
  }
}

person.sayHi() // hi john

```

- we can also have used *person* instead of *this* but has you know references can be changed. so that could have created a problem

```
let person = {
  name:'john',
  sayHi: function(){
    return "hi "+ this.name;
  }
}
```

person.sayHi() // hi john

- you can even have *this* without an object

```
function sayHi(){
  return "hi "+ this.name;
}
sayHi() // Error
// here this will "undefined" in Strict mode
let obj1 = {name: 'john'}
let obj2 = {name: 'wick'}
```

// you can add functional property

```
obj1.say = sayHi;
obj2.say = sayHi;
```

obj1.say() // hi john
 obj2.say() // hi wick

- Arrow functions don't have a *this*. they use outer context

```
let person = {
  name:'john',
  sayHi: ()=> {
    return "hi "+ this.name;
  }
}
```

person.sayHi() // Error

Symbol

- JavaScript also has a *Symbol* data type. This data type is used as *property name* in Objects.
- Object can only have 2 types of *properties* - String and Symbol. If you put any other data type they will convert to String

```
let person = {
  0:'john',
  sayHi: ()=> {
    return "hi "+ this.name;
  }
}

person["0"] // this number will convert to string
```

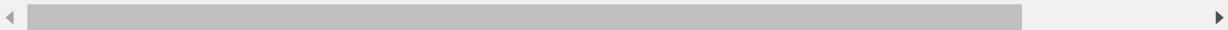
- *Symbol* is used for making hidden (library used properties)

```
const id = Symbol("id"); // "id" is descriptor

let person = {
  name:'john',
  [id]:1
}

person[id] // 1

// note that we have put square [] on property so that it is not confused with
```



- *Symbol* are always unique - so there is no chance of collision. Even with same "descriptor" they will be uniquely initialized.
- You can get *Symbol* for some descriptor or key using some methods

```
// get symbol by name
let sym = Symbol.for("name");
```

```
let sym2 = Symbol.for("id");
```

for..in loop ignore Symbols. Also methods like *Object.keys()* ignore these properties.

3. Functions

functions are objects

- they already have some predefined properties *name*, *length* etc
- you can also make more properties on functions (but generally it's not required, except for Constructor function)

```
function sayHi(greet){  
    return greet  
}  
sayHi.name // name of function  
sayHi.length // Length of arguments  
  
sayHi.count =0; // function can have properties  
sayHi.count++;  
sayHi.count;
```

function declaration are hoisted

```
sayHi() // works  
function sayHi(greet){  
    return greet  
}  
  
sayHello() // Error  
let sayHello = function(){ // functional expression  
  
}  
  
sayHello.name // sayHello
```

function can be called as constructor

```
function Person(name){
    this.name = name
}

const p = new Person('john') // constructor
```

Named function expression (NFE)

```
let sayHello = function fx(user){ // named functional expression

    if(user){
        return "hello " + user
    } else {
        return fx('anonymous')
    }
}

// this can help in case where sayHello is re-assiged to something

let sayHi = sayHello
sayHello = null
sayHi()
```

Decorator (Wrappers)

- It's a *design pattern* in which you modify the functionality of a function by covering it inside a wrapper.

```
let modifiedFx = Decorator(preDefinedFx)
```

Memoization (Caching)

```

function heavy(x) {
  console.log(x + ':heavy');
  return x + ':heavy';
}

function memoized(fx) {
  let map = new Map();

  return function (x) { // wrapper
    if (map.has(x)) {
      return map.get(x);
    } else {
      let memoValue = fx(x);
      map.set(x, memoValue);
      return memoValue;
    }
  };
}

let memoizedHeavy = memoized(heavy)
memoizedHeavy(2);
memoizedHeavy(2); // take from cache

```

Another Problem

- if you try to use this on a *method* of object, this approach can fail

```

let task = {
  name: 'demo',
  heavy(x) {
    console.log(x + ':heavy:' + this.name);
    return x + ':heavy' + this.name;
  },
};

function memoized(fx) {
  let map = new Map();
  return function (x) {
    if (map.has(x)) {

```

```

        return map.get(x);
    } else {
        let memoValue = fx(x);
        map.set(x, memoValue);
        return memoValue;
    }
};

task.memoizedHeavy = memoized(task.heavy)
task.memoizedHeavy(1) // 1:heavyundefined

```

Solution : use *function.call()*

changing 'this'

Call

```

person = {
    name: 'demo',
    age: 12,
    location: 'delhi',
};

function checkName(a) {
    return !!this.name;
}

checkName() // Error
checkName.call(person)
checkName.call(person, 1) // a = 1

```

apply

```

person = {
    name: 'demo',
    age: 12,
    location: 'delhi',
};

```

```

function checkName(a) {
    return !!this.name;
}

checkName() // Error
checkName.apply(person)
checkName.apply(person, [1]) // a = 1

```

bind

```

person = {
    name: 'demo',
    age: 12,
    location: 'delhi',
};

function checkName(a) {
    return !!this.name;
}

checkName() // Error
let boundCheckName = checkName.bind(person)
boundCheckName();

```

Solution

```

let task = {
    name: 'demo',
    heavy(x) {
        console.log(x + ':heavy:' + this.name);
        return x + ':heavy' + this.name;
    },
};

function memoized(fx) {
    let map = new Map();
    return function (x) {
        if (map.has(x)) {

```

```

        return map.get(x);
    } else {
        let memoValue = fx.call(this,x);
        map.set(x, memoValue);
        return memoValue;
    }
};

}

task.memoizedHeavy = memoized(task.heavy)
task.memoizedHeavy(1) // 1:heavydemo

```

Debounce

- Run a function only when - if it has not been called again for a fixed *period*
- Suppose you are typing and take a pause of 1 second. Only then that function should be called.

```

let count = 1;
function showCount() {
    count++;
    console.log({ count });
}

function debounce(fx, time) {
    let id = null;
    return function (x) {
        if (id) {
            clearTimeout(id);
        }
        console.log({ id });
        id = setTimeout(() => {
            fx(x);
            id = null;
        }, time);
    };
}

let showCountD = debounce(showCount, 2000);
setTimeout(showCountD, 1000);
setTimeout(showCountD, 1500);

```

```
setTimeout(showCountD, 2000);
setTimeout(showCountD, 2500);
setTimeout(showCountD, 5000);
```

Real Example

```
const el = document.getElementById('text1');
const logo = document.getElementById('text-output1');
el.addEventListener(
  'keyup',
  debounce(function (e) {
    logo.innerText = e.target.value;
  }, 1000)
);

<input type="text" id="text1">
<p id="text-output1"></p>
```

Throttle

- when you have to only allow 1 execution of a function within a *period* of time
- for example you are *scrolling* fast but only 1 scroll per 100 millisecond is considered.

