CSE 704 Data Center Computing
Intro

Steve Ko
Administrative Information

• Organizer: Steve Ko
• Ph.D., 2009, UIUC
• Interest: distributed systems, networking, and operating systems
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Seminar Overview

• Data Center Computing
  – Computing activities that utilize data centers
  – An attempt to look at the whole spectrum
  – “What technologies do you use when you access a Web service?”

• Components
  – Front-end, processing, storage, networking, and virtualization
Seminar Credits

• 1 Credit
  – Reading papers
  – Writing reviews
  – Presenting one paper (or two)
  – Participating in discussions

• 3 Credits
  – Additional research project
  – Cannot be used for your master’s project
  – Meet me after class
Reading Papers

• 24 papers, 2 papers per week
• Recommended reading: "How to Read a Paper" by S. Keshav (only 2 pages!)
• “A three-pass approach”
Reading Papers

• First-pass
  – Read the title, abstract, and intro
  – Read the titles of all sections and subsections
  – Read the conclusion
  – Goal: five C’s
    • Category: which category is this paper in?
    • Context: related papers?
    • Correctness (on the assumptions)
    • Contributions
    • Clarity
Reading Papers

• Second-pass
  – Read with greater care, but still ignore details (e.g., proofs)
  – Jot down key points, ideas, background readings, etc.

• Third-pass
  – Virtually re-create the paper
  – Put down the paper, start from the same assumptions, and re-create the work.
Writing Reviews

• Format
  – What is the research problem?
    • Do you agree that it’s a problem? Why or why not?
  – What are the main approaches/ideas? Strengths and weaknesses?
  – Other comments
    • E.g., what you liked, what you didn’t understand, possible future work, compare & contrast with other papers, hidden assumptions, etc.

• Don’t need to be long
Presentation

• Prepare PowerPoint slides
• Lead a discussion for an hour (presentation + questions/answers/discussions)
• Incorporate others’ comments (e.g., what people didn’t understand well)
• Schedule a time with me for a practice run
• You can use other people’s slides
  – Make sure you acknowledge them
Assignment for Today

• Email me whether or not you’re going to stay
• If you decide to stay, do the rest
• Look through the schedule
• Pick two papers you’d like to present
  – 1\textsuperscript{st} choice & 2\textsuperscript{nd} choice
  – FCFS
  – Exception: OpenFlow & NOX (from “Networking – 1” on 10/6) should be presented together with some demo
• Email me your choices
Topics Overview

• What makes these possible?
Topics Overview

Internet

Facebook

Google

Amazon
Data Centers
Data Centers

• Hundreds of locations in the US
Inside

• Servers in racks
  – Usually ~40 blades per rack
  – ToR (Top-of-Rack) switch

• Incredible amounts of engineering efforts
  – Power, cooling, etc.
Inside

- Network
Inside

• 3-tier for Web services
Topics Overview

• What makes these possible?
Components

• Front-end Web browsers
• File and storage systems
• Data processing frameworks
• Networking
• Virtualization
• Maybe not an exhaustive list, but a good set...
Front-End Web Browsers

• Why Web browsers?
  – Practically, they are the OSes in the current generation of computing

• They run applications
  – Maps, email clients, etc. (AJAX programs) have hundreds of thousands of LOC
  – All traditional OS problems exist
    • Protection, reliability, privacy, performance, etc.

• Exciting new area of research
A Glimpse into the Issues

• How much do you trust javascripts?
A Glimpse into the Issues

• SOP (Single-Origin Policy)

  http://integrator.com/

  <script
  src="http://provider.com/p.js">
  </script>

• How do you control the level of trust?
File and Storage Systems
Facebook Statistics

• 13 M users update their statuses at least once each day
• 2.5 M users become fans of Pages each day
• 700 M new photos per month
• 4 M new videos per month
• 15 M pieces of content shared per month
• 2 M new events per month
• 19 M active groups
File and Storage Systems

• How do you store?
• How do you not lose?
• How do you provide good access latency?
• How do you maintain?
• …
Data Processing Frameworks

• Google
  – 20+ billion web pages
    • ~20KB each = 400 TB
  – ~ 4 months just to read the data
  – And growing...
    • 1999 vs. 2009: ~ 100X

• Yahoo!
  – US Library of Congress every day (20TB/day)
  – 2 billion photos
  – 2 billion mail + messenger sent per day
  – And growing...
Data Processing Frameworks

• How do you process this large amounts of data?
  – Page rank, ad click statistics, search query trend, user profiling, etc.
• Again, ~ 4 months to read the data
Virtualization

• VMM: a piece of software that exposes hardware interfaces (ISA, I/O, etc.)
Virtualization

• Many data centers are virtualized
  – Ease of management (start, stop, migrate, etc.)
  – Consolidation (multiplexing one physical machine)

• How did we get here?
Networking

• Obviously, we need a network...
• But, what kind?
Networking Issues

• Oversubscription
• Management
• TCP performance
• Etc.
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