

Web Software Model

CS 4640 Programming Languages for Web Applications

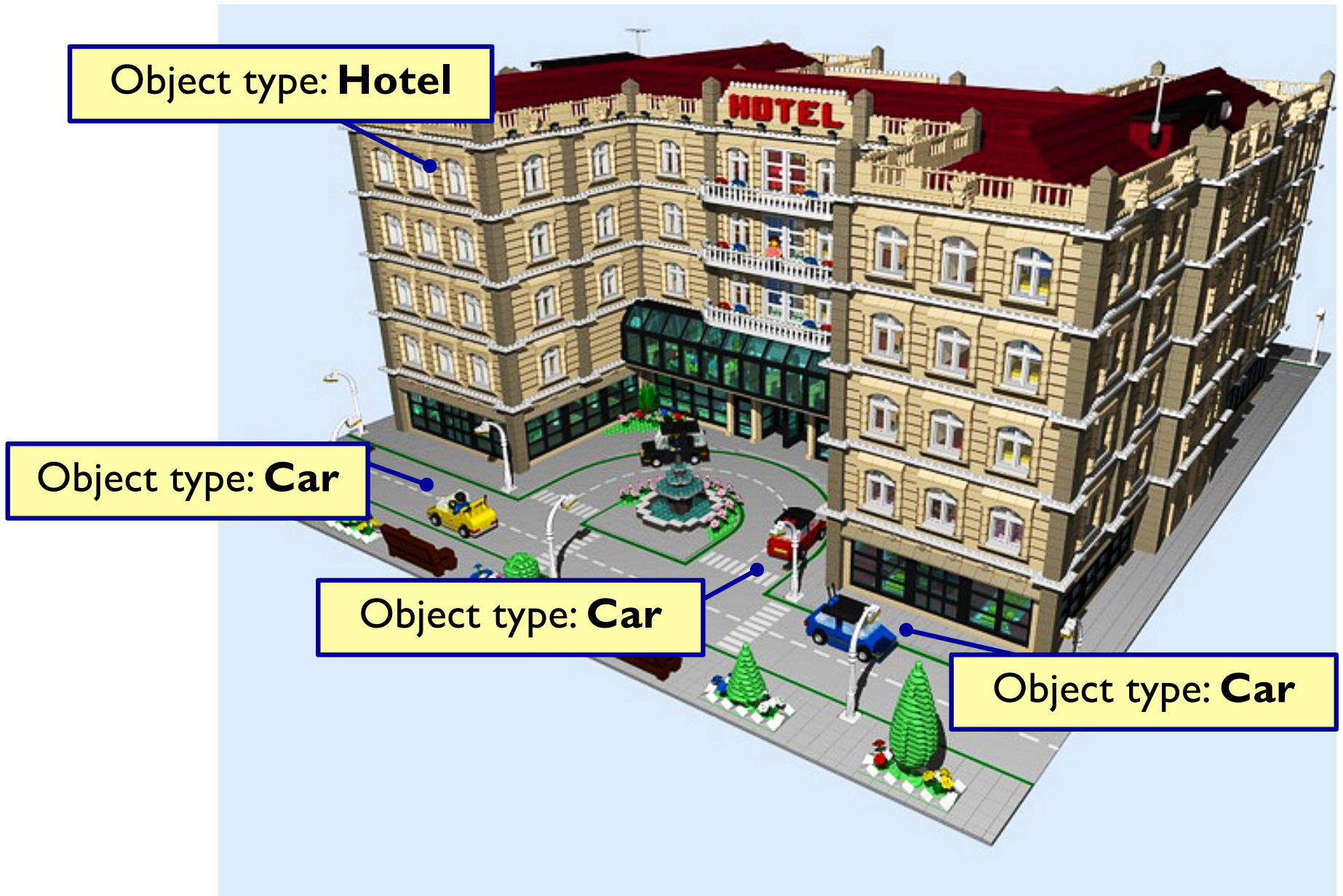
[Robert W. Sebesta, "Programming the World Wide Web"]

Web Applications

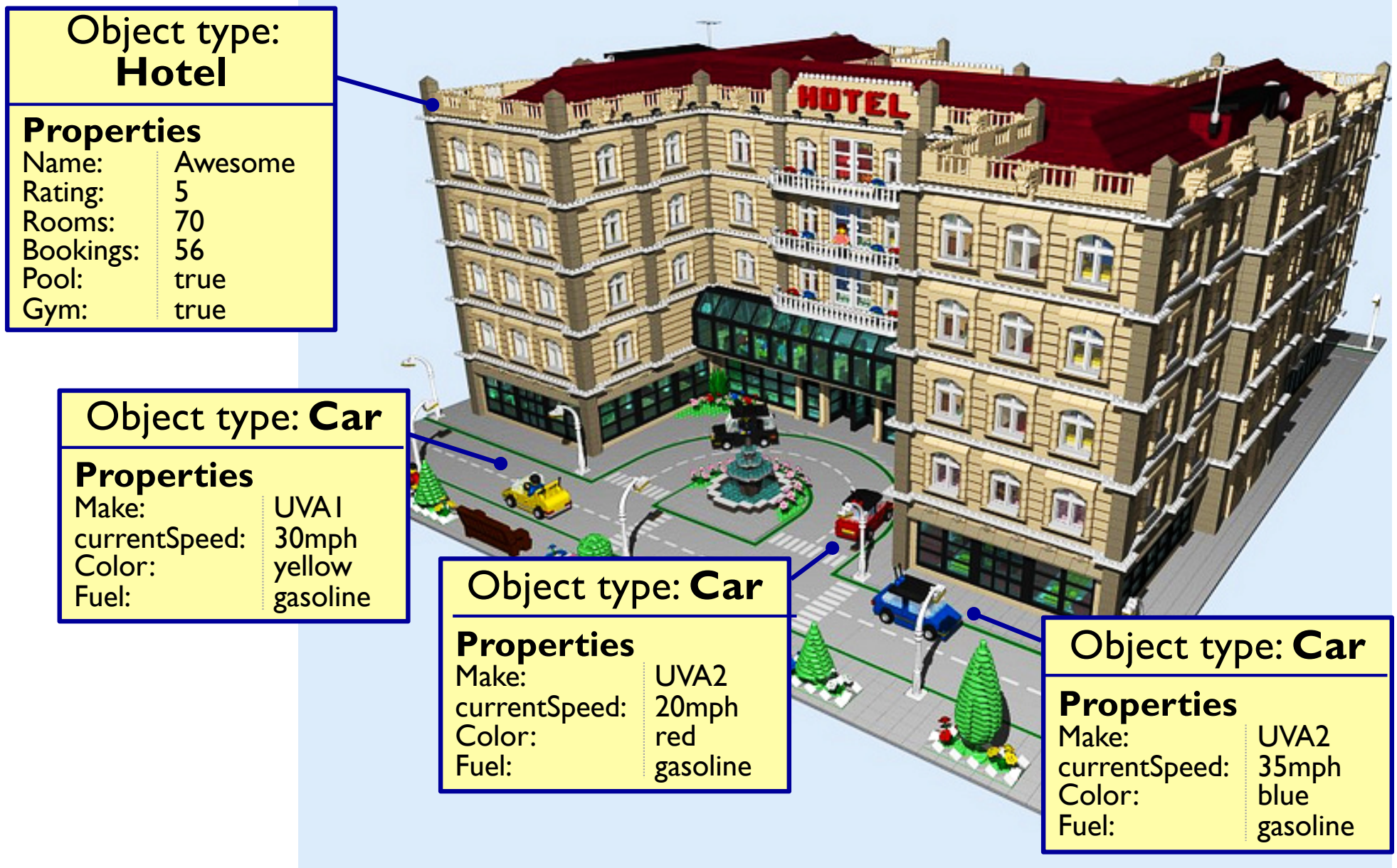
- User interactive software programs, **deployed on a web server, accessed via a web browser**
 - Browser features may affect the program's execution flow
- Use enabling technologies to
 - Make web site contents **dynamic**
 - Allow users of the system to implement business logic on the server
- Let users **affect state** on the server
- Constructed from **diverse, distributed, and dynamically generated web components**
 - Web components are software modules that implement different parts of the application's functionality

