Patterns

December 2022

Agenda

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2 CREATIONAL PATTERNS

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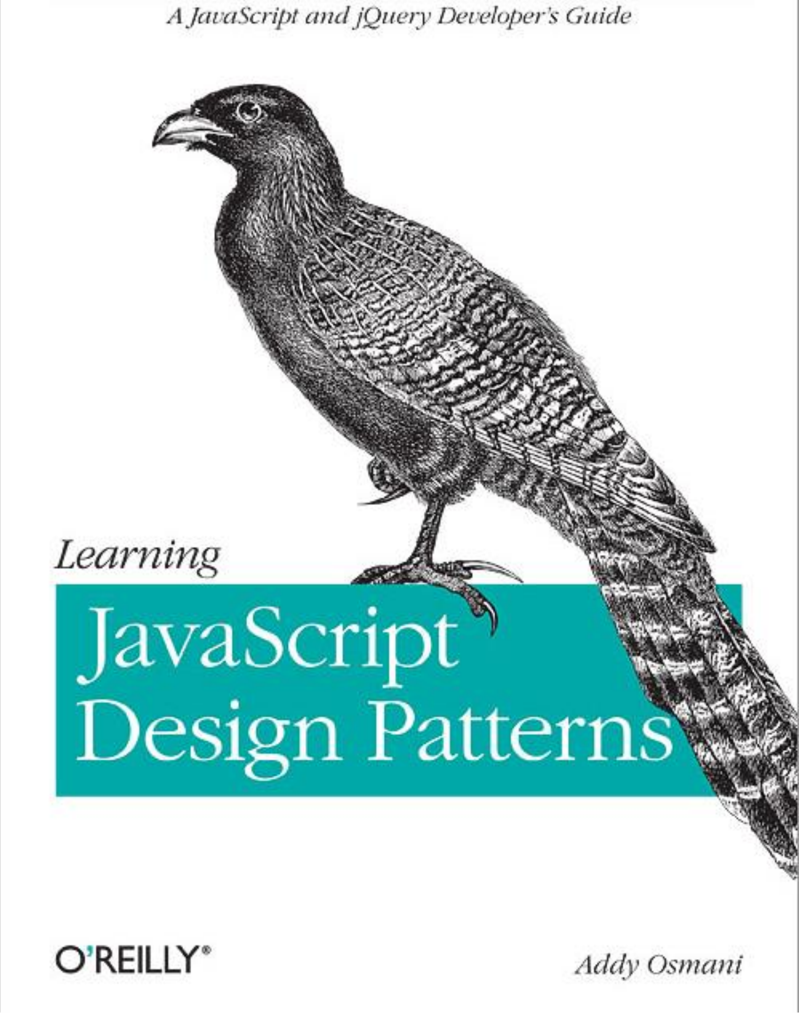
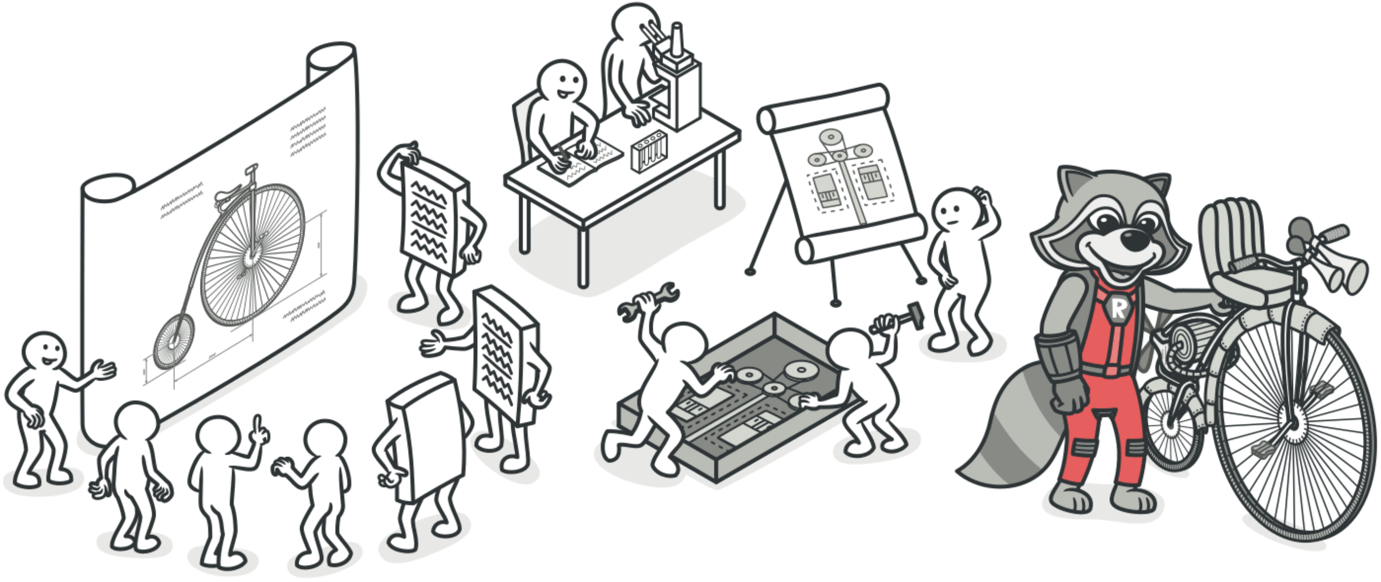
5 DEVELOPMENT PRINCIPLES



INTRODUCTION TO DESIGN PATTERNS

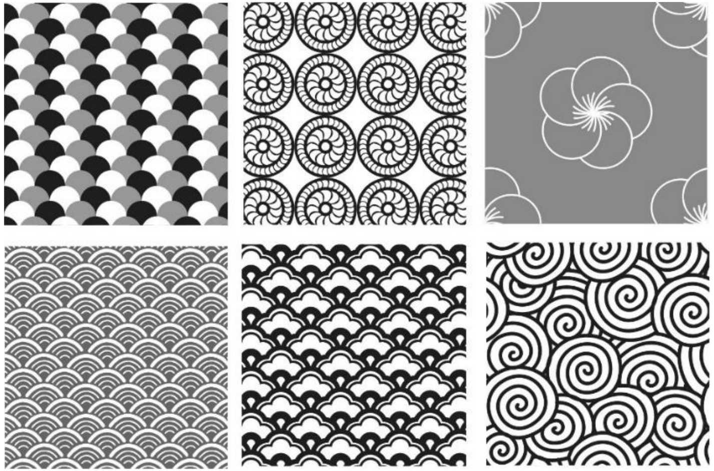
Design patterns

Each pattern it’s a solution for the problem in software programming. Pattern solves this problem millions and billions time in effective way.



What is pattern?

- A pattern is a reusable solution to a commonly occurring problem within a given context in software design.
- Patterns are as templates for how we solve problems—ones that can be used in quite a few different situations
- Patterns are proven solutions (*not* exact solutions)



Types of design patterns

- Creational *(Factory, Abstract Factory, Singleton, Builder, etc.)*
    - Deal with initializing and configuring classes and objects

- Structural *(Adapter, Façade, Decorator, etc.)*
    - Deal with decoupling interface and implementation of classes and objects
    - Composition of classes or objects

- Behavioral *(Mediator, Observer, Strategy, etc.)*
    - Deal with dynamic interactions among societies of classes and objects
    - Distribute responsibility

Module

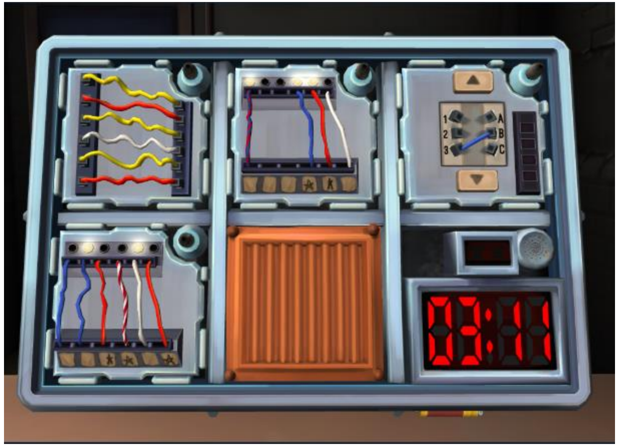
WHEREFORE

In JavaScript, the Module pattern is used to further emulate the concept of classes in such a way that we're able to include both public/private methods and variables inside a single object, thus shielding particular parts from the global scope.