```
let count = 1;
function showCount() {
  count++;
  console.log({ count });
}

function throttle(fx, time) {
  let id = null;
  let arg = [];
  return function (x) {
    arg[0] = x;
    if (!id) {
```

```

    id = setTimeout((() => {
      fx(arg[0]);
      id = null;
    }, time);
  }
  console.log({ id });
};

}

let showCountT = throttle(showCount, 2000);
setTimeout(showCountT, 1000);
setTimeout(showCountT, 1500);
setTimeout(showCountT, 2000);
setTimeout(showCountT, 2500);
setTimeout(showCountT, 5000);

```

Real Example

```

function throttle(fx, time) {
  let id = null;
  let arg = [];
  return function (x) {
    arg[0] = x;
    if (!id) {
      id = setTimeout((() => {
        fx(arg[0]);
        id = null;
      }, time));
    }
  };
}

function sayHi(){console.log('hi')}
document.addEventListerner('scroll',throttle(sayHi,1000))

```

Arrow functions

Differences

- they don't have *this*
- they don't have *arguments*,
- they can't be called with *new* (as constructor)

Similarities

- they have properties like *name*, *length*

4. Iterables, Generators

Iterables and Iterators

Iterable (protocol)

- *Iterables* are objects in which we can make array like iteration (Example using *for..of* loop or *spread operators*)
 - Array are *iterables*
 - String are *iterables*
- To make any object iterable we have these conditions
 - implement a *Symbol.iterator* property, which should be a function which return an *Iterator Object*

```
iterable[Symbol.iterator]() => Iterator
```

Iterator (protocol)

Iterators are objects which have :

- a *next()* method which return a object which is of format {*value*:-some-value-, *done*:- boolean-} e.g. `{value: 1, done: false}`
- **value** is the value we are interested in, while **done** tells us when to stop. Generally when *done:true* the *value:undefined*

Now, making an Iterable is like this:

```
let iterator = {
  i: 0,
  next: function () {
    return { value: this.i, done: this.i++ > 5 };
```

```

    },
};

let iterable = {
  name: 'john',
  age: 34,
  [Symbol.iterator]() {
    return iterator;
  },
};

```

Example - Range :

```

let range = {
  start: 0,
  end: 5,
  [Symbol.iterator]() {
    let that = this; // this line is very important
    let i = this.start;
    return { // iterator object
      next: function () {
        return { value: i, done: i++ > that.end };
      }
    };
  },
};

```

Array

```

let num = [1, 2, 3];
let iterator = num[Symbol.iterator]();
iterator.next();
iterator.next();
iterator.next();
iterator.next();

```

Infinite iterators

- As we can see that we can control, how to control the `next()` function. In few cases, it will be useful to have *iterators* which can need to generate the next value infinitely
- If you use such *iterators* in a loop etc. it can be dangerous as can create infinite loop. But can be controlled by `break` etc.
- we will cover all this in generators.

Iterables vs Array-like

- *Iterable* objects are based on `Symbol.iterator` method as defined above
- *Array-like* objects are based on array protocols (index and length)

An object can be

- *Iterable + Array-like*
- *Iterable* only
- *Array-like* only
- None of them (not *Iterable* nor *Array-like*)

Example :

```
// iterable + array-like
let arr = [1,2,3]

// only iterable
let range = {
  start: 0,
  end: 5,
  [Symbol.iterator]() {
    let that = this; // this line is very important
    let i = this.start;
    return {
      next: function () {
        return { value: i, done: i++ > that.end };
      },
    };
  },
};

// only array-like
let array = {
  0: 1,
```

```

1: 5,
length:2
};
```

```

// none
let obj = {
  name:'john'
}
```

Conversions

Array-like to Array

- **Array.from()** : method is used for this

```

let arrayLike = {
  0: 0,
  1: 5,
  length: 2
};

let arr = Array.from(arrayLike);

// also used for general things

let set = new Set()
set.add(1);
set.add(2);
let arr2 = Array.from(set) // [1,2]
```

Map

- this data type is also *iterable*
- special this is can have keys also as *numbers, booleans, objects*
- also map maintains the *order* of keys added.

```

let map = new Map();

let person = {name:'john'}
let personAccount = {balance: 5000}

map.set('1', 'str1');    // string key
map.set(1, 'num1');     // numeric key
map.set(true, 'bool1');
map.set(person, personAccount)

map.get(1) // 'num1'
map.get('1') // 'str1'
map.get(person) // { balance : 5000 }

map.size // 4

map.keys() // iterable of keys
map.values() // iterable of values
map.entries() // iterable of key-value pair

map.has(1) // key exists

```

Converting Object to Map

- We can use **Object.entries()** method for this.

```

let obj = {a:1,b:2,c:3};
let map = new Map(Object.entries(obj));

```

Converting Map to Object

- We can use **Object.fromEntries()** method for this.

```

let map = new Map();
map.set('a', 1);
map.set('b', 2);
map.set('c', 3);

```

```
let obj = (Object.fromEntries(map.entries())); // {a:1,b:2,c:3}
```

Set

- Set is another *iterable*
- Set only contains uniques elements

```
let set = new Set();

let obj1 = { name: "John" };
let obj2 = { name: "Jack" };
let obj3 = { name: "Peter" };

set.add(obj1);
set.add(obj2);
set.add(obj3);
set.add(obj2);
set.add(obj3);

// set keeps only unique values
set.size; // 3

set.keys() // iterable of keys
set.values() // iterable of values (Same as keys)
set.entries()
```

- duplicated values in *values()*, *entries()* etc are maintained to match *Map* compatibility

WeakMap and Weakset

- These are 2 alternative way of creating *Map* or *Set* like data types - when only object keys are considered.
- They have very limited operations and doesn't support all functionality
- Main purpose is that when *keys* are marked as *null* they are garbage collected. So this helps in better memory management

```

let weakMap = new WeakMap()
let person = {name:'john'}

weakMap.set(person, {...});

person = null // in future we decide to remove this key

// so weakMap will remove it from memory space automatically

```

Generators

- Easy way to create an *iterators* and *iterables*

```

function* generatorFunction(){
  yield 1;
  yield 2;
  yield 3
}

let generator = generatorFunction();
generator.next() // {value:1, done:false}
generator.next() // {value:2, done:false}
generator.next() // {value:3, done:false}
generator.next() // {done:true}

```

Infinite iterator

```

function* generator() {
  let i = 0;
  while (true) {
    yield i;
    i++;
  }
}

const gen = generator();

```

```

function createID(it) {
    return it.next().value;
}

createID(gen);
createID(gen);
createID(gen);
createID(gen);
createID(gen);

```

Generator objects are "iterables"

```

function* generatorFunction(){
    yield 1;
    yield 2;
    yield 3
}

let generator = generatorFunction();
let nums = [...generator] // [1,2,3]

```

NOTE: Don't put a *Spread operator* or *for..of* loop on infinite iterable

Range example - using generator

```

let range = {
    start: 0,
    end: 5,

    *[Symbol.iterator]() { // * makes it generator function
        for(let value = this.start; value <= this.end; value++) {
            yield value;
        }
    }
};

for(let r of range){
    console.log(r)
}

```

}

Better version - with function

```
function range(start,end){
  return {
    *[Symbol.iterator](){
      for(let value = start; value <= end; value++) {
        yield value;
      }
    }
  };
}

for(let r of range(1,5)){
  console.log(r)
}

let values = [...range(1,5)]
```

Better - Better version - with function

```
function* range(start,end){
  for(let value = start; value <= end; value++) {
    yield value;
  }
};

let generator = range(1,5)

console.log([...generator]) // [1,2,3,4,5]
```

return

- only difference it that instantly ends the iterator at that value;