An enabling technology makes web pages interactive and responsive to user input

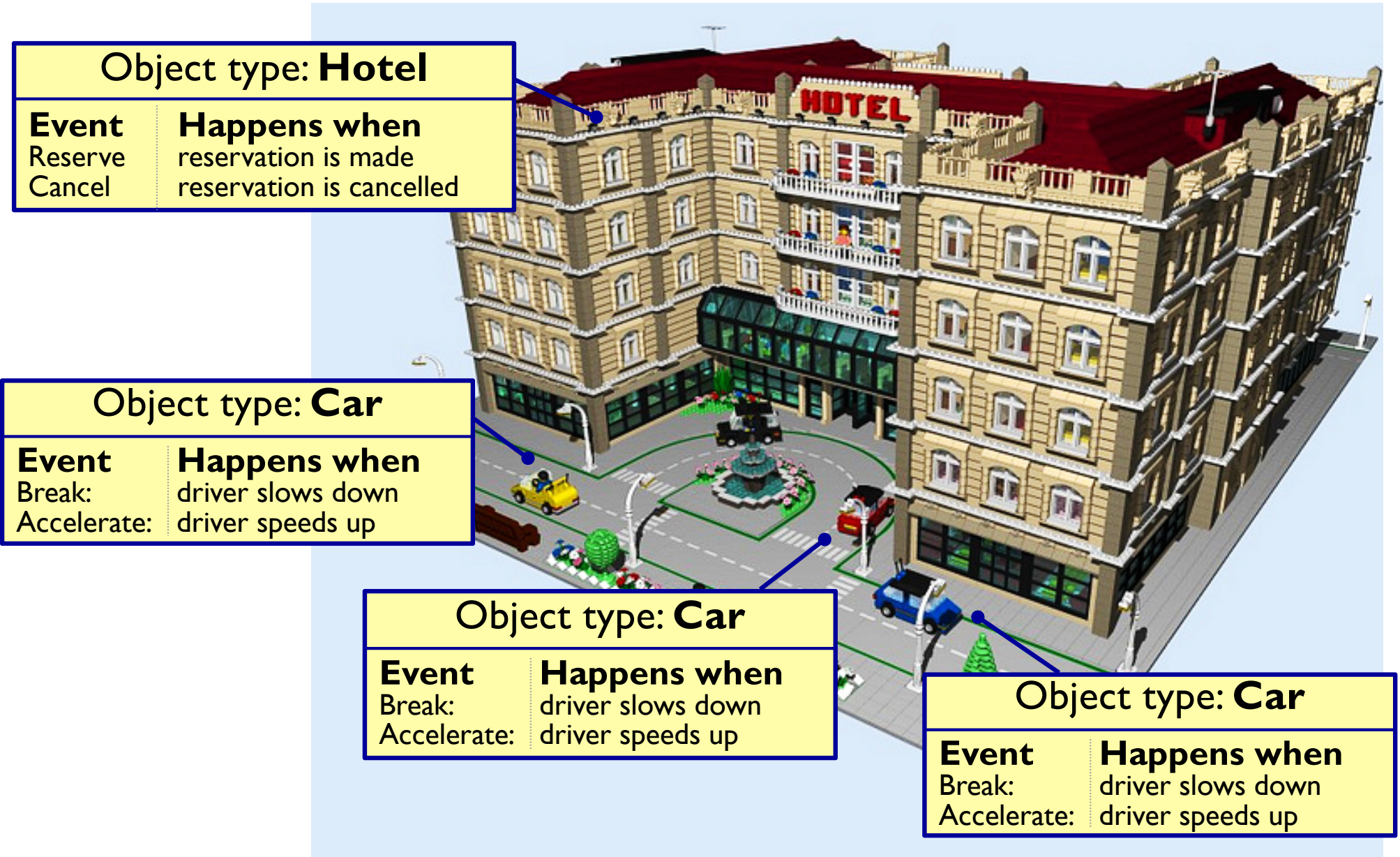
How do Web Apps fit in with the World Around Them?



Objects and Properties



Objects and Events



Objects and Methods

Object type: **Hotel**

Method

makeReservation()
cancelReservation()
checkAvailability()

What it does

increases value of *bookings* property
decreases value of *bookings* property
subtracts value of *bookings* property
from value of *rooms* property and
returns number of rooms available

Object type: **Car**

Method

changeSpeed()

What it does

increases or
decreases value of
currentSpeed
property

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Object type: **Car**

Method

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What it does

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decreases value of
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All Together

Object type: Hotel			
Event	Happens when	Method called	Properties
Reserve Cancel	reservation is made reservation is cancelled	makeReservation() cancelReservation()	
Method	What it does		
makeReservation() cancelReservation() checkAvailability()	increases value of <i>bookings</i> property decreases value of <i>bookings</i> property subtracts value of <i>bookings</i> property from value of <i>rooms</i> property and returns number of rooms available		Name: Awesome Rating: 5 Rooms: 70 Bookings: 56 Pool: true Gym: true

Object type: Car			
Event	Happens when	Method called	Properties
Break Accelerate	driver slows down driver speeds up	changeSpeed() changeSpeed()	
Method	What it does		
changeSpeed()	increases or decreases value of <i>currentSpeed</i> property		Make: UVA I currentSpeed: 30 Color: yellow Fuel: gasoline

Let's Try

Activity:

"Thing" in the World and "Object" in Web App

Web Browsers and Objects

Object type: Window

Properties
Location: <http://www.cs.virginia.edu/~up3f/cs4640/syllabus.html>

Object type: Document

Properties
URL: <http://www.cs.virginia.edu/~up3f/cs4640/syllabus.html>
lastModified: 05/21/2022 20:24:21
Title: CS4640 - WebPL

CS4640: Web PL

Summer 2022 — Syllabus

Note: This is an initial course description and may be updated without prior notice.

COVID-19 Course Policy

In this course, we will diligently follow all University policy, while also requesting that we respect and care for each other (and our families).

For now:

- Although masking is not mandatory, I would like to encourage you, and if at all possible, to **please wear a mask** in class for the duration of the class meeting
- **No eating or drinking** in Thornton Hall D222

General information:

- Class will be recorded (refer to [Class recordings](#) for more information)
- If you feel **unwell**:
 - Please stay home, rest, and watch the class recordings; the most importance is your health and everyone's health
 - I will happily work with you — if you stay home — to make sure there is no impact to your grade
- If you have any questions or concerns before or after class, the best way to reach me is via email

Contact information

Instructor: Upsorn Praphamontripong
Office Hours: TBD

Class meetings

Monday – Friday and one Saturday (18-June), 1:00pm – 3:15pm EST, Thornton Hall D222
(Please refer to the [Summer session calendar](#): Class meets 23-May - 17-June)

[**You** are the main driver!]

[Is attendance required?]

Class recordings

My current plan is to record synchronous lectures during the official meeting times and you will be able to catch up by viewing the recording. The recordings will be available under Class Recordings in [UVA Collab](#), accessible by Summer 2022 CS 4640 students and course staff. By default, the recordings will be made available within 24-48 hours after class. If the recordings are unavailable due to technical difficulty or any unavoidable reasons, I will happily work with you to make sure that you do not miss anything.

