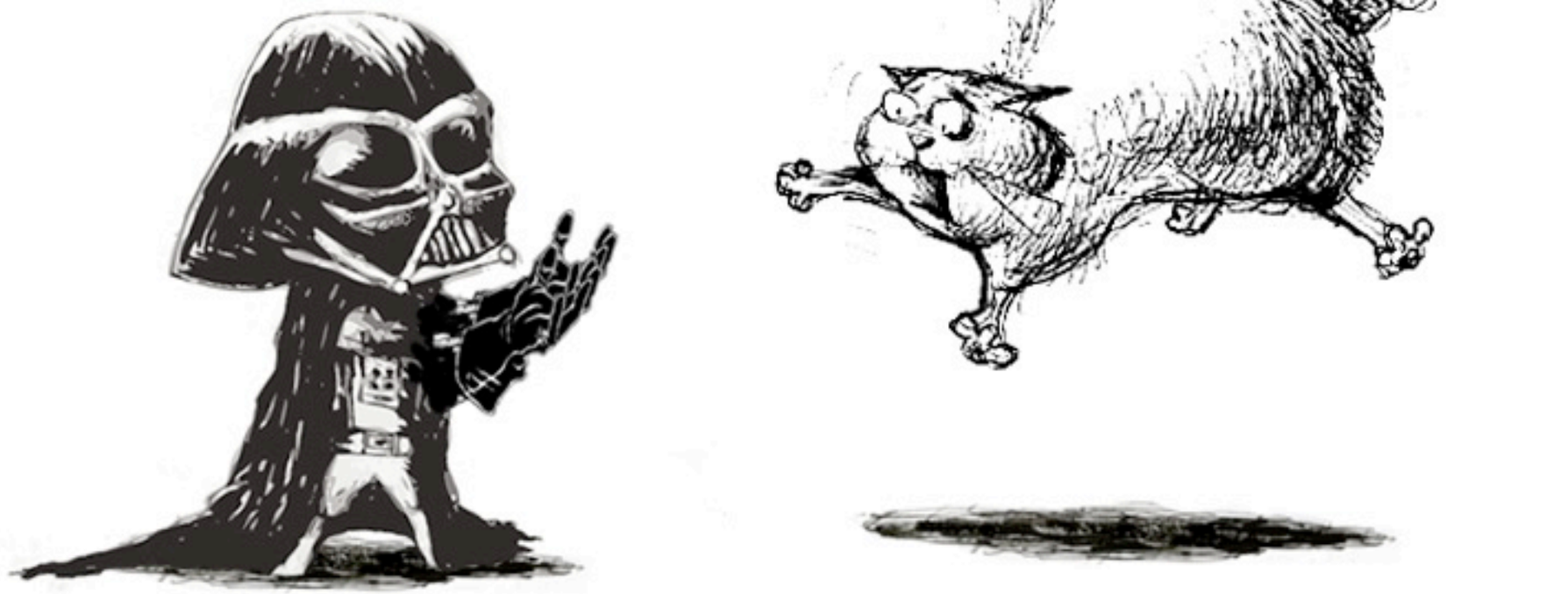


LARGE-SCALE JAVASCRIPT APPLICATION ARCHITECTURE

ORGANIZING YOUR SMALL TO LARGE JAVASCRIPT EMPIRES WITH EASE

WITH ADDY OSMANI, JAVASCRIPT DEVELOPER, AOL.

Today, we're going to look at how to create small to medium jQuery apps and large to really large JavaScript apps.

jQuery is a fantastic DOM manipulation library.

However, unlike Dojo it doesn't provide recommendations for application structure or how to organise your code.

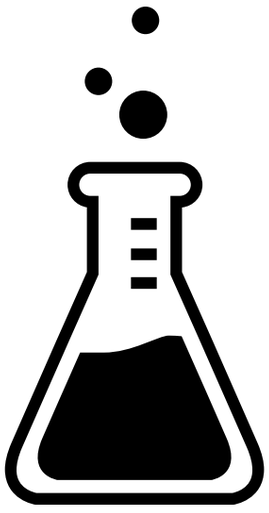
That's not it's job.

Remember: there are situations where it makes sense to use just jQuery..

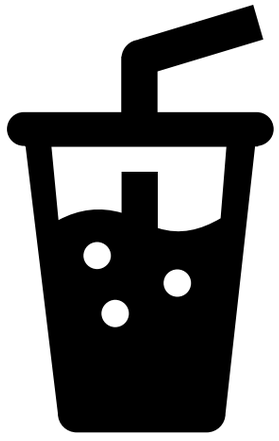
and those where it makes more sense to use additional tools like Backbone or alternatives (e.g Dojo).

The Schedule

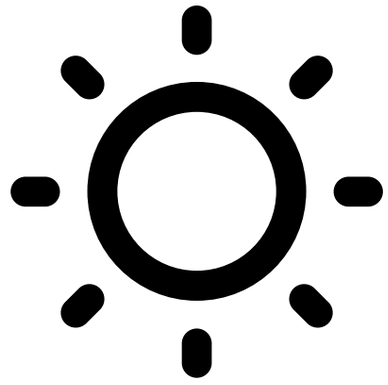
What are we looking at today?



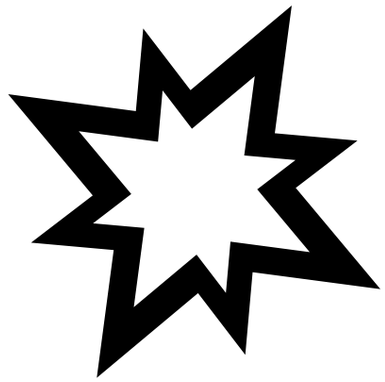
Design Patterns



jQuery & MVC
Frameworks
Resources



JavaScript Patterns
For organising applications



Scalable Application Architecture
Patterns for building really large apps

Part I: Patterns - A New Hope.

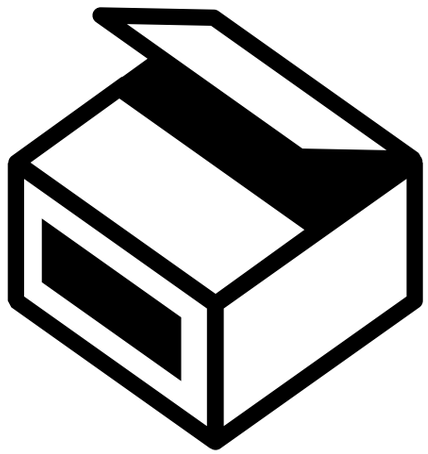
Design Patterns

Reusable solutions that can be applied to commonly occurring problems in software design and architecture.

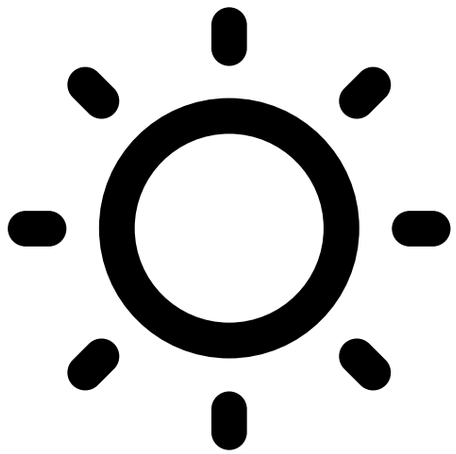
“We search for some kind of harmony between two intangibles: a form we have not yet designed and a context we cannot properly describe’
- Christopher Alexander, the father of design patterns.

They’re proven

Patterns are generally proven to have successfully solved problems in the past.

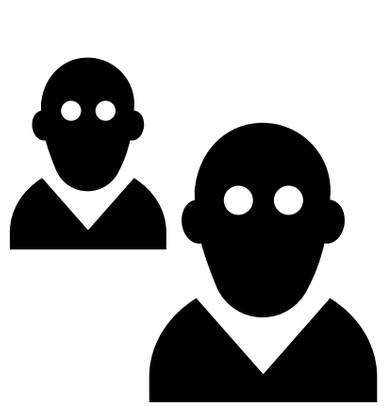


Solid



Reliable
approaches

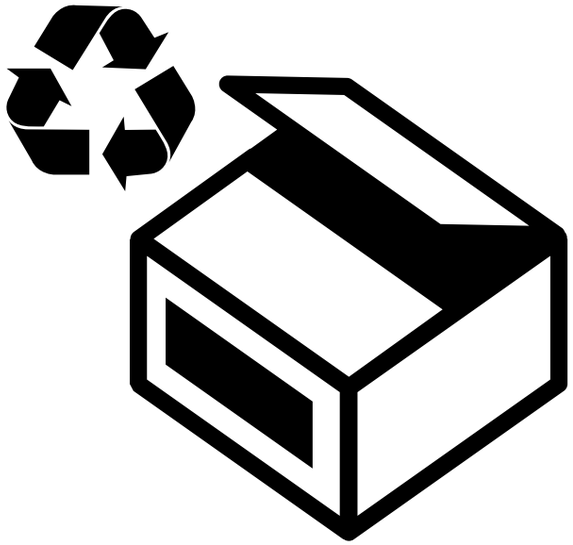
Reflect
experience



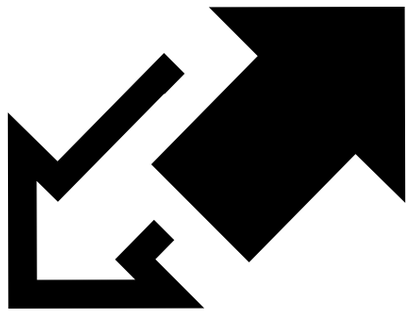
Represent
insights

They’re reusable

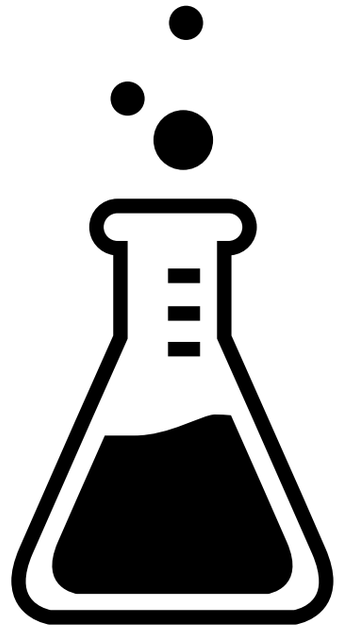
Patterns can be picked up, improved and adapted without great effort.



Out-of-the-box
solutions



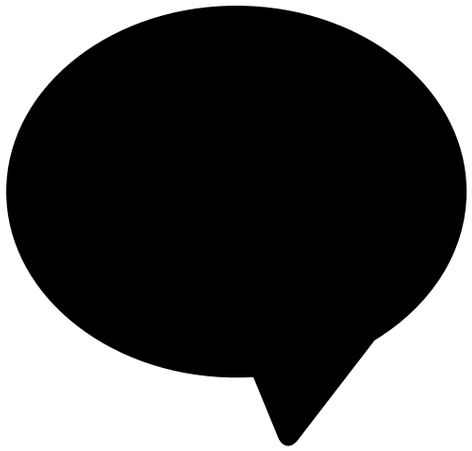
Incredibly flexible



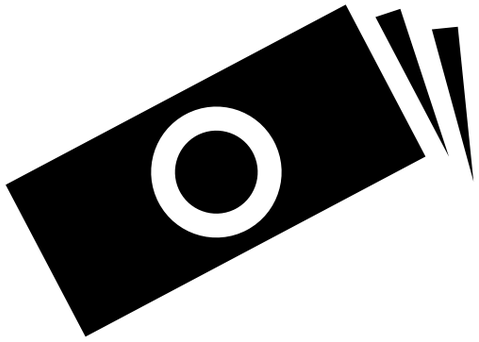
Easily adapted

They’re expressive

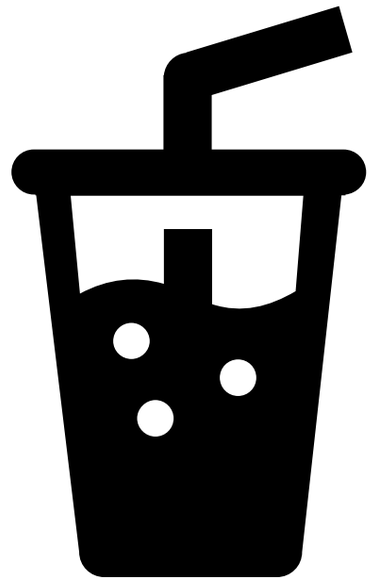
Patterns provide us a means to describing approaches or structures.



Common vocabulary for expressing solutions elegantly.



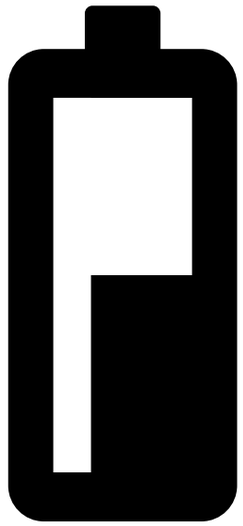
Easier than describing syntax and semantics



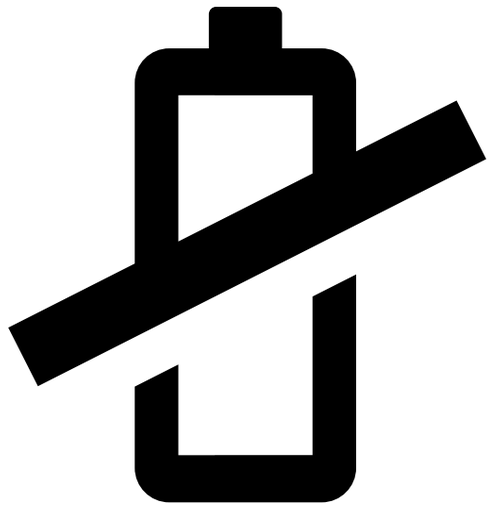
Problem agnostic

They offer value

Patterns genuinely can help avoid some of the common pitfalls of development.



