CS 188

Scalable Internet Services

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Today’s Agenda

- Course Introduction
  - Motivation
  - Course Structure

Course Introduction

Let’s say...

...I want to find a home to live in.

...I am lost in a foreign city.

...I want to go on a date.

... what do I do?

Course Introduction

Every day, billions of people use the same suite of technologies to solve these problems: internet services.

As these services get increasingly popular, they need to continue to function.

Scaling even relatively simple web applications (Twitter) can be very complex.

Course Introduction

Suppose you’ve built something the world is excited about.

What do you do when your popularity doubles?

What do you do when your data set doubles in size?

- And doubles again. And again…

These are good problems to have, and this course is about how you solve them.

Course Introduction

What do we mean by an Internet Service?

- For the purposes of this class, we are referring to HTTP services.
- Yes, there are many other protocols on the internet, but HTTP is the 800 pound gorilla.
- Do we mean HTML?
  - Not necessarily. HTTP is much more than just HTML.

Course Introduction

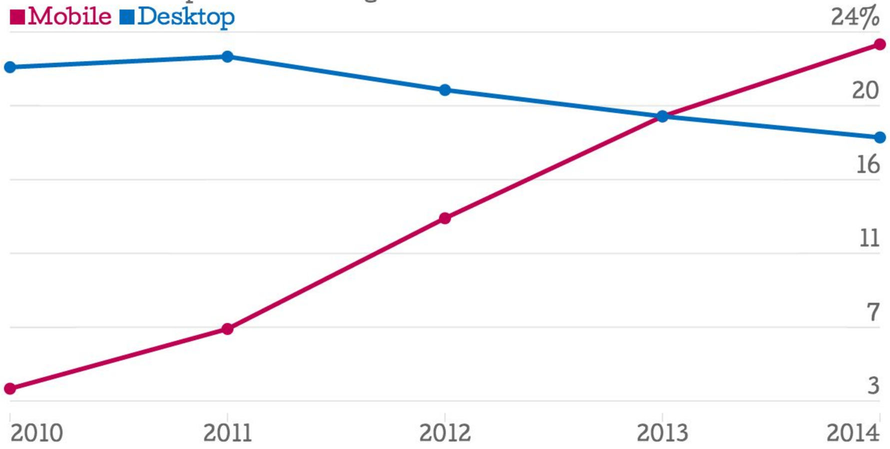
Do we mean web browsers?

Yes, but so much more.

- HTTP is the foundation for most APIs on the internet today
- REST and SOAP are conventions on top of HTTP for machine to machine communication.
- If two companies, or two applications today want to exchange data, HTTP is the go-to solution

Course Introduction

Do we mean mobile devices?



Share of time spent consuming media

Made with Chartbuilder

Data: eMarketer, April 2014

Yes!

- Mobile web is thriving
  - We will cover optimizations.
- Most native mobile applications are backed by internet services.
  - We will cover REST

Course Introduction

Ok, so we’re clear on what we mean by an “internet service”.

What do we mean by scalable?

Course Introduction

Ok, so we’re clear on what we mean by an “internet service”.

What do we mean by scalable?

An internet service is scalable if increasing demands can be effectively met with increasing capacity.

- By demands, we usually mean traffic
- Other demands apply as well, such as the size of data set

Course Introduction

What do we mean by “effectively meet demands”?

Course Introduction

What do we mean by “effectively meet demands”?

- Service stays available
- Response time does not excessively degrade

An example of an internet service that is not scalable:

- Run everything on one server.
- When traffic grows too high, buy a faster server
    - **Why is this not scalable?**

Course Introduction

Scaling is the core of the course, but along the way we will learn about the tools and technologies surrounding scalable internet services today:

- Performance
- Security
- Agile software development
- Test driven development
- The increasingly rich client

Course Introduction

In summary...

This course won’t teach you how to build an application that gets worldwide attention and usage.

- That’s your problem!

This course will teach you how to build an application **that can respond to** worldwide attention and usage.

Course Structure

Lectures Tuesday and Thursday at 4PM in Kinsey Science Teaching Pavilion 1240B.

- Lectures and reading will cover the concepts introduced in this class

Lab Friday at 12pm & 2pm in Boelter 2760.

- The lab will be focused on the course project.
- Demo each week.
- Remember to charge your laptops.

Office hours Friday 10am to 12pm in 4531M Boelter.

Course Structure

This course is **project intensive**. We will be learning about scalable internet services by building them. You will...

- Work in teams of four.
- Develop an interesting internet service
- Deploy it on Amazon EC2
- Measure its performance and scalability
- Apply the techniques presented in class to improve it
- Document these improvements and present them

Course Structure

This course demands a lot of work, but can be very rewarding.

