

University of Nottingham

Advanced Interfaces

- ❑ Design Patterns
- ❑ Design Patterns for the Web (PHP and Javascript)
- ❑ An example: the Model-View-Controller pattern
- ❑ Web Development Frameworks
- ❑ An example: AngularJS


University of Nottingham

Design Patterns

- ❑ Borrowed from architecture
- ❑ Christopher Alexander

When a designer designs something – whether a house, computer program, or lamp – they must make many decisions about how to solve problems. A single problem is documented with its typical place (the syntax), and use (the grammar) with the most common and recognised good solution seen in the wild, like the examples seen in dictionaries. Each such entry is a single design pattern.

Wikipedia (https://en.wikipedia.org/wiki/Pattern_language)



University of Nottingham

Design Patterns in software engineering

- ❑ A reusable solution to a commonly occurring problem
- ❑ Not a finished design
- ❑ Template for how to solve a problem
- ❑ Object-oriented design patterns specify relationships and interactions between classes without providing an implementation
- ❑ Very influential in the design of programming languages in the 70s and 80s
- ❑ Since the 90s they have been a part of mainstream software engineering

University of Nottingham


Why use design patterns?

- ❑ Don't reinvent wheels!
- ❑ Reliable solutions to non-trivial problems are hard!
- ❑ Patterns tend to give you a tried and trusted solution
- ❑ This makes code quicker to implement and easier to manage
- ❑ Code is also easier for others to understand

University of Nottingham

Common software design patterns

- ❑ **Factory**
 - ❑ A class that can automatically generate objects ready for use.
- ❑ **Singleton**
 - ❑ Allows access to one and only one instance of a class
- ❑ **Strategy (policy)**
 - ❑ Enables the selection of an algorithm at runtime
- ❑ **Front Controller**
 - ❑ A single entrance point for an application that handles all requests
- ❑ **Model - View - Controller**
 - ❑ Split code into functional entities




Design patterns for PHP & JavaScript

- ❑ Design patterns themselves are language and platform agnostic
- ❑ However, there are many publications (books, web site, tutorials etc.) for specific languages




Design patterns for PHP & JavaScript






Model View Controller

- ❑ Improves code organisation by separating layers of functionality
- ❑ **Model**
 - ❑ Enforces isolation of data
- ❑ **View**
 - ❑ User interface
- ❑ **Controller**
 - ❑ Manages logic and user input, and integrates the model and view




MVC History

- ❑ Designed in the 1970s and 80s when GUIs were rare and resource hungry
- ❑ **Separated Presentation**
 - ❑ Distinction between models of real-world entities (e.g. a photograph) and their rendering on screen (i.e. the view)
- ❑ **Smalltalk-80 took this further with MVC**
 - ❑ Decoupled logic from the user interface



Smalltalk-80 MVC

- ❑ **Model**
 - ❑ Represents domain-specific data and is ignorant of the Views and Controllers
 - ❑ When a model changes it informs its observers
- ❑ **View**
 - ❑ Observes the model
 - ❑ Represents the current state of the model
- ❑ **Controller**
 - ❑ Handles user interaction
 - ❑ Makes decisions for the view
- ❑ **Presentation**
 - ❑ What is displayed on the screen
 - ❑ A view-controller pair

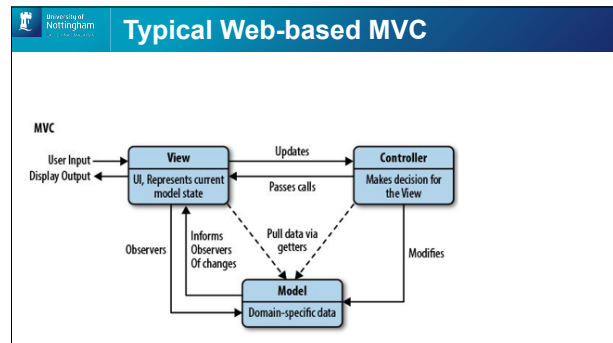


Relevance to the web

- ❑ **Scaling of web code**
 - ❑ Modern web sites can get very large and complex
 - ❑ As they grow they can become difficult to maintain
 - ❑ Reusability of code can be difficult
- ❑ **MVC pattern**
 - ❑ Based upon Smalltalk-80 MVC
 - ❑ Allows developers to structure their applications easily
 - ❑ Changes can be made to one part of the app location without impacting upon other parts
- ❑ **Used for both PHP and JavaScript**
- ❑ **Implemented in various web and OS frameworks**