Prevent minor issues
that can cause



Major problems
later down the line

For More Info

Get ‘Essential JavaScript Design Patterns’. It’s Free!

http://bit.ly/essentialjsdesignpatterns

If you find it useful, definitely check out:

Part II: The JavaScript Strikes Back

“I have all this jQuery code that does a few distinct things..but I’m not entirely sure how to organise it. What can I do?”

jQuery & MVC

Options for structuring your jQuery applications

Architecture

How do you structure your application?

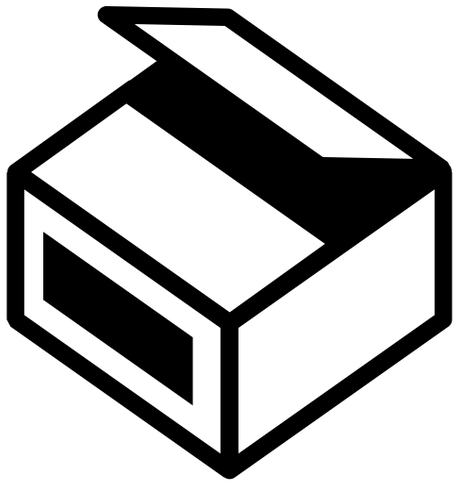
- Architecture patterns describe concepts for the **structure** of an application
- Certain patterns can be applied to both the **client** and **server-side**
- Most client-side architecture patterns have **roots** in the server-side

The pattern most commonly used on the front-end these days is ‘MVC’.

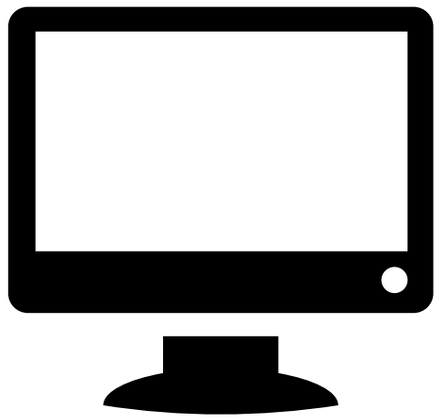
*It’s of course not the *only* option, just the most frequently implemented.

The MVC Pattern

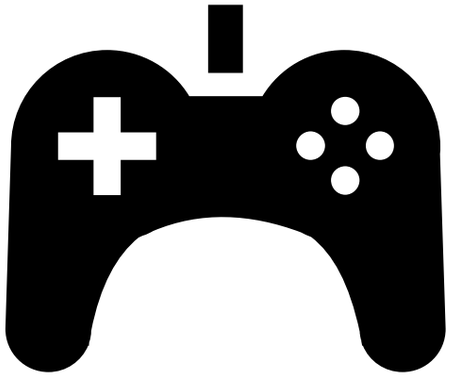
Separates applications into three main concerns:



Models



Views

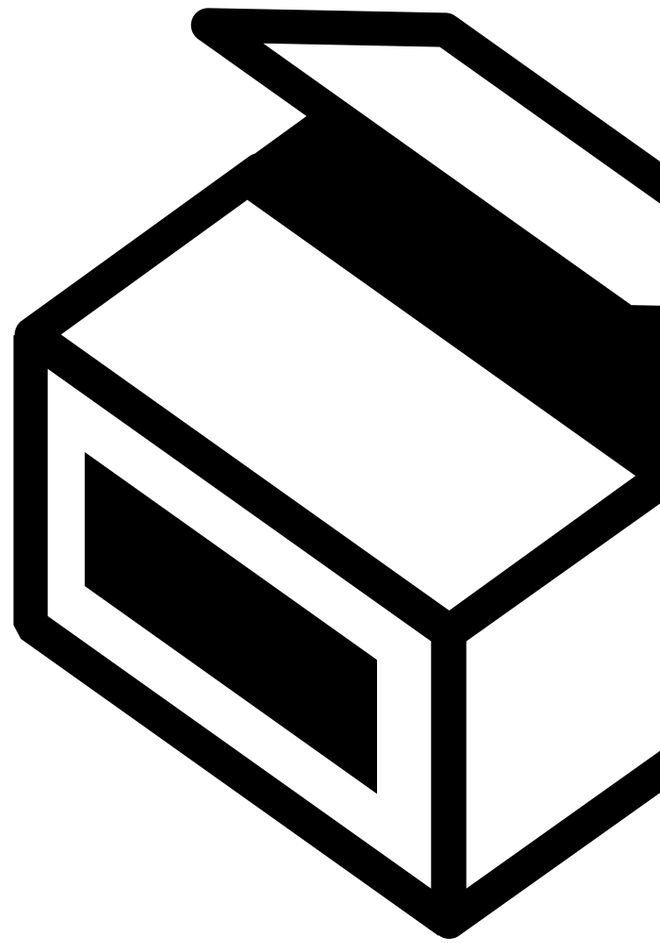


Controllers

MVC: Models

Manage the behaviour of the application data

- Represent **knowledge** and **data**
- Respond to changes of **state**
- Isolated from **views** and **controllers**
- Sometimes **grouped** (e.g collections)



MVC: Views

Render models into a form suitable for user interaction

- In most cases can be considered the **UI**
- Typically render to a specific user interface **element**
- Many frameworks rely on **templating** for this
- **Multiple views** can exist for single models

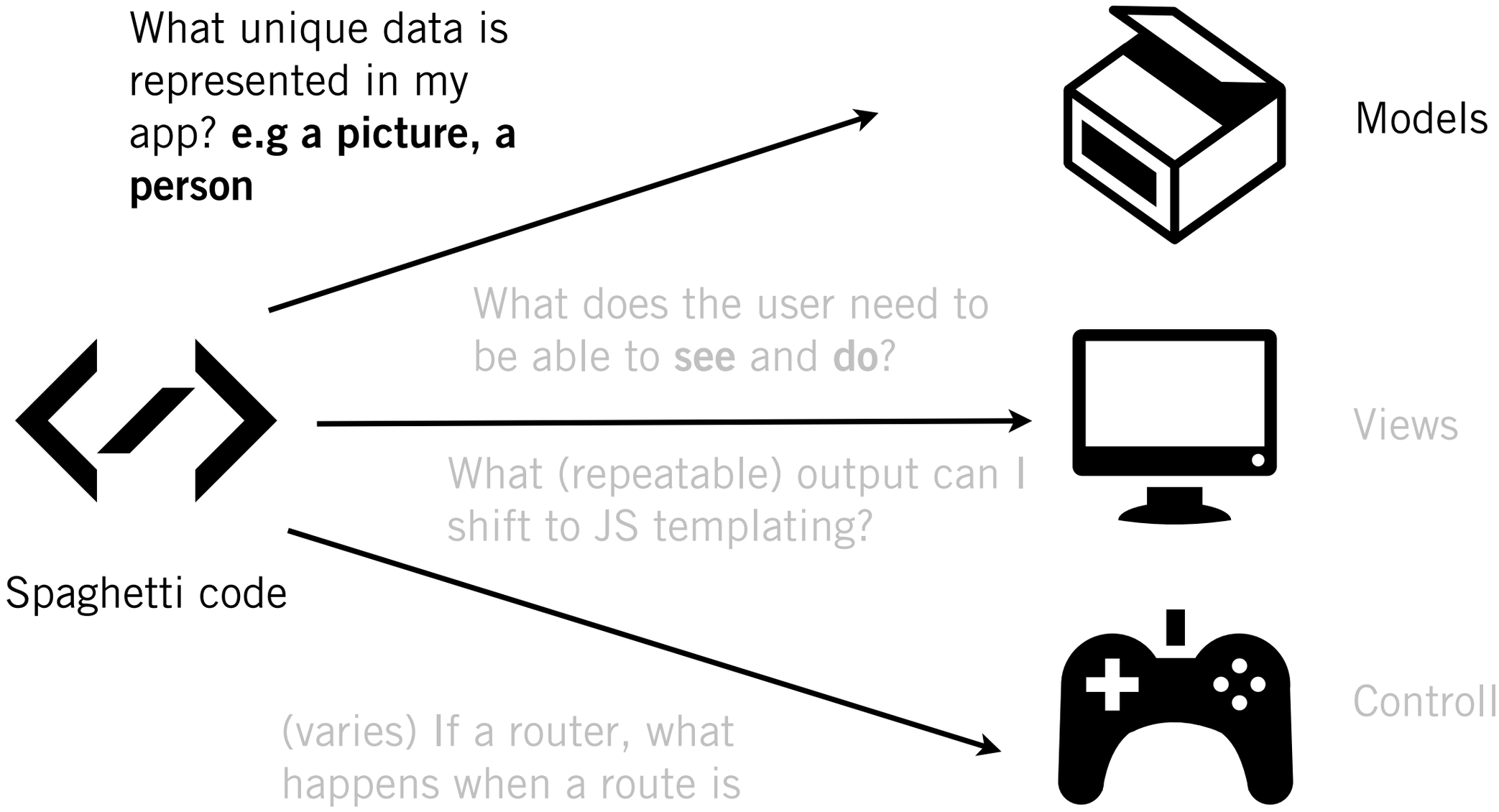
MVC: Controllers

Receive input and instruct models and views to respond accordingly

- Sits between **models** and **views**
- (May) perform business **logic** and data **manipulation**
- It's role in client-side MVC **heavily** varies
- Some replace it with a **router**, others use it as a logic handler

How Does This Work?

Converting spaghetti code to use MVC isn't all that hard..



How Does This Work?

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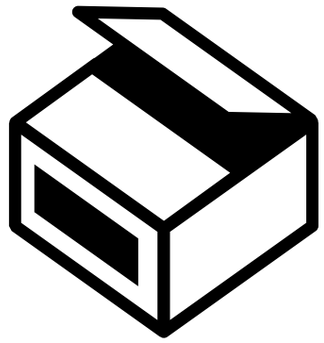
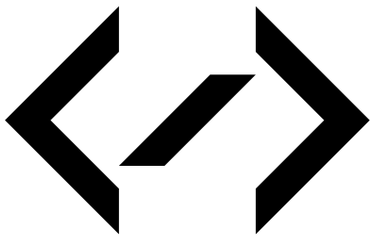
What unique data is represented in my app? **e.g a picture, a person**



Models

What does the user need to be able to **see** and **do**?

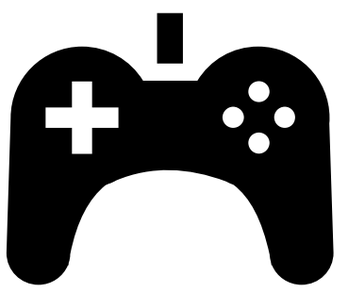


Spaghetti code

What (repeatable) output can I shift to JS templating?

Views

(varies) If a router, what happens when a route is navigated to? e.g. **/#admin**



Controllers

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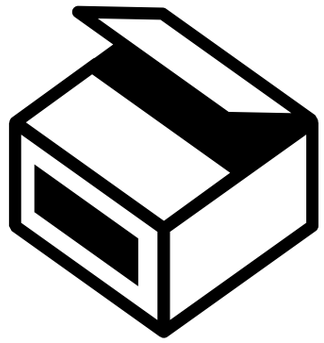

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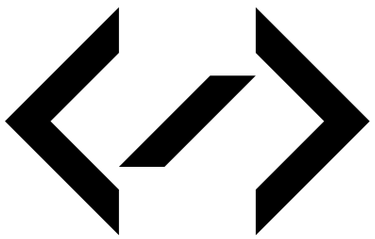

Spaghetti code

Views

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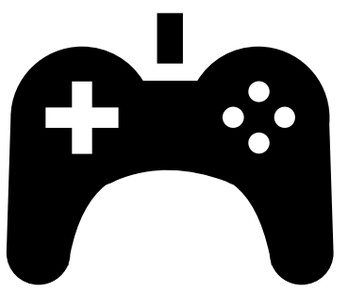


Controllers

On the client-side, I prefer to refer to this pattern as MVV (Model-View-Variation).

All JavaScript ‘MVC’ frameworks seem to interpret MVC differently.

MVC Implementations

Frameworks and libraries that provide MVC implementations

- Backbone.js
- Spine.js
- JavaScriptMVC
- AngularJS
- SproutCore
- YUILibrary
- Broke.js
- Fidel.js
- Sammy.js
- KnockoutJS (MVVM)