HOWTO

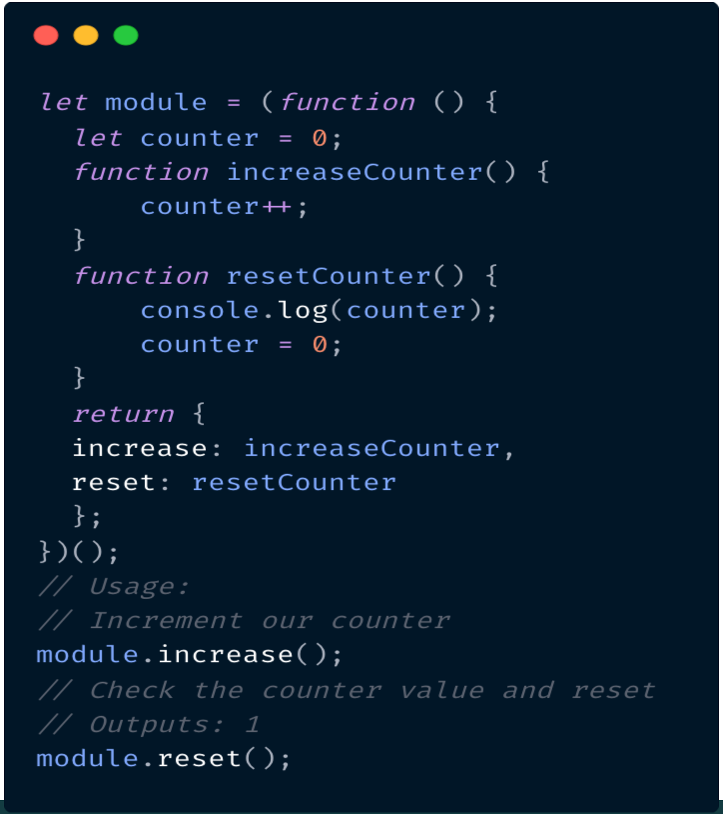
Module is a combination of 2 simple patterns:

- self-executing function
- private variables and methods



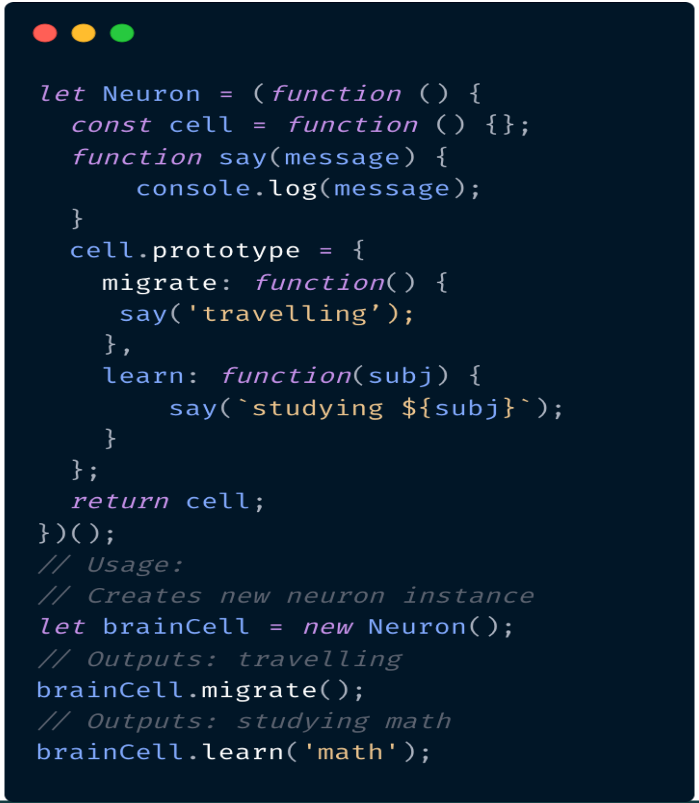
Module

MODULE-OBJECT



```
let module = (function () {
  let counter = 0;
  function increaseCounter() {
      counter++;
  }
  function resetCounter() {
      console.log(counter);
      counter = 0;
  }
  return {
  increase: increaseCounter,
  reset: resetCounter
  };
})();
// Usage:
// Increment our counter
module.increase();
// Check the counter value and reset
// Outputs: 1
module.reset();
```

MODULE-CONSTRUCTOR



```
let Neuron = (function () {
  const cell = function () {};
  function say(message) {
      console.log(message);
  }
  cell.prototype = {
    migrate: function() {
     say('travelling’);
    },
    learn: function(subj) {
        say(`studying ${subj}`);
    }
  };
  return cell;
})();
// Usage:
// Creates new neuron instance
let brainCell = new Neuron();
// Outputs: travelling
brainCell.migrate();
// Outputs: studying math
brainCell.learn('math');
```

Module. Pros/Cons

ADVANTAGES

- support of private data
- splitting the project into logical blocks
- reuse

DISADVANTAGES

- inability to test private data
- dependencies need to be handled manually
- modules structure organization (ES6 modules)

CREATIONAL PATTERNS

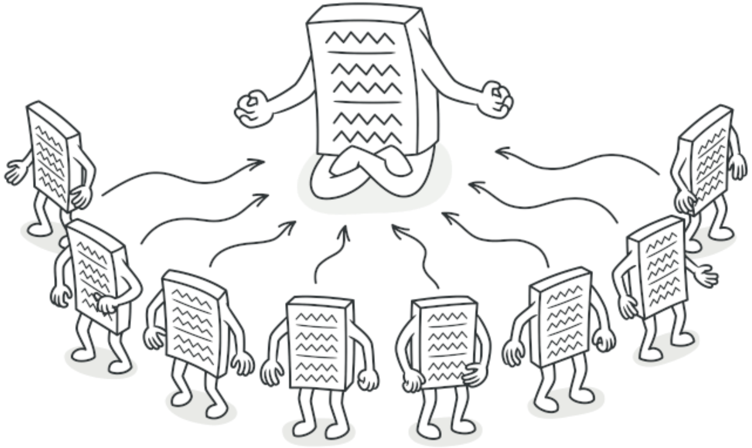
Singleton

WHEREFORE

- Provide single instance of class. When you try to create another instance, the program should receive an item that has already been created.

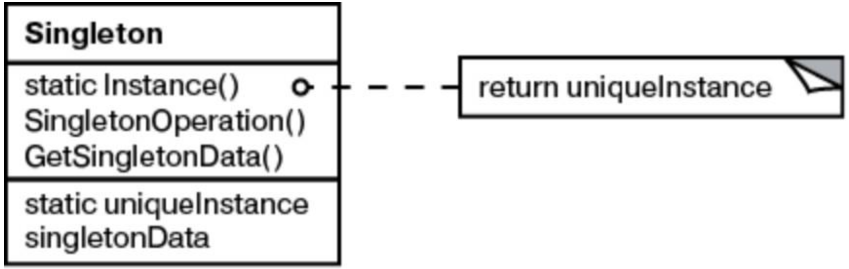
HOWTO

- Using module pattern



Singleton

Singleton pattern involves a single class which is responsible to create an object while making sure that only single object gets created. This class provides a way to access its only object which can be accessed directly without need to instantiate the object of the class.



Singleton

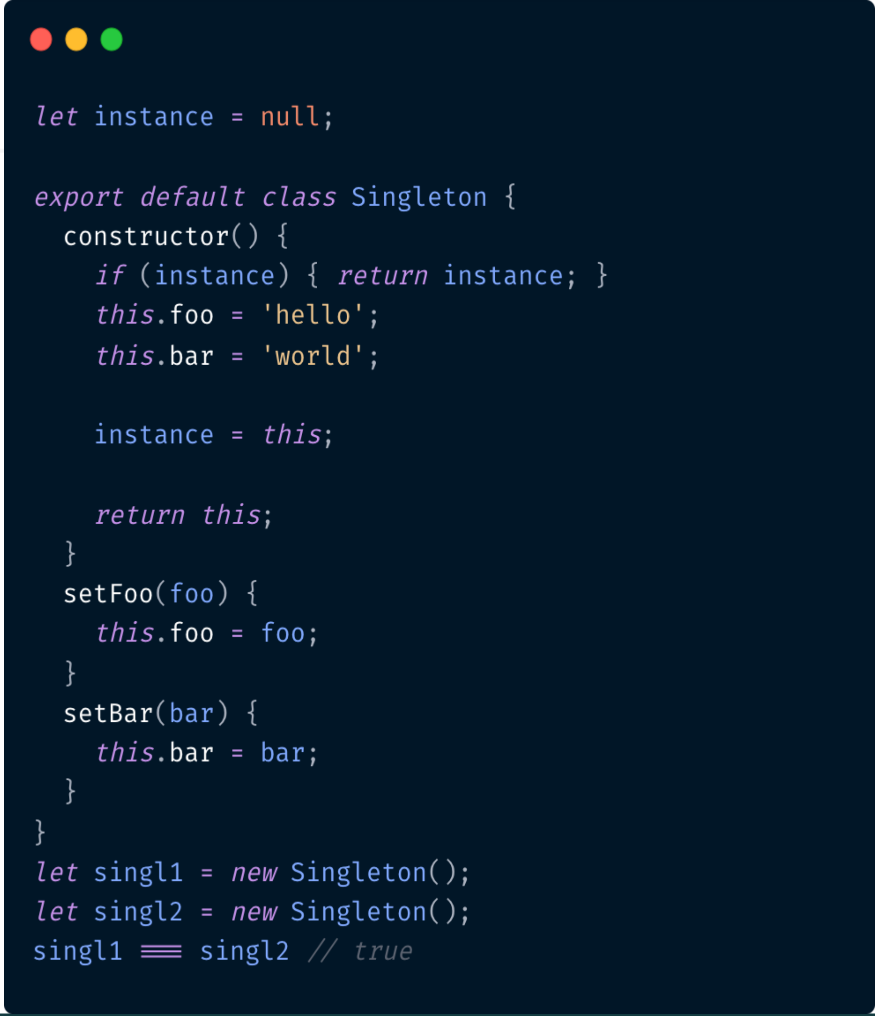
static Instance()
SingletonOperation()
GetSingletonData()

static uniqueInstance
singletonData

return uniqueInstance

Use when:

- EnsProvide a global point of access to the object.
- Share state across the application
- ure that only one instance of a class is created.



```
let instance = null;

export default class Singleton {
  constructor() {
    if (instance) { return instance; }
    this.foo = 'hello';
    this.bar = 'world';

    instance = this;

    return this;
  }
  setFoo(foo) {
    this.foo = foo;
  }
  setBar(bar) {
    this.bar = bar;
  }
}
let singl1 = new Singleton();
let singl2 = new Singleton();
singl1 === singl2 // true
```

Singleton. Pros/Cons

ADVANTAGES

- controlled access to a single instance

DISADVANTAGES

- global access
- problems with testing are possible
- often there is a desire to expand singleton

Factory

WHEREFORE

- Factory can provide a generic interface for creating objects, where we can specify the type of factory object we wish to be created.

HOWTO

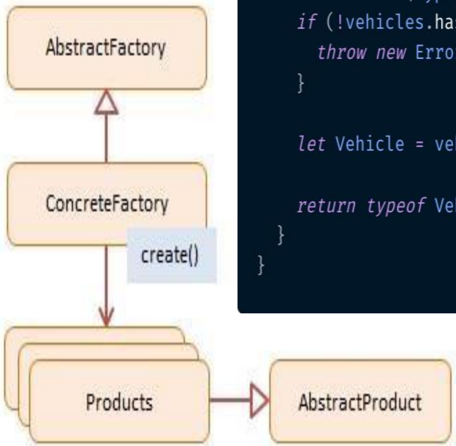
- Using the factory method, which will select the appropriate constructor.

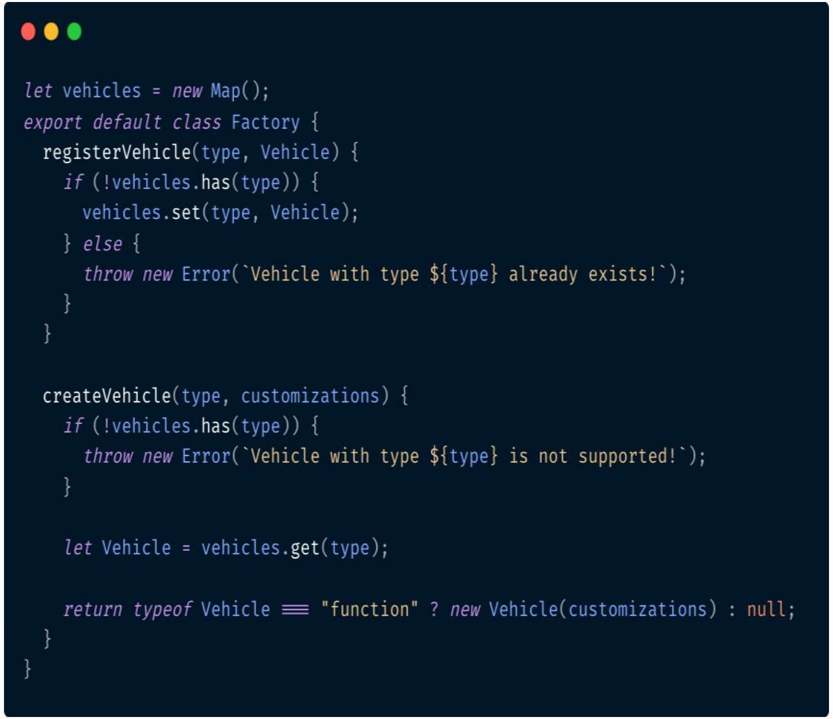
Factory

In Factory pattern, we create object without exposing the creation logic to the client and refer to newly created object using a common interface.

Use when:

- You want to encapsulate a group of individual factories with a common goal
- When we need to easily generate different instances of objects depending on the environment we are in
- When our object or component setup involves a high level of complexity
- You need to separate the details of implementation of a set of objects from their general usage

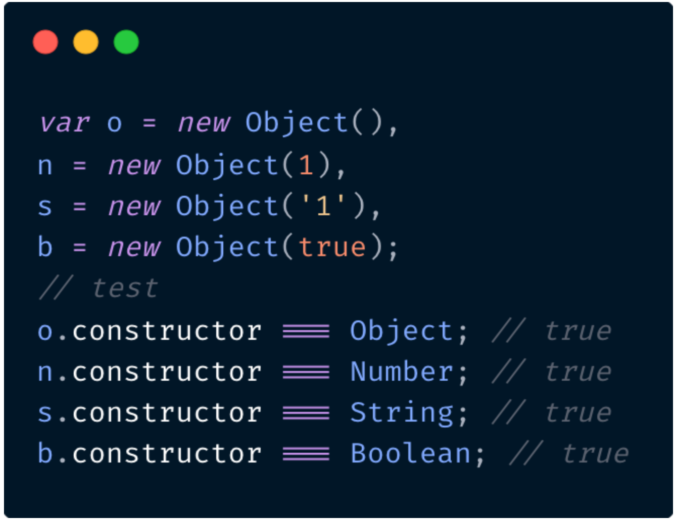




```
let vehicles = new Map();
export default class Factory {
  registerVehicle(type, Vehicle) {
    if (!vehicles.has(type)) {
      vehicles.set(type, Vehicle);
    } else {
      throw new Error(`Vehicle with type ${type} already exists!`);
    }
  }

  createVehicle(type, customizations) {
    if (!vehicles.has(type)) {
      throw new Error(`Vehicle with type ${type} is not supported!`);
    }

    let Vehicle = vehicles.get(type);

    return typeof Vehicle === "function" ? new Vehicle(customizations) : null;
  }
}
```

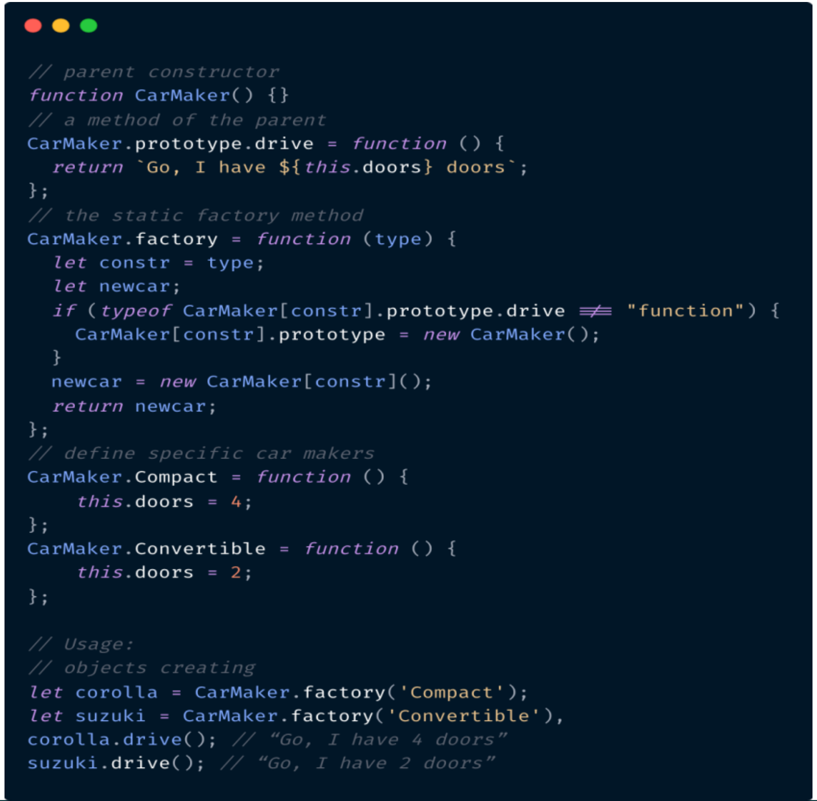
Factory example

BUILD-IN FACTORY



```javascript
var o = new Object(),
n = new Object(1),
s = new Object('1'),
b = new Object(true);
// test
o.constructor === Object; // true
n.constructor === Number; // true
s.constructor === String; // true
b.constructor === Boolean; // true
```