```
function* generatorFunction(){
  yield 1;
  yield 2;
  return 3
}

let generator = generatorFunction();
generator.next() // {value:1, done:false}
generator.next() // {value:2, done:false}
generator.next() // {value:3, done:true} **
```

Generator - composition

- using *generator* inside another *generator* is easy

**Composed Generator using - yield*

```
function* range(start,end){
  for(let value = start; value <= end; value++) {
    yield value;
  }
};

function* multiRange(){
  yield* range(0,5),
  yield* range(100,105)
  yield* range(200,205)
}

let generator = multiRange();

console.log([...generator]) // [0, 1, 2, 3, 4, 5, 100, 101, 102, 103, 104, 105,
```



Generator can also take inputs

- `next()` method can also take arguments which act as return value of previous `yield` statement
- ```

function* generatorFunction(){
 let result = yield 1;
 console.log(result)
 let result2 = yield 2;
 console.log(result2)
 let result3 = yield 3
 console.log(result3)

}

let generator = generatorFunction();
let r1 = generator.next()
let r2 = generator.next(r1.value)
let r3 = generator.next(r2.value)
generator.next(r3.value)

```

## Async Iterators/ Async generators

---

### **without generators**

```

let range = {
 start: 0,
 end: 5,
 [Symbol.asyncIterator]() {
 let that = this; // this line is very important
 let i = this.start;
 return {
 next: async function () {
 await new Promise((resolve) => setTimeout(resolve, 1000));
 return { value: i, done: i++ > that.end };
 },
 };
 },
};

(async function () {

```

```

for await (let f of range) {
 console.log(f);
}
})();

```

### with generators

```

let range = {
 start: 0,
 end: 5,
 async *[Symbol.asyncIterator]() {
 for(let i = this.start; i <= this.end; i++) {
 await new Promise((resolve) => setTimeout(resolve, 1000));
 yield i
 };
 },
};

(async function () {
 for await (let f of range) {
 console.log(f);
 }
})();

```

### Real-life Example - Paginated API calls

- this example has also used *Composition* of generators

```

async function* getDataAsync(page) {
 let response = await fetch(
 'https://projects.propublica.org/nonprofits/api/v2/search.json?q=x&page=' + page
);
 let result = await response.json();
 for(let org of result.organizations){
 yield org.name;
 }
}

```

```
async function* getData() {
 let response = await fetch(
 'https://projects.propublica.org/nonprofits/api/v2/search.json?q=x'
);
 let result = await response.json();

 for (let i = 0; i <= result.num_pages; i++) {
 yield* await getDataAsync(i);
 }
}

(async function () {
 let orgs = []
 for await (let f of getData()) {
 orgs.push(f);
 }
 console.log(orgs); // List of all organization in API
})();
```

---

## 5. Prototypes

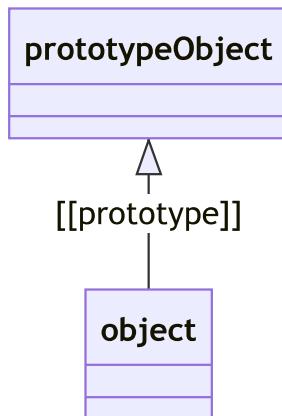
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### Prototypical Inheritance

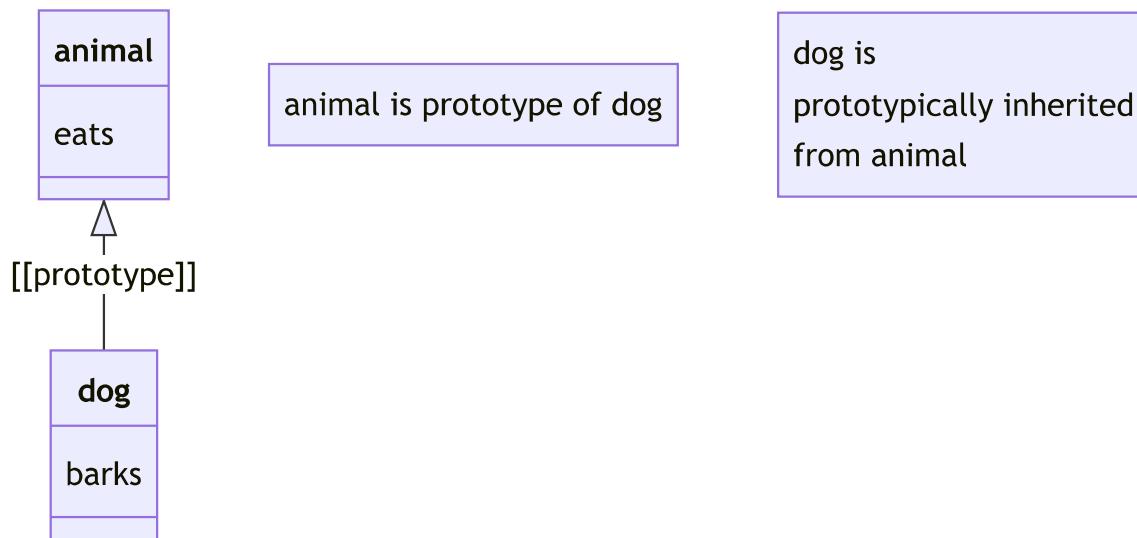
---

- Objects are *extended* from other Objects. And we can re-use their *properties* and *methods*.
- Objects are chained in *prototypical inheritance*
- Objects have a hidden property called `[[Prototype]]`

## Prototype Inheritance



### Prototype example



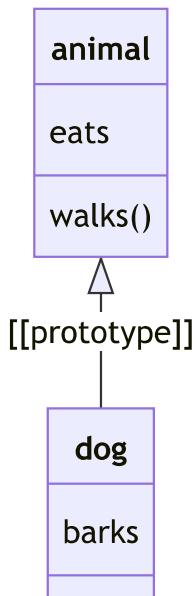
```

let animal = { eats: true };
let dog = { barks: true };
dog.__proto__ = animal;

dog.barks // true
dog.eats // true

```

## Prototype chaining

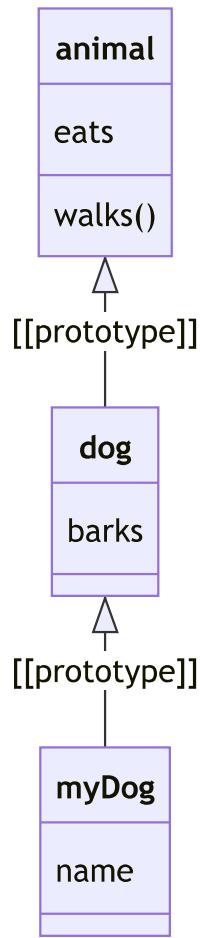


