Course Introduction

Modern Application Development Patterns (Web + Mobile + Cloud)

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Welcome to ITWS-4500

Advanced Web Systems Development

Today's Agenda

Learning Objectives

1. Understand the course structure, expectations, and assessments
2. Learn a **pattern-first** way to think about modern applications
3. Compare common patterns across **web and mobile** clients
4. Preview backend, data, and deployment patterns you'll use all semester
5. Start thinking about project ideas and teams

About Your Instructor

Jason Kuruzovich

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- Research: AI/ML applications, digital platforms, entrepreneurship
- Industry: Enterprise software, startups, consulting
- Teaching: Web systems, data science, analytics

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Course Overview

Why This Course?

> Build **production-quality** applications as **integrated systems**.

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This is not only about writing code. We'll focus on:

- **Architecture** — how systems are structured and why
- **Patterns** — reusable solutions to common problems
- **Trade-offs** — choosing "good defaults" and knowing when to change them
- **Integration** — making components work together
- **Operations** — deploying, monitoring, and evolving systems

Big Idea: Patterns Outlast Tools

Tools and frameworks change quickly.

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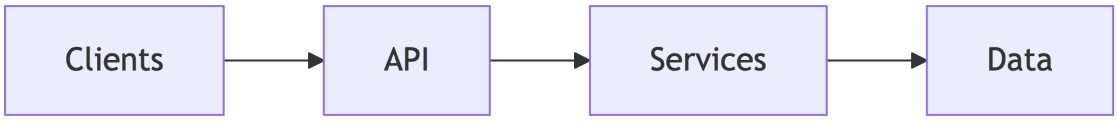
Patterns stick around:

- Client server communication
- Authentication and sessions
- Data modeling and persistence
- Scaling and reliability
- Dev workflows and deployment

A Pattern Map

The Full-Stack View



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We'll revisit this diagram all semester and add details as your systems grow.

Client Patterns: Web vs Mobile

Web Applications

Common pattern:

- Browser UI (React, Vue, etc.)
- Communicates over **HTTP/HTTPS**
- Mostly **stateless** requests

Typical concerns:

- Routing
- Authentication
- State management
- Performance (latency, bundle size)

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Mobile Applications

Common pattern:

- Native or cross-platform app
- Often the **same backend** as the web app
- More constraints (battery, offline use, flaky networks)

Key takeaway: Web and mobile usually share the same backend.

Backend Patterns

API-Centered Design

Most systems revolve around APIs:

- REST (common default)
- GraphQL (when it fits)

Typical responsibilities:

- Authentication & authorization
- Business logic
- Validation & error handling

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Service Organization

You'll commonly see:

- **Monolith** — everything in one deployable
- **Modular monolith** — one deployable, clean internal boundaries
- **Microservices** — multiple deployables, more coordination

Rule of thumb: Start simple; add distribution when you have clear reasons.

Data Patterns

Databases (Common Choices)

- Relational: PostgreSQL, MySQL
- Document: MongoDB

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What Matters More Than the Brand

- Data modeling (entities, relationships, constraints)
- Indexing and query patterns
- Security (least privilege, injection prevention)
- Migrations and change management

Data Access Pattern

Application → Data access layer → Database

Infrastructure & Deployment Patterns

From Laptop to Cloud

A common progression: 1. Local development 2. Containers (Docker) 3. Cloud deployment

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Infrastructure as Code

Instead of manual setup:

- Configuration files
- Repeatable environments
- Version-controlled deployments

If it can't be reproduced, it's not done.

AI-Assisted Development

The New Reality

Modern developers use AI to:

- Generate boilerplate
- Explore unfamiliar stacks
- Debug and refactor faster

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The Catch

> AI is most useful when you understand the underlying patterns.

This course will help you **ask better questions** and evaluate AI output critically.

How This Course Flows

Patterns → Tools → Systems

We will move from:

- Concepts and patterns
- To implementation and integration
- To deployment and operations

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Coming Up

- Web & API architectures
- Databases and persistence
- Docker and deployment
- Multi-service systems

Expectations

- You do not need to know every tool in advance
- You *do* need to think clearly about design choices
- Focus on the **why** behind decisions

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Your job this semester: build something real, learn patterns, explain trade-offs.

Logistics

- **Office Hours:** Tuesday 9–11 AM, Pitt 2206
- **Email:** kuruzj@rpi.edu
- **Appointments:** bit.ly/jason-rpi

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Next Class

Docker and Infrastructure as Code