**03 Prototypes**

**1) Inheritance**:

Inheritance is one of the core concepts of object-oriented programming that enables an object to take on the properties and methods of another object. And this makes it easy to reuse code in different parts of an application.

**Example**:

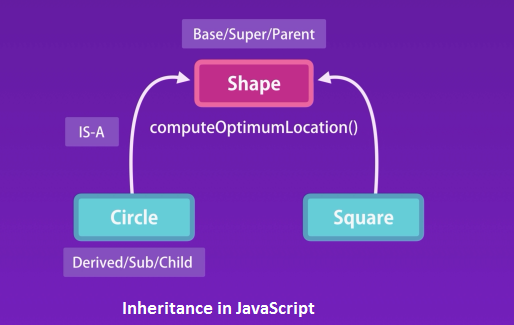
Suppose we have a "Circle" class and inside it we have "computeOptimumLocation()" method. Now in our application we have another class called "Square" and it also need the method same method "computeOptimumLocation ()".

Imagine the implementation of this method is exactly the same across these two different classes; we don’t want to repeat this implementation. Because if there is a bug in this implementation, we have to fix it in multiple places. Or if we want to change the implementation and make it better, again, we have to repeat this in different places.

For resolve this type of problem inheritance concept comes to the rescue.

We can define a new class called "Shape", put the "computeOptimumLocation ()" in this class. Then "Circle" and "Square" inherit this method, from the "Shape" class.

**Diagram**:



**Classical vs. Prototypical Inheritance in JavaScript**:

In the above we discuss the classical definition of inheritance. But in JavaScript, we don’t have classes, we only have objects. For these reason prototypical inheritances comes in the picture. So essentially we have two types of inheritance, classical and prototypical.

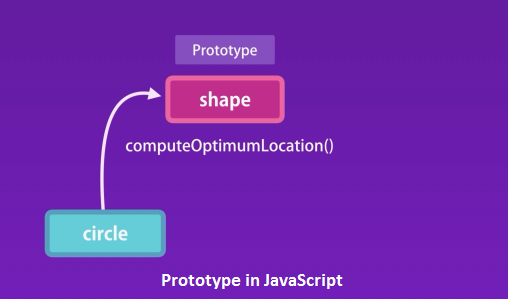
**2) Prototypes and Prototypical Inheritance**:

In JavaScript we don’t have classes. We only have objects. In JavaScript we have to implements inheritance only using objects.

Here we have a "Shape" object. We can define another object name "Circle" and add all the common behavior of "Shape" object like in "Circle" Object. Suppose in "Shape" object we have "computeOptimumLocation ()" method and we want to add this in "Circle" object. For this, somehow we have to create a link between the two objects. Now we refer to the "Shape" object as the prototype of the "Circle" object.

So prototype is essential a parent of another object. Every object in JavaScript (Except only a single object) has a prototype or parent. And it inherits all the members define in its prototype.

**Diagram**:



**Example**:

In Firefox developer tool in the console define a new object named x.

let x = {}

If we print x we will see a property called "Object { }". This property is duplicated and we don’t directly access it. This only available here to only help for troubleshoot problems.

If we expand this we will see the prototype or parent for the x object

{}

<prototype>: {…}

\_\_defineGetter\_\_: function \_\_defineGetter\_\_()

\_\_defineSetter\_\_: function \_\_defineSetter\_\_()​​

\_\_lookupGetter\_\_: function \_\_lookupGetter\_\_()​​

\_\_lookupSetter\_\_: function \_\_lookupSetter\_\_()​​

…………..

**Diagram**:



We have x object in memory and x has a link to another object which is its prototype. For discussion lets call this object objectBase (It’s not an official name).

So every object that we create in JavaScript directly or indirectly inherits from object base. ObjectBase is the root of all objects in JavaScript and it doesn’t have a prototype or parent.

**Diagram**:

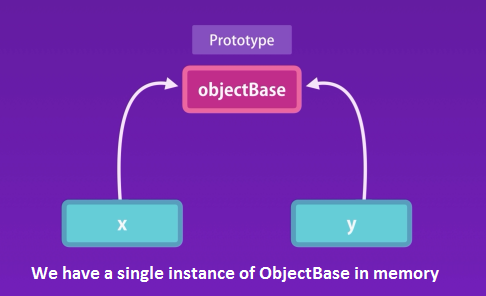


Here we see that ObjectBase doesn’t have a prototype or parent.

**We have a single instance of ObjectBase in memory**:

All of JavaScript object reference to ObjectBase and it has a single instance in memory.

