First Things

- Instructor
  - Steve Ko
  - 10th year at UB
- TAs
  - Chang Min Park
  - Yuyang Chen
  - Sux Piao
  - Bekir Turkkan
- Add/drop
  - This course has never been full in the past few years.
  - Please make up your mind as soon as possible. Help your fellow students and drop if you are going to drop.
  - Please don’t email me for force registration.

Welcome to CSE 486/586

- Why do you want to take this course?
- Some positive feedback of this course...
  - "(CSE 486/586) didn’t only helped with understanding the concepts involved, but have also always given me something cool and interesting to talk about in interviews."
  - "I am actually learning new things."
  - "(CSE 486/586) literally got me a job."
- Some negative feedback of this course...
  - "Projects are a bit too much on the difficult side."
  - "The midterm came almost out of nowhere."
  - "Stay away at all cost!"
- Are you ready? ;-)
Why Is It Hard to Build One?

- **Scale:** hundreds or thousands of machines
  - Google: 4K-machine MapReduce cluster
  - Yahoo!: 4K-machine Hadoop cluster
  - Akamai: 70K machines distributed over the world
  - Facebook: 60K machines providing the service
  - Hard enough to program one machine!

- **Dynamism:** machines do fail!
  - 50 machine failures out of 20K machine cluster per day (reported by Yahoo!)
  - 1 disk failure out of 16K disks every 6 hours (reported by Google)

  - As we will learn, these come with:
    - Concurrent execution, consistency, etc.

OK; But Who Cares?

- **This is where all the actions are!**
  - What is the two biggest driving forces in the computing industry for the last 7-8 years?
  - It’s the cloud!
  - And smartphones!
  - (And there’s also machine learning.)

  - **Still, it’s all about distributed systems!**
    - Well…with a bit of exaggeration…;-)

OK, Cool; How Am I Going to Learn?

- **Textbook**

- **Lectures**
- (Non-graded) HW assignments
- Programming assignments
- Exams

What Am I Going to Build?

- A “starter” project: PA1
  - This will be out today and due next week Friday.
  - A distributed key-value storage (based on Amazon Dynamo) on Android in multiple stages
  - Individual submission

Important Policies

- Late submissions only allowed for one day
  - 20% penalty
  - The deadlines are on Friday, and we don’t count weekends, so technically you have 3 more days.
- **Regrading**
  - if requested, the entire work will be regraded
  - No “I”
- No makeup exam
- No grade negotiation

I Have a Confession to Make…

- I have a split personality disorder.
  - Jekyll
  - Hyde

  - Most of you (I expect) will just see my Jekyll’s side. If you…
    - work with good ethics,
    - respect others on Piazza, during office hours, etc.,
    - follow class and submission rules,
    - and generally use common sense and are a good citizen in the class.

  - Some of you might see my Hyde’s side. If you…
    - copy other people’s code or exams,
    - try to negotiate your way in the class,
    - generally are not such a good citizen in the class.
Academic Integrity Policies

- Academic integrity: exams, HW, and code
  - Copying others’ code: no
  - Copying from other sources (the Web, books, etc.): get permission
  - Exceptions: http://developer.android.com (copy freely, but mark clearly that you copied)
  - http://stackoverflow.com (generally OK to see how things get done; but do not copy and paste.)
  - If found, the incident will be reported to the university.
- Will use an automatic similarity checker.
  - When similar submissions are found, both will get an F for the entire semester.
- Please be careful when using an online code repository, e.g., GitHub, BitBucket, etc.

How Can I Reach the Teaching Staff?

- Steve: 113F Davis
  - Lectures (MWF 1:00 pm-1:50 pm)
  - Office hours (MWF 2:00 pm-3:00 pm)
- TAs
  - Office hours: Posted on Piazza
  - Please do not expect that the TAs will stay more than the announced office hours.
  - Use Piazza (http://piazza.com/class), instead of email, mailing list, blog, etc.
  - The teaching staff will not have any activity during weekends and holidays.
  - Signup link: http://piazza.com/buffalo/spring2020/cse486586
  - http://www.cse.buffalo.edu/~stevko/courses/cse486/spring20/

Background Required

- You must have some background in the following topics.
- OS topics
  - Threads, processes, and synchronization (e.g., locks)
- Systems programming experience
  - Programming experiences with sockets, processes, threads, synchronization primitives, and file I/O.
  - Experiences with setting up environment variables and running scripts
- Programming environment
  - Linux or Mac
  - No support for Windows

Background Check: PA1

- Programming Assignment (PA) 1
  - Use this as a background check.
  - If you can finish this in a week all by yourself, then you are ready to take this class.
  - See for yourself!
  - Due on next Friday (2/7) 11:59:59 am.
- SimpleMessenger on Android
  - Overall, need to implement a chatting app
  - Need to set up an Android programming environment
  - Need to use sockets
  - Need to understand the code provided
  - Need to read Android tutorials and understand them
  - Need to understand and use Android APIs

What Exactly Am I Going to Learn?
Distributed Systems 10 Questions!

- Course goal: answering 10 questions on distributed systems
  - At the end of the semester, if you can answer only 10 questions about distributed systems, you’ll probably get an A.
  - Easy enough!
- What are those questions?
  - Organized in 6 themes
  - 1–2 questions in each theme
  - A few (or several) lectures to answer each question

Theme 1: Hint

What’s up?
Hey!
Theme 1: Communications

- Q1: how do you talk to another machine?
  - Networking basics
- Q2: how do you talk to multiple machines at once?
  - Multicast
- Q3: can you call a function/method/procedure running in another machine?
  - RPC

Theme 2: Concurrency

- Q4: how do you control access to shared resources?
  - Distributed mutual exclusion, distributed transactions, 2-phase commit, etc.

Theme 3: Consensus

- Q5: how do multiple machines reach an agreement?
  - Time & synchronization, global states, snapshots, mutual exclusion, leader election, paxos
  - Bad news: it’s impossible!
  - The impossibility of consensus

Theme 2: Hint

- I’m shaking my tail.
  - I thought I was doing it…
  - What? I’m doing it too!

Theme 3: Hint

- I want to shake my tail.
  - OK
  - No, I don’t want to.
  - No way!

Theme 4: Hint

- Who has a brain?
  - I do.
  - I don’t.
Theme 4: Storage Management

- Q6: how do you locate where things are and access them?
  - DHT, DFS

Theme 5: Non-Byzantine Failures

- Q7: how do you know if a machine has failed?
  - Failure detection
- Q8: how do you program your system to operate continually even under failures?
  - Replication, gossiping

Theme 6: Byzantine Failures

- Q9: how do you deal with attackers?
  - Security
- Q10: what if some machines malfunction?
  - Byzantine fault tolerance

Acknowledgements

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