

Web Applications: Overview and Architecture

Computer Science and Engineering ■ College of Engineering ■ The Ohio State University

Lecture 1

Road Map in Pictures: Web App UI

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The screenshot displays the Yelp web application interface. At the top, the browser address bar shows the URL `yelp.com/search?find_desc=ice%20cream&find_loc=ohio%20state%20university`. The Yelp logo is on the left, and the search bar contains 'ice cream' and 'ohio state university'. Navigation links for 'For Businesses', 'Write a Review', 'Log In', and 'Sign Up' are on the right. Below the search bar, there are filters for 'Restaurants', 'Home Services', 'Auto Services', and 'More'. On the left side, there are sections for 'Curbside Pickup', 'Open Now 10:40 AM', 'Yelp Delivery', 'Category' (Ice Cream & Frozen Yogurt, Restaurants, Food, Bars), 'Features' (Curbside Pickup, Open Now 10:40 AM, Yelp Delivery), 'Cities' (See all), and 'Distance' (Bird's-eye View, Driving (5 mi.), Biking (2 mi.), Walking (1 mi.), Within 4 blocks). The main content area shows three ice cream shops:

- 1. CRMD**: (833) 438-2763, 1190 N High St, Italian Village. 1.5 Miles. Ice Cream & Frozen Yogurt. Delivery. Rating: 4.5 stars (125 reviews). Description: "Installed plastic shields, and clearly marked social distancing spots every 6 feet. I feel safe and welcome, and the unique, tasty **ice cream** flavors are the cherry on top! This isn't your dad's **ice cream** shop, and that's why I love it. Try the puffle cone, it will change your life!" more
- 2. Graeters Ice Cream**: (614) 488-3222, 1534 W Lane Ave. 1.8 Miles. Ice Cream & Frozen Yogurt, Candy Stores. Delivery, Takeout. Rating: 4.5 stars (108 reviews). Description: "Wonderful **ice cream** and service. Very thankful I decided to go here and get some fresh frozen dairy. Great time to go on a warm afternoon and evening and taste some of the finest treats in the capital." more
- 3. Jeni's Splendid Ice Creams**: (614) 294-5364, 714 N High St, Short North. 2.1 Miles. Ice Cream & Frozen Yogurt. Delivery, Takeout. Rating: 4.5 stars (465 reviews).

On the right side, there is a map of Columbus, Ohio, showing the locations of the three ice cream shops marked with red pins and numbered 1, 2, and 3. The map includes street names, highways, and a search bar that says 'Search as map moves'.