MVC Frameworks

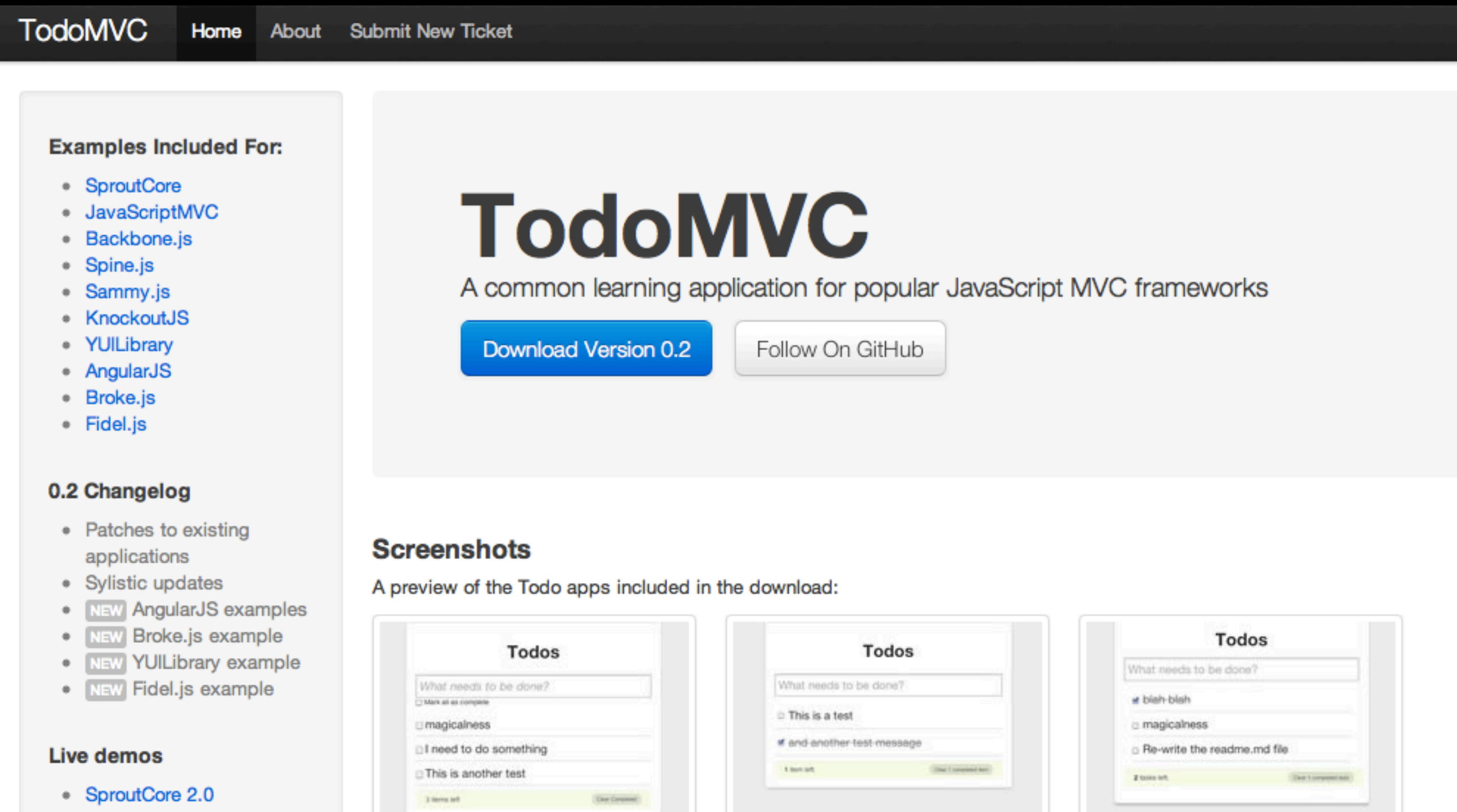
A quick overview of what's available

- **Backbone.js** - light, mature, popular.
- **JavaScriptMVC** - MVC, integrated dev tools
- **Spine.js** - light, best option for CoffeeScript devs
- **SproutCore** - 2.0 is also light, good docs
- **AngularJS** - light, relies on data-bindings
- **Sammy.js** - routes/controllers but no MV. Better for bootstrapping just the parts needed

To help make deciding on an MVC framework easier, I created TodoMVC.

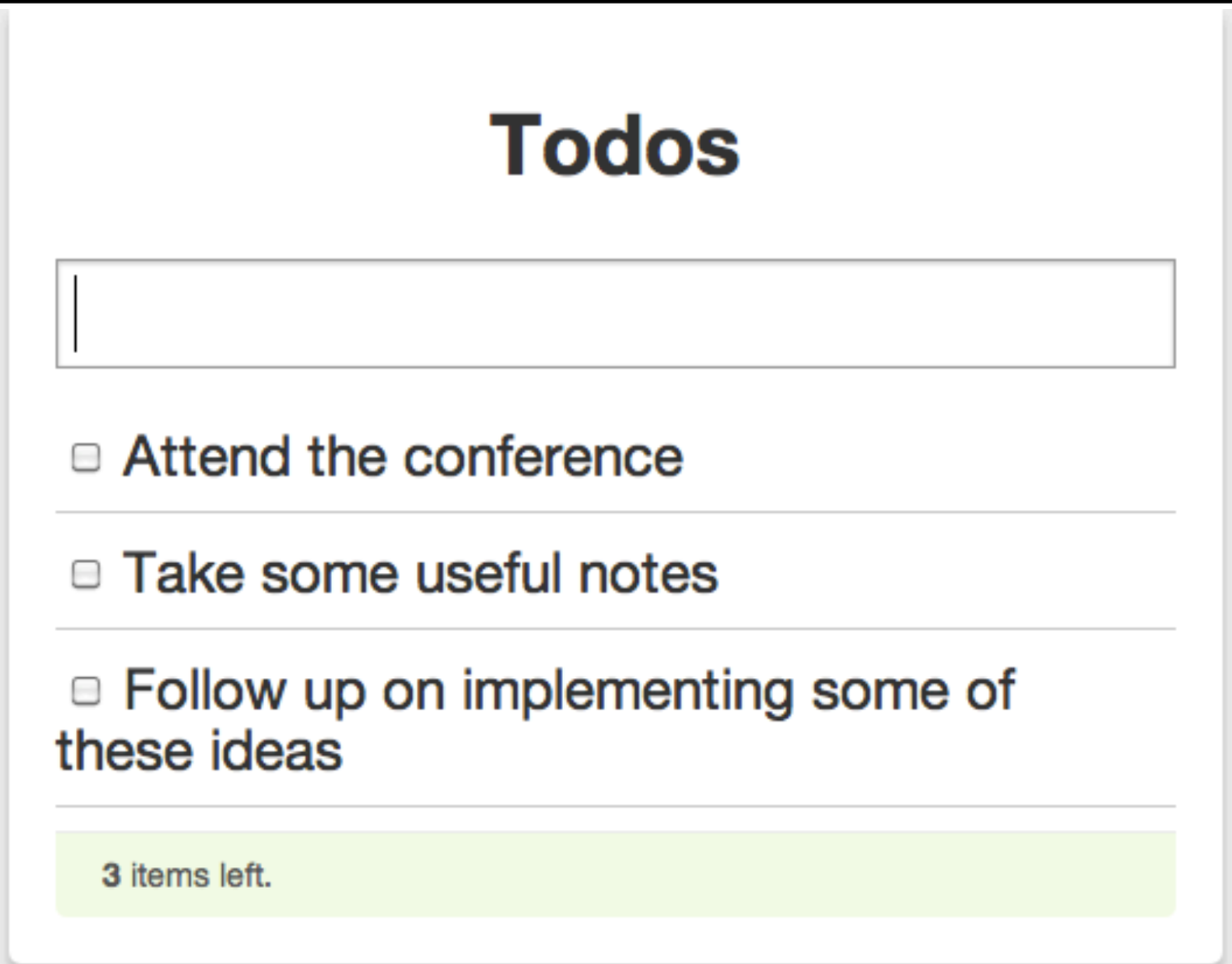
Same app, different frameworks.

http://addyosmani.github.com/todomvc



Easy to compare

With the same functionality, it's easier to compare implementations.



Moving beyond MVC, there are times when you want to further break down your application. Patterns can help with this.

JavaScript Patterns

Writing code that's expressive, encapsulated & structured

Modules

Interchangeable single-parts of a larger system that can be easily re-used. In JS we use the module pattern.

"*Anything* can be defined as a reusable module"

- Nicholas Zakas, author 'Professional JavaScript For Web Developers'

Stepping stone: IIFE

Immediately invoked function expressions (or self-executing anonymous functions)

```
(function() {
   // code to be immediately invoked
}()); // Crockford recommends this way

(function() {
   // code to be immediately invoked
})(); // This is just as valid


(function( window, document, undefined ){
    //code to be immediately invoked
})( this, this.document);

(function( global, undefined ){
    //code to be immediately invoked
})( this );
```

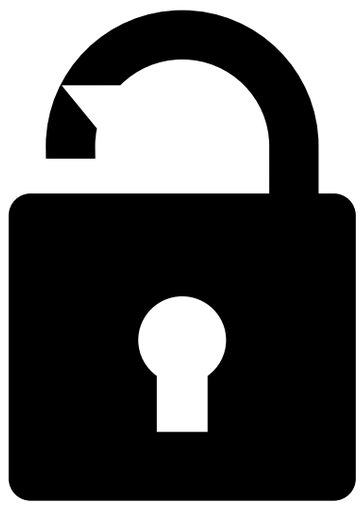
This is great, but..


There's no privacy!

Privacy In JavaScript

There isn't a *true* sense of it in JavaScript.

No Access Modifiers



Variables & Methods
can't be '**public'**

Variables & Methods
can't be '**private'**

Module Pattern

The typical module pattern is where immediately invoked function expressions (IIFEs) use **execution context** to create 'privacy'. Here, **objects** are returned instead of functions.

```
var basketModule = (function() {
    var basket = []; //private
    return { //exposed to public
        addItem: function(values) {
            basket.push(values);
        },
        getItemCount: function() {
            return basket.length;
        },
        getTotal: function(){
           var q = this.getItemCount(),p=0;
            while(q--){
                p+= basket[q].price;
            }
            return p;
        }
    }
}());
```

- In the pattern, variables declared are **only** available **inside** the module.
- Variables defined **within** the **returning object** are available to everyone
- This allows us to **simulate** privacy

Sample usage

Inside the module, you'll notice we return an object. This gets automatically assigned to basketModule so that you can interact with it as follows:

```
//basketModule is an object with properties which can also be methods
basketModule.addItem({item:'bread',price:0.5});
basketModule.addItem({item:'butter',price:0.3});

console.log(basketModule.getItemCount());
console.log(basketModule.getTotal());

//however, the following will not work:
// (undefined as not inside the returned object)
console.log(basketModule.basket);
//(only exists within the module scope)
console.log(basket);
```

Module Pattern: Dojo

Dojo attempts to provide 'class'-like functionality through **dojo.declare**, which can be used for amongst other things, creating implementations of the module pattern. Powerful when used with **dojo.provide**.

```
// traditional way
var store = window.store || {};
store.basket = store.basket || {};

// another alternative..
// using dojo.setObject (with basket as a module of the store namespace)
dojo.setObject("store.basket.object", (function() {
    var basket = [];
    function privateMethod() {
        console.log(basket);
    }
    return {
        publicMethod: function(){
                privateMethod();
        }
    };
}()));
```

Module Pattern: jQuery

In the following example, a **library** function is defined which declares a new library and automatically binds up the **init** function to document.ready when new libraries (ie. modules) are created.

```
function library(module) {
  $(function() {
    if (module.init) {
      module.init();
    }
  });
  return module;
}

var myLibrary = library(function() {
    return {
      init: function() {
        /*implementation*/
      }
    };
}());
```

Module Pattern: YUI

A YUI module pattern implementation that follows the same general concept.

```
YAHOO.store.basket = function () {

    //"private" variables:
    var myPrivateVar = "I can be accessed only within YAHOO.store.basket .";

    //"private" method:
    var myPrivateMethod = function () {
            YAHOO.log("I can be accessed only from within YAHOO.store.basket");
        }

    return {
        myPublicProperty: "I'm a public property.",
        myPublicMethod: function () {
            YAHOO.log("I'm a public method.");

            //Within basket, I can access "private" vars and methods:
            YAHOO.log(myPrivateVar);
            YAHOO.log(myPrivateMethod());

            //The native scope of myPublicMethod is store so we can
            //access public members using "this":
            YAHOO.log(this.myPublicProperty);
        }
    };

}();
```

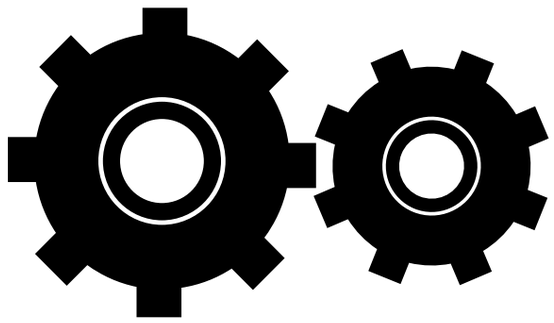
Module Pattern: ExtJS

Another library that can similarly use the module pattern.

```
// define a namespace
Ext.namespace('myNamespace');

// define a module within this namespace
myNameSpace.module = function() {
    // recommended that you don't directly access the DOM
    // from here as elements don't exist yet. Depends on
    // where/how you're waiting for document load.

    // private variables

    // private functions

    // public API
    return {
        // public properties

        // public methods
        init: function() {
            console.log('module initialised successfully');
        }
    };
}(); // end of module
```

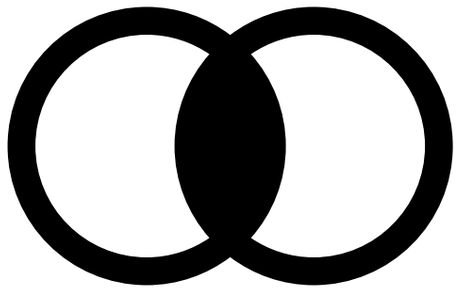
Better: AMD

Take the concept of reusable JavaScript modules further with the **A**synchronous **M**odule **D**efinition.



Mechanism for defining **asynchronously** loadable modules & dependencies

Non-blocking, parallel loading and well defined.



Stepping-stone to the module system proposed for ES Harmony

AMD: define()

define allows the definition of modules with a signature of
define(**id** /*optional*/, **[dependencies]**, **factory** /*module instantiation fn*/);

```
/* wrapper */
define(
    /*module id*/
    'myModule',

    /*dependencies*/
    ['foo','bar','foobar'],

    /*definition for the module export*/
    function (foo, bar, foobar) {

        /*module object*/
        var module = {};

        /*module methods go here*/
        module.hello = foo.getSomething();
        module.world = bar.doSomething();

        /*return the defined module object*/
        return module;
    }
);
```

AMD: require()

require is used to load code for top-level JS files or inside modules for dynamically fetching dependencies

```
/* top-level: the module exports (one, two) are passed as
 function args to the callback.*/
require(['one', 'two'], function (one, two) {

});
```

```
/* inside: complete example */
define('three', ['one', 'two'], function (one, two) {

    /*require('string') can be used inside the function
    to get the module export of a module that has
    already been fetched and evaluated.*/

    var temp = require('one');

    /*This next line would fail*/
    var bad = require('four');

    /* Return a value to define the module export */
    return function () {};
});
```

AMD modules can be used with RequireJS and curl.js amongst other script loaders.

They're compatible with Dojo, MooTools and even jQuery.