```
let animal = {
 eats: true,
 walks: function () {
 return 'walks';
 },
};
let dog = { barks: true };

dog.__proto__ = animal;

dog.walks() // walks
```

Prototype chain can be longer and longer



```

let animal = {
 eats: true,
 walks: function () {
 return 'walks';
 },
};

let dog = { barks: true };

let myDog = { name: 'sifu' };

```

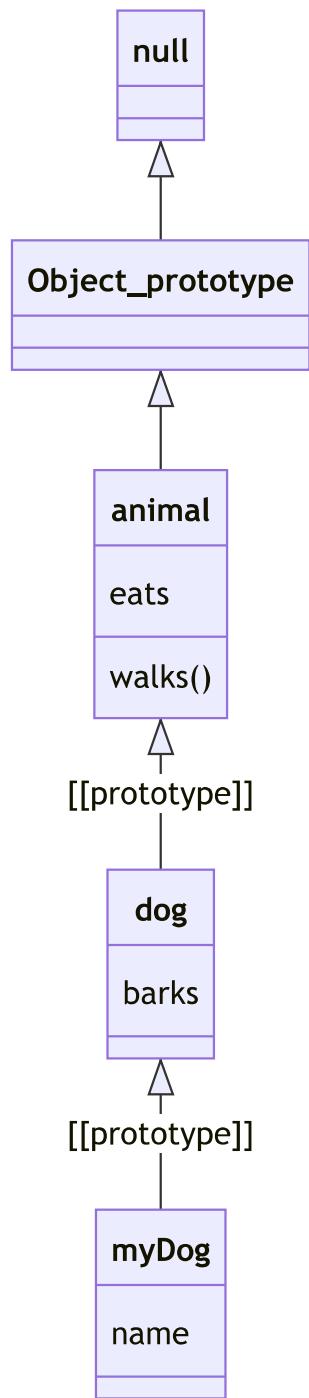
```

dog.__proto__ = animal;
myDog.__proto__ = dog;

myDog.name // sifu
myDog.barks // true
myDog.walks() // walks

```

Prototype end at "null"



## \_\_proto\_\_

- `__proto__` is a getter/setter for `[[Prototype]]`
- Writing property, doesn't call inherited properties. Except for getter/setter properties.

- `__proto__` is not used now, and recommended way is to use `Object.getPrototypeOf()` and `Object.setPrototypeOf`

```

let animal = {
 eats: true,
 walks: function () {
 return 'walks';
 },
};

let dog = { barks: true };
let myDog = { name: 'sifu' };

dog.__proto__ = animal;
myDog.__proto__ = dog;

myDog.walks = function(){
 return 'walks slowly'; // this will not affect prototype
}

myDog.walks() // walks slowly
dog.walks() // walks

```

- `for..in` loop works on all properties which are *enumerable - inherited or own*
- if you want to avoid looping on inherited ones use `Object.hasOwn` or `Object.prototype.hasOwnProperty`
- `Object.keys()` and `Object.values()` these will avoid inherited properties.

## .prototype property, constructor

---

### properties

```

// simple object initialization

let usr = {
 name : 'john'
}

```

```
// now using a constructor function
```

```
function User(name){
 this.name = name
}

let user = new User('john');

console.log(user)
// User{ name : 'john'}
console.log(usr)
// {name : 'john'}
```

- Step 1 : **.prototype** property is automatically created (on *User*) and is assigned an object (empty Object)

```
function User(name){
 this.name = name
}

let user = new User('john');

console.log(User.prototype) // prototype object
```

- Step 2 :**constructor** method is assigned to this prototype, and that is *User* function itself.

```
// User.prototype.constructor = User

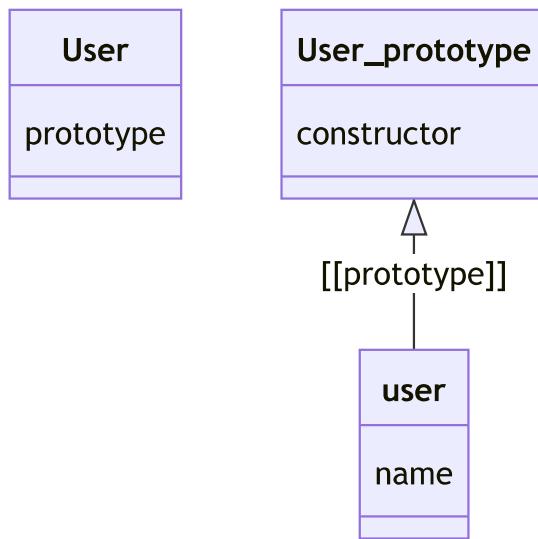
// this above assignment is done by the constructor call itself
User.prototype.constructor === User // true
```

- Step 3: **.prototype** property's object is assigned to created instances.

```
// user.__proto__ = User.prototype
// this above assignment is done by the constructor call itself
```

```
user.__proto__ === User.prototype // true
```

## .prototype property



## methods

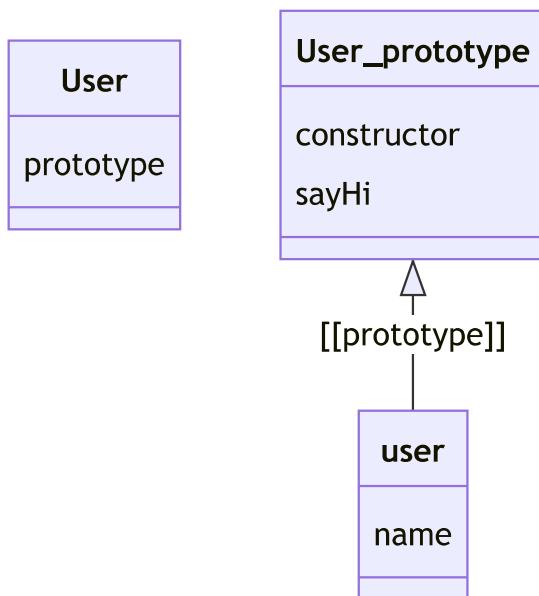
```
function User(name){
 this.name = name
}

User.prototype.sayHi = function () {
 return this.name;
};

let user = new User('john');
let user1 = new User('wick');

user.sayHi()
// 'john'
user1.sayHi();
// 'wick'
```

- this is the main benefit of prototypes. you can have inherited methods.  
.prototype property



A useful method : reverseString

## methods

```

function User(name){
 this.name = name
}

User.prototype.reverseName = function () {
 return this.name.split('').reverse().join('');
};

let user = new User('john');
let user1 = new User('wick');

user.reverseName()
// 'nhoj'
user1.reverseName();
// 'kicw'

```

- remember *prototype* based *methods* are directly available on their created *object instances*.
- you can also change the *prototype* completely, not recommended though

