Principles of Software Construction: Objects, Design, and Concurrency

DevOps

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Administrivia

• Final Exam: Monday, May 6, 2019 05:30 p.m. - 08:30 p.m.
  – LOCATION: GHC 4401
  – Review Session Saturday, May 4th, 1-3pm in NSH 3305
COURSE DESCRIPTION
The course takes a software engineering perspective on building software systems with a significant machine learning or AI component. It discusses how to take an idea and a model developed by a data scientist (e.g., scripts and Jupyter notebook) and deploy it as part of a scalable and maintainable system (e.g., mobile apps, web applications, IoT devices). Rather than focusing on modeling and learning itself, the course assumes a working relationship with a data scientist and focuses on issues of design, implementation, operation, and assurance and how those interact with the data scientist’s modeling.

This course is aimed at software engineers who want to understand the specific challenges of working with AI components and at data scientists who want to understand the challenges of setting a prototype model into production. It facilitates communication and collaboration between both roles.

WHAT QUESTIONS WILL THIS COURSE ADDRESS?
- How can correctness or usefulness of a system with an AI component be specified or evaluated? How does requirements engineering change for AI-enabled systems?
- How to analyze and mitigate worse results and how to design robust systems? Is modular design still possible with AI components?
- How and where to deploy models? How and when to update models, and what telemetry to collect? How to design learning and evaluation infrastructure that scales?
- How to compose multiple AI components within a system and detect feedback loops? What does software architecture for AI-enabled systems look like?
- How to detect poor data quality, poor model quality, and data drift? What would unit testing for data look like?
- How to assure quality of an AI-enabled system? How would test automation look like to test correctness of infrastructure or models?
- How to assure fairness and privacy of AI-enabled systems?

SOFTWARE ENGINEERING FOR AI-ENABLED SYSTEMS
17-445/645 · FALL 2019

LOGISTICS
When: Monday/Wednesday 1:30-2:50 // FALL 2019
Instructors: Christian Kastner
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Open to undergraduate and master students meeting the prerequisites.

Visit the course website to learn more:
ckaestner.github.io/sea/
Simple Layers App
More functionality
Even more functionality
Organize our backend

Our Cool App

Frontend

Backend Server

Mod 1
Mod 2
Mod 3
Mod 4
Mod 5
Mod 6

Database
How to scale?

Our Cool App

Frontend

Backend Server
- Mod 1
- Mod 2
- Mod 3
- Mod 4
- Mod 5
- Mod 6

Backend Server
- Mod 1
- Mod 2
- Mod 3
- Mod 4
- Mod 5
- Mod 6

Backend Server
- Mod 1
- Mod 2
- Mod 3
- Mod 4
- Mod 5
- Mod 6

Database
Monolith

- What happens when we need 100 servers?
- What if we don’t use all modules equally?
- How can we update individual models?
- Do all modules need to use the same DB, language, runtime, etc?
Microservices

Our Cool App

Frontend

“Dumb” Backend

NodeJS, Firebase

Todos

REST service

Database

Google Service

Accounts

REST service

Database

Java, MySQL

Mailer

REST service

Database

Search Engine

REST service

Database

Java, Neo4J

Analytics

REST service

Database

C#, SQLServer

Facebook Crawler

REST service

Database

Python, Firebase
Microservices should be:

- Modelled around business domain
- Culture of automation
- Hide implementation details
- Decentralized governance
- Deploy independently
- Design for failure
- Highly observable
Microservice prerequisites

- Rapid Provisioning
- Basic Monitoring
- Rapid Application Deployment
- Devops Culture
MICROSERVICES...

...SO HOT RIGHT NOW
Why are microservices such a big deal?
Impact on development practices

- Amazon transitioned to “two-pizza” teams
- “Full Stack” developers
- ”Devops” as a prereq
- Live testing and rollback
- Migrating from “monolith to microservices” is popular, but comes at a cost
Microservices benefits

- Strong Module Boundaries
- Independent Deployment
- Technology Diversity
Microservices overhead

For less-complex systems, the extra baggage required to manage microservices reduces productivity.

As complexity kicks in, productivity starts falling rapidly.

The decreased coupling of microservices reduces the attenuation of productivity.

But remember the skill of the team will outweigh any monolith/microservice choice.
Microservice costs

• Distribution
• Eventual Consistency
• Operational complexity
• Leads to more API design decisions
Microservice prerequisites

- Rapid Provisioning
- Basic Monitoring
- Rapid Application Deployment
- Devops Culture
Why DevOps?

• Developers and Operations don’t have the same goals
  – Devs want to push new features
  – Ops wants to keep the system available (stable, tested, etc.)
• Poor communication between Dev and Ops
• Limited capacity of operations staff
• Want to reduce time to market for new features
• Reduce “Throw it over the fence” syndrome
DevOps Definition

• “DevOps is a set of practices intended to reduce the time between committing a change to a system and the change being placed into normal production, while ensuring high quality.”