AMD + jQuery

A very simple AMD module using jQuery and the color plugin

```
define(["jquery", "jquery.color", "jquery.bounce"], function($) {
    //the jquery.color and jquery.bounce plugins have been loaded

    // not exposed to other modules
    $(function() {
        $('#container')
            .animate({'backgroundColor':'#ccc'}, 500)
            .bounce();
    });

    // exposed to other modules
    return function () {
       // your module's functionality
    };

});
```

AMD/UMD jQuery Plugin

Recommended by Require.js author James Burke

```
(function(root, factory) {
  if (typeof exports === 'object') {
    // Node/CommonJS
    factory(require('jquery'));
  } else if (typeof define === 'function' &&
define.amd) {
    // AMD. Use a named plugin in case this
    // file is loaded outside an AMD loader,
    // but an AMD loader lives on the page.
    define('myPlugin', ['jquery'], factory);
  } else {
    // Browser globals
    factory(root.jQuery);
  }
}(this, function($) {
  $.fn.myPlugin = function () {};
}));
```

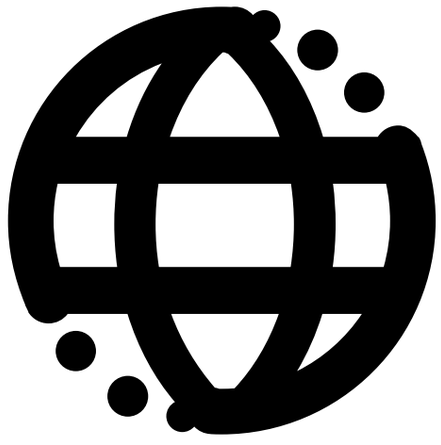
Want to see a Backbone.js + RequireJS + AMD + jQuery demo? Hang on until the end.

*or look at:

https://github.com/addyosmani/backbone-aura

Alternative: CommonJS

Another easy to use module system with wide adoption server-side



CommonJS
Working group designing, prototyping, standardizing JS APIs

Format widely accepted on a number of server-side platforms (Node)

Competing standard. Tries to solve a few things AMD doesn't.

CommonJS Modules

They basically contain two parts: an **exports** object that contains the objects a module wishes to expose and a **require** function that modules can use to import the exports of other modules

```
/* here we achieve compatibility with AMD and CommonJS
using some boilerplate around the CommonJS module format*/
(function(define){
    define(function(require,exports){
        /*module contents*/
        var dep1 = require("foo");
        var dep2 = require("bar");
        exports.hello = function(){...};
        exports.world = function(){...};
    });
})(typeof define=="function"? define:function(factory)
{factory(require,exports)});
```

ES Harmony Modules

A module format proposed for EcmaScript Harmony with goals such as static scoping, simplicity and usability. This **isn't** final.

```
// Basic module
module SafeWidget {
    import alert from Widget;
    var _private ="someValue";
    // exports
    export var document = {
        write: function(txt) {
            alert('Out of luck, buck');
        },
        ...
    };
}

// Remote module
module JSONTest from 'http://json.org/modules/json2.js';
```

DART modules

A module created using Google's recently proposed Dart

```
// 17,000 lines of code
// couldn't fit on the slides
// Sorry, guise!
```

Modules are regularly used in MVC applications..but there are other patterns that can make building large apps easier too.

Remember..jQuery generally plays a smaller role in larger-apps than most people might think.

Facade Pattern

Convenient, high-level interfaces to larger bodies of code that hide underlying complexity

"When you put up a facade, you're usually creating an outward appearance which conceals a different reality. Think of it as simplifying the API presented to other developers"
- Essential JavaScript Design Patterns

Facade Implementation

A higher-level facade is provided to our underlying module, without directly exposing methods.

```
var module = (function() {
    var _private = {
        i:5,
        get : function() {
            console.log('current value:' + this.i);
        },
        set : function( val ) {
            this.i = val;
        },
        run : function() {
            console.log('running');
        },
        jump: function(){
            console.log('jumping');
        }
    };
    return {
        facade : function( args ) {
            _private.set(args.val);
            _private.get();
            if ( args.run ) {
                _private.run();
            }
        }
    }
}());
module.facade({run: true, val:10}); //outputs current value: 10, running
```

Facade Implementation

A higher-level facade is provided to our underlying module, without directly exposing methods.

```
var module = (function() {
    var _private = {
        i:5,
        get : function() {
            console.log('current value:' + this.i);
        },
        set : function( val ) {
            this.i = val;
        },
        run : function() {
            console.log('running');
        },
        jump: function(){
            console.log('jumping');
        }
    };
    return {
        facade : function( args ) {
            _private.set(args.val);
            _private.get();
            if ( args.run ) {
                _private.run();
            }
        }
    }
}());
module.facade({run: true, val:10}); //outputs current value: 10, running
```

We're really just interested in this part.

Facade Implementation

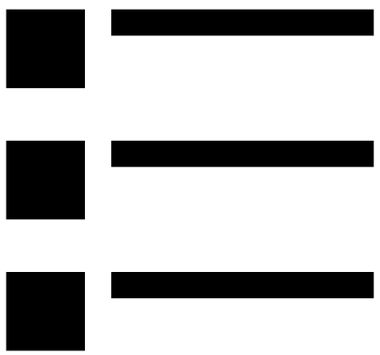
A higher-level facade is provided to our underlying module, without directly exposing methods.

```
return {
    facade : function( args ) {
        // set values of private properties
        _private.set(args.val);
        // test setter
        _private.get();
        // optional: provide a simple interface
        // to internal methods through the
        // facade signature
        if ( args.run ) {
            _private.run();
        }
    }
}
```

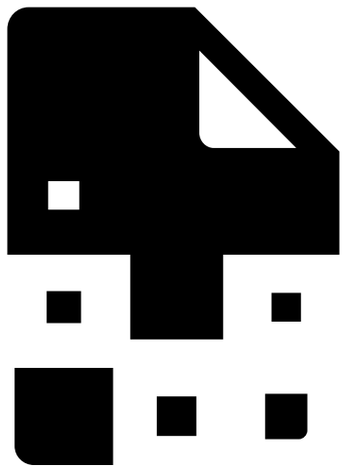
Limited public API of functionality. Differs greatly from the reality of the implementation.

A Facade

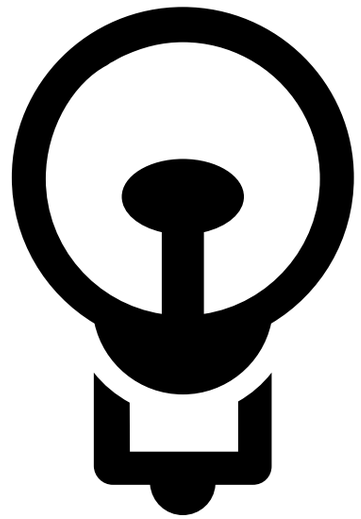
A structural pattern found in many JavaScript libraries and frameworks (eg. jQuery).



Simplifies usage through a limited, more **readable** API



Hides the inner-workings of a library. Allows implementation to be **less important.**

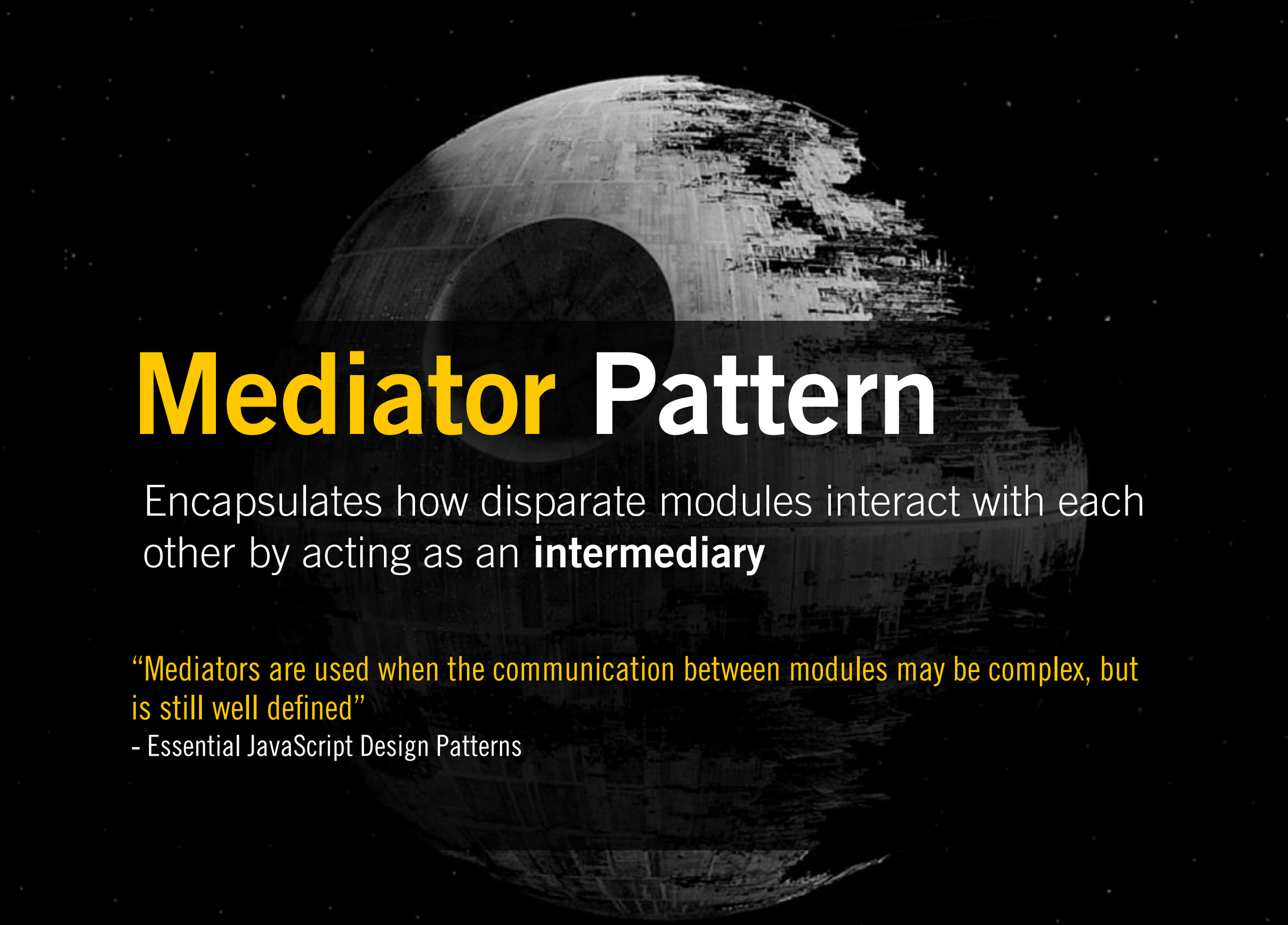


This lets you be **more creative** behind the scenes.

Facade Pattern

How does it differ from the module pattern?

- Differs from the module pattern as the exposed API can **greatly differ** from the public/private methods defined
- Has many uses including application **security** as we'll see a little later in the talk



Mediator Pattern

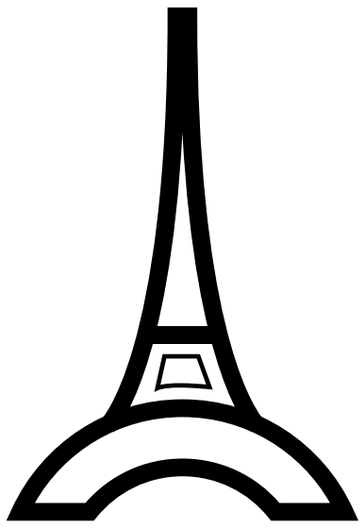
Encapsulates how disparate modules interact with each other by acting as an **intermediary**

"Mediators are used when the communication between modules may be complex, but is still well defined"

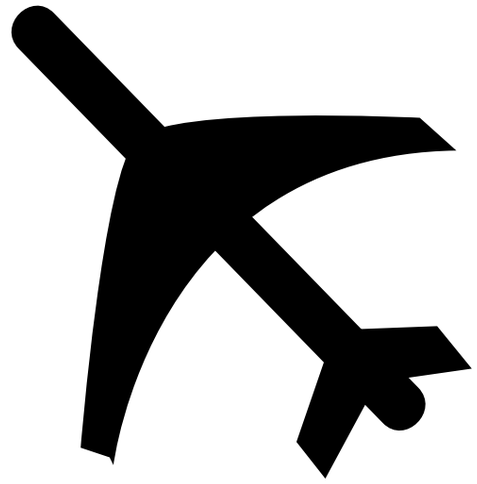
- Essential JavaScript Design Patterns

Air Traffic Control

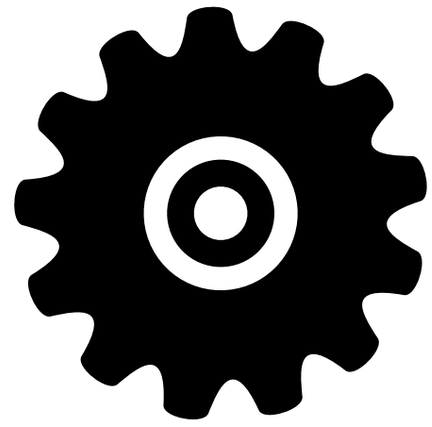
I always find this mediator analogy helps when discussing this pattern:



The tower handles what planes can take off and land



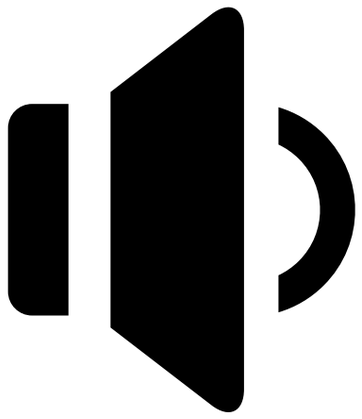
All communication done from planes to tower, not plane to plane



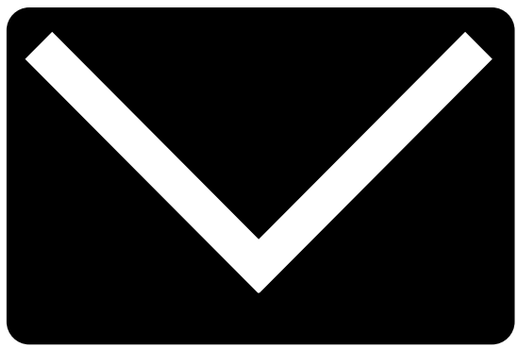
Centralised controller is key to this success. Similar to mediator.