```
let animal = {
 eats: true,
 walks: function () {
 return 'walks';
 },
};

function Dog(){
 this.barks = true
}

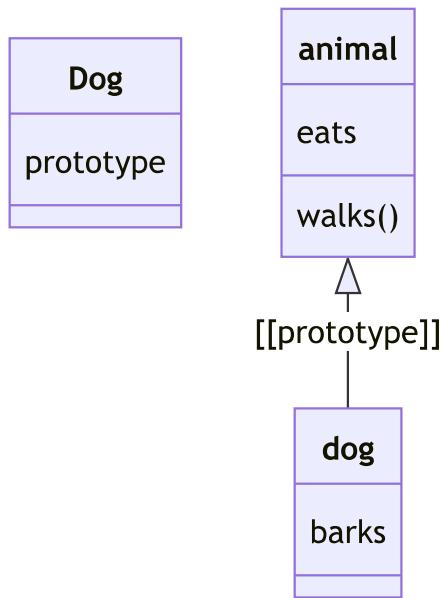
Dog.prototype = animal;

let dog = new Dog();

dog.walks()
// walks

dog.__proto__ === animal; // true
Dog.prototype === dog.__proto__ // true
```

## .prototype property



## Native Prototypes

---

- Object.prototype
- Array.prototype
- Function.prototype

### Object.prototype

```

let obj = {}

let obj1 = new Object();

Object.prototype === obj1.__proto__ // true
Object.prototype === obj.__proto__ // true

```

- `toString()`
- `isPrototypeOf()`
- `toLocaleString()`

### Array.prototype

```
let arr = []

let arr1 = new Array();

Array.prototype === arr1.__proto__ // true
Array.prototype === arr.__proto__ // true
```

- push()
- pop()
- slice()
- splice()
- reverse()
- ....and many more

## Function.prototype

```
function Fx(){

}

Function.prototype === Fx.__proto__ // true
```

- call()
- apply()
- bind()
- arguments
- caller
- length

## Date.prototype

```
let d = new Date();

d.getTime(); // getTime is given by Date.prototype
```

- `getTime()`
- `getDay()`
- `getDate()`
- .... more

## Primitives

---

Primitive types also get wrapped into a Object when used as an Object

### `String.prototype`

```
"hello".toString()
```

### `Number.prototype`

```
10.1111.toFixed(2)
```

### `Boolean.prototype`

## Polyfills

---

- polyfill is a way of providing futuristic API not available in browser.
- polyfills are made often Native prototype modifications, so that we can get a feature/API (which is not available in current browser)
- This can help us write code / libraries which can run on many systems (old or modern)

```
if(!Array.prototype.contains){
 Array.prototype.contains = function(searchElement) {
 return this.indexOf(searchElement)>=0 ? true : false
 }
}
```

```

 }
// similar to includes()

```

**NOTE :** Shims are piece of code to correct some existing behaviour, while Polyfills are new API/behaviours.

## Static properties and methods

---

Some properties and methods are directly created on these Native constructors.

- **Object.create()**
- **Object.keys()**
- **Object.values()**
- **Object.hasOwn()**
- **Array.from()**
- **Date.now()**

These are not available on instances, and only available on Native constructors

---

## 6. Class

---

Classes are *easier* way to implement inheritance in JavaScript.

---

### Syntactic Sugar

---

It's a syntactic sugar to *Prototypical Inheritance* BUT more functionalities than it.

*ProtoType Version*

```

function User(name){
 this.name = name
}

User.prototype.sayHi = function () {
 return this.name;
};

let user = new User('john');
user.sayHi() // john

```

*Class Version*

```

class User {
 constructor(name) {
 this.name = name;
 }

 sayHi() {
 return this.name;
 }
}

let user = new User('john');
user.sayHi() // john

```

**Similarities:**

1. Same kind of *prototype* property with constructor method is added when called with `new`;
2. you can use *prototype* also on class based things

```

class User {
 constructor(name) {
 this.name = name;
 }

 sayHi() {
 return this.name;
 }
}

User.prototype.sayHello = function(){
 return "hello "+this.name;
}

let user = new User('john');
user.sayHello() // hello john

```

## Differences:

1. Class methods are *non-enumerable*
2. Class `toString()` is different
3. Class can only be called with `new`. Not as a normal function
4. Class is always in *use strict* mode.

## getter/setters

---

- Accessor properties can also be used in class

```
class User {
 constructor(firstName, lastName) {
 this.firstName = firstName;
 this.lastName = lastName;
 }

 get fullName(){
 return this.firstName + ' ' + this.lastName;
 }
 set fullName(_fullName){
 this.firstName = _fullName.split(' ')[0];
 this.lastName = _fullName.split(' ')[1];
 }
}

let user = new User('john', 'wick');
user.fullName // john wick
user.fullName = "john cena"

user.firstName // john
user.lastName // cena
```

## Computed property names

---

- properties which don't have a fixed name and assigned by [ ]

```
let variableName = "hello"
class User {
```

```

constructor(name) {
 this.name = name;
}

[variableName]() {
 return this.name;
}
}

let user = new User('john');
user.hello() // john```

```

## "this" binding issue

---

```

class Button {
 constructor(value) {
 this.value = value;
 }

 click() {
 return this.value;
 }
}

let button = new Button("play");

button.click() // play

setTimeout(button.click, 1000);
// this has issue - this has changed here

```

- here we lose the context of this.

### 2 Solution exists :

1. Arrow functions : use arrow function wrappers.

```
setTimeout(()=>button.click(), 1000);
```

2. use `.bind()` to constructor object.

```
setTimeout(button.click.bind(button), 1000);
```

Also you can add this **arrow** style function in class definition - which will act as class field

```
class Button {

 constructor(value) {
 this.value = value;
 }

 click = () => { // this is a class field
 return this.value;
 }
}

let button = new Button("play");

button.click() // play

setTimeout(button.click, 1000);
```

## Inheritance

---

- We can inherit Parent Class properties and methods in a Child Class. using `extends` keyword
- Here we have **Shape** as *Parent* and **Rectangle** as *Child* :

```
class Shape {
 constructor(name) {
 this.name = name;
 }
 displayShape() {
```

```
 return 'Shape ' + this.name;
 }
}

class Rectangle extends Shape {
}

let rect1 = new Rectangle('rect1');