Skills you will learn in the next 10 weeks:

- A programming language (Ruby)
- An application development framework (Rails)
- Amazon Web Services: EC2, S3, CloudFormation
- How to load test an internet service using Tsung
- Test-Driven Development
- Agile/Scrum software development

Course Structure

This is **not a deep-dive** in Relational Databases, Networking, Distributed Systems, Network Security, or Cloud Computing, but will touch on each of these.

- If you are looking for deep dives, please see
  - Networking: CS 118, 117, 211, 218
  - Distributed Systems: 133
  - Databases: 143
  - Network Security: 136

Course Structure

This course has an **industrial focus**. We will use industrial software development techniques.

- The goal of the course is successful projects that demonstrate the concepts introduced in the course
- All project code will be open source
  - Learn from your classmates!
- Toolchain will be from industry:
  - Git(hub), Ruby/Rails, Travis CI, NewRelic

Course Structure

Why Ruby on Rails?

- Rails weaknesses: CPU usage, memory usage
- Rails strengths: building applications quickly

In order to teach advanced scaling topics, you need to get a project from zero to working quickly.

Course Structure

1.) Ruby on Rails
2.) Objective C
3.) Python
4.) Java
5.) C++
6.) JavaScript
7.) C
8.) R
9.) C#
10.) Visual Basic

What does this course have to offer you?

- If you’re going into academia, knowledge of industrial software engineering is valuable
  - Sets the context for many important problems
- If you’re headed for industry, there’s never been a better time to understand this technology stack

Source: http://www.businessinsider.com/best-tech-skills-resume-ranked-salary-2014-11

Course Structure

There are two course texts:

- **Concepts**
  - "High Performance Browser Networking"
  - by Ilya Grigorik
  - Available for free online
- **Practice**
  - Ruby on Rails Tutorial Book
  - by Michael Hartl
  - Available for free online

Course Structure

Your grade will be based on three main factors

- **Your final project presentation**
- Your final project paper
- Your teammates’ evaluation of your contributions

Also considered, to a lesser degree

- Weekly demo progress
- Assistance to other students on Piazza

Course Structure

Course Project

- Goal: Gain hands-on experience building and deploying a scalable web service

- Your project will...
  - Use Ruby/Rails/EC2
  - Have an interesting and large data set
  - Demonstrate scaling improvements with measurements
  - Ideally, relate to something that interests you

Course Structure

Course Project

- Process
  - Project teams of 4 students
  - Use weekly sprints to make progress
  - Use modern software engineering techniques:
    - Scrum, TDD, Pair programming
- Production deployed on Linux
- For your development machines, you have choice, but Unix is **highly** recommended (Mac OS, Linux, etc.)
  - Development on Windows is discouraged and not supported

Course Structure

Course Project

Want inspiration?

- Look to http://scalableinternetservices.com/projects
- Some fun ideas:
  - Uber for haircuts: hail a hairdresser/barber
  - Location-based game: compete for control of campus
  - AirBnB for pets: timeshare your dog

Course Structure

- Course websites
  - http://scalableinternetservices.com
  - https://github.com/scalableinternetservices
  - http://piazza.com/ucla/fall2016/cs188
    - Email notifications are a good idea
    - Students helping others is strongly encouraged

Course Structure

Lecture Structure

- The course lectures will cover material you need to build a successful project, and additional material that won’t be directly applied.
- Necessary content for successful projects is front-loaded so you can apply these concepts early.
- The lectures in the second half of the quarter will be additional material and guest lectures.

Course Structure

First five weeks will cover:

- Intro to the basics: HTTP & HTML
- Industrial software engineering: Agile, TDD, CI, Pairing
- HTTP Application Server architectures
- High availability via load balancing: a share-nothing web stack
- Client-side and server-side caching
- Using relational databases in web applications: concurrency control and query analysis
- Scaling via sharding
- Scaling via SOA
- Scaling via read-slaves

Course Structure

Subsequent lectures will be guest speakers and

- Scaling via non-relational data stores (NoSQL)
- Basics of web security: Firewalls, HTTPS, XSS, CSRF
- HTTP 2.0
- Client-side renaissance: Client-side MVC
- Thicker clients: Asm.js, Emscripten, Webruby
- Content-delivery networks
- Elixir, Phoenix, and Erlang (maybe)

For Next Time...

- No lab this week!
- Read Chapters 1 & 2 of HPBN
- Read http://scalableinternetservices.com/projects/
    - Start thinking about projects and groups
    - Post to Piazza with project ideas
- Start working on Ruby CodeAcademy
    - http://www.codecademy.com/en/tracks/ruby/