Web Applications: Overview and Architecture

Lecture 1
Road Map in Pictures: Web App

The image shows a section of a web page with a search for ice cream in Columbus, Ohio, using Yelp. The results are filtered by location near the Ohio State University, with a map showing the locations of the ice cream shops. The shops listed include:

1. Cold Stone Creamery
   - University District
   - 5 reviews
   - $ - Ice Cream & Frozen Yogurt
2. Jeni's Splendid Ice Creams
   - Upper Arlington
   - 4 reviews
   - $$$$ - Ice Cream & Frozen Yogurt

The map provides a visual representation of the locations and can be used to navigate to the ice cream shops.
Road Map in Pictures

Browser ➔ Request ➔ Web Server ➔ Response

Controller ➔ Model ➔ View

Dispatcher ➔ Routes ➔ Web Server
Road Map in Pictures

Request

Response

Browser

Web Server

HTTP

Rails

Controller

Model

View

Dispatcher

Routes

Web Server

Rails

Ruby

HTML

CSS

JavaScript

Computer Science and Engineering  ■  The Ohio State University
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

- Class website
  - Syllabus (note exam requirement)
  - Handouts, lecture notes, lab assignments
  - Pointers to more resources
- Piazza
  - Discussion forum, news, announcements
- Slack
  - Group collaboration, messaging, chat
- Carmen
  - Grades
- Face time (not FaceTime™)
  - Instructor, TA
  - Each other
Technical Content

- Languages and Technologies
  - HTTP
  - XML, HTML, CSS, JavaScript
  - Ruby, Ruby on Rails

- Tools and techniques
  - Design patterns (MVC)
  - git, linux
  - Regular expressions, unicode, 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
  - Ruby
  - JQuery
  - git
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 like Rails, Express.js...
  - Ruby gems like Middleman, Nokogiri, Cucumber...
  - JavaScript libraries like Angular, React
  - HTML/CSS libraries like Bootstrap, Baseline, Foundation...
Meta Content: Software Eng.

- Lasting relevance
- Project development in the "real world"
  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
In This Course...

- Group work: 4 people / group
- Multidisciplinary teams
  - I will create cross-cutting technical areas
- Open-ended projects
- Communication skills
  - Presentations to class
Architecture: Desktop App

User Interface

Application

Data

Graphical events (mouse moves, button pushed)

Processing, Calculating

Persistence, Transactions, Triggers
Client-Server App: 2-Tier

Where should we cut?

- **User Interface**
  - Ultra-thin client (aka “dumb terminal”)
    - [X11, RDP, character echo from mainframe]
  - UI on client, processing just for display
    - [browser rendering static HTML]
  - Some processing on client
    - [validate form fields before submission]
  - Thick client: connect directly to DB mngr
    - [native look & feel]
  - Cache data on client
    - [responsiveness, less network congestion]
Basic Web App Skeleton: 3-Tier

User Interface

http

HTML, CSS, Javascript

Application

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SQL

Data

SoftwareLogos:
- PHP
- Java
- Apache Tomcat
- IIS7
- MySQL
- SQL Server
- SQLite
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

User Interface

Presentation Layer

Business Logic

Data
Web App Skeleton: n-Tier...

User Interface
  ↕
Caching
  ↕
Presentation Layer
  ↕
Workflow
  ↕
Business Logic
  ↕
Data
Summary

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