CS 6464: Advanced Distributed Storage Systems

Spring 2009

Instructor: Hakim Weatherspoon
Who am I?

• Prof. Hakim Weatherspoon
  – (Hakim means Doctor, wise, or prof. in Arabic)
  – Background in Education
    • Undergraduate University of Washington
      – Played Varsity Football
        » Some teammates collectively make $100’s of millions
        » I teach!!!
    • Graduate University of California, Berkeley
      – Some class mates collectively make $100’s of millions
      – I teach!!!
  – Background in Operating Systems
    • Peer-to-Peer Storage
      – Antiquity project - Secure wide-area distributed system
      – OceanStore project – Store your data for 1000 years
    • Network overlays
      – Bamboo and Tapestry – Find your data around globe
    • Tiny OS
      – Early adopter in 1999, but ultimately chose P2P direction
Goals for Today

• Be brief!
• Why take this course?
• Goals of distributed storage systems
• Intro to cloud computing
• How does this class operate?
Why take this course?
Why take this course?

Google

YouTube

Yahoo! Mail

flickr
Why take this course?

• We have access to state-of-the-art equipment
  – Cornell National Lambda Rail (NLR) Rings
Why take this course?

- We have access to state-of-the-art infrastructure
Distributed Storage Systems
Distributed Storage System Goals

• Problem: No single server is capable of
  – Holding hundreds of terabytes of data
  – Serving millions of requests per second

• Goals
  – Stable performance – load balance
  – Scalable performance
  – High availability
  – Durability
  – security
Cloud Computing
Cloud Computing Intro

• Web service expensive to deploy
  – Provision for peak load
Cloud Provider Leases Resources

- Low server utilization
A Service Running in the Cloud

Under client web service control
Server Consolidation Through Virtualization
Oversubscription

Datacenter

- Memory
- CPU
- Disk
- Network
- ...

![Diagram of datacenter and applications like YouTube, CNN, and flickr connected to users through memory, CPU, disk, and network resources.](image-url)
Observations

• Memory is the local bottleneck resource
  – Swap solves this problem using disk
  – Disk I/O is slow

• Large datacenter environment
  – Managed
  – Guests run standard VMs
  – Very fast network

• Few guests overloaded at one time
  – Memory is not a global bottleneck resource
How class operates
How this class operates

• Instructor: Hakim Weatherspoon
  – hweather@cs.cornell.edu
  – Office Location: 4105C Upson

• TA: Tudor Marian
  – tudorm@cs.cornell.edu

• Lectures:
  – CS 6464: Tu, Th: 10:10 – 11:25 PM, Hollister 362
Course Help

• Course staff, office hours, etc:
CS 6464: Overview

• Prerequisite:
  – Mastery of CS 4410 material
    • Fundamentals of OS design
    • How parts of the OS are structured
    • What algorithms are commonly used
    • What are the mechanisms and policies used

• Class Structure
  – Papers Readings (whole semester)
  – Paper Presentations (whole semester)
  – Labs (first 1/3)
  – Research Project (second 2/3)
CS 6464: Class Structure

• Paper readings
  – Read paper before each class
  – Write a review and turn in at beginning of class
  – Review has three components
    • Summary, 2 – 3 strengths, and 2 – 3 weaknesses

• Paper presentations
  – Each person will present a paper 1-3 times, depending on class size
  – Have presentation prepared a week ahead of time and show slides or “chalk talk” to professor
CS 6464: Class Structure

• Labs (first 1/3 of semester)
  – 2 – 3 labs
  – Using Amazon’s EC2/S3 infrastructure
  – Building your own distributed file system

• Research Project
  – Initial project proposal – due beginning of March
  – Midterm survey paper – due beginning of April
  – Final demo/presentation – due beginning of May
  – Final project report – due beginning of May
Grading

• CS 6464: Operating Systems
  – Midterm ~ 30%
  – Final ~ 50%
  – Assignments ~ 10%
  – Subjective ~ 10%
  – Regrade policy
    • Submit written request to lead TA. TA will pick a different grader
    • Submit another written request, lead TA will regrade directly.
    • Submit another written request for professor to regrade.

• CS 4411: Systems Programming
  – Six projects ~ 100%

• This is a rough guide
Academic Integrity

• Submitted work should be your own

• Acceptable collaboration:
  – Clarify problem, C syntax doubts, debugging strategy

• Dishonesty has no place in any community
  – May NOT be in possession of someone else’s homework/project
  – May NOT copy code from another group
  – May NOT copy, collaborate or share homework/assignments
  – University Academic Integrity rules are the general guidelines

• Penalty can be as severe as an ‘F’ in CS 6464
Next time

- Read *Cumulus* and write review
  - *Cumulus: Filesystem Backup to the Cloud*, Michael Vrable, Stefan Savage and Geoffrey M. Voelker
  - http://www-cse.ucsd.edu/Dienst/UI/2.0/Describe/ncstrl.ucsd_cse/CS2008-0927

- Lab 0
  - Using Amazon’s EC2/S3 infrastructure

- Check website for updated schedule