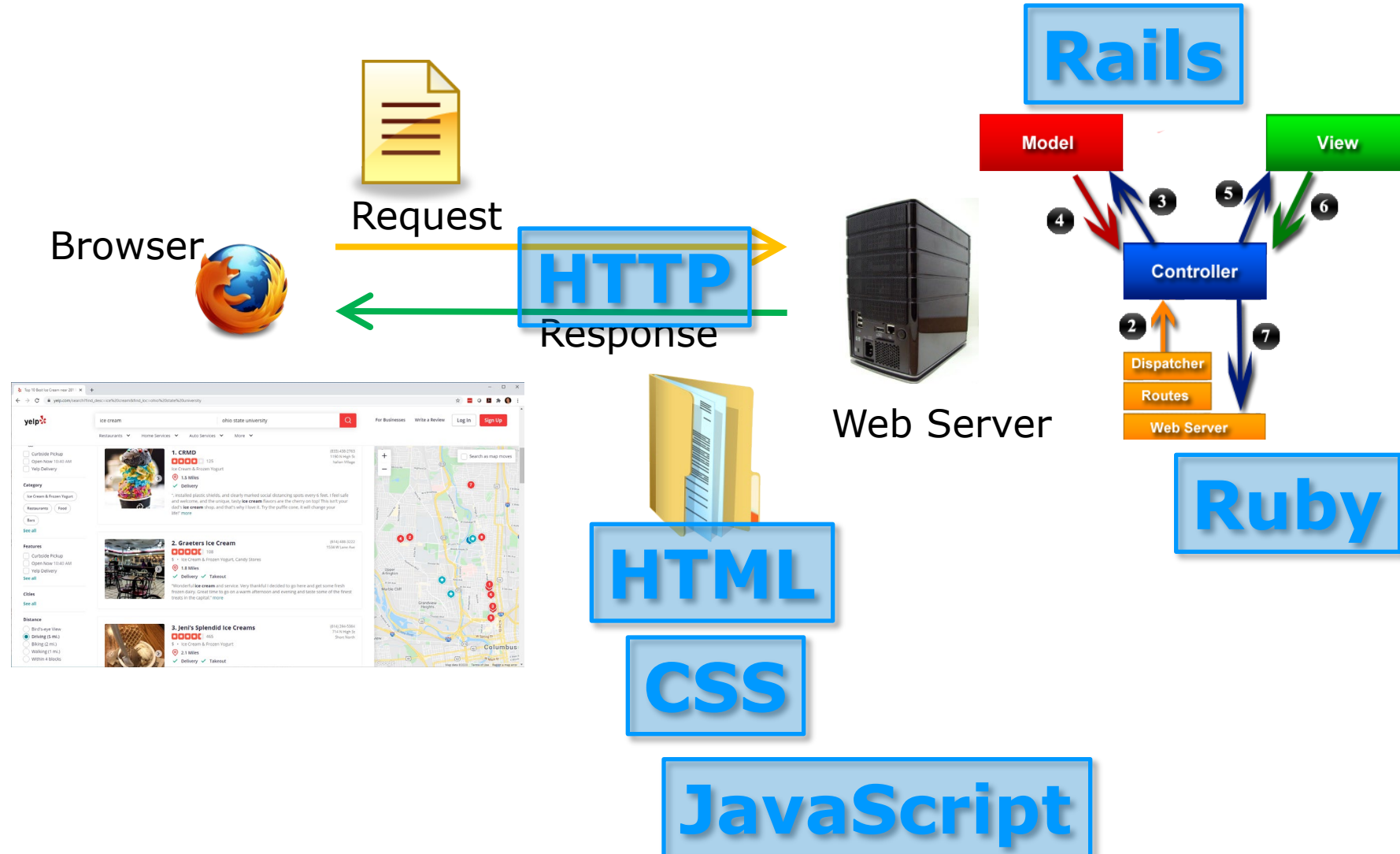
Road Map in Pictures: App Flow of Control

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Road Map in Pictures: App Technologies

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Road Map: Schedule of Topics

- A Language
 - Ruby
- Foundations
 - Version Control, Networking, Regular Expressions
- Static web pages
 - HTML & CSS
- Dynamic web pages
 - JavaScript
- Framework for web applications
 - Rails
- Applied Topics
 - Security, Encodings

Resources

- Lectures, office hours, meetings
 - Instructor, grader(s)
 - Each other
- Discord Server
 - Q&A and discussion forum
 - News and announcements
- Class website
 - Handouts, lecture notes, lab assignments
 - Pointers to more resources
- Carmen
 - Syllabus (note exam requirement)
 - Grades, deadlines, rubrics

Mens Sana in Corpore Sano

- Running plan for the semester:
 - Run from here to Louisville, KY
 - Equivalently, run 210 miles
 - Equivalently, run 8 marathons

Technical Content

- Languages and Technologies
 - HTTP
 - HTML, CSS, JavaScript, JSON
 - Ruby, Ruby on Rails
- Tools and techniques
 - Design patterns (MVC)
 - git, linux
 - Regular expressions, unicode, system time
- Advanced topics
 - Programming languages, networking, cryptography, databases, operating systems

Stability of Content: Concepts

- Conceptual underpinnings will be relevant forever
- In this course:
 - Single-point of control over change
 - Abstraction (vs realization)
 - Design patterns
 - Regular Expressions (the math part)
 - Cryptography (the math part)
 - Motivation for version control
 - Time-space performance trade-offs

Stability of Content: Technology

- Some technologies have been around a long time, and will likely be relevant for many more years
- Examples in this course:
 - Linux
 - SQL
 - HTTP
 - HTML
 - CSS
 - JavaScript

Stability of Content: Tools

- ❑ Some tools come and go
- ❑ They are useful for getting things done now, but may not be as relevant or fashionable in 10 years
- ❑ Examples in this course
 - VS Code
 - git
 - Ruby
- ❑ Aside on generative AI...