A Mediator

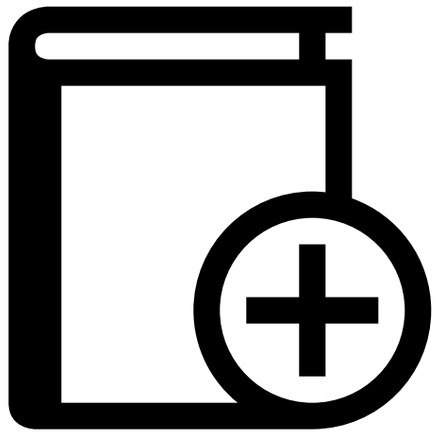
Promotes loose coupling. Helps solve module inter-dependency issues.



Allow modules to **broadcast** or **listen** for notifications without worrying about the system.



Notifications can be handled by **any number** of modules at once.



Typically easier to **add** or **remove** features to loosely coupled systems like this.

Mediator Implementation

One possible implementation, exposing publish and subscribe capabilities.

```
var mediator = (function(){
    var subscribe = function(channel, fn){
        if (!mediator.channels[channel])mediator.channels[channel] = [];
        mediator.channels[channel].push({ context: this, callback:fn });
        return this;
    },

    publish = function(channel){
        if (!mediator.channels[channel]) return false;
        var args = Array.prototype.slice.call(arguments, 1);
        for (var i = 0, l = mediator.channels[channel].length; i <l; i++) {
            var subscription = mediator.channels[channel][i];
            subscription.callback.apply(subscription.context,args);
        }
        return this;
    };

    return {
        channels: {},
        publish: publish,
        subscribe: subscribe,
        installTo: function(obj){
            obj.subscribe = subscribe;
            obj.publish = publish;
        }
    };
}());
```

Example

Usage of the implementation from the last slide.

```
//Pub/sub on a centralized mediator

mediator.name = "tim";
mediator.subscribe('nameChange', function(arg){
        console.log(this.name);
        this.name = arg;
        console.log(this.name);
});

mediator.publish('nameChange', 'david'); //tim, david


//Pub/sub via third party mediator

var obj = { name: 'sam' };
mediator.installTo(obj);
obj.subscribe('nameChange', function(arg){
        console.log(this.name);
        this.name = arg;
        console.log(this.name);
});

obj.publish('nameChange', 'john'); //sam, john
```

Part III: Return of the patterns

Scalable Application Architecture

Strategies for decoupling and future-proofing the structure of your application. Let's build empires.

Thanks to Nicholas Zakas, Rebecca Murphey, John Hann, Paul Irish, Peter Michaux and Justin Meyer for their previous work in this area.

Challenge

Define what it means for a JavaScript application to be ‘large’.

- It’s a very **tricky** question to get right
- Even experienced JavaScript developers have trouble accurately defining this

Some Answers

I asked some intermediate developers what their thoughts on this were.

Umm..JavaScript apps with over 100,000 lines of code?

Some Answers

I asked some intermediate developers what their thoughts on this were.

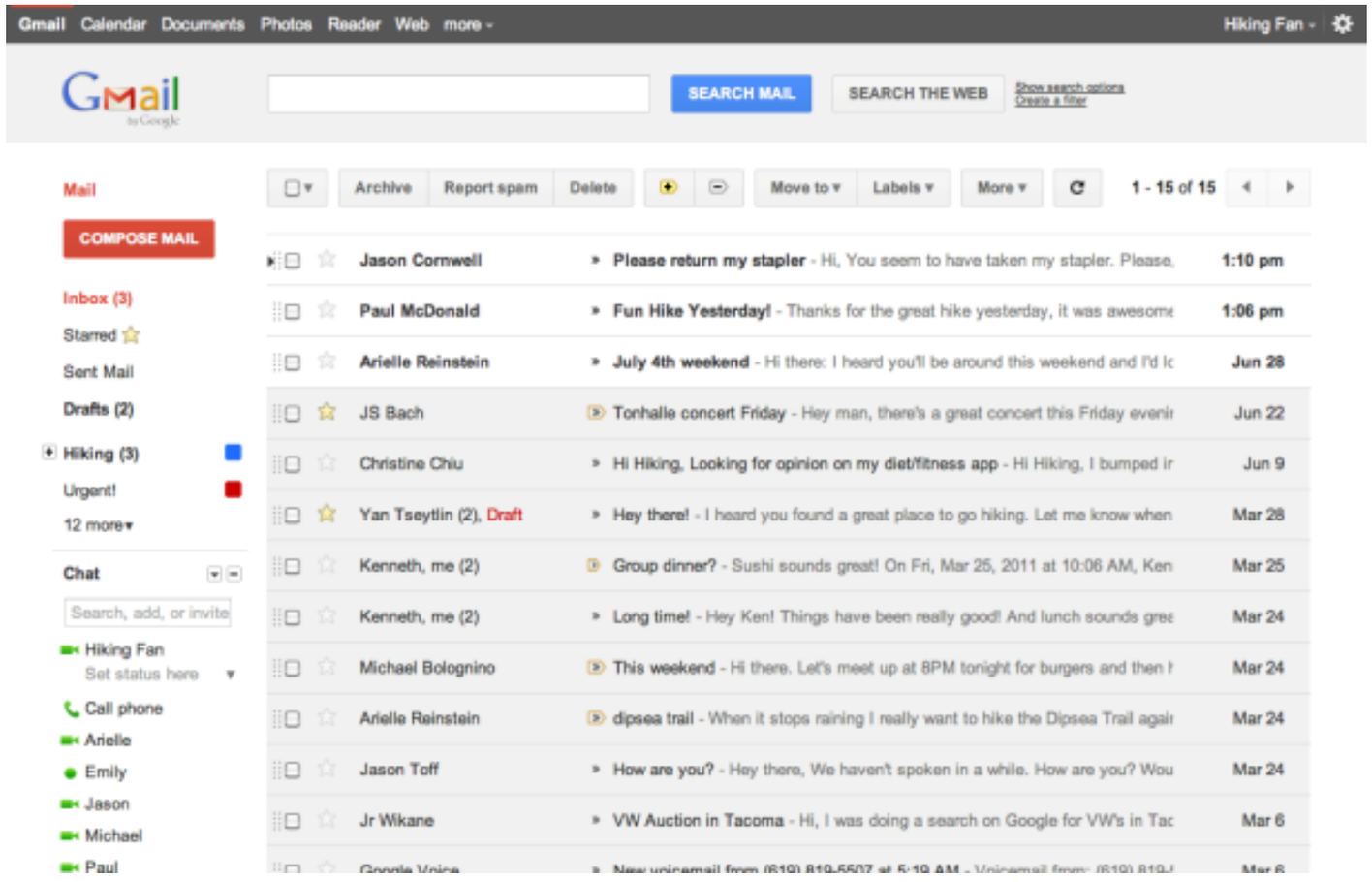
Obviously, apps with over 1MB of JavaScript code written in-house!

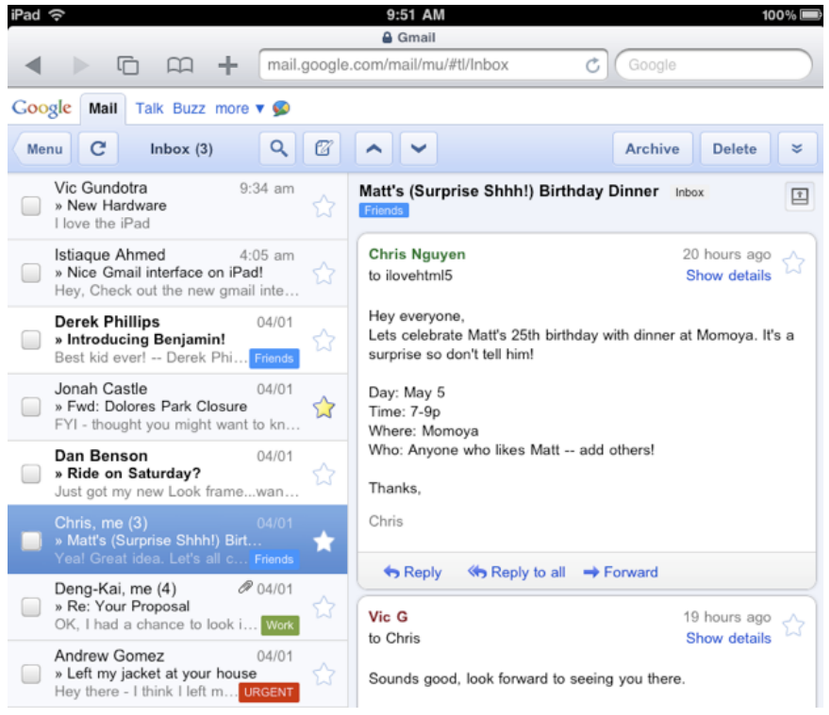
My Answer

Large-scale JavaScript apps are **non-trivial** applications requiring **significant** developer effort to maintain, where most heavy lifting of data manipulation and display falls to the **browser**.