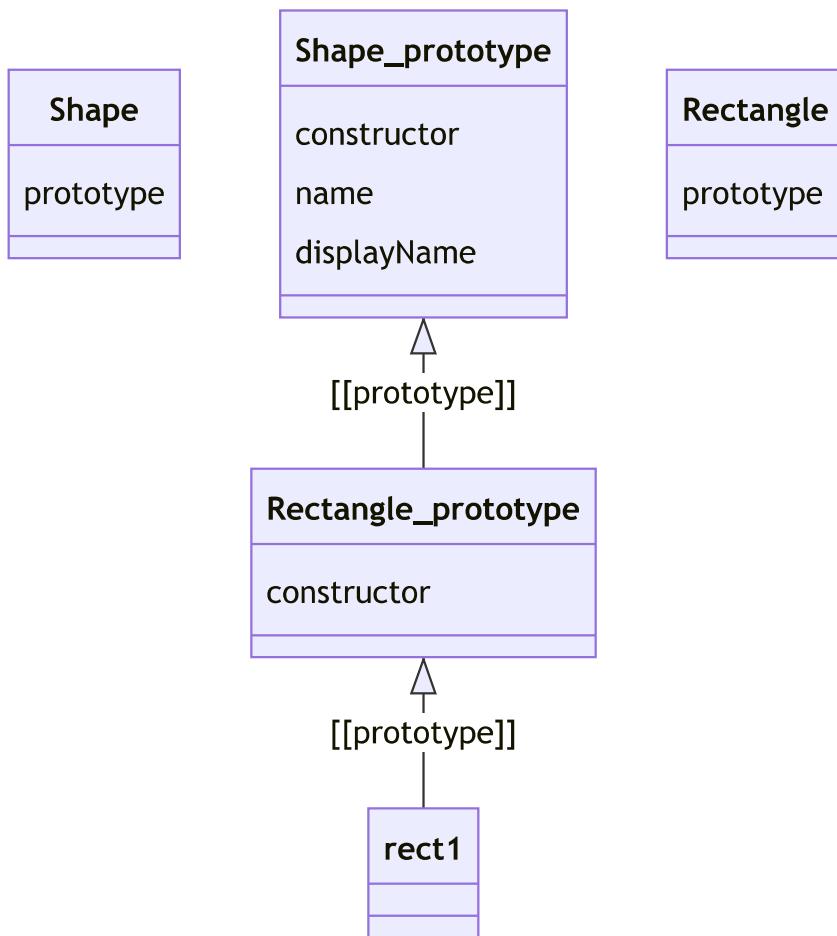
rect1.displayShape(); // Shape rect1

// constructor of Child is implicitly created and it calls constructor of Parer

// constructor(...args){
// super(..args)
// }
```



## .prototype property



- Now adding more properties to *constructor* of Rectangle. You have to call *super constructor* - which will call *Shape constructor*.

```

class Shape {
 constructor(name) {
 this.name = name;
 }
 displayShape() {
 return 'Shape ' + this.name;
 }
}

class Rectangle extends Shape {
 constructor(name, width, height) {
 super(name);
 this.width = width;
 this.height = height;
 }
}

```

```

 this.area = width * height;
}
}

let rect1 = new Rectangle('rect1', 10, 11);
rect1.displayShape();
rect1.area;

```

## Static Methods

---

- We can have *methods* on *constructor* function also.
- These methods are called *static* methods and they don't apply on *prototype*. So they are not accessible to created objects also.
- Use of such methods is limited to Class wide applications
- *this* remains same as the *class*

```

class Shape {
 constructor(name,area) {
 this.name = name;
 this.area = area;
 }
 static areEqual(shape1, shape2){
 return shape1.name === shape2.name && shape1.area === shape2.area
 }
}

let s1 = new Shape('rectangle',100)
let s2 = new Shape('rectangle',100)

Shape.areEqual(s1,s2) // true

```

- *static* property are also available as a new feature, but rarely used.

## Private and Protected properties

---

- in Object Oriented Programming there is a concept of *Encapsulation* or *Data Hiding* - so that you just interact with object via given methods/properties. This avoids changing some internal properties which are not meant for public use.

```
class User {
 type = "admin"
 constructor(name) {
 this.name = name;
 }
}

let user = new User('john')
user.type = "normal"
```

- properties type and name both are accessible - so they are called public

## Protected

- this is something not provided by javascript but by convention and *get/set* method we can create it
- you have to use convention of \_ in front of property name - making it known to developer that this property is not directly accessible and used only via *get/set* accessors.

```
class User {
 _type = "admin"
 constructor(name) {
 this.name = name;
 }
 get type(){
 return this._type
 }
 set type(type){
 this._type = type;
 }
}
```

```
let user = new User('john')
user.type = "normal"
```

But what is benefit ?

```
class User {
 _type = "admin"
 constructor(name) {
 this.name = name;
 }
 get type(){
 return this._type
 }
 set type(type){
 if(type==('normal' || 'admin')){
 this._type = type;
 } else {
 throw Error('admin / normal ?')
 }
 }
}

let user = new User('john')
user.type = "normal"
```

## Private

- this is a new feature and is not very frequently used.
- you can name any property with #

```
class User {
 #type = "admin"
 constructor(name) {
 this.name = name;
 }
 get type(){
 return this.#type
 }
 set type(type){
 if(type==('normal' || 'admin')){
 this.#type = type;
 } else {
```

```

 throw Error('admin / normal ?')
 }
}

let user = new User('john')
user.type = "normal"
user.#type // Error

```

## instanceOf

---

- to check if object is instance of a Class or inherited from a Class

```

class Shape {
 constructor(name) {
 this.name = name;
 }
 displayShape() {
 return 'Shape ' + this.name;
 }
}

class Rectangle extends Shape {
 constructor(name, width, height) {
 super(name);
 this.width = width;
 this.height = height;
 this.area = width * height;
 }
}

let rect1 = new Rectangle('rect1', 10, 11);

rect1 instanceof Rectangle // true
rect1 instanceof Shape // true

```

---

## 7. Async JavaScript

---

### Asynchronous APIs

---

- JavaScript itself is not asynchronous language it uses some API from browser or environment to achieve this behaviour

```
console.log(1)
setTimeout(console.log,1000,3); // Timer API
console.log(2)
```

- Now suppose, we have a function which does something meaningful and return a value - but *asynchronously*.

```
function sum(a, b) {
 return a + b
}

let asyncFx =(a,b)=>setTimeout(()=>sum(a,b),1000)
```

How to get that value back in program ??

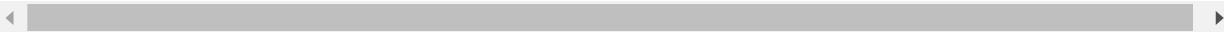
### Callbacks

---

```
function sum(a, b) {
 return a + b
}

let asyncFx = (a,b,cb)=>setTimeout(()=>cb(sum(a,b)),1000)
// callback is passed from outside, and called from inside of async function.

asyncFx(3, 1, function (result) {
 console.log({result})
})
```



## Errors

```

function sum(a, b) {
 if(a>0 && b>0){
 return [null,a + b]
 } else{
 return ['input', null]
 }
}

let asyncFx = (a,b,cb)=>setTimeout(()=>cb(...sum(a,b)),1000)

asyncFx(3, 1, function (error,result) {
 if(error){
 console.log({result})
 } else{
 console.log({error})
 }
})

```

## Multiple callbacks

```

function sum(a, b) {
 if(a>0 && b>0){
 return [null,a + b]
 } else{
 return ['input', null]
 }
}

let asyncFx = (a,b,cb)=>setTimeout(()=>cb(...sum(a,b)),1000)

let x = 4;
let y = 5;