Generative AI (aka Coding Assistants)

□ Advantages

- Generate boilerplate code and performs routine tasks
- Explain code blocks and errors
- Generate idiomatic code, usually positive exemplars of common style, structures, and practices
- Used extensively in industry

□ Disadvantages

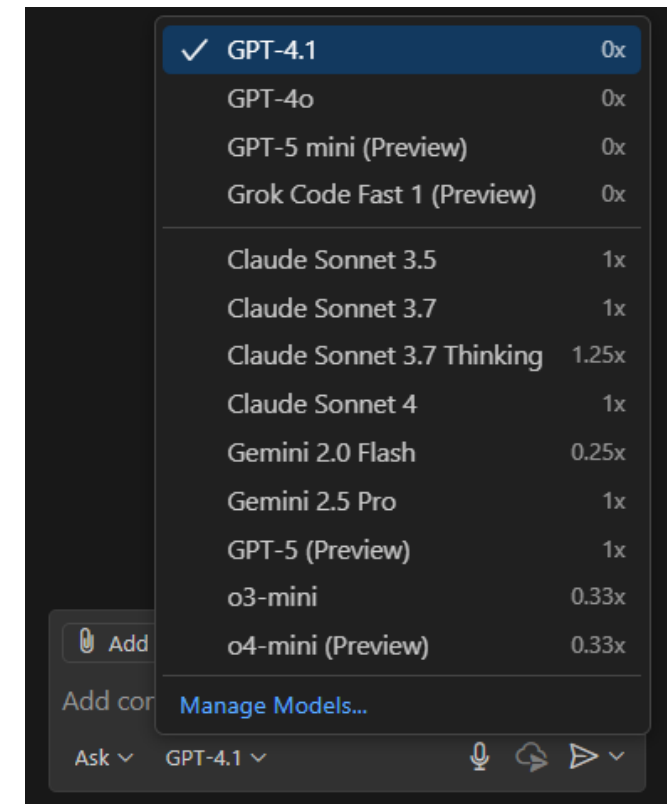
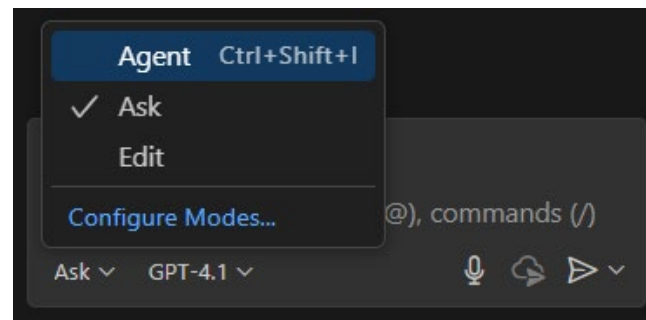
- Make mistakes
- Shortcut some problem solving, which is where good learning often happens
- You won't have access to it on midterms and final

□ Summary

- OK for projects, but understand, assess, and edit everything

VSCode CoPilot

- ❑ Code completion, next edit suggestion, chat
- ❑ Many models available, different costs and strengths
- ❑ Agent, ask, and edit modalities



Stability of Content: Framework

- There are many frameworks and libraries for web development
- They come and go so quickly, there is always something new
- Examples:
 - Web frameworks (Rails, Express.js...)
 - Ruby gems (Middleman, Nokogiri, Cucumber...)
 - JavaScript libraries (React, Angular...)
 - HTML/CSS libraries (Bootstrap, Bulma, Tailwind...)

Meta Content: Software Eng.