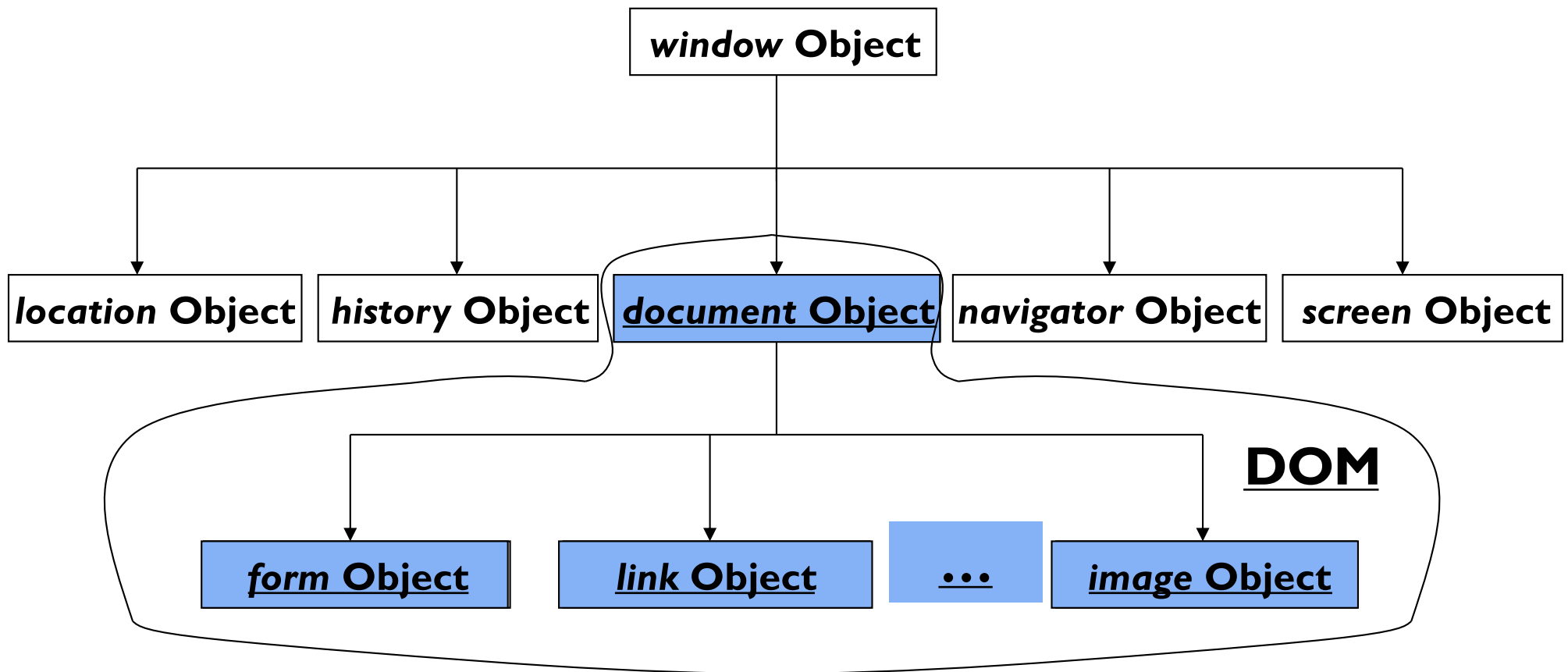
Per [UVA policy on recording of class sessions](#), the University prohibits the recording of class sessions by students, regardless of purpose or modality. Students are **not** allowed to record class sessions / meetings / discussions, regardless of purpose or modality. "The University prohibits the recording of class sessions by students, regardless of purpose or modality, unless written permission has been obtained from the instructor, and all students in the class as well as guest speakers have been informed that recording will occur. Instructors may revoke permission at any time, and permission to allow a recording is not a transfer of any copyrights in the recording."

Overview

Have you ever wondered how web applications are built? How are data exchanged within web software or between web software? How does the software know where each user left off? What can be done to improve the usability of web software? Many new technologies have emerged everyday. With what technologies or languages should you be familiar? How will you keep up with web development technologies?

BOM: Browser Object Model

BOM – collection of objects that the browser makes available to us for use with JavaScript



DOM: Document Object Model

CS4640 - WebPL

www.cs.virginia.edu/~up3f/cs4640/syllabus.html

50%

CS 4640: Web PL

Syllabus Schedule Assignments Policies

Summer 2022 — Syllabus

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- COVID-19 policy
- Contact
- Class meetings
- Overview
- Learning objectives
- Prerequisite
- Reading
- Learning activities
- Assessment
- Discussion board
- Academic integrity
- SDAC and other special circumstances
- Religious accommodations
- Safe environment
- Student support team

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Object type: Document	
Properties	
URL:	http://www.cs.virginia.edu/~up3f/cs4640/syllabus.html
lastModified:	05/21/2022 20:24:21
Title:	CS4640 - WebPL
Event	Happens when
Load	page and content have finished loading
Click	user clicks the mouse over the page
Keypress	user presses down on a key
Method	What it does
write()	adds content to the document
getElementById()	accesses an element of a given <i>id</i> attribute

Page

CS 4640: Web PL

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[Is attendance required?] +

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Do users look at web apps the way they are? Or do users look at web apps the way they think?

The browser receives an HTML page

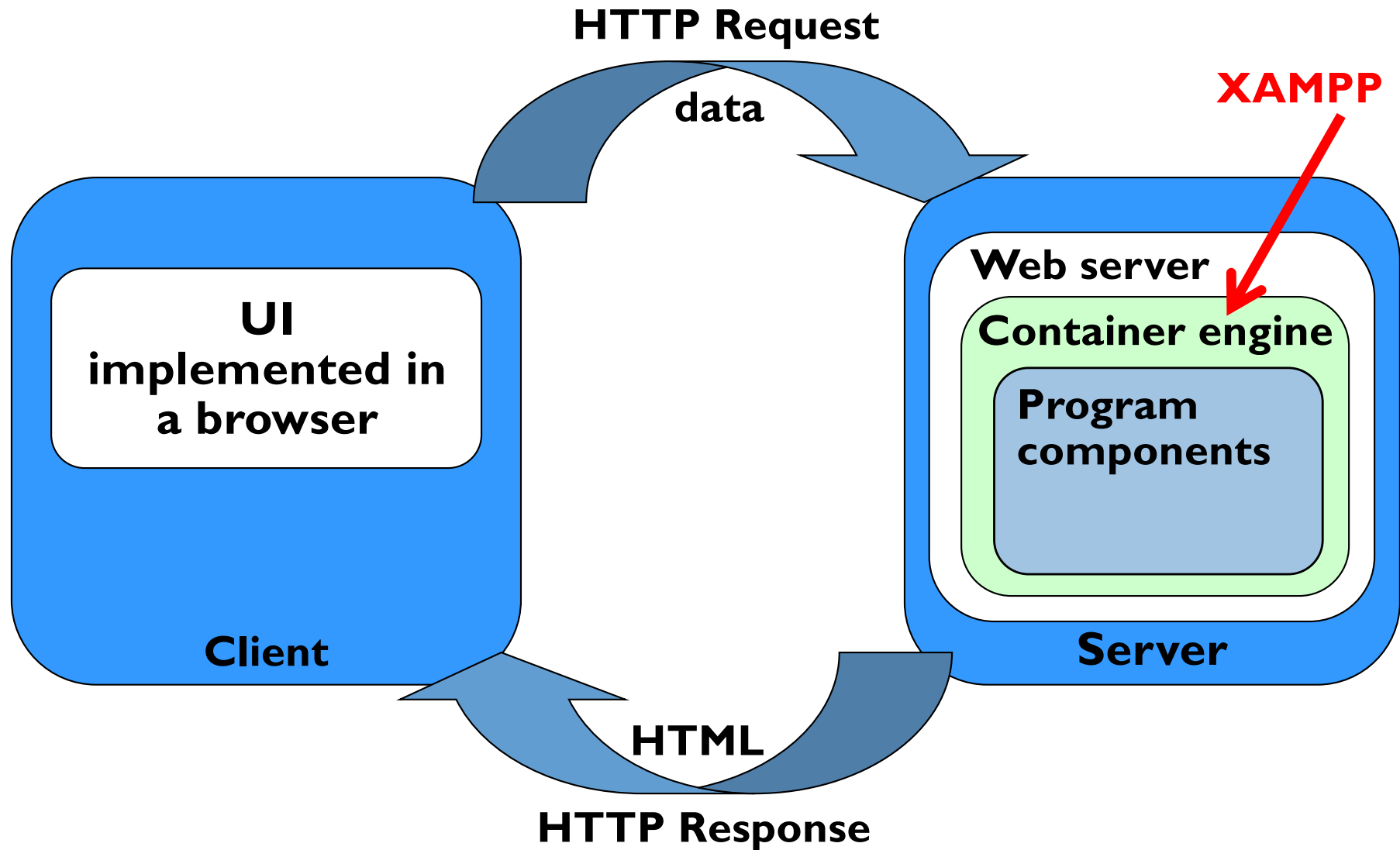
It creates a model of the page and stores it in memory