asyncFx(3, 1, function (error, result) {
 console.log({ result });
}

```

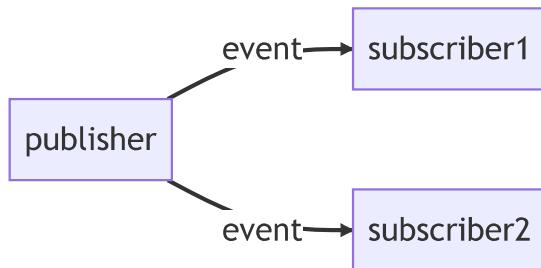
```
asyncFx(x, result, function (error, result) {
 console.log({ result });
 asyncFx(y, result, function (error, result) {
 console.log({ result }); // Callback hell
 });
});
});
```

## Promise

---

- Promise are based on *Publish-Subscribe* pattern.

### Publish Subscriber model



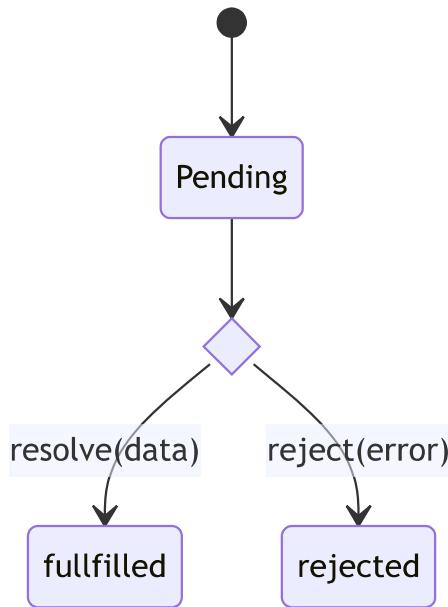
**Example :** Youtube video release

- *subscribers* are people who are subscribed to channel (with bell icon)
- *publisher* is video uploader channel
- When the *release event* happens, automatically people are notified about the released video.

### Promise constructor

```
let promise = new Promise((resolve, reject)=>{
 // async task is inside this
 // if async task is successful
 resolve(data);
 // else task is having error
 reject(error)
})
```

## Promise has many states



## Promise Consumers

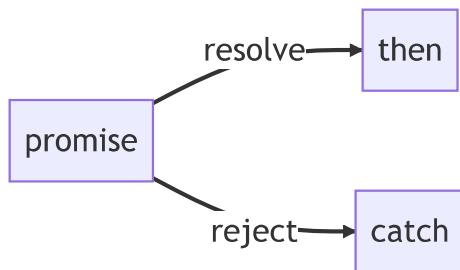
```

let promise = new Promise((resolve, reject)=>{
 // async task is inside this
 // if async task is successful
 resolve(data);
 // else task is having error
 reject(error)
})

```

`promise.then(successCallback).catch(errorCallback)`

## then-catch subscribers



### Callback version

```

function sum(a, b) {
 if(a>0 && b>0){
 return [null,a + b]
 } else{
 return ['input', null]
 }
}

let asyncFx = (a,b,cb)=>setTimeout(()=>cb(...sum(a,b)),1000)

asyncFx(3, 1, function (error,result) {
 if(error){
 console.log({result})
 } else{
 console.log({error})
 }
})

```

### Promise version

```

function sum(a, b) {
 if (a > 0 && b > 0) {
 return [null, a + b];
 } else {
 return ['input not correct', null];
 }
}

let asyncFx = (a, b) =>
 new Promise((resolve, reject) => {
 setTimeout(() => {
 let output = sum(a, b);
 if (output[0]) {
 reject(output[0]);
 } else {

```

```

 resolve(output[1]);
 }
}, 1000);
});

asyncFx(-2,4)
.then(data=>console.log(data))
.catch(err=>console.log(err))

```

## Promise chain

---

```

asyncFx(1, 4)
.then((data) => {
 console.log(data);
 return asyncFx(1, 4);
})
.then((data) => {
 console.log(data);
 return asyncFx(3, 6);
})
.then((data) => {
 console.log(data);
})
.catch((err) => console.log(err));

```

*Note : catch is only one it catches for all above then. Also note that catch works for reject and also any error throw by code.*

### finally

```

asyncFx(1, 4)
.then((data) => {
 console.log(data);
 return asyncFx(1, 4);
})
.then((data) => {
 console.log(data);
 return asyncFx(3, 6);
}

```

```

 })
 .then((data) => {
 console.log(data);
 })
 .catch((err) => console.log(err));
 finally(()=>{
 doSomething() // after everything is completed
 })
)

```

## Promise API

---

### Promise.all

Parallel execution of async functions - only work when *all promises are fulfilled*

```

Promise.all([
 asyncFx(1,2),
 asyncFx(2,3),
 asyncFx(5,6)
]).then(results=>{
 console.log(results) // array of resolved value, same order
})

```

### Promise.allSettled

Parallel execution of async functions - only work when *all promises are fulfilled or rejected*

```

Promise.allSettled([
 asyncFx(1,2),
 asyncFx(2,3),
 asyncFx(5,6)
]).then(results=>{
 console.log(results) // array of resolved/reject objects, same order
})

```

## Promise.race

Parallel execution of async functions - works when *any one of promises are fulfilled or rejected*

```
Promise.race([
 asyncFx(1,2),
 asyncFx(2,3),
 asyncFx(5,6)
]).then(results=>{
 console.log(results) // value of first settled (resolved/rejected) promise
})
```



## Promise.any

Parallel execution of async functions - works when *any one of promises are fulfilled*

```
Promise.race([
 asyncFx(1,2),
 asyncFx(2,3),
 asyncFx(5,6)
]).then(results=>{
 console.log(results) // value of first fulfilled promise
})
```

## Promise.reject

created already promise which gets rejected just after creation

```
let promise = Promise.reject('error')
```

## Promise.resolve

created already promise which gets resolved just after creation

```
let promise = Promise.resolve(123)
```

## Async/Await

---

- *async* keyword makes every function to return promise.

```
async function sayHi(){
 return "hi"
}

sayHi().then(result=>console.log(result)) // hi
```

- "hi" is wrapped inside using `Promise.resolve`
- we can use *await* only inside a *async* function
- *await* is a *syntactic sugar* for `Promise.then()`\*

```
function sum(a, b) {
 if (a > 0 && b > 0) {
 return [null, a + b];
 } else {
 return ['input not correct', null];
 }
}

let asyncFx = (a, b) =>
 new Promise((resolve, reject) => {
 setTimeout(() => {
 let output = sum(a, b);
 if (output[0]) {
 reject(output[0]);
 } else {
 resolve(output[1]);
 }
 }, 1000);
 });

async function init() {
```

```

let result = await asyncFx(4, 5);
console.log({ result });
}

init();

```

## Handling Error in Async/Await function

```

async function init() {
 try {
 let result = await asyncFx(4, 5);
 console.log({ result });
 } catch (err) {
 console.log(error);
 }
}

init();

```

- **async** works for all promise-compatible things

```

async function init() {
 let results = await Promise.all([
 asyncFx(1, 2),
 asyncFx(2, 3),
 asyncFx(5, 6),
]);
 console.log(results)
}

```

Move to Async Generators ==

---

## Property of Object

---

3 criteria to check on every property

1. own or inherited
2. enumerable or non-enumerable
3. String or Symbol

## Property configurations

1. writeable - true/false
2. configurable - true/false
3. enumerable - true/false
4. value : value of property

```
object1 = {property1:42}
```

```
Object.defineProperties(object1, {
 property1: {
 value: 42,
 writable: true,
 enumerable: true,
 configurable: true
 },
 property2: {}
});
```

## Strict Mode

It shows up many *silent* errors in JavaScript.

