Distributed Systems
CPSC 416
Fall 2018

Course: September 6 - November 30, 2018

Sep 6, 2018 Lecture (first class!)

Course staff

- **Ivan** Beschastnikh, instructor
- TAs
  - **Anny** Gakhokidze (u)
  - **Vaastav** Anand (g)
  - **Adam** Geller (g)

Logistics

- 2016: 77 students (open-ended project)
- 2017: 117 students (assignment hell)
- 2018W: 160 students (assignments + projects)
- 2018F: ~**70** students (mix of above)
  - 3 full TAs
  - 2 assignments, 2 projects. 3/4 require group work. One (group) open-ended project

Logistics

- Everything on the website, updated continuously: http://www.cs.ubc.ca/~bestchai/teaching/cs416_2018w1/
- Use Piazza for **all** course-related communication
- 4 hrs office hours/week

Course overview via the website

- Learning goals
- Go programming language (start learning!)
- Schedule (a work in progress)
  - Assignment 1 due Sep 18 (12 days from now)
- Exam ('just' a final)
- Advice for doing well
  - learn Go (a must to pass the course)
  - don't hack, engineer
  - choose team, wisely
  - reach out on Pizza/email for help.
- Collaboration guidelines

Learning goals

- Understand key principles in designing and implementing distributed systems

- Reason about problems that involve distributed components

- Become familiar with important techniques for solving problems that arise in distributed contexts

- Build distributed system prototypes using the Go programming language

Learning goals

- Understand key principles in designing and implementing distributed systems
- Reason about problems that involve distributed components
- Become familiar with important techniques for solving problems that arise in distributed contexts
- Build distributed system prototypes using the Go programming language (the key to all the above)

Some workload comments from last year’s course

- *The workload for this course is easily double that of any other course I had this term.*

- *Ivan has very high expectations of his students.*

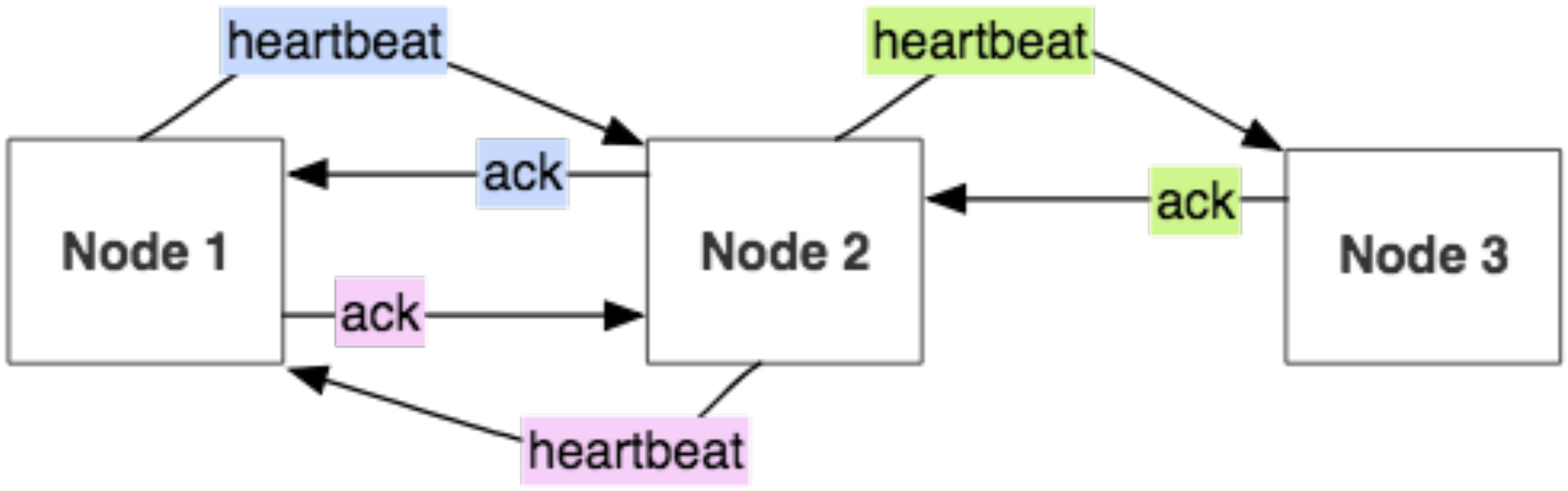
- *I love and hate the fact that this class was a "sink or swim" approach to learning*

Assignment 1: Failure detector lib

- What’s a failure detector?
- Why is this a distributed systems topic? And, why do we need a failure detector?
- Isn’t there a library I can use for this already?
- Deeper: why doesn’t Go/OS/switch/network/universe provide a service for this already?