container
bottom ...

It shows the page on screen using a rendering engine

contact
information

Server Side Processing



Spaghetti Code



[ref: image by Ekarin Apirakthanakorn]

- Unstructured
- All-in-one
- Lack of style rules or patterns
- Hard to read, debug, maintain, reuse, evolve

General Design Issues

Separation of concerns: design goals of web app design

- Presentation
- Logic
- Data

Seven criteria the design should support:

- Reliability
- Usability
- Security
- Availability (and also Accessibility)
- Scalability
- Maintainability
- Performance and Time to market

Separation of Concerns

Presentation

→ HTML, view

Logic

→ Functions and classes, software

Data

- Data content
- Data representation
- Data storage

→ Classes, objects

→ Data structure, classes, objects

→ Database and files, Oracle, SQL, NoSQL

Assumptions about data

- **Data values**: contents of memory – change very frequently (during execution)
- **Data presentation**: how the data are presented – change occasionally
- **Data structure**: types, organization and relationships of different data elements, changes infrequently

Architectural Styles

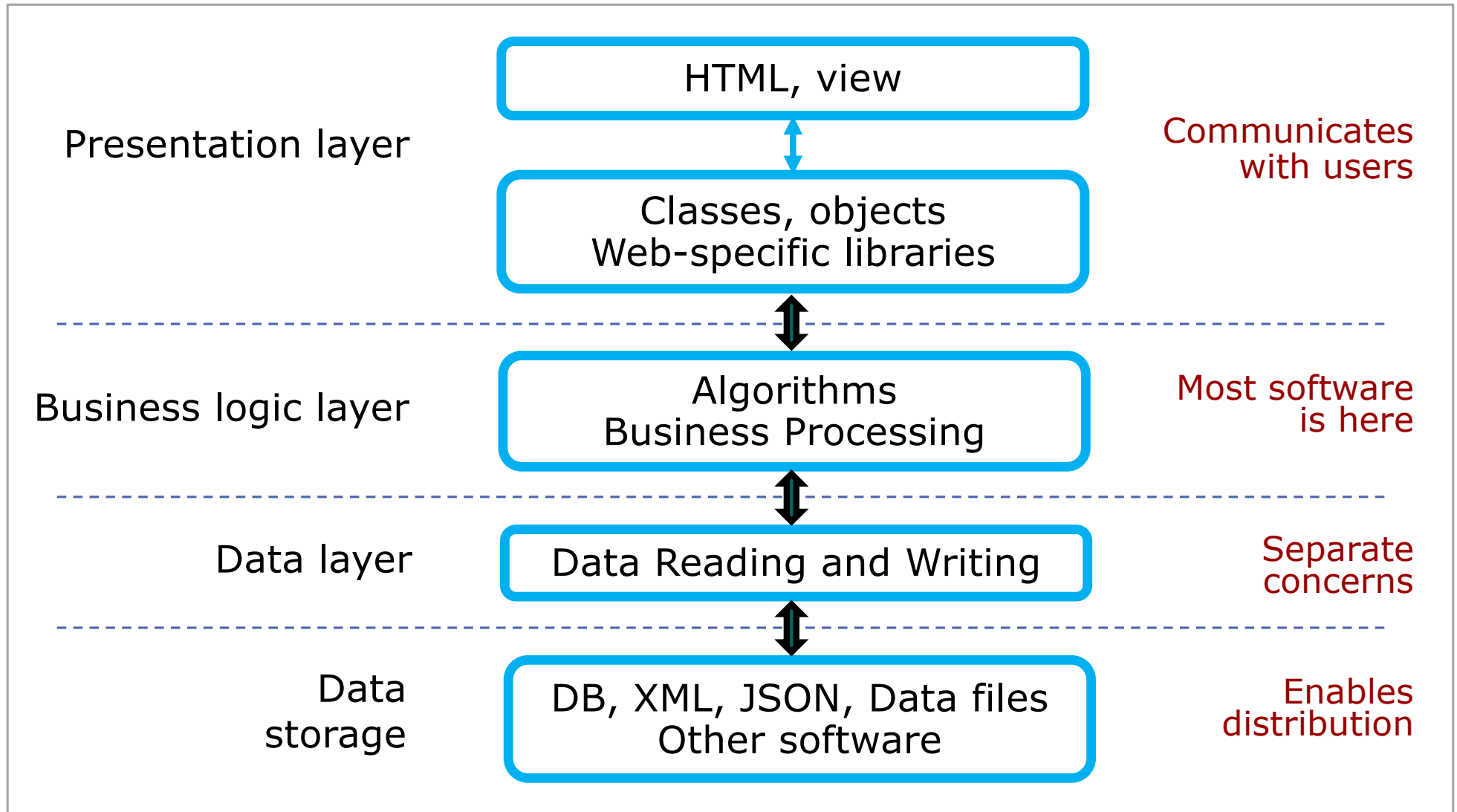
- How to partition a system
- How components identify and communicate with each other
- How information is communicated
- How elements in a system can evolve