```
'use strict' // file Level strict mode

function myStrictFunction() {
 // Function-level strict mode syntax
 "use strict";

}
```

- *window* global object is not available
- *assigning* a variable *without declaration* cause issues

```
variable = 10
```

- *duplicate property name* throw error

```
let obj = {a:1,a:2}
```

## Object Constructor API

1. **Object()** : new Object() and Object() are same
2. **Object.prototype.constructor** : instance of object created will have constructor set to the reference of creator function. Not enumerable

```
const o1 = {};
o1.constructor === Object; // true
```

```
const o2 = new Object();
o2.constructor === Object; // true
```

```
const a1 = [];
a1.constructor === Array; // true
```

```
const a2 = new Array();
a2.constructor === Array; // true
```

```
const n = 3;
n.constructor === Number; // true
```

3. **Object.prototype.\_\_proto\_\_** :

- it's simple an accessor property of Object.prototype
- should not be used as deprecated
- use instead Object.getPrototypeOf and Object.setPrototypeOf
- It will give same results as Array.prototype if applied on array object.

4. **Object.assign()** : used to copy all the property from source object (objects) to a target object.

- copies enumerable and own properties ONLY

- not suitable to copy getter/accessors - as it only copies the value.
- String and Symbol both type of properties are copied.
- Only for Shallow Copy

```
const target = { a: 1, b: 2 };
const source = { b: 4, c: 5 };

const returnedTarget = Object.assign(target, source);

console.log(target);
// Expected output: Object { a: 1, b: 4, c: 5 }

console.log(returnedTarget === target);
// Expected output: true
```

## 5. **Object.create()** : creates a new empty object, with an existing object as prototype

- should not be used these days, better to use class syntax
- don't set constructor automatically its an issue
- {} (Object initializer syntax) is syntactic suger to this syntax only

```
o = {};
// Is equivalent to:
o = Object.create(Object.prototype);

o = Object.create(Object.prototype, {
 // foo is a regular data property
 foo: {
 writable: true,
 configurable: true,
 value: "hello",
 enumerable: true,
 },
 // bar is an accessor property
 bar: {
 configurable: false,
 get() {
 return 10;
 },
 set(value) {
 console.log("Setting `o.bar` to", value);
 },
 },
});
```

```

 },
});

o = Object.create(null);
// Is equivalent to:
o = { __proto__: null };

```

```

function Constructor() {}
o = new Constructor();
// Is equivalent to:
o = Object.create(Constructor.prototype);

```

6. **Object.defineProperties()**: defines new properties or modifies old ones,directly on object,  
return the object

```

const object1 = {};

Object.defineProperties(object1, {
 property1: {
 value: 42,
 writable: true,
 enumerable: true,
 configurable: true
 },
 property2: {}
});

console.log(object1.property1);
// Expected output: 42

```

7. **Object.defineProperty()**: defines a new property or modifies old one ,directly on object,  
return the object

```
Object.defineProperty(object1, 'property1', {
 value: 42,
 writable: false
});

object1.property1 = 77;
// Throws an error in strict mode

console.log(object1.property1);
// Expected output: 42
```

8. **Object.entries()** : array of array of key-value pairs on an object property (own, enumerable)

9. **Object.freeze()** : Freezing objects makes properties non-writable and non-configurable.

- Highest integrity level of JS object. *Object.isFrozen()* checks if object is frozen.

10. **Object.fromEntries()** : key-value pairs (inside an iterable, array or Map) are converted in object.

- convert Map to an Object
- convert Array to an Object
- transform object

```
// Map to Object
const map = new Map([
 ["foo", "bar"],
 ["baz", 42],
]);
const obj = Object.fromEntries(map);
console.log(obj); // { foo: "bar", baz: 42 }

// Transform object

const object1 = { a: 1, b: 2, c: 3 };

const object2 = Object.fromEntries(
 Object.entries(object1).map(([key, val]) => [key, val * 2]),
);

console.log(object2);
// { a: 2, b: 4, c: 6 }
```

11. **Object.getOwnPropertyDescriptor()** : return configuration object of a specific property. that object is mutable but won't affect the original configurations  
**Object.getOwnPropertyDescriptors()** - is similar to this but return configuration of all properties at once.

```
const object1 = {
 property1: 42
};

const descriptor1 = Object.getOwnPropertyDescriptor(object1, 'property1');

console.log(descriptor1.configurable);
// Expected output: true

console.log(descriptor1.value);
// Expected output: 42
```

12. **Object.getOwnPropertyNames()** : array of all properties *including non-enumerable* but not "Symbols" only "Strings". Similary to this is *Object.getOwnPropertySymbols()* which takes only "Symbols"

```
// Only getting enumerable properties - trick
const target = myObject;
const enumAndNonenum = Object.getOwnPropertyNames(target);
const enumOnly = new Set(Object.keys(target));
const nonenumOnly = enumAndNonenum.filter((key) => !enumOnly.has(key));

console.log(nonenumOnly);
```

13. **Object.getPrototypeOf()** : get the prototype of an Object

```
const proto = {};
const obj = Object.create(proto);
Object.getPrototypeOf(obj) === proto; // true
```

14. **Object.hasOwn()** : return true if own property. *Object.hasOwnProperty()* is older version of same.

```
const object1 = {
 prop: 'exists'
};

console.log(Object.hasOwn(object1, 'prop'));
// Expected output: true

console.log(Object.hasOwn(object1, 'toString'));
// Expected output: false

console.log(Object.hasOwn(object1, 'undeclaredPropertyValue'));
// Expected output: false
```

15. **Object.is()** : two values are same or not, including primitives

- Its almost same as === but it also differentiate +0 and -0 and NaN

16. **Object.isExtensible()** : true if you can add more properties to an object.

17. **Object.prototype.isPrototypeOf()** : check if object exists in another object's proto chain

```
function Foo() {}
function Bar() {}

Bar.prototype = Object.create(Foo.prototype);

const bar = new Bar();

console.log(Foo.prototype.isPrototypeOf(bar));
// Expected output: true
console.log(Bar.prototype.isPrototypeOf(bar));
// Expected output: true
```

18. **Object.keys()** : array of keys (own, enumerable, string type)

19. **Object.preventExtensions()** : prevents adding of new properties, also prevents re-assignment of prototype value.

20. **Object.prototype.propertyIsEnumerable()** : check if enumerable own property.

21. **Object.seal()** : seals objects for further addition of new properties, and also make configurable: false for all properties. but allow old property value modifications.

22. **Object.setPrototypeOf()** :

```
const obj = {};
const parent = { foo: 'bar' };

console.log(obj.foo);
// Expected output: undefined

Object.setPrototypeOf(obj, parent);

console.log(obj.foo);
// Expected output: "bar"
```

23. \*\*Object.prototype.LocaleString() :

```
const date1 = new Date(Date.UTC(2012, 11, 20, 3, 0, 0));

console.log(date1.toLocaleString('ar-EG'));
// Expected output: "٢٠١٢/١٢/٢٠ ٣:٠٠:٠٠"

const number1 = 123456.789;

console.log(number1.toLocaleString('de-DE'));
// Expected output: "123.456,789"
```

24. **Object.prototype.toString()** : for converting object in String format

25. **Object.prototype.valueOf()** : for converting Object in primitive values by when primitive value is expected.

26. **Object.values()** : array of vaules (own, enumbeable,string keyed)