Some Examples

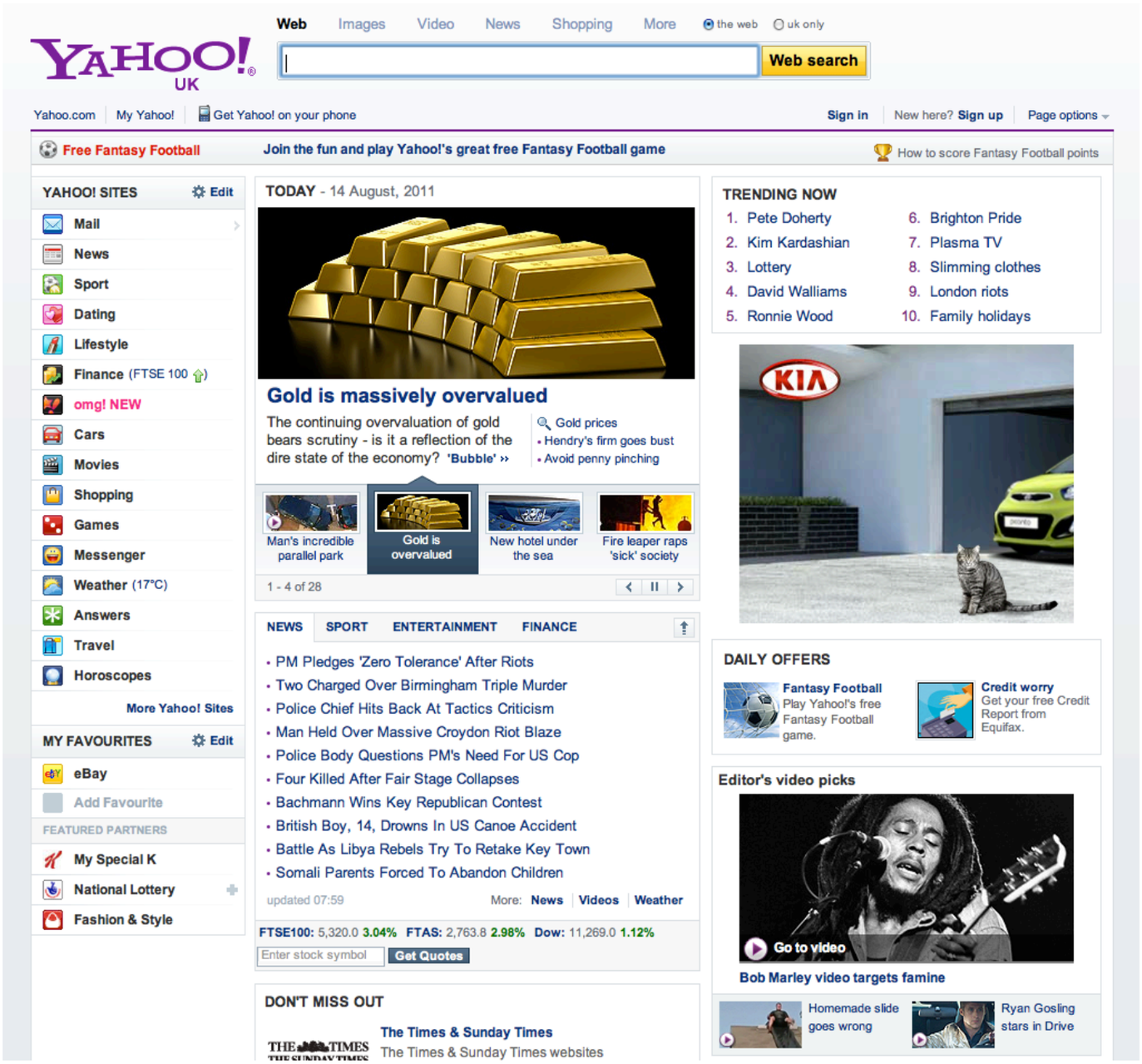
Google's GMail





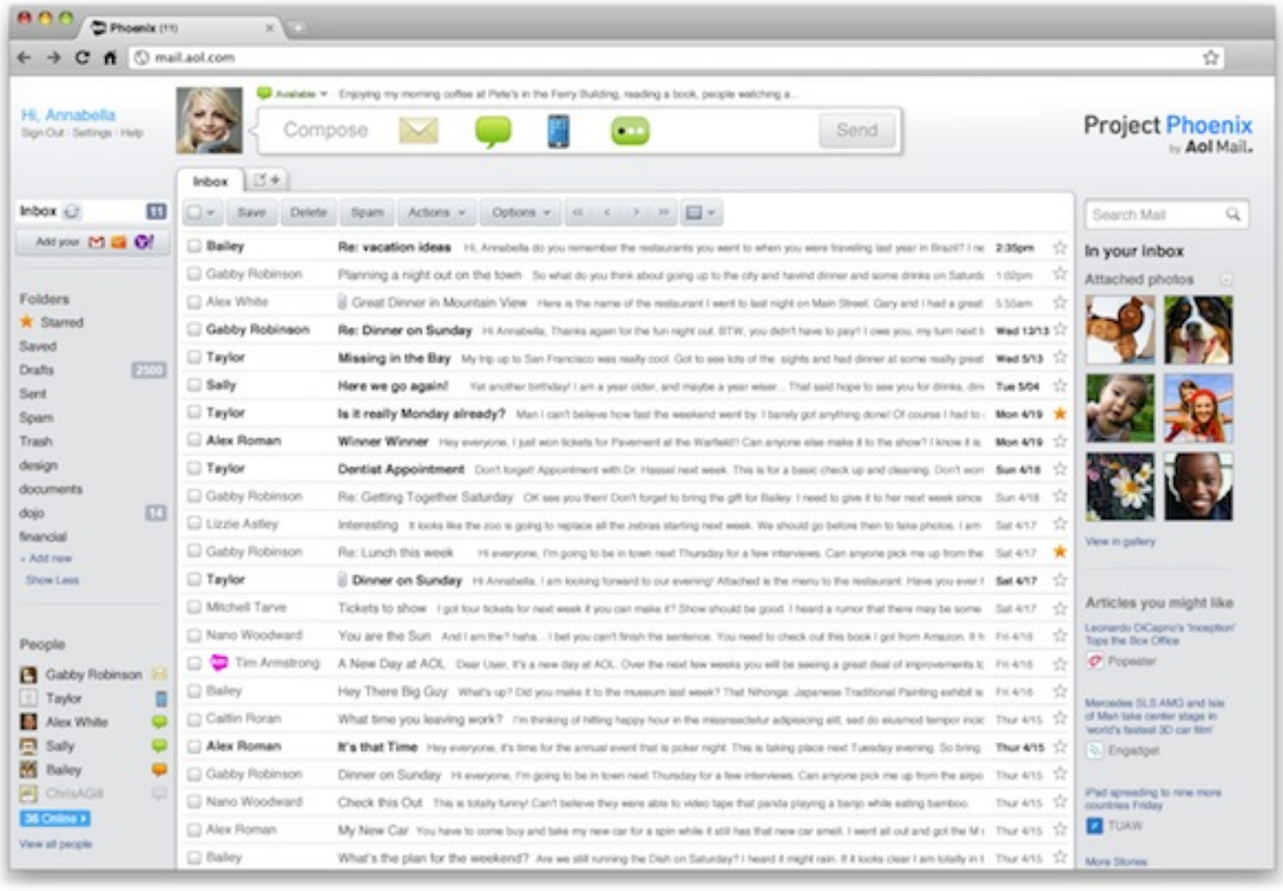
Some Examples

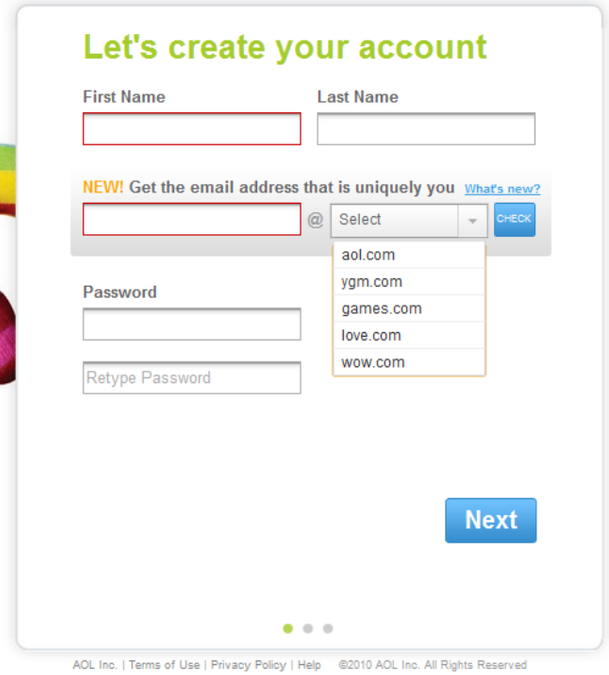
The Yahoo! Homepage



Some Examples

AOL Mail / Phoenix





Current Architecture

If working on a **significantly** large JavaScript app, remember to dedicate **sufficient time** to planning the underlying architecture that makes the most sense.

It's often **more complex** than we initially think.

Your Current Architecture

might contain a mixture of the following:

Custom Widgets

Modules

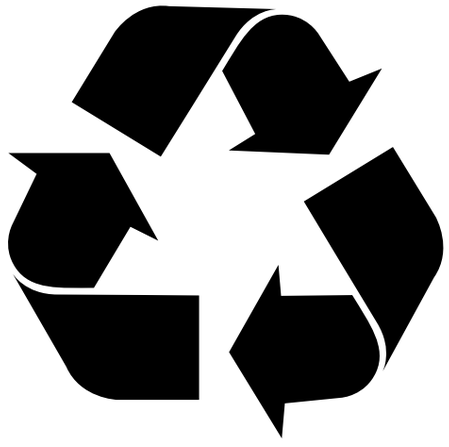
An Application Core

MVC (Models/Views/Controllers)

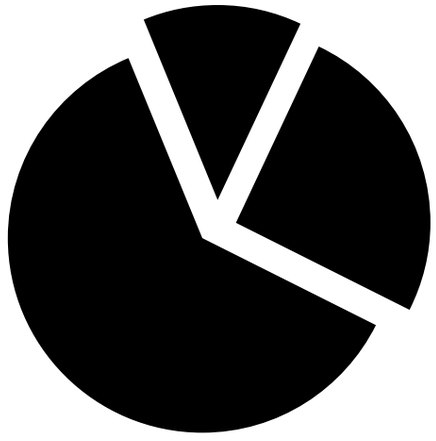
JavaScript Libraries & Toolkits

Possible Problems

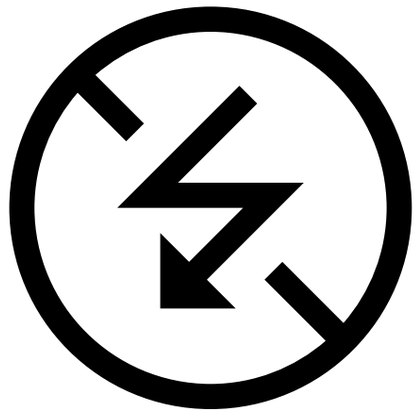
The last slide contains some great architectural components, but used non-optimally they can come with a few problems:



How much of this is instantly **re-usable**?



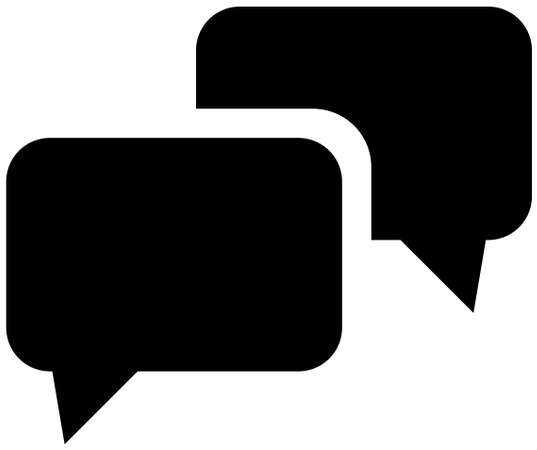
Can single modules exist on their own **independently**?



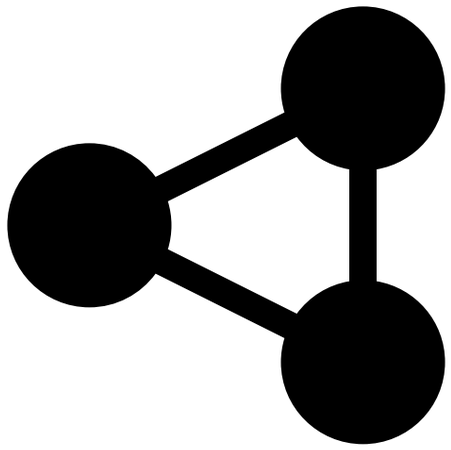
Can single modules be **tested independently?**

Possible Problems

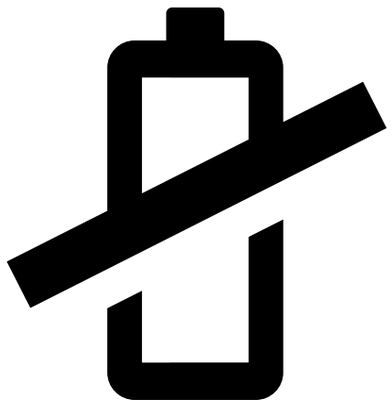
Some further concerns:



How much do modules **depend** on others in the system?



Is your application **tightly coupled**?



If specific parts of your app fail, can it **still function**?

Think Long-Term

What future concerns haven't been factored in to this architecture?

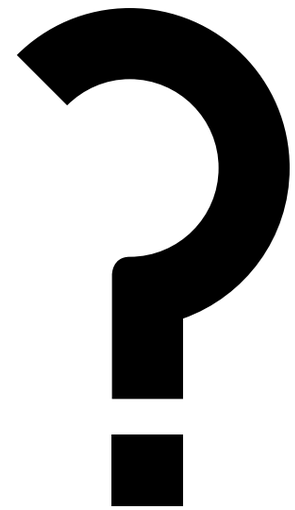
- You may decide to **switch** from using jQuery to Dojo or YUI for reasons of performance, security or design
- Libraries are **not easily interchangeable** and have high switching costs if tightly coupled to your app

Think long term - what future concerns haven't been factored in yet?

Ask Yourself

This is important.

If you reviewed your architecture right **now**, could a decision to switch libraries be made without rewriting your **entire** application?



“The secret to building large apps is **never** build large apps. Break your applications into **small** pieces. Then, **assemble** those testable, bite-sized pieces into your big application”

- Justin Meyer

“The more **tied** components are to each other, the **less reusable** they will be, and the more **difficult** it becomes to make changes to one without accidentally affecting another”

- Rebecca Murphey

“The key is to acknowledge from the **start** that you have **no idea** how this will grow.

When you accept that you **don't** know everything, you begin to design the system **defensively**.”

- Nicholas Zakas

Solution: Combine Patterns

Fixing our architecture with what we've learned to date.

"The only difference between a problem and a solution is that people understand the solution.'
- Charles F. Kettering

Let's Combine Our Patterns

We're going to build something special.

Module Pattern

+

Facade Pattern

+

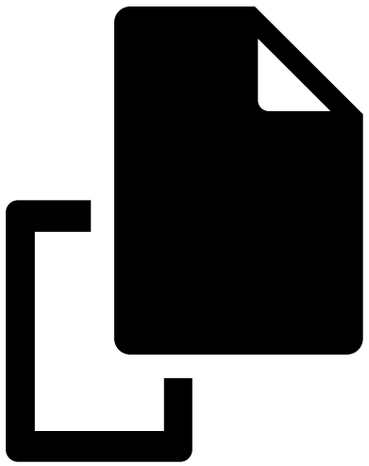
Mediator Pattern

=

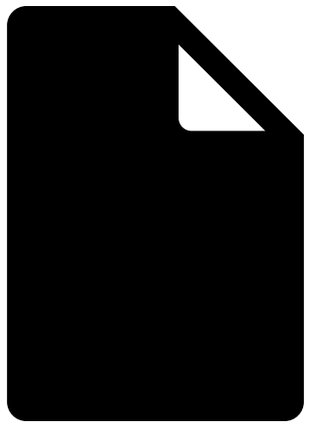
WIN

Brainstorm.

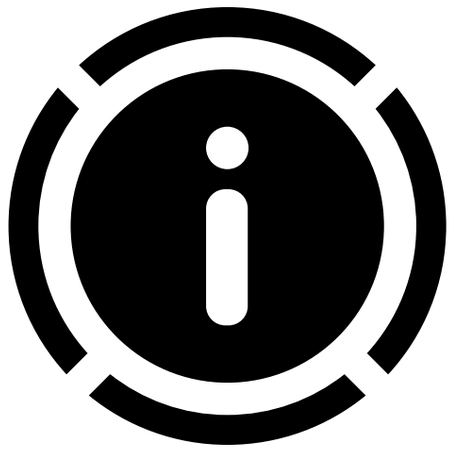
What do we want?



Loosely coupled architecture



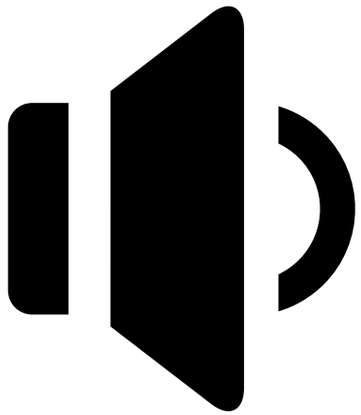
Functionality broken down into smaller **independent** modules



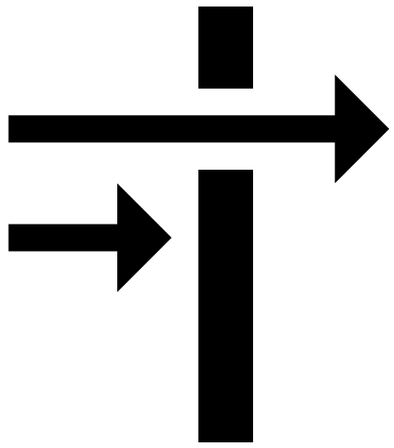
Framework or library **agnostic.** Flexibility to change in future.

Some More Ideas.

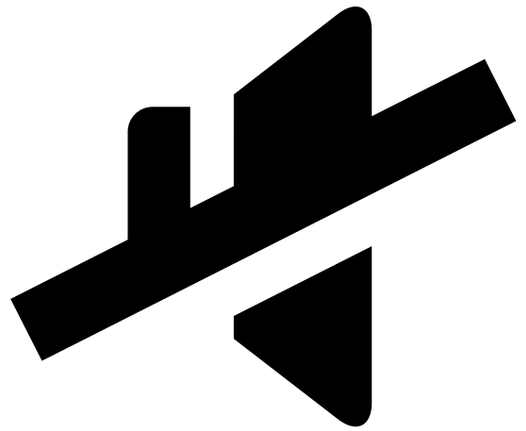
How might we achieve this?



Single modules speak to the app when something interesting happens



An intermediate layer interprets requests. Modules **don't** access the core or libraries directly.