University of Nottingham

Simplified Example



University of Nottingham

Web Development Frameworks

- ❑ **MVC is extremely useful for the maintenance of professional data-driven web sites**
- ❑ **But a non-trivial implementation is quite complex**
- ❑ **Therefore it is usually implemented via one of various web development frameworks**

University of Nottingham

Commonest Frameworks

- ❑ **Some popular web development frameworks today (2018)**
 - ❑ Laravel
 - ❑ Node.js
 - ❑ Ruby on Rails
 - ❑ Symfony
 - ❑ ReactJS (Facebook)
 - ❑ ASP.NET (Microsoft)
 - ❑ AngularJS (Google)

University of Nottingham


Laravel

- ❑ Open Source MVC framework for PHP
- ❑ Intended for database-driven web sites
- ❑ Very modular with a dependency manager and a CLI for testing
- ❑ Released in 2011, version 5.6 in 2018
- ❑ <https://laravel.com/>


University of Nottingham

Node.js


- ❑ JavaScript run-time environment that executes JavaScript on the server
- ❑ "JavaScript everywhere" paradigm for dynamic web pages
- ❑ Implements MVC, and much more
- ❑ Open source (released in 2009, version 9.11 in 2018)
- ❑ Used by Netflix, Paypal, Microsoft, IBM, Yahoo! and many more
- ❑ <https://nodejs.org/>




Ruby on Rails (RoR)




- ❑ Written in and based upon the Ruby programming language
- ❑ Server-side system - integrates various other languages and technologies
- ❑ Intended for database-driven web sites and web services
- ❑ Entirely MVC-based
- ❑ Open source (released in 2005, version 5.1.6 in 2018)
- ❑ Used by Hulu, AirBNB and many more
- ❑ <http://rubyonrails.org/>




Symfony



- ❑ PHP framework for large enterprise projects
- ❑ Developed by SensioLabs - now Open Source
- ❑ Released in 2005, v.4.0.1 in 2017
- ❑ Designed for large scale software engineering, and includes its own unit testing framework
- ❑ Used by Drupal CMS and many online shopping and gaming sites
- ❑ <https://symfony.com/>




React.js




React

- ❑ Open Source (mostly) JavaScript library maintained by Facebook
- ❑ Designed to build user interfaces for large web applications with data that changes regularly
- ❑ This is a JavaScript framework designed to work with a Flux backend
- ❑ Not MVC - React provides a View, flux is an alternative to MVC.
- ❑ Used for Facebook newsfeed in 2011, Instagram in 2012 and Open Source release in 2013
- ❑ <http://reactjs.org/>




ASP.NET




ASP.NET


- ❑ Open Source Microsoft Framework
- ❑ Server-side technology, supports Windows, Mac and Linux
- ❑ Intended for building web services and data driven web sites
- ❑ Built on Common Language Runtime and Supports all .NET languages (C++, C#, Visual Basic and many more)
- ❑ Implements MVC and many other patterns
- ❑ <https://www.asp.net>



AngularJS



- ❑ Open Source JavaScript framework maintained by Google
- ❑ Major rewrite of the earlier Angular framework (Angular 2.0 was renamed AngularJS)
- ❑ Intended for single page web development
- ❑ Implements MVC
- ❑ <https://angularjs.org>
- ❑ There is a W3Schools Angular Tutorial at: <https://www.w3schools.com/angular/>



AngularJS Demonstration

Summary

- ❑ Design patterns allow developers to avoid reinventing wheels
- ❑ MVC is a design pattern that is widely used in web development
- ❑ This makes for scaleable and reusable code
- ❑ MVC can be quite complex, so it is usually implemented using a development framework
- ❑ The Google AngularJS is probably the most popular framework for JavaScript currently