- Lasting relevance
- Project development in the “real world” is characterized by
 1. Vague open-ended requirements
 2. Large, complex problems
 3. Teams

Topic 1: Vague Requirements

- Two aspects to engineering:
 - Satisfying the constraints (solving the problem)
 - Optimizing the solution (better, faster, cheaper)
- Must first identify and understand the problem
 - Requirements elicitation
- Recognize tradeoffs
 - Improvement in one aspect at the expense of another

Topic 2: Size and Complexity

- “Programming in the large”
 - Does not all fit in one person’s head or schedule
 - Interfaces, modules, components, classes
- Design
 - Measure twice, cut once
- Process
 - Agile, waterfall, TDD,...
- Documentation
- Testing

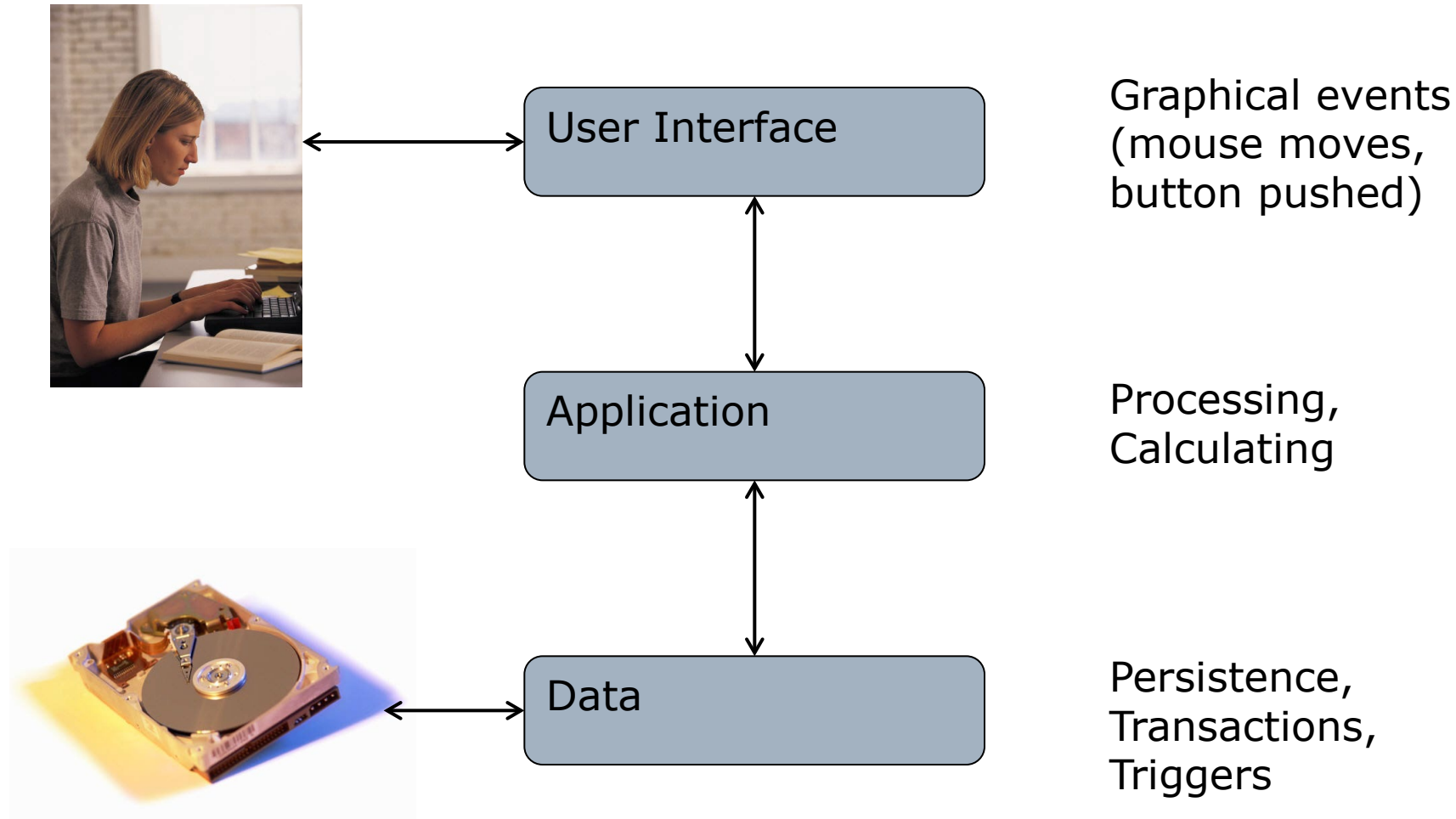
Topic 3: Group Work

- ❑ Naïve view of CS: Lone wolf hacker
- ❑ Reality: large multidisciplinary teams
 - Developers, testers, marketing, HR, management, clients
 - Communication skills are critical
- ❑ Many challenges
 - Rely on others
 - Compromises become necessary
 - Personalities
- ❑ Many rewards
 - Accomplish more
 - Learn more

SE In This Course...