**Diagram**:



**Example**:

let x = {};

let y = {};

let c = Object.getPrototypeOf(x) === Object.getPrototypeOf(y);

console.log(c); *//true*

console.log(x.\_\_proto === y.\_\_proto); *//true*

When we access a property or a method on an object JavaScript engine first looks for that property or method on that object itself. If it cannot find it, then it looks at the prototype for that object. This is prototypical inheritance.

When accessing a prototype or a method on an object JavaScript engine works up the prototype chain to find the target member.

**3) Multi-level Inheritance**:

JavaScript support multilevel inheritances. In console if we declare an array and we see the property of the array we will see the following property.

let myArray = [];

myArray

[]​

length: 0​

<prototype>: []​​ **//prototype property of the array**

concat: function concat()​​

constructor: function Array()​​

copyWithin: function copyWithin()​​

entries: function entries()​​

every: function every()​​

fill: function fill()​​

filter: function filter()​​

find: function find()​​

findIndex: function findIndex()​​

flat: function flat()​​

flatMap: function flatMap()​​

forEach: function forEach()​​

includes: function includes()​​

indexOf: function indexOf()​​

join: function join()​​

keys: function keys()

​​lastIndexOf: function lastIndexOf()

​​length: 0​​

map: function map()

​​pop: function pop()

​​push: function push()

​​reduce: function reduce()

​​reduceRight: function reduceRight()

​​reverse: function reverse()

​​shift: function shift()

​​slice: function slice()

​​some: function some()

​​sort: function sort()

​​splice: function splice()

​​toLocaleString: function toLocaleString()

​​toSource: function toSource()

​​toString: function toString()

​​unshift: function unshift()

​​values: function values()

​​Symbol(Symbol.iterator): function values()

​<prototype>: {…} **// another proto property which is object base**

​​​\_\_defineGetter\_\_: function \_\_defineGetter\_\_()

​​​\_\_defineSetter\_\_: function \_\_defineSetter\_\_()

​​​\_\_lookupGetter\_\_: function \_\_lookupGetter\_\_()

​​​\_\_lookupSetter\_\_: function \_\_lookupSetter\_\_()

​​​constructor: function Object()

​​​hasOwnProperty: function hasOwnProperty()

​​​isPrototypeOf: function isPrototypeOf()

​​​propertyIsEnumerable: function propertyIsEnumerable()

​​​toLocaleString: function toLocaleString()

​​​toSource: function toSource()

​​​toString: function toString()

​​​valueOf: function valueOf()

​Here we have a prototype property of the array. All this methods are define in this array objects which

is the prototype or parent for all arrays in JavaScript. So in memory we have

**myArray ------(derive from)------> arrayBase**

After that we have another proto property which is object base. This is the root object in JavaScript. In memory

**myArray ------(derive from)------> arrayBase ------(derive from)------> objectBase**

This process is called multilevel inheritances.

**Multilevel inheritance and custom constructor**:

Suppose we have a constructor named "Circle" and using it we create a "circle" object.

function Circle(radious){

*this*.radious = radious;

*this*.draw = function(){

console.log("draw");

};

}

const circle = new Circle(10);

In Console

circle

Circle {radious: 10, draw: ƒ}

draw: ƒ ()

radious: 10

\_\_proto\_\_: //protype for all circle object

constructor: ƒ Circle(radious)

\_\_proto\_\_: //Object Base

constructor: ƒ Object()

hasOwnProperty: ƒ hasOwnProperty()

isPrototypeOf: ƒ isPrototypeOf()

propertyIsEnumerable: ƒ propertyIsEnumerable()

toLocaleString: ƒ toLocaleString()

toString: ƒ toString()

valueOf: ƒ valueOf()

\_\_defineGetter\_\_: ƒ \_\_defineGetter\_\_()

\_\_defineSetter\_\_: ƒ \_\_defineSetter\_\_()

\_\_lookupGetter\_\_: ƒ \_\_lookupGetter\_\_()

\_\_lookupSetter\_\_: ƒ \_\_lookupSetter\_\_()

get \_\_proto\_\_: ƒ \_\_proto\_\_()

set \_\_proto\_\_: ƒ \_\_proto\_\_()

Here for circle object we have a prototype. This prototype is the prototype for all circle objects that we create using our Circle constructor. Every time we call the circle constructor "new Circle(10)" to create a new circle object this constructor will create a new object and set it’s prototype to circle base.

In other words object created by a giving constructor will have the same prototype. All circle objects created by the Circle constructor will have the same prototype, and similarly all arrays object created by the array constructor have same prototype.

So in memory

**circle ------(derive from)------> circleBase ------(derive from)------> objectBase**

**4) Property Descriptors**:

**5) Constructor Prototypes**:

**6) Prototype vs. Instance Members**:

**7) Iterating Instance and Prototype Members**:

**8) Avoid Extending the Built-in Objects**:

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