Web architectural styles constantly change

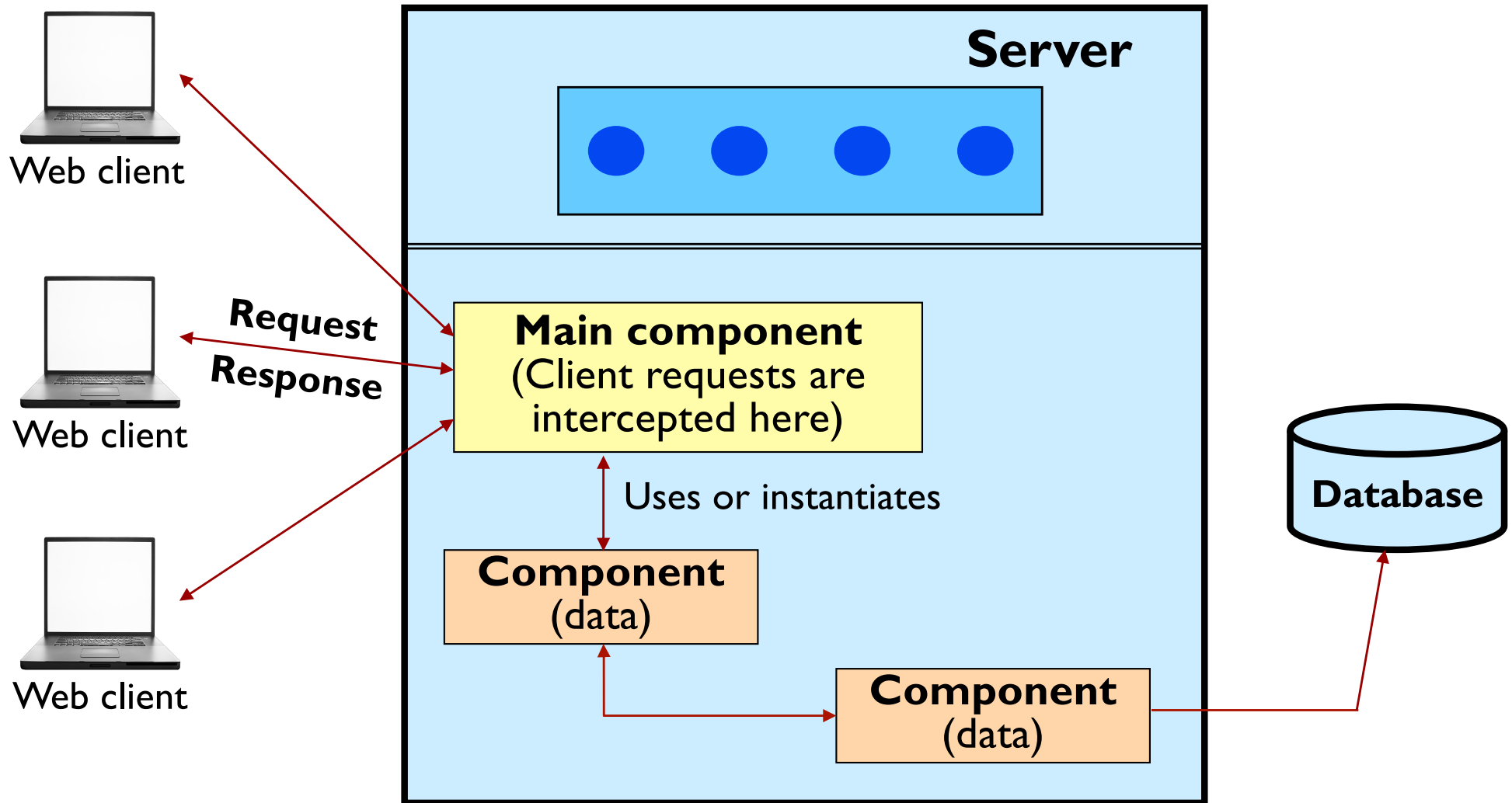
The goal is to **separate logic** from **presentation** and to **separate** as many **concerns** in the logic as possible
– aiming to improve maintainability, reusability, scalability, responsiveness, and continuous development

Multi-Tiered Architectures

Each software layer only communicates with adjacent layers

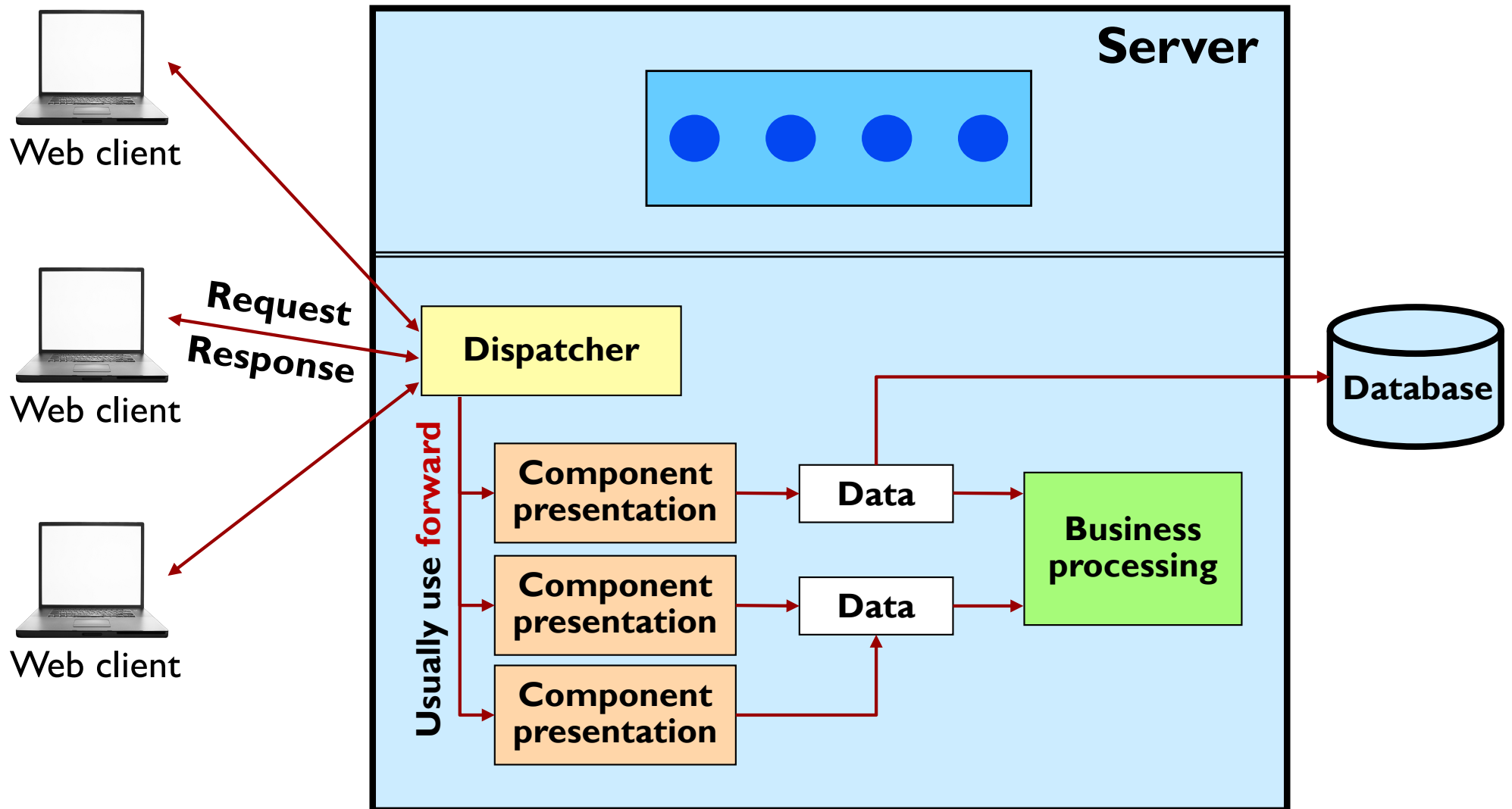


Page-centric Design



Requests are made to a main component and the main component response to clients – “client-server”

