CSE 124: NETWORKING, CLOUD COMPUTING, AND COURSE OVERVIEW

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ATTRIBUTION

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• These slides incorporate material from:
  • Michael Freedman and Kyle Jamieson, Princeton University
Outline

1. Networking and cloud computing
2. Course overview
3. Open Q&A
CSE 124: NETWORKED SERVICES

- Add networking support to software
  - Between two computers
  - Between computer and datacenter (“The Cloud”)

- Develop software that is:
  - Scalable (handles 100s of M to 1+ billion users)
  - Fault-tolerant (survives failures)
  - Evolvable (how to support different versions?)
  - Secure
OUR LIVES ARE (LARGELY) ONLINE!
NETWORKED SERVICES DRIVEN BY DATA

Data + = Product Recommendations

Data + = Custom Stations

Data + = Personalized Search
DATA-DRIVEN, PER-USER CUSTOMIZATION

Data + = Product

Recommendations

App 1

App 2

App 3
DATA CENTERS: THE HOME OF ALL THIS COMPUTING AND STORAGE

Microsoft

Google

Facebook
Google 2012
MASSIVE NETWORKED INFRASTRUCTURE

- **To build:**
  - Google spends about $3B per year
  - Microsoft spent $15B in total

- **To operate:**
  - 1-2% of global energy consumption
  - 91 billion kWh (34 500-MW coal-fired power plants)

- **By 2020:**
  - 140 billion kWh (50 power plants)
  - $13 billion in electricity bills
  - 100 metric tons of carbon pollution per year

1. LBNL, 2013
2. NRDC report
THE NETWORK HAS SEEN RAPID GROWTH
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1989
Web Created

1993

1997

2001

2005

2009

2013

Google’s 1st cluster (15 years)
THE NETWORK HAS SEEN RAPID GROWTH

1989 - Web Created
1993
1997
2001
2005
2009
2013

Google’s 1st cluster (15 years)

facebook (10 years)
THE IMPORTANCE OF SCALE

• Network primitives are designed to scale

• Techniques we learn are directly applicable to global-scale services like Google, Facebook, ...

• Your projects will be tested in small scale
  • Yet could scale immensely with minimal to no modifications
CSE 124 VS. 123

• **123: Networking**
  • Theory of how the network works
  • Routing protocols, congestion control theory, switching and forwarding
  • “Up to layer 4”

• **124: Networked services**
  • How to program networked software
  • Socket programming, RPC, DNS, protocol design and implementation, consensus and consistency, security, TLS, ...
WHY FOCUS ON CORRECTNESS?

MOVE FAST AND BREAK THINGS
SELF-DRIVING CARS
SMART CITIES AND SMART GRIDS

Smart, cleanly-powered grid
Interconnected grid with: 1. Distributed, regional, and central generation; 2. Hybrids (multiple means) of power generation at each scale; 3. Smart sensors in buildings for efficient use; 4. Smart technologies to designate critical areas during power losses; 5. New generation batteries and other storage technologies.
FACEBOOK MORE RECENTLY

MOVE FAST WITH STABLE INFRA
THE CHALLENGE OF NETWORKING

- Undergraduate program includes:
  - Algorithms
  - Programming languages
  - Architecture
  - Data structures
  - Etc...
- How does the network change each of these areas?
Outline

1. Networking and cloud computing
2. Course overview
3. Open Q&A
RESOURCES

• Course web page
  • Linked off of www.cs.ucsd.edu/~gmporter
  • Syllabus, schedule, and blog/uploads

• Books

• TA discussion section

• Class meetings

• Each other!
CLASS MEETINGS (M/W/F 10-10:50AM)

- Overview of material, work through examples/demos, small-group activities
- To help you do what you need to do for your projects/homeworks
- **Be involved**--don’t expect 45 minute speeches!
  - Attendance is not taken
  - Engagement:
    - Being unengaged saps energy from your peers and me
BOOKS

**Required**

TCP/IP SOCKETS in C

A PRACTICAL GUIDE FOR PROGRAMMERS
SECOND EDITION
Michael Donahoo
Kenneth Calvert

**Required**

The Datacenter as a Computer
An Introduction to the Design of Warehouse-Scale Machines
SECOND EDITION
Luiz André Barroso
Jimmy Clidarás
Urs Hölzle

SYNTHESIS LECTURES ON COMPUTER ARCHITECTURE
Mark D. Hill, Series Editor

**Optional**

DISTRIBUTED SYSTEMS
Principles and Paradigms
SECOND EDITION
Andrew S. Tanenbaum
Maarten Van Steen

(free PDF online)
TEACHING ASSISTANTS

• Ojas Gupta
• Akash Agrawal
• Rob McGuinness
• Discussion: Tuesday 7-8pm, LEDDN AUD
• Small(er) group meeting to work through examples, ask questions, seek out help on the projects/homeworks, etc.
WEEKLY LECTURES

• M/W/F 10-11am

• Electronic device policy: None allowed in first few rows (ok in back)

Devices permitted
(But no TV, movies, video, or games!)

No devices in first few rows

Picture courtesy http://tinyurl.com/znkuezc
ASSESSMENT

• Six homeworks (25%, lowest dropped)
• Projects
  • Build a webserver (25%)
  • Build a Dropbox-like cloud storage app (30%)
• Final exam (20%)
• Deploy your code on Amazon AWS to datacenters on five continents

• Mumbai, India; Dublin Ireland; Sao Paulo Brazil; Seoul, Korea, San Diego, Calif.
COLLABORATION POLICY

• Homeworks to be completed individually
• Projects can be done in groups of 1 or 2
• GitHub:
  • For all assignments, must use private GitHub repos that we will provide to you
  • Do not post code online, on the web, in a public repo, on discussion forums, etc.
• Be aware of Googling for answers
• Isn’t that what “real” programmers do?
• Will be available if you want to discuss topics from the course with fellow students

• Can ask questions about projects and homeworks, but...

• We may choose to answer questions by updating the assignment specification on the web site to prevent the answers from being buried, and to prevent “notification overload”
Q&A

For Monday:
• Reading due: Donahoo and Calvert, Chapters 1 and 5
QUESTIONS?  COMMENTS?

For Monday:
- Read Donahoo and Calvert, Chapter 5
- Homework 1 has been posted (due Oct 9, 5pm)