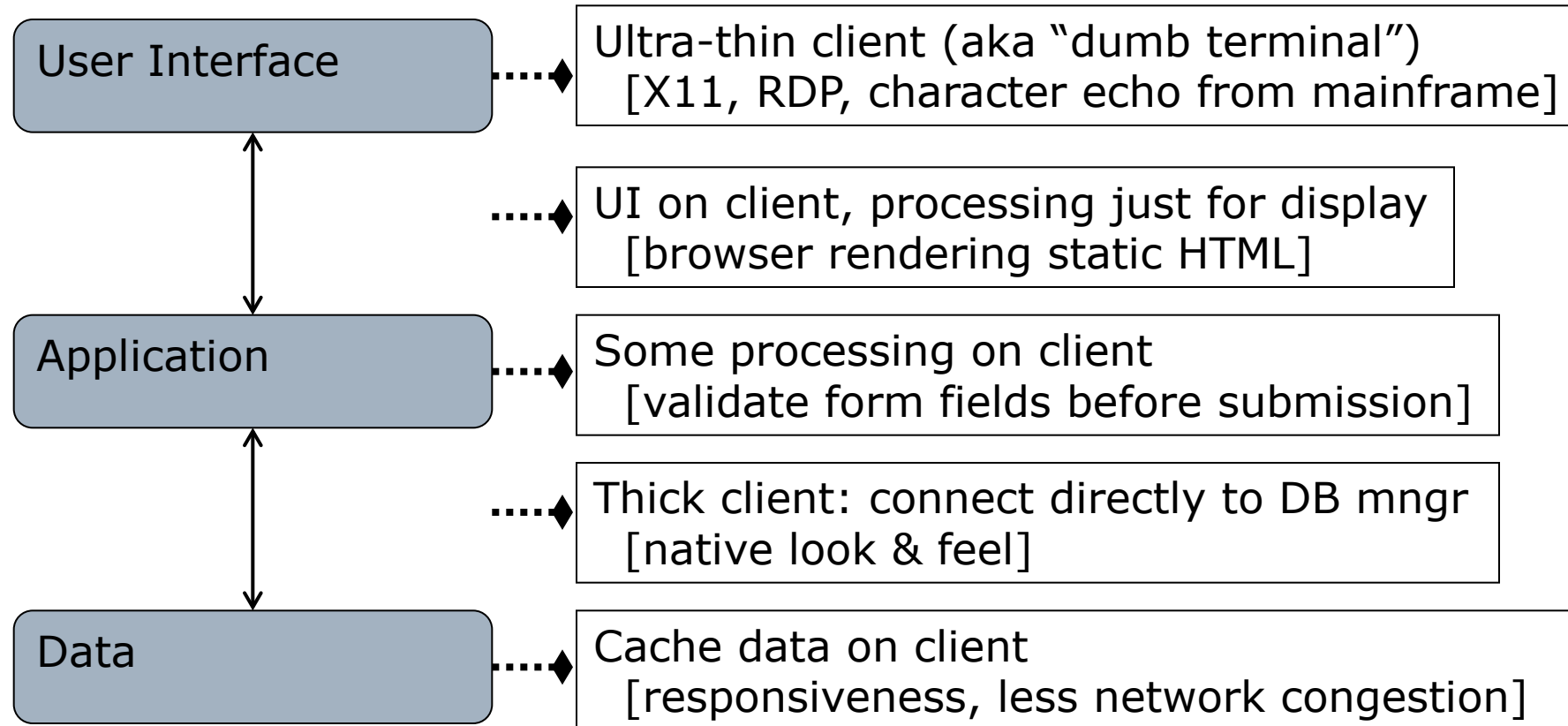
- Group work! You will be part of *two* different groups:
 - A “home group” for projects
 - A “technology team” for tasks
- Multidisciplinary teams
 - Tech teams cut across project groups
- Open-ended projects
- Communication skills
 - Presentations to class