EXAMPLE



```javascript
// parent constructor
function CarMaker() {}
// a method of the parent
CarMaker.prototype.drive = function () {
  return `Go, I have ${this.doors} doors`;
};
// the static factory method
CarMaker.factory = function (type) {
  let constr = type;
  let newcar;
  if (typeof CarMaker[constr].prototype.drive !== "function") {
    CarMaker[constr].prototype = new CarMaker();
  }
  newcar = new CarMaker[constr]();
  return newcar;
};
// define specific car makers
CarMaker.Compact = function () {
    this.doors = 4;
};
CarMaker.Convertible = function () {
    this.doors = 2;
};

// Usage:
// objects creating
let corolla = CarMaker.factory('Compact');
let suzuki = CarMaker.factory('Convertible'),
corolla.drive(); // “Go, I have 4 doors”
suzuki.drive(); // “Go, I have 2 doors”
```

Factory. Pros/Cons

ADVANTAGES

- allows you to make the code more flexible
- provides a single interface for creating objects

DISADVANTAGES

- difficult to add support for new types of objects

Patterns: Fabric, Abstract Fabric

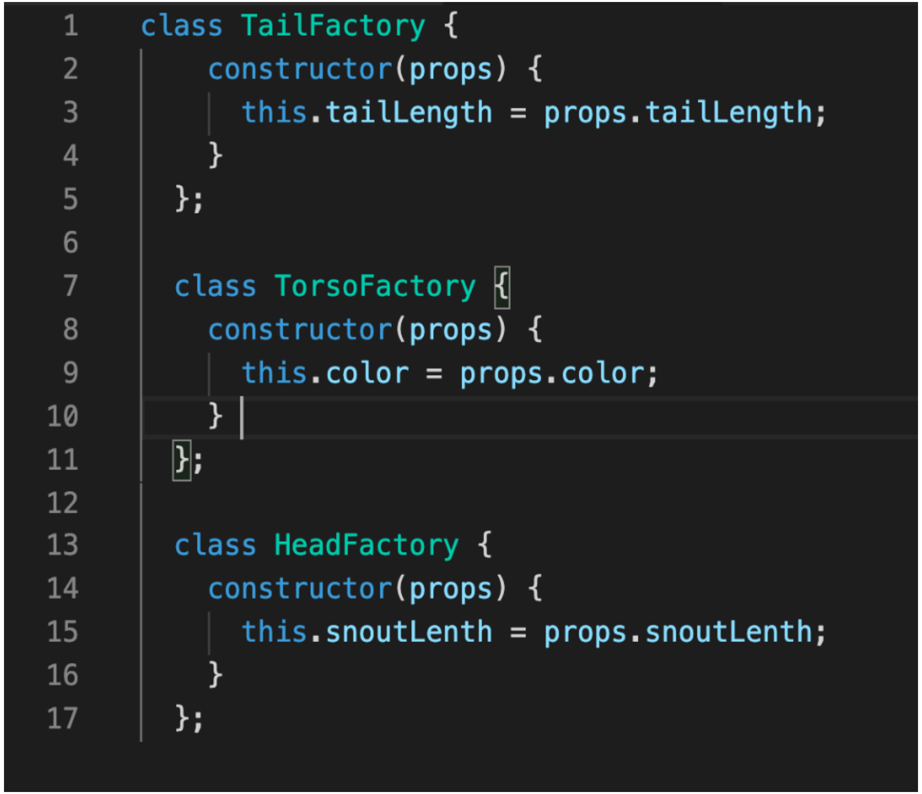
Organizing code is going to save us from a lot of pain. Using the features of Object Oriented programming, we can employ certain design patterns to achieve better readability, reduce redundancy and create abstractions, if needed. One such pattern is the factory pattern.

The factory pattern is a type of Object Oriented pattern which follows the DRY methodology. As the name suggests, object instances are created by using a factory to make the required object for us.

Patterns: Fabric, Abstract Fabric

Let’s have a look at a very simple example of using the factory pattern to assemble an alligator object.

To do that we first need to make factories that create the alligator parts for us:

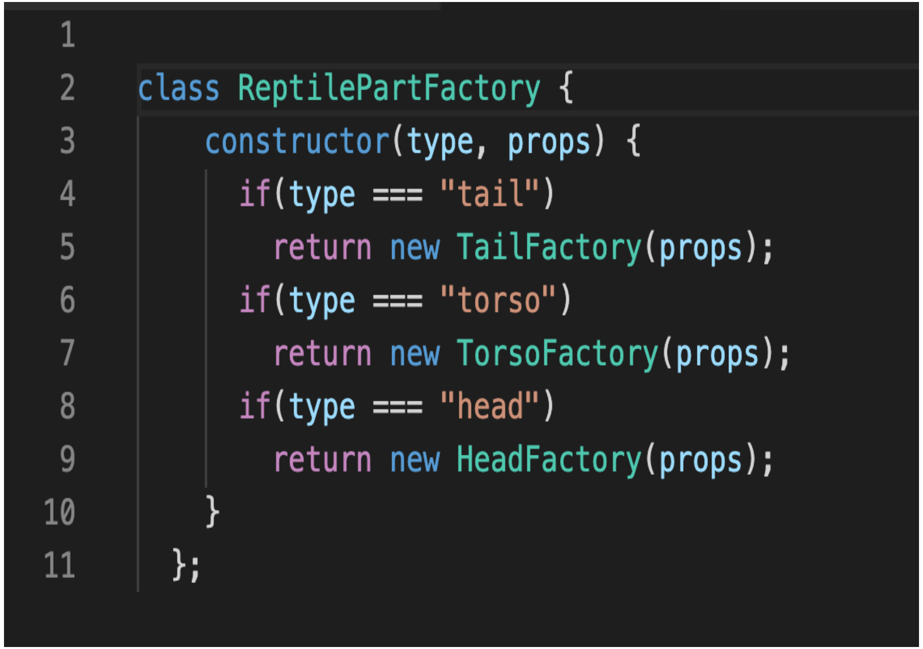


```
class TailFactory {
  constructor(props) {
   this.tailLength = props.tailLength;
  }
 };

 class TorsoFactory {
  constructor(props) {
   this.color = props.color;
  }
 };

 class HeadFactory {
  constructor(props) {
   this.snoutLenth = props.snoutLenth;
  }
 };
```

Patterns: Fabric, Abstract Fabric

Now, we create a class that acts as an intermediary between the actual factories classes and the user.

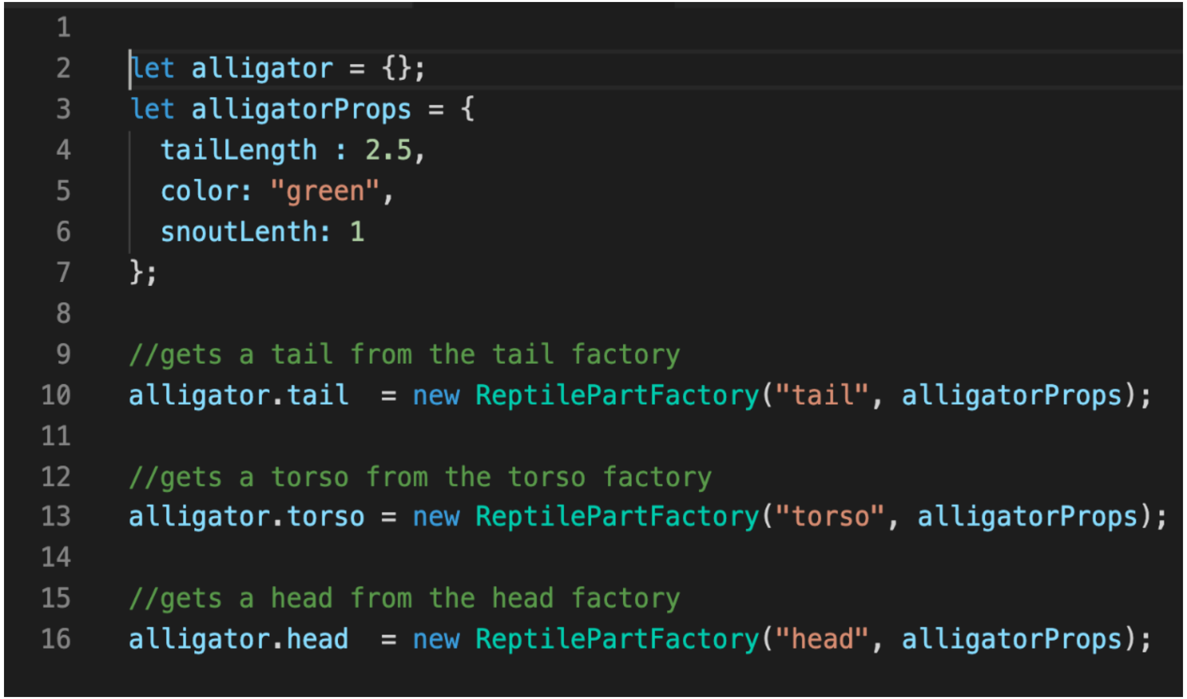
Let’s call this the ReptilePartFactory:



```

class ReptilePartFactory {
    constructor(type, props) {
      if(type === "tail")
        return new TailFactory(props);
      if(type === "torso")
        return new TorsoFactory(props);
      if(type === "head")
        return new HeadFactory(props);
    }
  };
```