Dispatcher (N-tier) Design

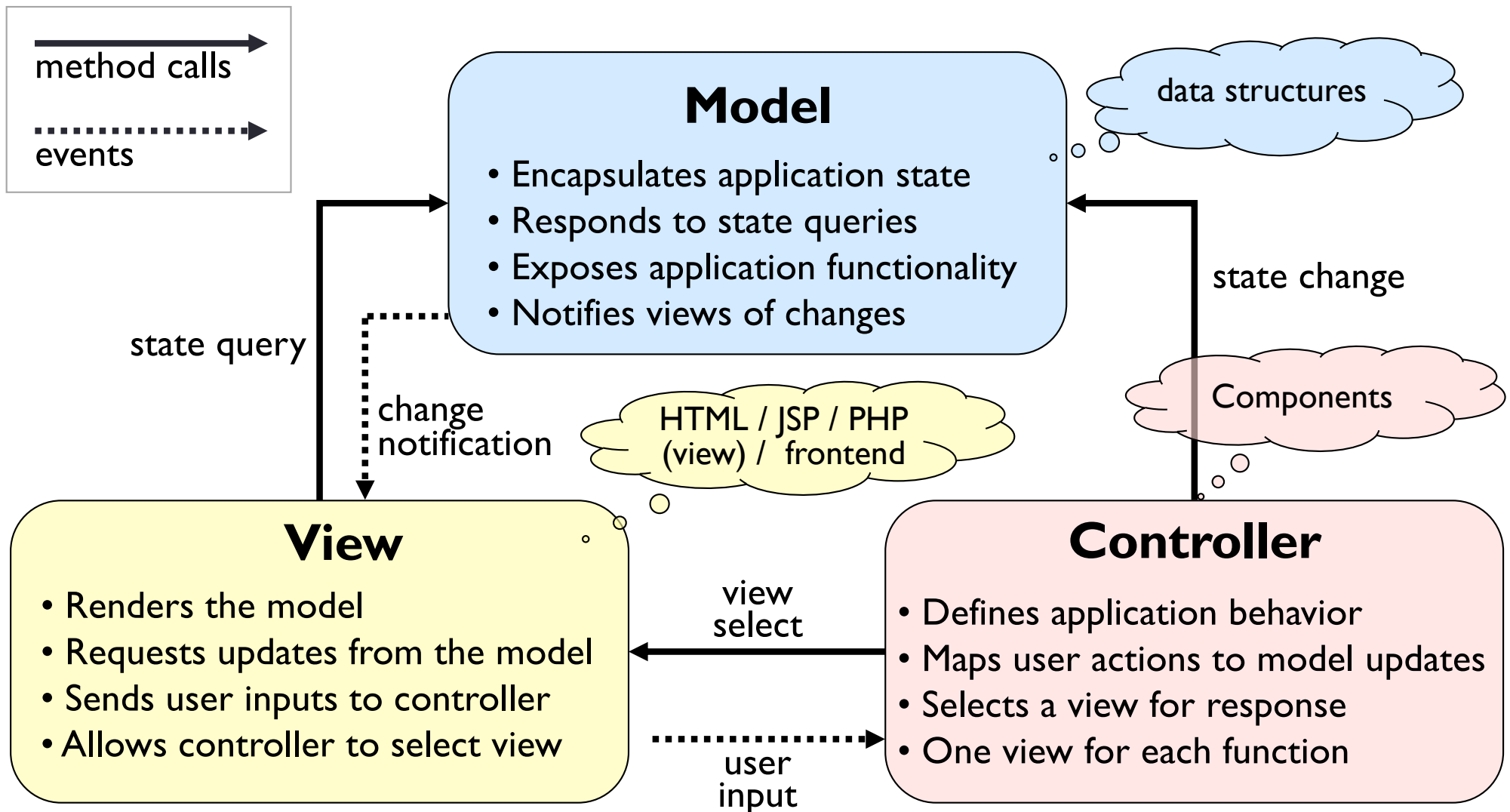


Requests are sent to a dispatcher that then forward the requests to another component (using *forward* or *redirect* control connection)

Model View Controller

- An abstraction frequently used in web app design
- Provide a way to divide the responsibilities of objects
- Decreases coupling between objects and layers (supports easier maintenance)
- Help divide the work (supports development expertise areas)

Model View Controller (2)



[Graphic from Designing Enterprise Applications with the Java 2 Platform, Enterprise Edition, Nicholas Kassem et al., October 2000]

Server-Side Scripting

- Generate HTML on the **server** through scripts
- Early approaches emphasized embedding server code inside HTML pages
- Examples: PHP, JSP

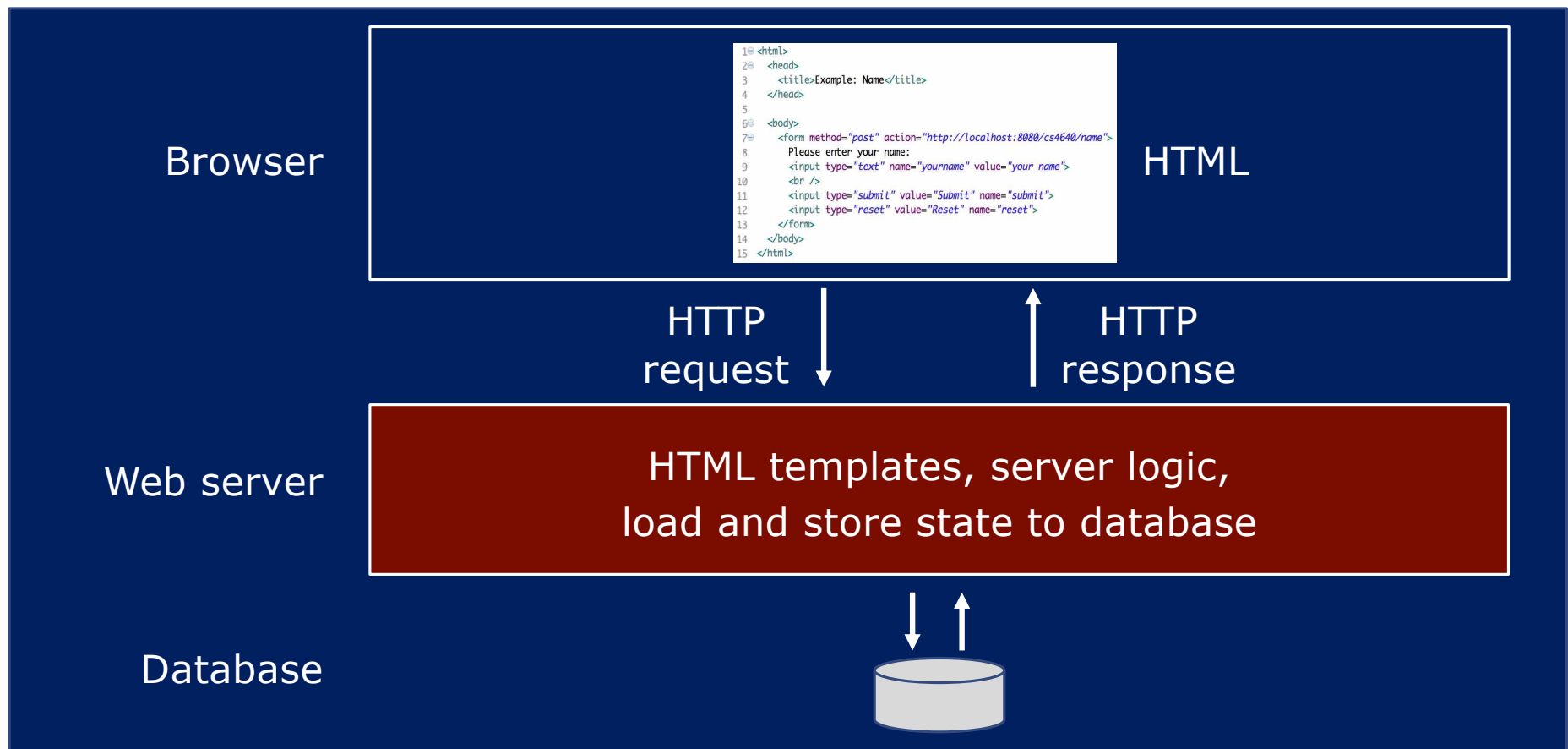
```
1 <!doctype html>
2 <html>
3 <head>
4   <title>Login example</title>
5 </head>
6 <body>
7   You logged in as <font color="green"><b><?php echo $_POST["name"]; ?></b></font><br>
8   with password <font color="green"><b><?php echo $_POST["pwd"]; ?></b></font>
9 </body>
10 </html>
```