Architecture: Desktop App



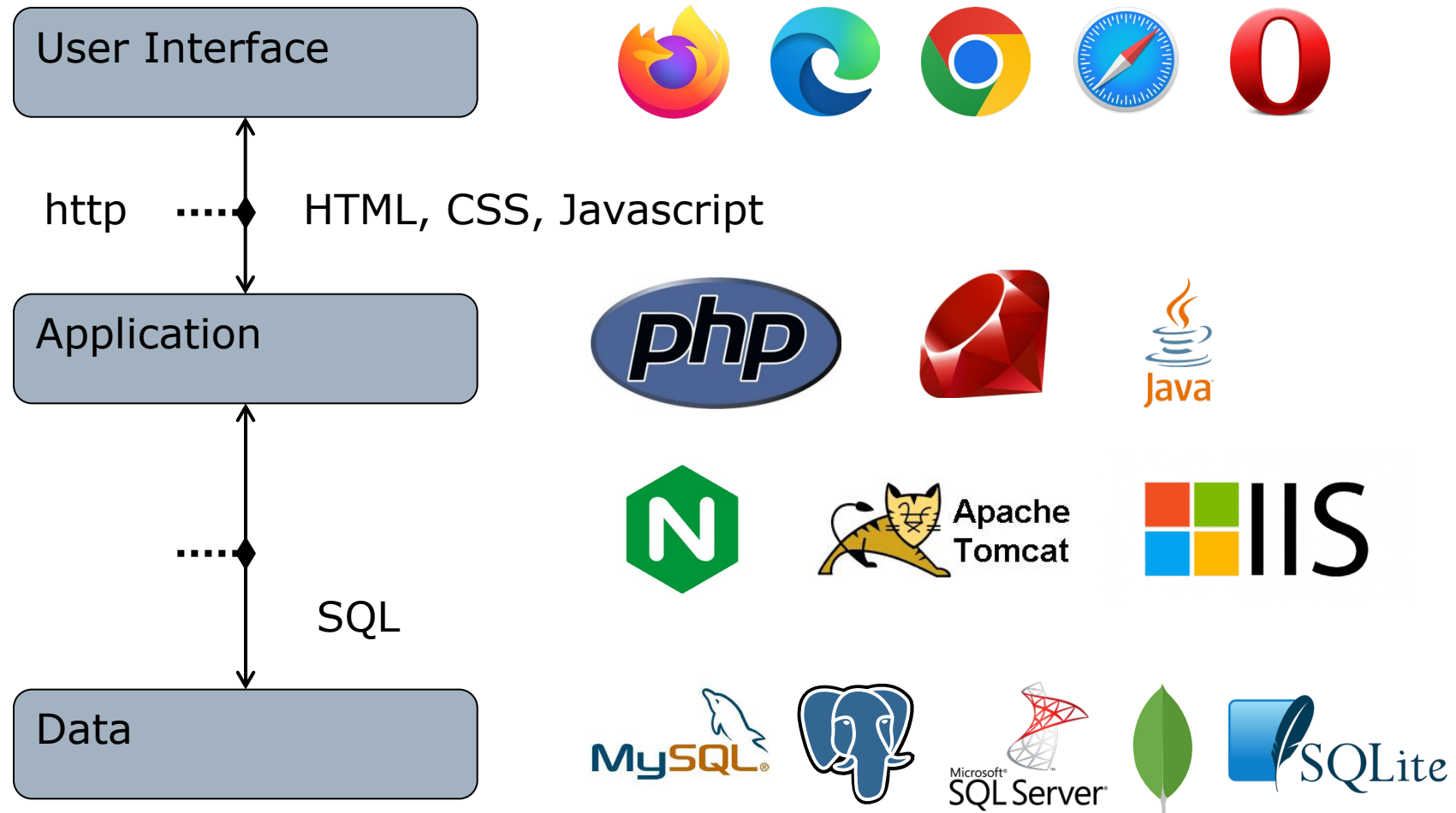
Client-Server App: 2-Tier

Where should we cut?