Patterns: Fabric, Abstract Fabric

Let’s go ahead and assemble the actual alligator now and use the ReptilePartFactory to get the required parts for us:

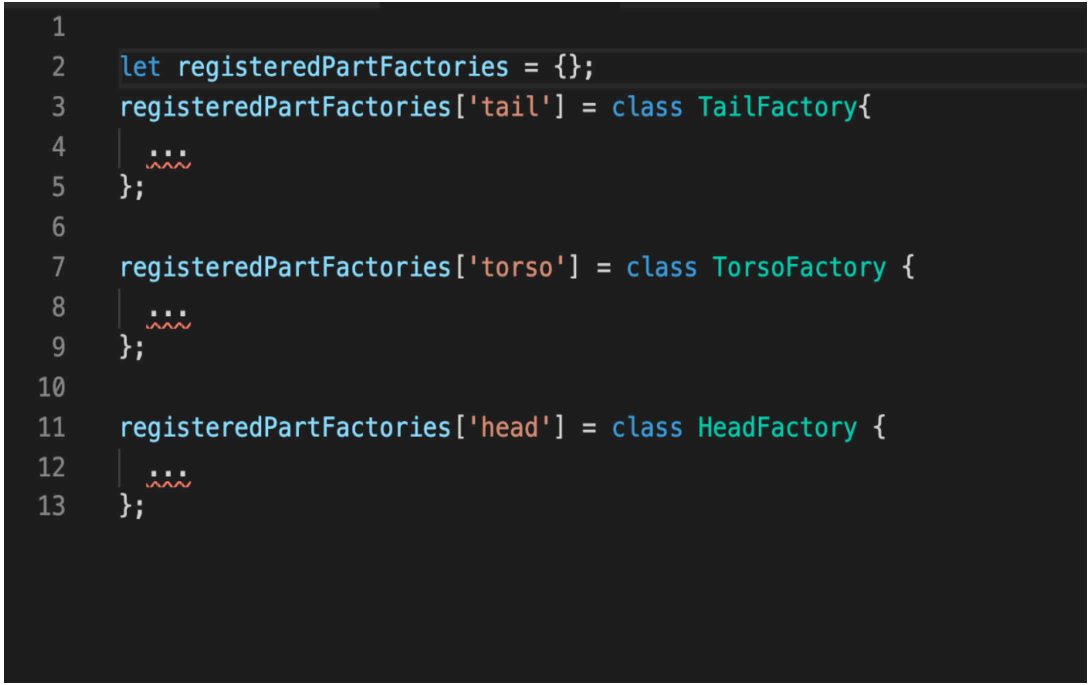


```
let alligator = {};
let alligatorProps = {
  tailLength : 2.5,
  color: "green",
  snoutLenth: 1
};

//gets a tail from the tail factory
alligator.tail  = new ReptilePartFactory("tail", alligatorProps);

//gets a torso from the torso factory
alligator.torso = new ReptilePartFactory("torso", alligatorProps);

//gets a head from the head factory
alligator.head  = new ReptilePartFactory("head", alligatorProps);
```

Patterns: Fabric, Abstract Fabric

How about we store the factory classes in an object and call the required part factory by using the part we want as the key?

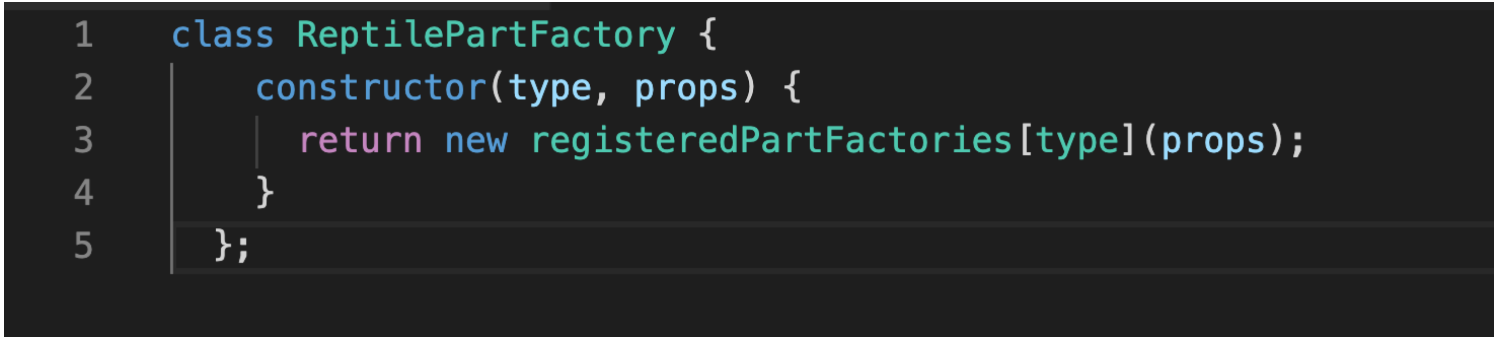
First we'd have to register the factories, it'd be as simple as:



```

let registeredPartFactories = {};
registeredPartFactories['tail'] = class TailFactory{
  ...
};

registeredPartFactories['torso'] = class TorsoFactory {
  ...
};

registeredPartFactories['head'] = class HeadFactory {
  ...
};
```

Patterns: Fabric, Abstract Fabric

And now, the abstract layer can call the factories like this:



```
class ReptilePartFactory {
    constructor(type, props) {
      return new registeredPartFactories[type](props);
    }
  };
```

This approach is much cleaner and allows to expand our factories without affecting code in the ReptilePartFactory.

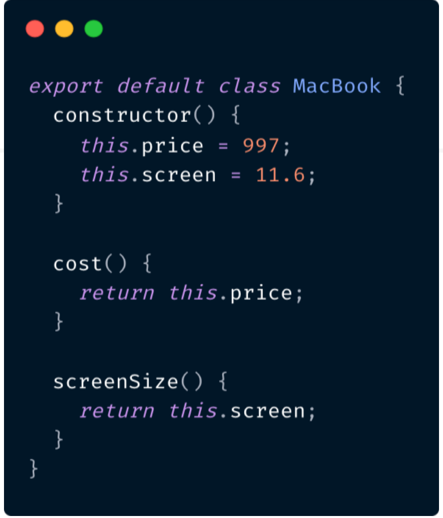
STRUCTURAL PATTERNS

Decorator

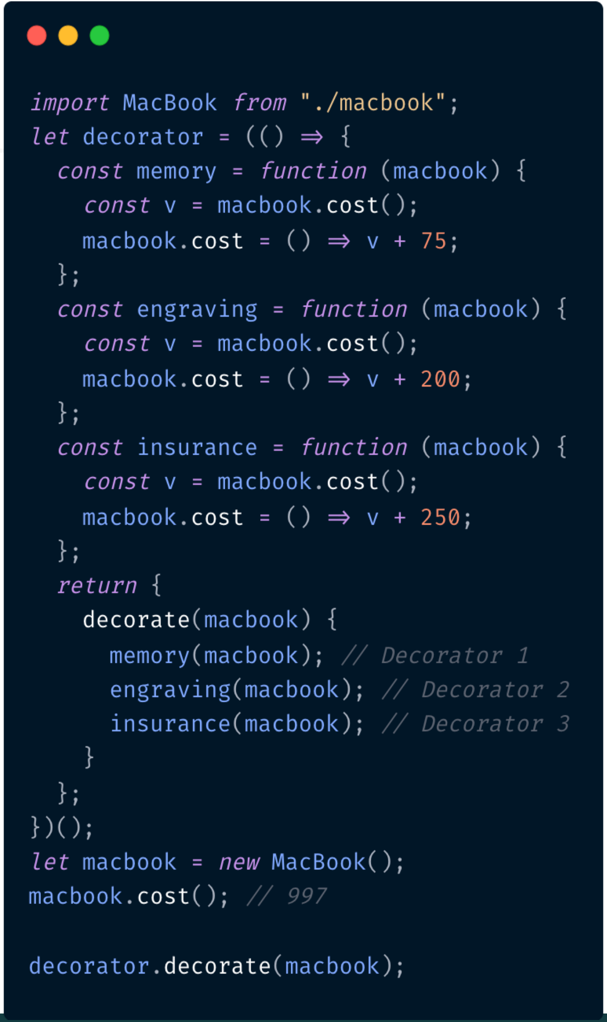
Decorator pattern allows a user to add new functionality to an existing object without altering its structure.