PHP

```
1 <html>
2 <head>
3   <title>Counting with a JSP</title>
4 </head>
5 <body>
6   <!-- Set global information for the page -->
7   <%@ page language="java" %>
8
9   <!-- Declare the variable -->
10  <%! int count = 0; %>
11
12  <!-- Scriptlet - Java code -->
13  <%
14    for (int i = 0; i < 10; i++)
15    {
16      count = count+1;
17    }
18    <br />
19    The counter value is: <%= count %>
20  <% } %>
21 </body>
22 </html>
```

JSP

Server-Side Scripting Site



Advantages

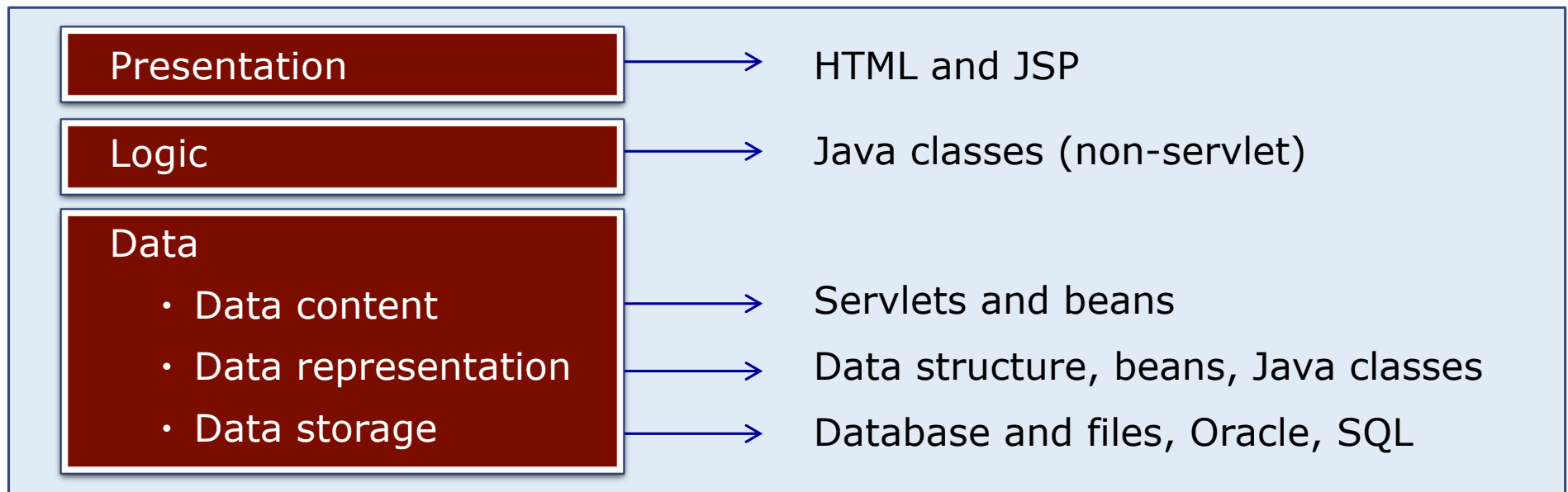
Server-side processing, browser independent, search optimization improvement, increased security

Disadvantages

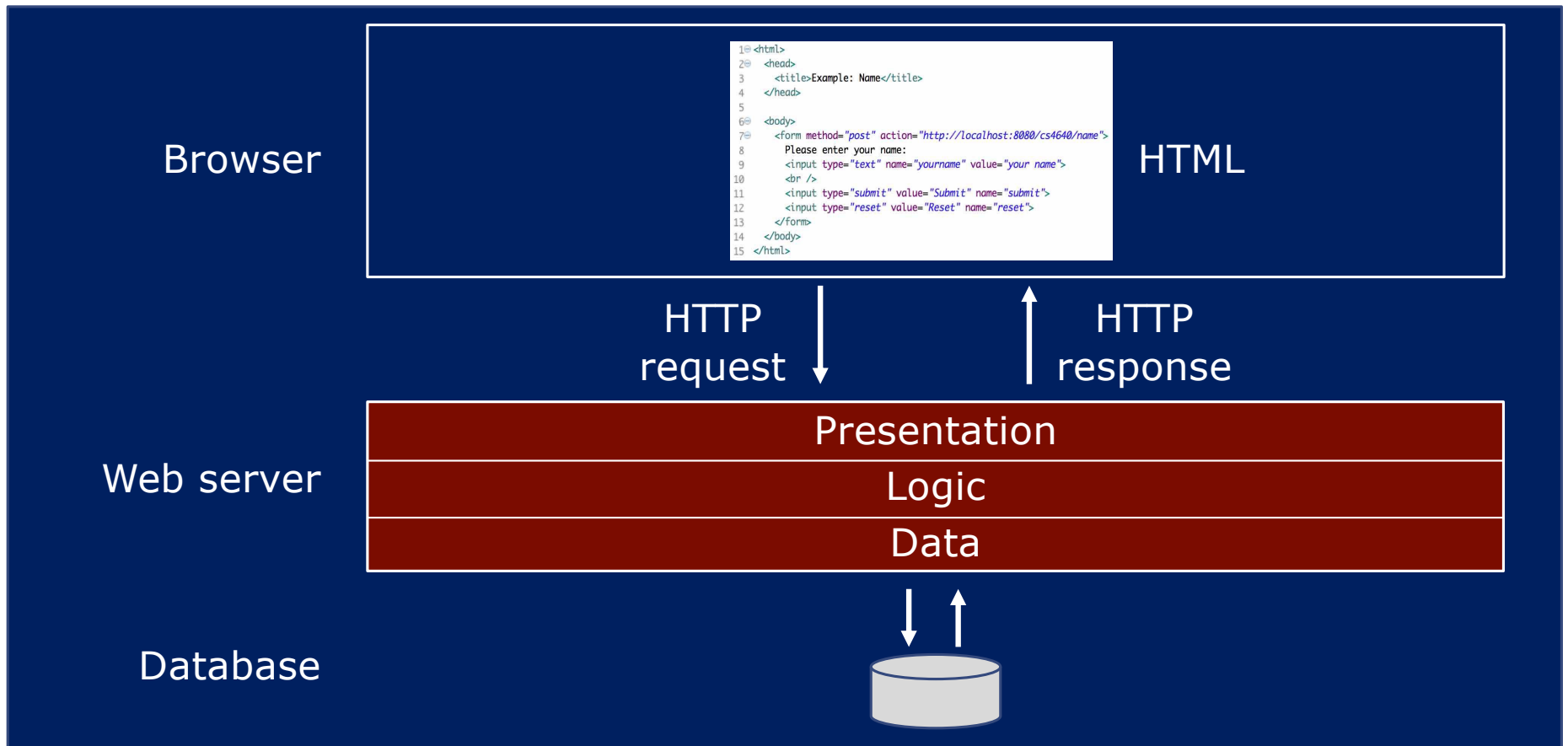
Poor modularity, hard to understand, difficult to maintain

Server-Side Framework

- Structure server into tiers, organizes logic into classes
- Execution on the server
- Can be single-page or multiple pages with page-centric design, dispatcher design, model-view-control design, or combination of any architectures
- Example: JSP (with separation of concerns)