Basic Web App Skeleton: 3-Tier

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Advantages over Thick Clients

□ Performance

- 1 (expensive) network call to app layer results in many calls to data layer
- Compute-intensive part on faster machine

□ Flexibility

- Update app logic without changing client

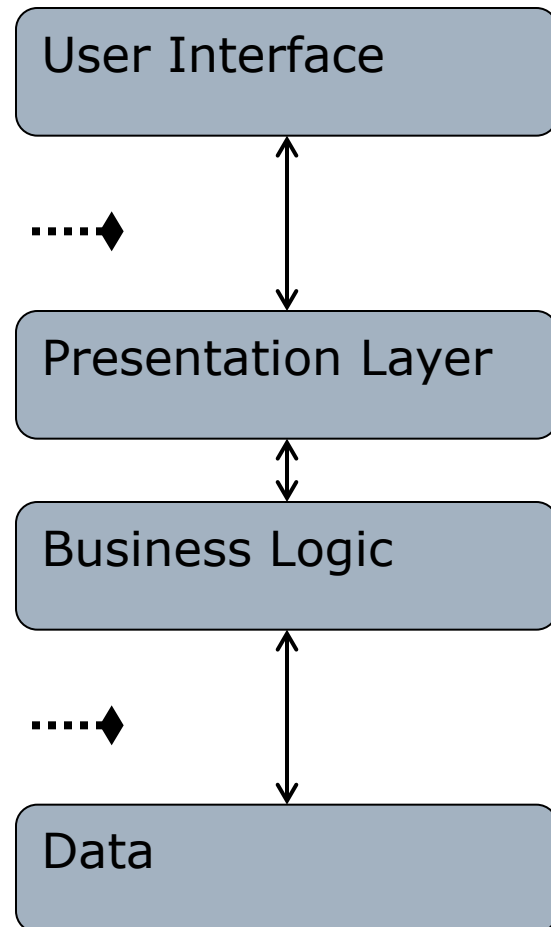
□ Robustness

- Transactions, logging at app level

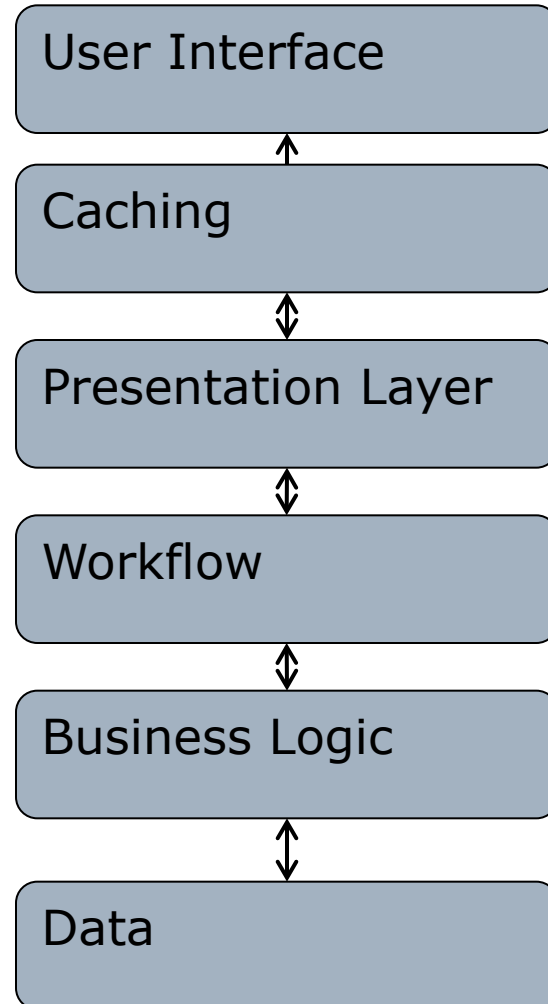
□ Security

- Login, authentication, encryption all better at app level than data level

Web App Skeleton: 4-Tier



Web App Skeleton: n-Tier...



Summary

- Technical aspects of course content
 - Many different web technologies
 - Rapidly evolving landscape
- Meta content: Software engineering
 - Vague requirements
 - Large systems
 - Teams
- 2-, 3-, 4-, n-Tier Architectures