Use when:

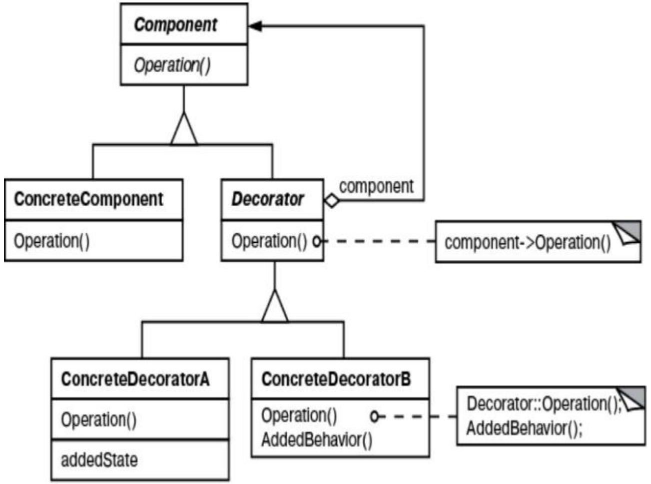
- You need sharing to support a large number of objects that have part of their internal state in common where the other part of state can vary.
- Rather than sub-classing, we add (decorate) properties or methods to a base object so it's a little more streamlined.
- We need to modify existing systems where we wish to add additional features to objects without the need to heavily modify the underlying code using them



```
export default class MacBook {
  constructor() {
    this.price = 997;
    this.screen = 11.6;
  }

  cost() {
    return this.price;
  }

  screenSize() {
    return this.screen;
  }
}
```



```
import MacBook from "./macbook";
let decorator = (() => {
  const memory = function (macbook) {
    const v = macbook.cost();
    macbook.cost = () => v + 75;
  };
  const engraving = function (macbook) {
    const v = macbook.cost();
    macbook.cost = () => v + 200;
  };
  const insurance = function (macbook) {
    const v = macbook.cost();
    macbook.cost = () => v + 250;
  };
  return {
    decorate(macbook) {
      memory(macbook); // Decorator 1
      engraving(macbook); // Decorator 2
      insurance(macbook); // Decorator 3
    }
  };
})();
let macbook = new MacBook();
macbook.cost(); // 997

decorator.decorate(macbook);
```



Facade

WHEREFORE

- This pattern provides a convenient higher-level interface to a larger body of code, hiding its true underlying complexity.

HOWTO

- Creating set of facade methods and joining them in one place

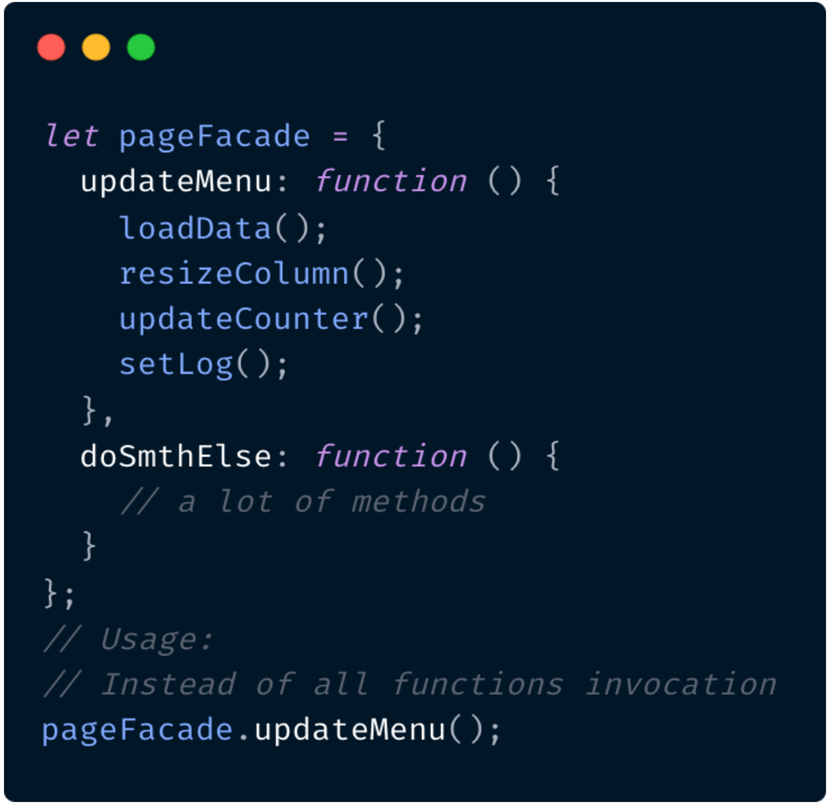
Facade

Advantages

- easy access to a complex system
- resistance to changes

Disadvantages

- It’s not always obvious what's going on in a certain method
- methods can be duplicated



```
let pageFacade = {
  updateMenu: function () {
    loadData();
    resizeColumn();
    updateCounter();
    setLog();
  },
  doSmthElse: function () {
    // a lot of methods
  }
};
// Usage:
// Instead of all functions invocation
pageFacade.updateMenu();
```

Conclusions

BENEFITS OF DESIGN PATTERNS

- Patterns can be easily reused.
- Patterns can make the system more transparent.
- Patterns help improve developer communication
- Patterns help ease the transition to Object Oriented technology

DRAWBACKS OF DESIGN PATTERNS

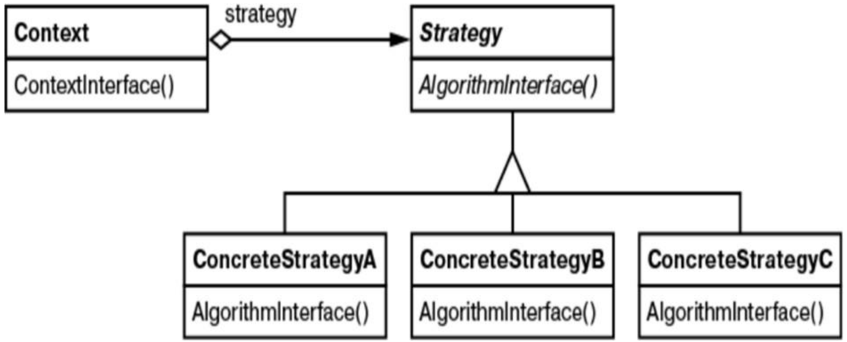
- Patterns do not lead to direct code reuse
- Teams may suffer from pattern overload
- Patterns are validated by experience and discussion rather than by automated testing
- Integrating patterns is a human-intensive activity

BEHAVIOURAL PATTERNS

Strategy

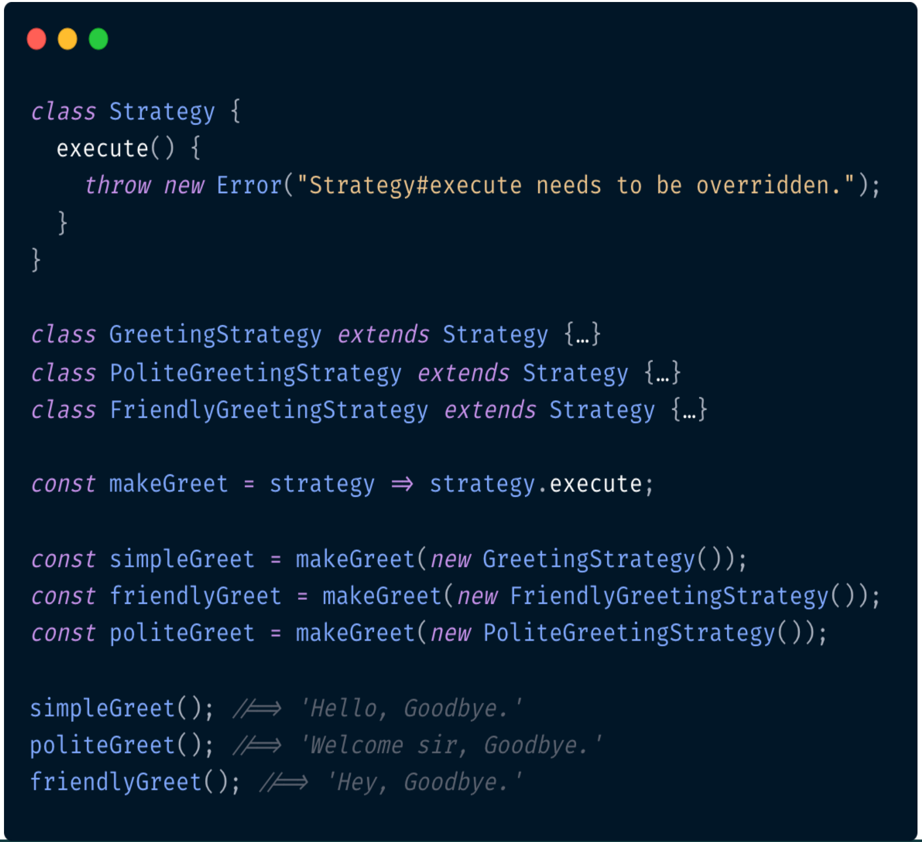
In Strategy pattern, we create objects which represent various strategies and a context object whose behaviour varies as per its strategy object.