Prevent apps from falling over due to errors with specific modules.

The Facade

The Facade pattern will play the role of:

- An **abstraction** of the application core that sits in the middle between it and modules
- Ensures a **consistent interface** to our modules is available at all times
- Should be the **only thing** modules are aware of - they shouldn't know about other components

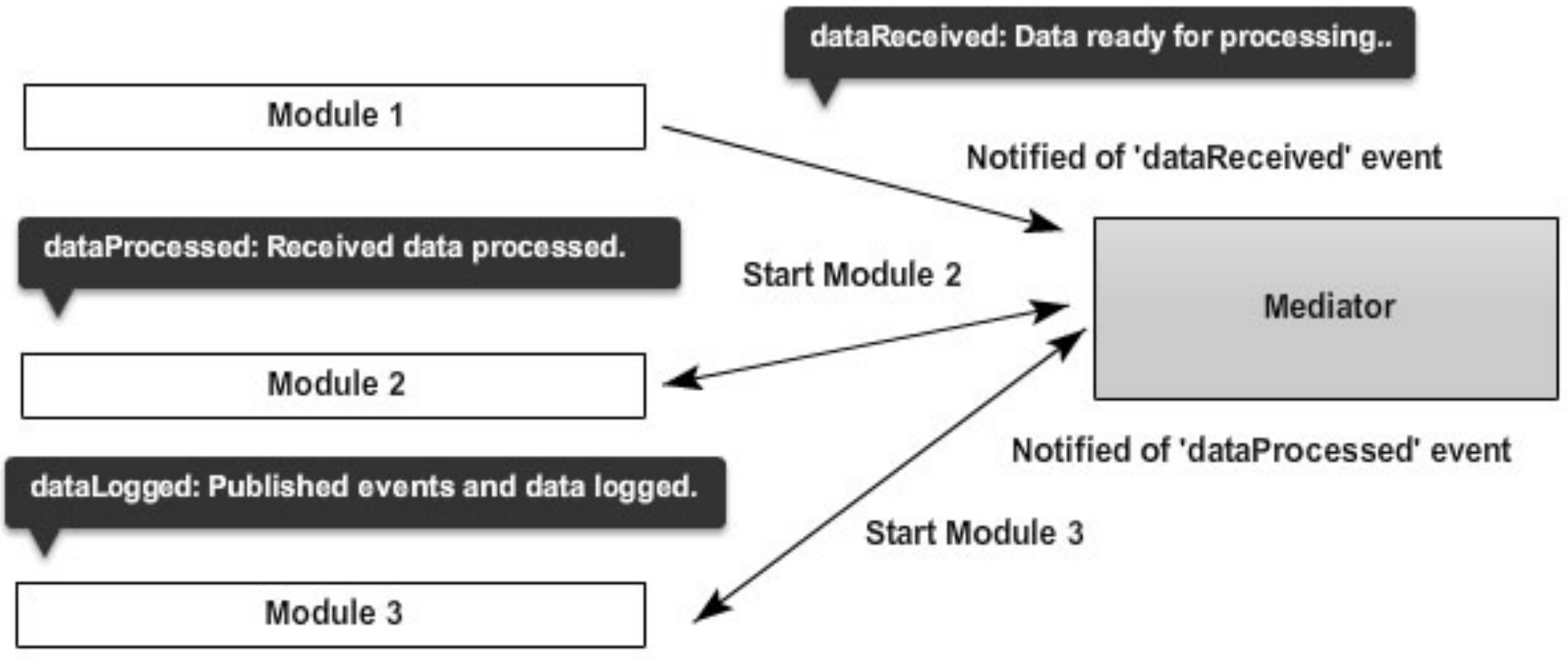
The Facade

How else can it help?

- Components communicate via the facade so it needs to be **dependable**
- It acts as a **security guard**, determining which parts of the application a module can access
- Components only call **their own** methods or methods from a sandbox, but nothing they don't have permission to

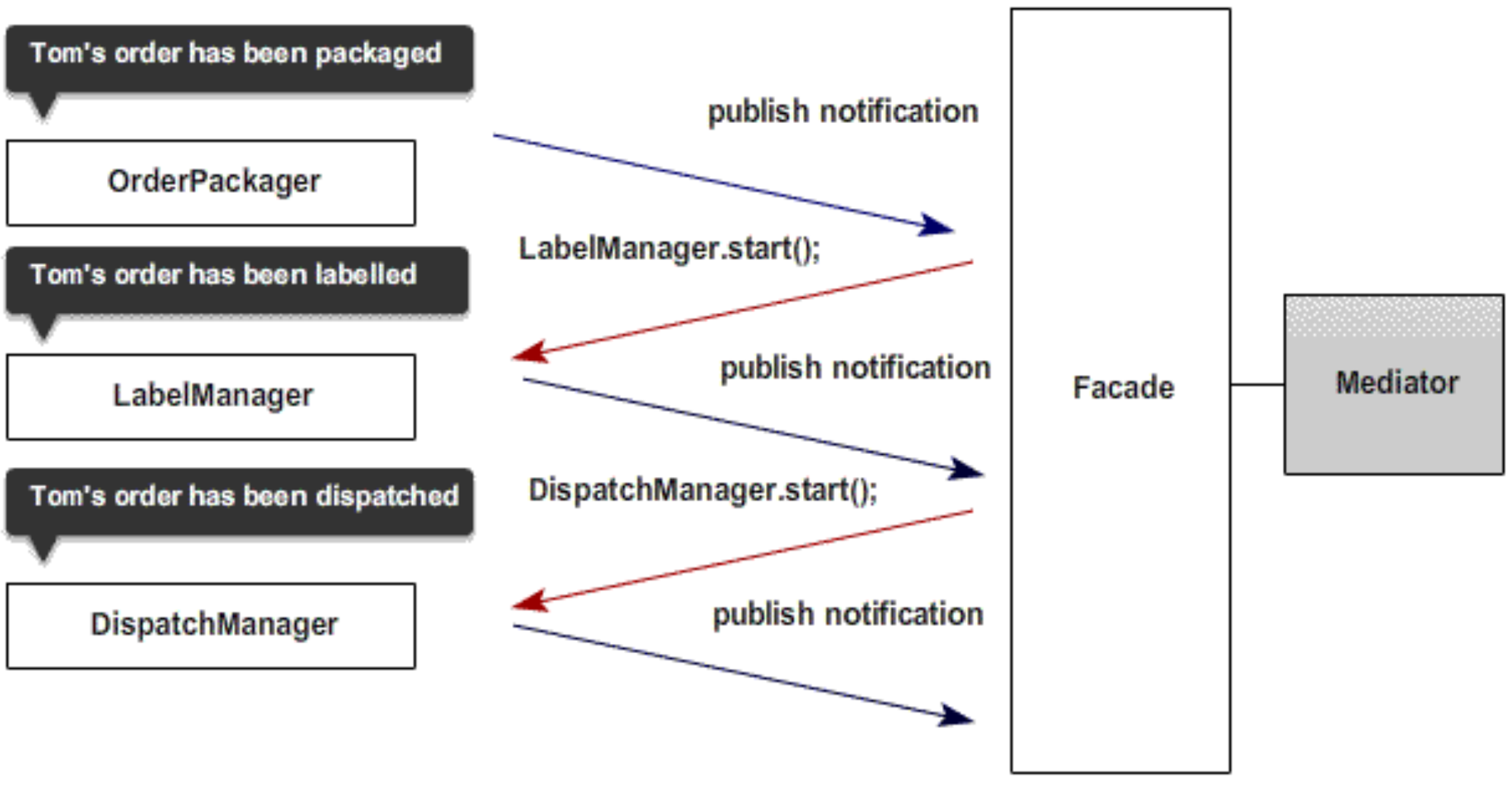
The Facade

This is how modules might normally communicate with the mediator.



The Facade

This is where the Facade fits in. The intermediate security layer that pipes notifications back to the mediator for processing.



The Facade

An abstraction of the core, it **listens** out for **interesting** events and says ‘Great. What happened? Give me the details’.

The Facade

It also acts as a permissions manager. Modules **only** communicate through this and are only able to do what they've been **permitted** to.

A Quick Note:

- Nicholas Zakas refers to the facade as a **sandbox controller**
- Agrees it could equally be considered the adapter, proxy or facade pattern
- I prefer ‘facade’ as it matches the purpose most closely

The Application Core

The Mediator Pattern

- It's job is to **manage** the module lifecycle
- When is it **safe** for a module to start?
- When should it **stop**?
- Modules should execute **automatically** when started

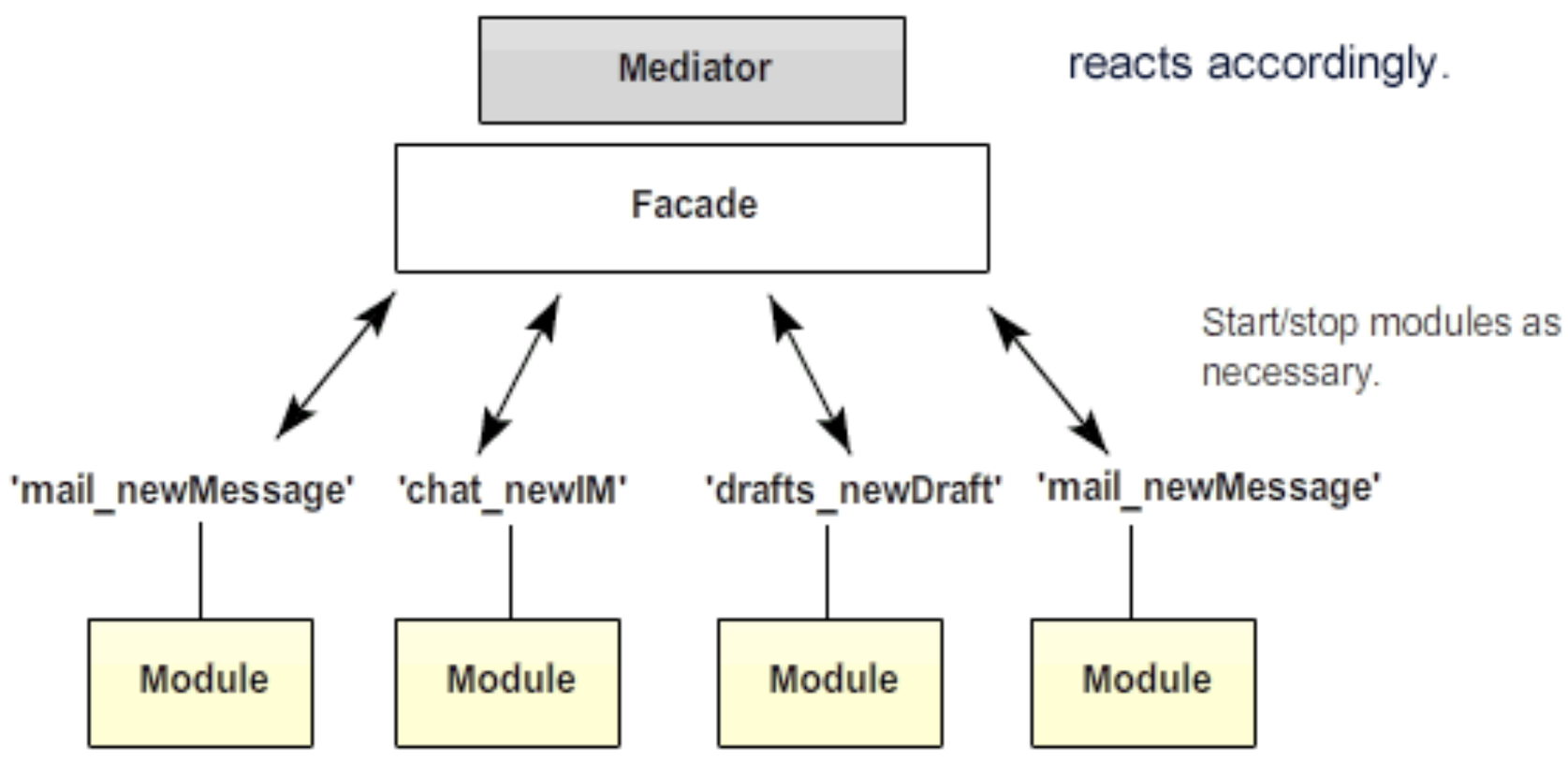
The Application Core

The Mediator Pattern

- It's **not** the core's job to decide whether this should be when the DOM is ready.
- The core should enable **adding or removing** modules without breaking anything.
- It should ideally also handle **detecting** and managing **errors** in the system.

The Application Core

The core acts as a 'Pub/Sub' manager using the mediator pattern



The Application Core

Manages the module **lifecycle**. It reacts to events passed from the facade and **starts, stops** or **restarts** modules as necessary. Modules here **automatically** execute when loaded.