Server-Side Framework Site



Advantages

Separation of concerns, maintainable and reusable

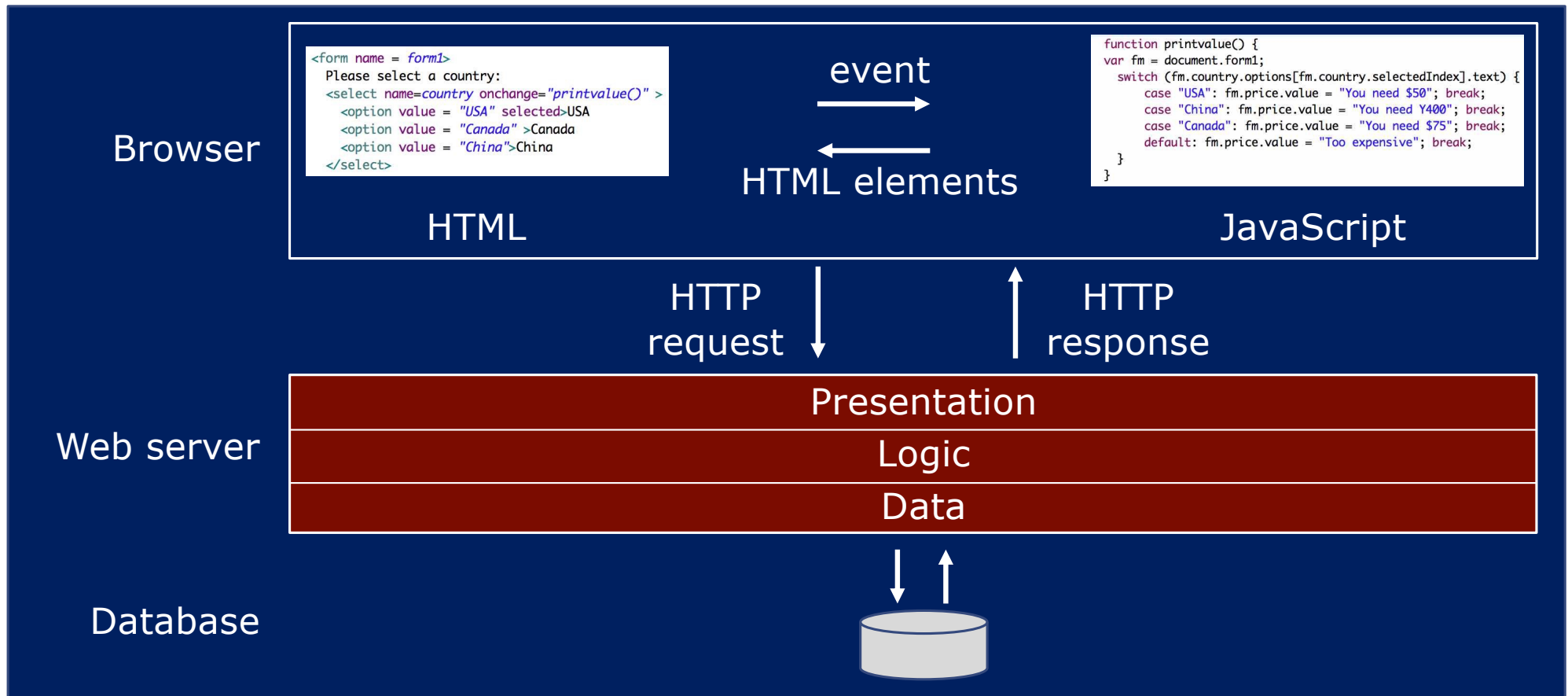
Disadvantages

Need to load an entire page to get new data

Single Page Application (SPA)

- Client-side logic sends messages to server, receives response
- Logic is associated with a single HTML page, typically written in JavaScript
- HTML elements dynamically added and removed through DOM manipulation
- Enabling technologies
 - AJAX – set of technologies for sending asynchronous request and receiving response
 - DOM Manipulation – methods for updating HTML elements
 - JSON – standard syntax for describing and transmitting JavaScript data object
 - JQuery – wrapper library built on HTML standard
- Example: Gmail

Single Page Application Site



Advantages

Fast (load most resources once; only data are transmitted)

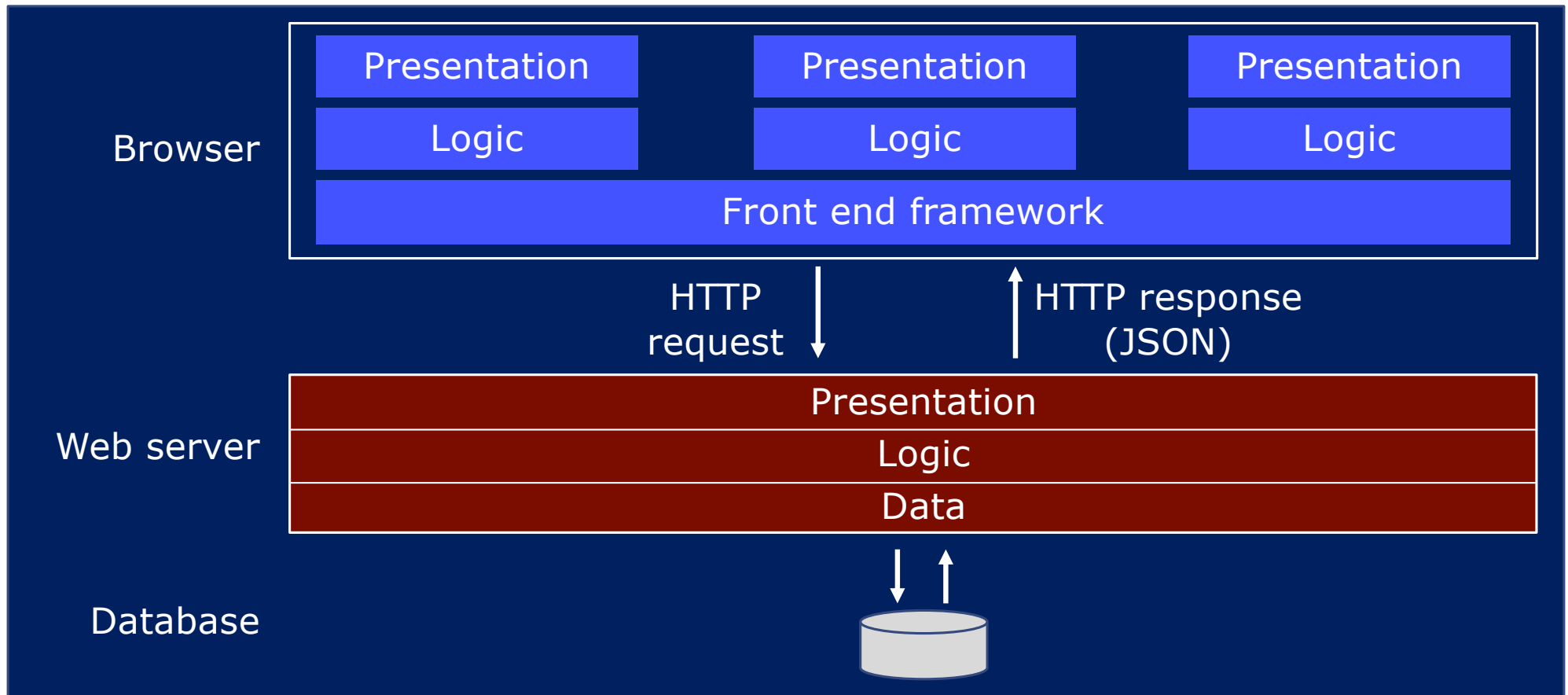
Disadvantages

Poor modularity client-side, tightly coupled logic to HTML elements (leading to redundant code), hard to maintain and reuse, cross-site scripting

Front-End Frameworks

- Client is organized into separate components, capturing model of web application data
- Components separate logic from presentation
- Components dynamically generate corresponding code based on component state
- Example: Angular, React

Front-End Framework Site



Advantages

Code organization, reuse, quick and easy to develop

Disadvantages

Duplicate logic in client and server, tight coupling – changes to server logic require changes to client logic, difficult to reuse server logic

Summary: Web Apps

- Deploy across the Web
 - Other (software) deployment methods include bundling, shrink-wrapping, embedding, and contracting
- New technologies
- New conceptual language constructs for programming
 - Integration
 - Data management
 - Control connections
- Browser features may affect the execution flow
- Architectures – no silver bullet

These differences affect every aspect of how to engineer high quality software