The strategy object changes the executing algorithm of the context object.



Use when:

- When you need to define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.



```
class Strategy {
  execute() {
    throw new Error("Strategy#execute needs to be overridden.");
  }
}

class GreetingStrategy extends Strategy {…}
class PoliteGreetingStrategy extends Strategy {…}
class FriendlyGreetingStrategy extends Strategy {…}

const makeGreet = strategy => strategy.execute;

const simpleGreet = makeGreet(new GreetingStrategy());
const friendlyGreet = makeGreet(new FriendlyGreetingStrategy());
const politeGreet = makeGreet(new PoliteGreetingStrategy());

simpleGreet(); //=> 'Hello, Goodbye.'
politeGreet(); //=> 'Welcome sir, Goodbye.'
friendlyGreet(); //=> 'Hey, Goodbye.'
```

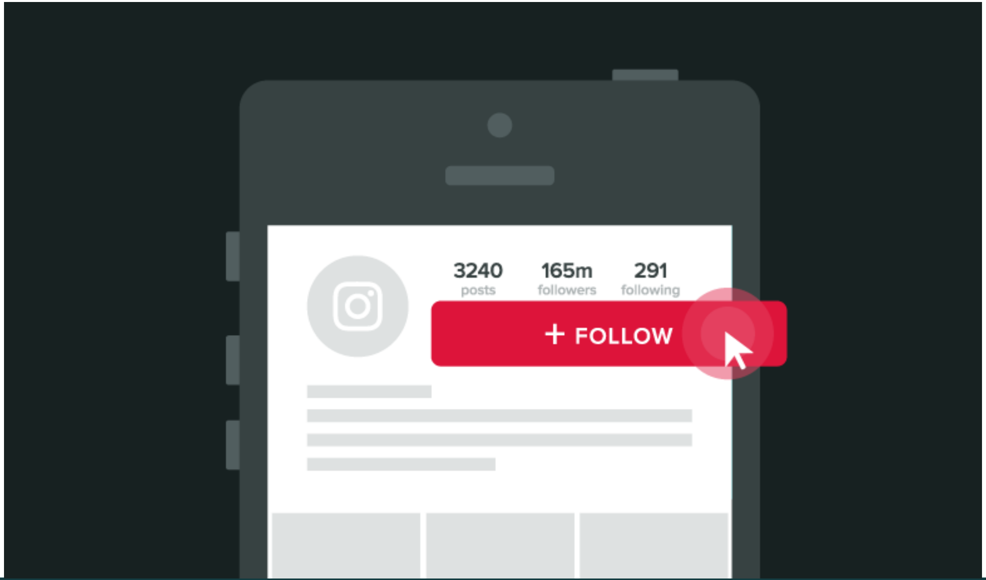
Observer

WHEREFORE

- This is where the objects in a system may subscribe to other objects and be notified by them when an event of interest occurs.

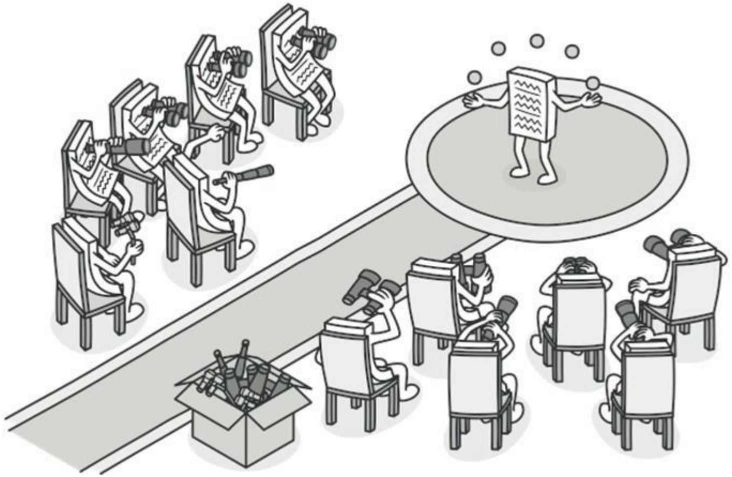
HOWTO

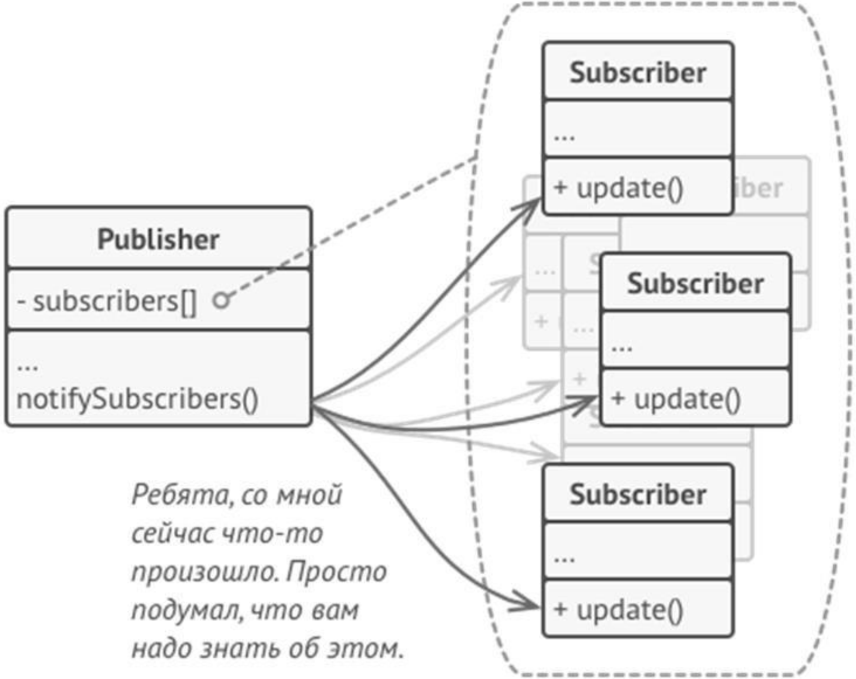
- Using javascript events



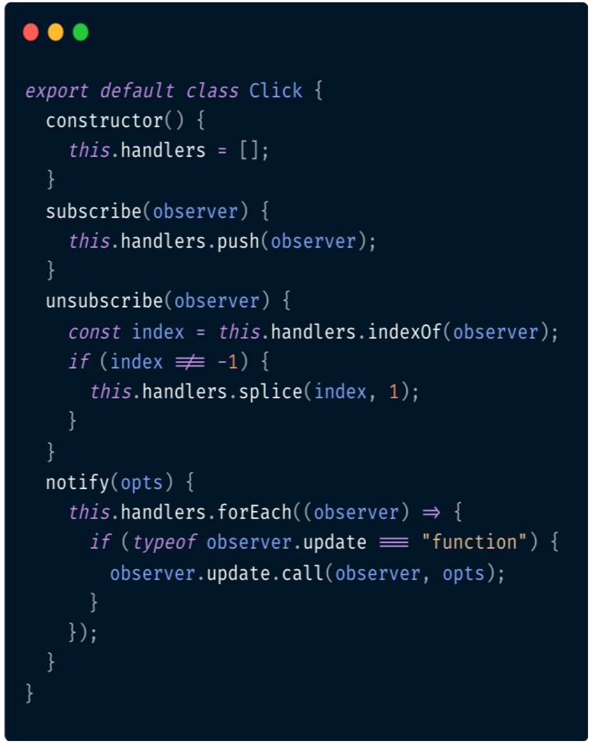
Observer

Observer pattern is used when there is one-to-many relationship between objects such as if one object is modified, its depenedent objects are to be notified automatically.