Modules

Tying in modules into the architecture

- Modules want to **inform** the application when something interesting happens. e.g. a new message has arrived
- Correctly **publishing** events of interest should be their primary concern

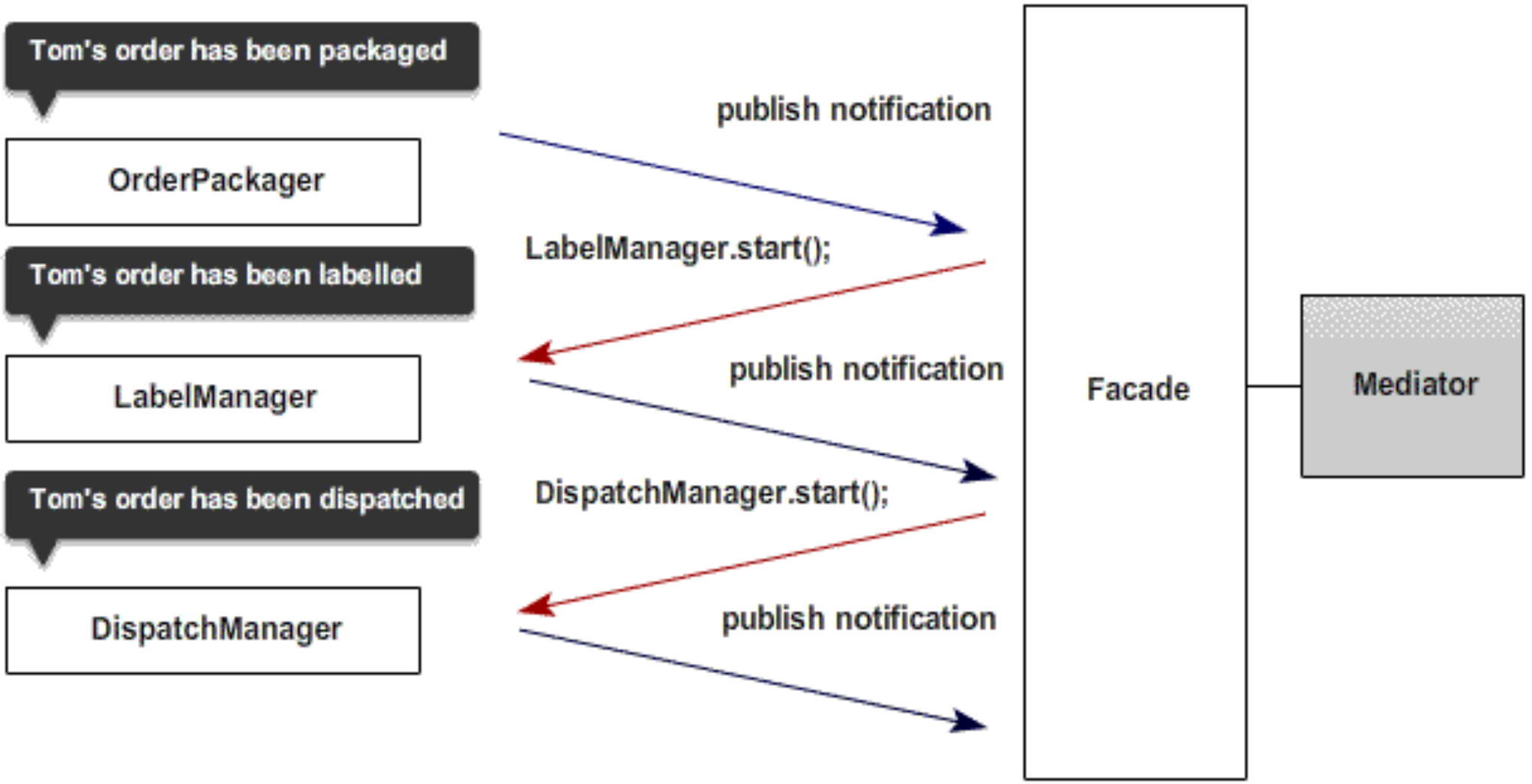
Modules

Tying in modules into the architecture

- Modules should ideally not be concerned about:
  - **what** objects or modules are being notified
  - **where** these objects are based (client? server?)
  - **how many** objects subscribe to notifications

Modules

Modules contain specific pieces of functionality for your application. They publish notifications informing the application whenever something interesting happens



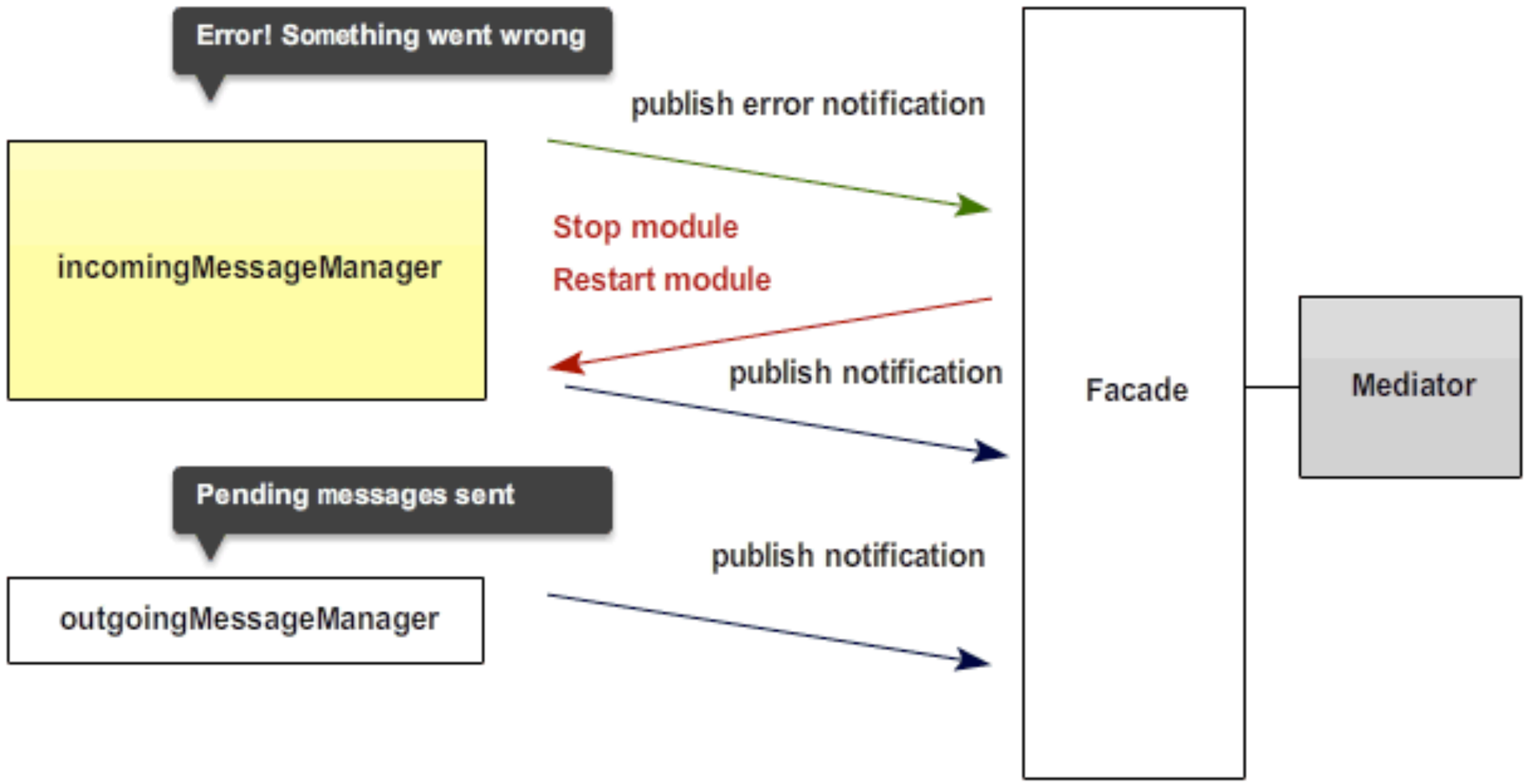
Modules

Tying in modules into the architecture

- They also **shouldn't** be concerned with what happens if other modules in the system fail to work
- Leave this up to the mediator

Modules

If a single module fails, the facade and mediator should stop and restart it.



Modules

Unique blocks of functionality for your application. They inform the application when something **interesting** happens. Don't talk to each other **directly**, only concerned with publishing events of interest.

Live demo 1: Backbone.js + RequireJS + AMD modules + mediator pattern

https://github.com/addyosmani/backbone-aura

Aura: A Preview

Enough talk! Let's take a look at some real code.

Aura is a framework I'm building at AOL that provides a boilerplate for one way to approach implementing this architecture. It will be released for open-source consumption once stable.

Aura: Core

The Mediator / Application Core

- **Swappable** Mediator with a light wrapper around a specific JavaScript library
- Ability to **start** and **stop** modules
- By default it comes with wrappers for both **Dojo** and **jQuery**, with core syntax that **resembles** the latter

Aura: Core

How does this work?

- Accessing this wrapper, the facade doesn't care what framework has been slotted in. It works with the **abstraction**
- Behind the scenes, arguments are **mapped** to the relevant jQuery or dojo **methods** and **signatures** for achieving specific behaviour

Aura: Core

A sample of the method signatures and namespaces supported

```
// some core methods for module management
core.define(module_id, module_definition); // define a new module
core.start(module_id);   // initialise a module
core.startAll();         // initialise all modules
core.stop(module_id);    // stop a specific module
core.stopAll();          // stop all modules
core.destroy(module_id); // destroy a specific module
core.destroyAll();       // destroy all modules

// core namespaces available out of the box
core.events  // bind, unbind etc.
core.utils   // type checking, module extension
core.dom     // DOM manipulation, CSS Styling
```

Aura: Core.dom > CSS Styling, Chaining

Chaining and CSS Style Manipulation are both supported.

```
// Chaining and CSS style manipulation
aura.core.dom.query('body').css({'background':'#1c1c1c'});
aura.core.dom.query('#search_input').css({'background':'blue'}).css({'color':'pink'});
aura.core.dom.query('#search_button').css({'width':'200','height':'100'});
```

```
// Manipulating styles within a context
aura.core.dom.css('body', {'background':'red'});
aura.core.dom.css('#shopping-cart',{'color':'green','background':'yellow'});
aura.core.dom.css('#product-panel li', {'background':'purple'});

// Passing in DOM nodes also works
var test = aura.core.dom.query('#shopping-cart'); //.query should handle this.
aura.core.dom.css(test, {'background':'purple'});
```

Aura: Core.dom > CSS Styling, Chaining

Look familiar? In my case I've modelled my abstraction around the jQuery API. Behind the scenes, this works with both jQuery and Dojo, providing a single abstraction.

```
// Chaining and CSS style manipulation
aura.core.dom.query('body').css({'background':'#1c1c1c'});
aura.core.dom.query('#search_input').css({'background':'blue'}).css({'color':'pink'});
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// Passing in DOM nodes also works
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aura.core.dom.css(test, {'background':'purple'});
```

Aura: Core.dom > Attribs, Anim

Attribute manipulation and animation are also abstracted using an API similar to jQuery. Remember, with Dojo this actually maps arguments back to the relevant Dojo methods needed to achieve the task.

```
// Get and set attributes
console.log(aura.core.dom.query('#seach_input').attr('title','foobar'));
console.log(aura.core.dom.query('#search_input').attr('title'));
```

```
// Passing in DOM nodes
var q = aura.core.dom.query('#shopping-cart');
console.log(aura.core.dom.attr(q, 'id'));
```

```
// Animation support
aura.core.dom.animate('#product-panel li', { width: 400, height:20}, 5000);
aura.core.dom.animate('button', {width: 200, duration: 100});
aura.core.dom.animate('p', {width:20, height:40, padding:10,duration:200});
```

Aura: Core.dom > Create, Ajax

Similarly, element creation and ajax are also supported in the abstracted core interface.

```
// Element creation
var el = aura.core.dom.create("a", {
          href: "foo.html",
          title: "bar!",
          innerHTML: "link"
 },
 'body');


// XHR/Ajax requests (deferred support coming soon)
 aura.core.dom.ajax({
          url:'index.html',
          type:'get', //post, put
          dataType: "text",
          success:function(data){
                  console.log('success');
          },
          error:function(){
                  console.log('error');
          }
 });
```

Live demo 2: Aura preview.

What We Learned

Let’s review what we looked at today.

‘Anyone who stops learning is old, whether at twenty or eighty. Anyone who keeps learning stays young. The greatest thing in life is to keep your mind young’
- Henry Ford

We looked at design patterns, jQuery & MVC, JavaScript patterns and how to finally build a large, scalable app.

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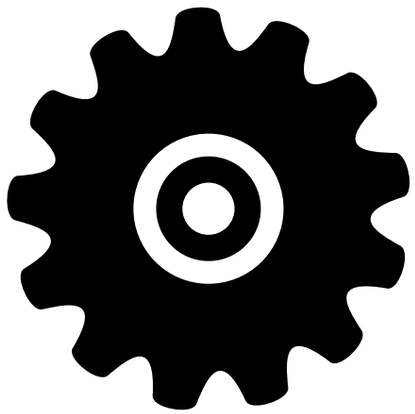
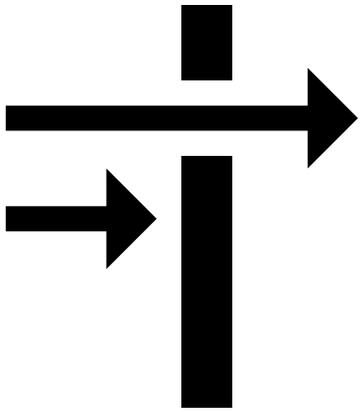
Summary

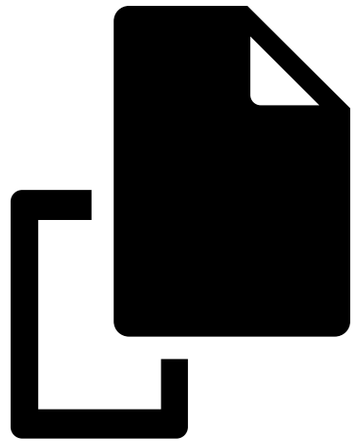
Large-scale apps: Three design patterns to create scalable ‘future-proof’ application architectures. The idea is to have:



Application core
Mediator
Module manager
Swappable



Facade
Core abstraction
Permission manager



Modules
Highly decoupled
Unique blocks
(Optionally) Framework agnostic

Summary

This can be very useful as:

- Modules are **no longer** dependent on anyone
- They can be managed so that the application **doesn't** (or shouldn't) fall over.
- You can theoretically pick up **any** module, drop it in a page and start using it in another project

Further Reading

I've written about some of these topics in more depth:

- Writing Modular JavaScript with AMD, CommonJS & ES Harmony http://addyosmani.com/writing-modular-js
- Patterns For Large-scale JavaScript Application Architecture http://addyosmani.com/largescalejavascript/
- Essential jQuery Plugin Patterns http://coding.smashingmagazine.com/2011/10/11/essential-jquery-plugin-patterns/
- Building Large-Scale jQuery Applications http://addyosmani.com/blog/large-scale-jquery/

That's it.

For more on this architecture and other topics, check out:

Blog

http://addyosmani.com

Twitter

@addyosmani or @addy_osmani

GitHub

http://github.com/addyosmani