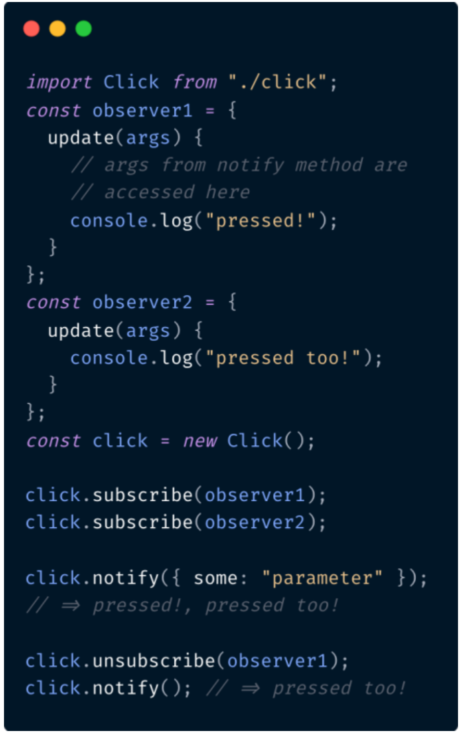




Observer



```javascript
export default class Click {
  constructor() {
    this.handlers = [];
  }
  subscribe(observer) {
    this.handlers.push(observer);
  }
  unsubscribe(observer) {
    const index = this.handlers.indexOf(observer);
    if (index !== -1) {
      this.handlers.splice(index, 1);
    }
  }
  notify(opts) {
    this.handlers.forEach((observer) => {
      if (typeof observer.update === "function") {
        observer.update.call(observer, opts);
      }
    });
  }
}
```



```javascript
import Click from "./click";
const observer1 = {
  update(args) {
    // args from notify method are
    // accessed here
    console.log("pressed!");
  }
};
const observer2 = {
  update(args) {
    console.log("pressed too!");
  }
};
const click = new Click();

click.subscribe(observer1);
click.subscribe(observer2);

click.notify({ some: "parameter" });
// => pressed!, pressed too!

click.unsubscribe(observer1);
click.notify(); // => pressed too!
```

Observer usage:

- When building web apps you end up writing many event handlers
- Event handlers are functions that will be notified when a certain event fires
- These notifications optionally receive an event argument with details about the event (for example the x and y position of the mouse at a click event)

Advantages

- weakens the relationship between objects
- helps to simplify objects

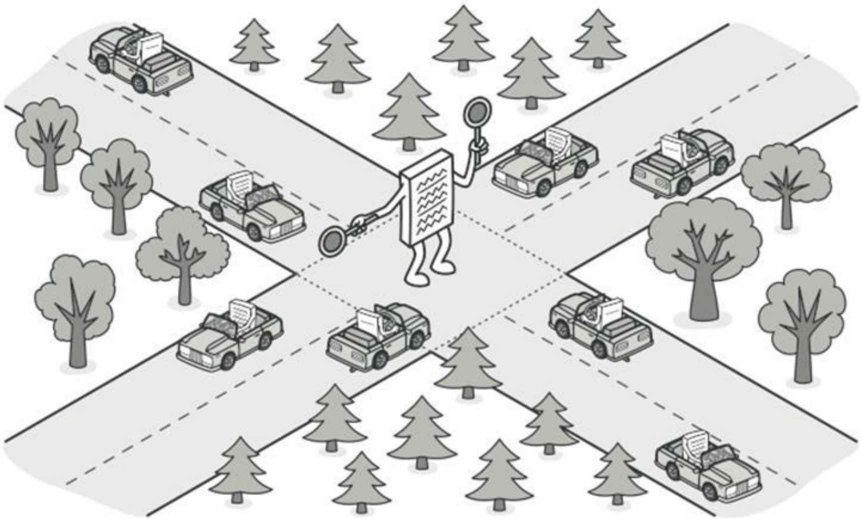
Disadvantages

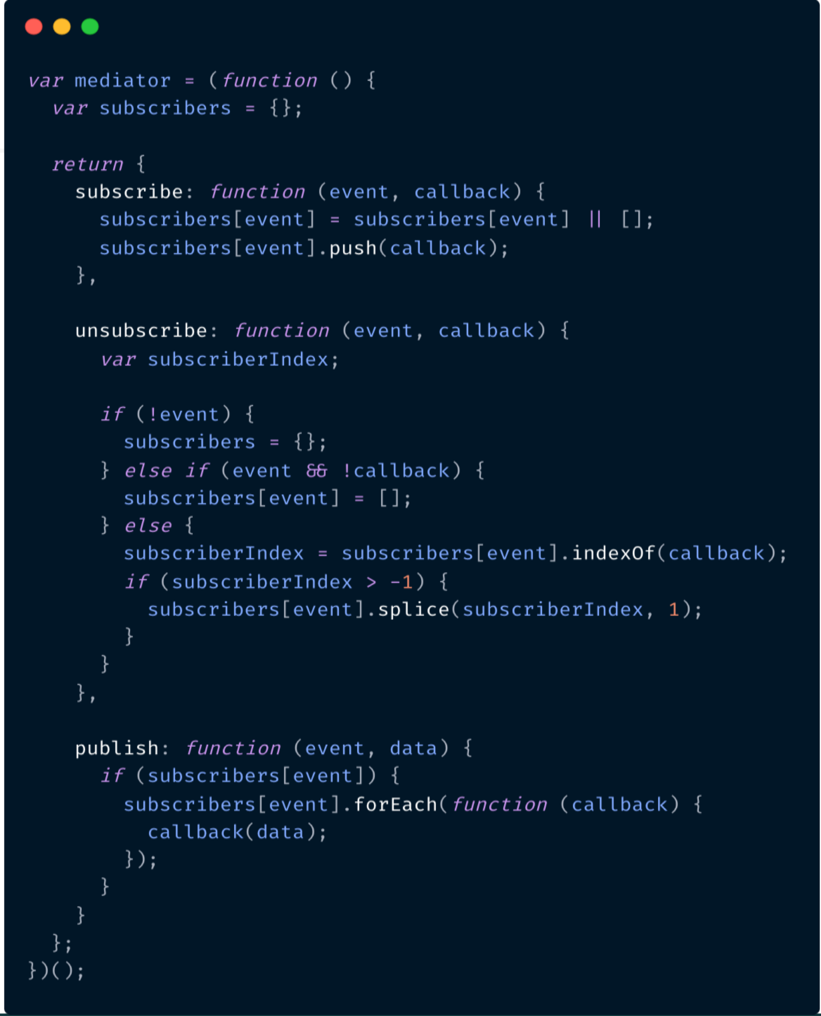
- system is getting less transparent

Mediator

Mediator is a behavioral design pattern that lets you reduce chaotic dependencies between objects.

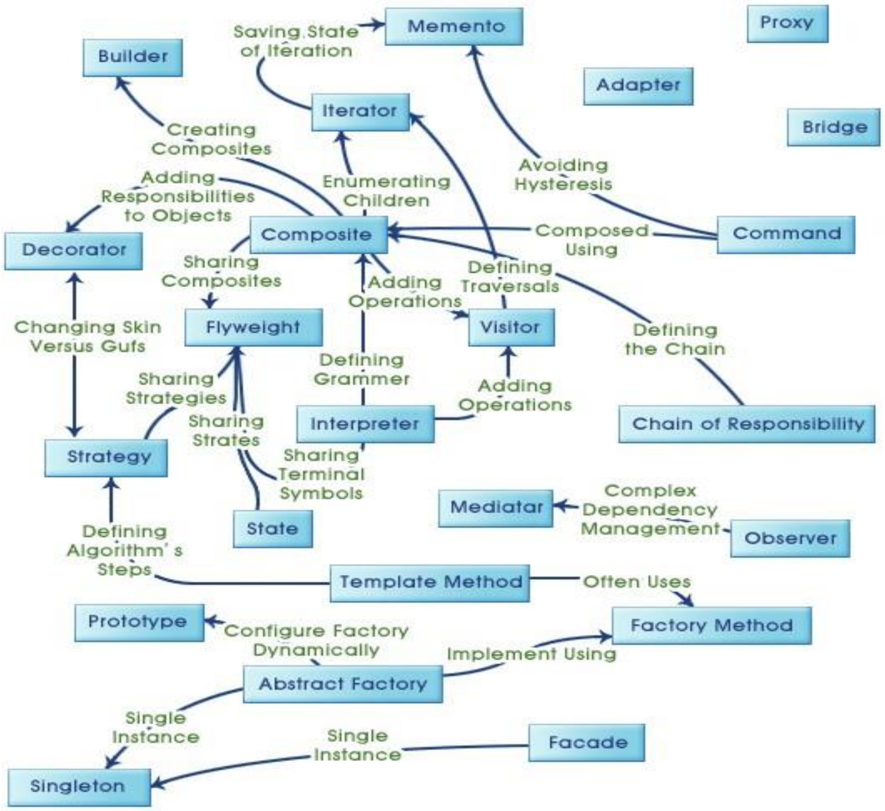
The pattern restricts direct communication between the objects and forces them to collaborate only via a mediator object





```
var mediator = (function () {
  var subscribers = {};

  return {
    subscribe: function (event, callback) {
      subscribers[event] = subscribers[event] || [];
      subscribers[event].push(callback);
    },

    unsubscribe: function (event, callback) {
      var subscriberIndex;

      if (!event) {
        subscribers = {};
      } else if (event && !callback) {
        subscribers[event] = [];
      } else {
        subscriberIndex = subscribers[event].indexOf(callback);
        if (subscriberIndex > -1) {
          subscribers[event].splice(subscriberIndex, 1);
        }
      }
    },

    publish: function (event, data) {
      if (subscribers[event]) {
        subscribers[event].forEach(function (callback) {
          callback(data);
        });
      }
    }
  };
})();
```

Design patterns relationships…



Development principles

- DRY - Don't repeat yourself
- KISS - Keep it simple, stupid
- SOLID
    - S – Single Responsibility Principle
    - O – Open-Closed Principle
    - L – Liskov Substitution Principle
    - I – Interface Segregation Principle
    - D – Dependency Inversion Principle
- YAGNI - You ain’t gonna need it
- BDUP - Big design up front

Etc….

THANK YOU!