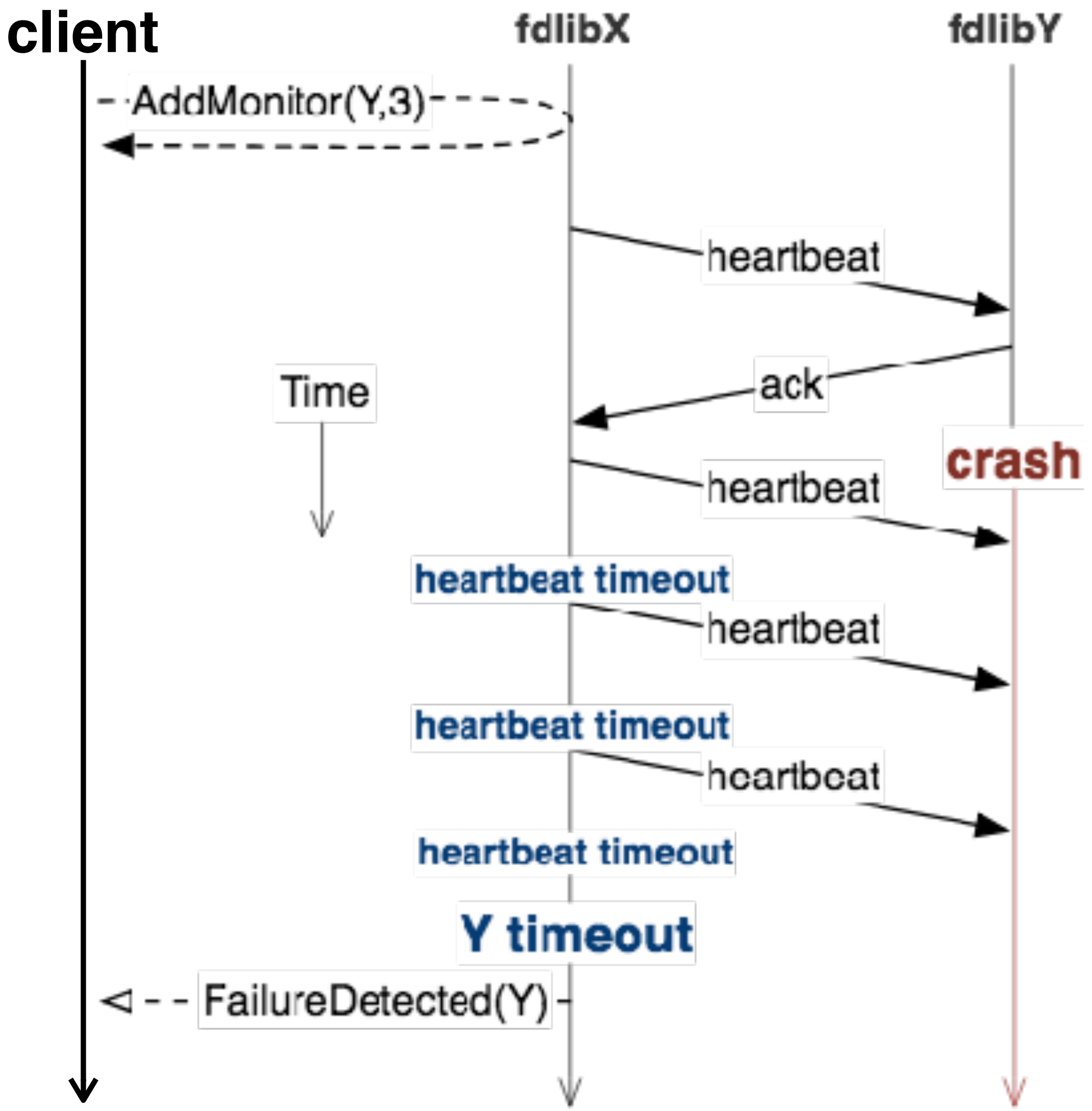
Assignment 1: Failure detector lib

- Topology, message types (hbeat/ack), transport (UDP)



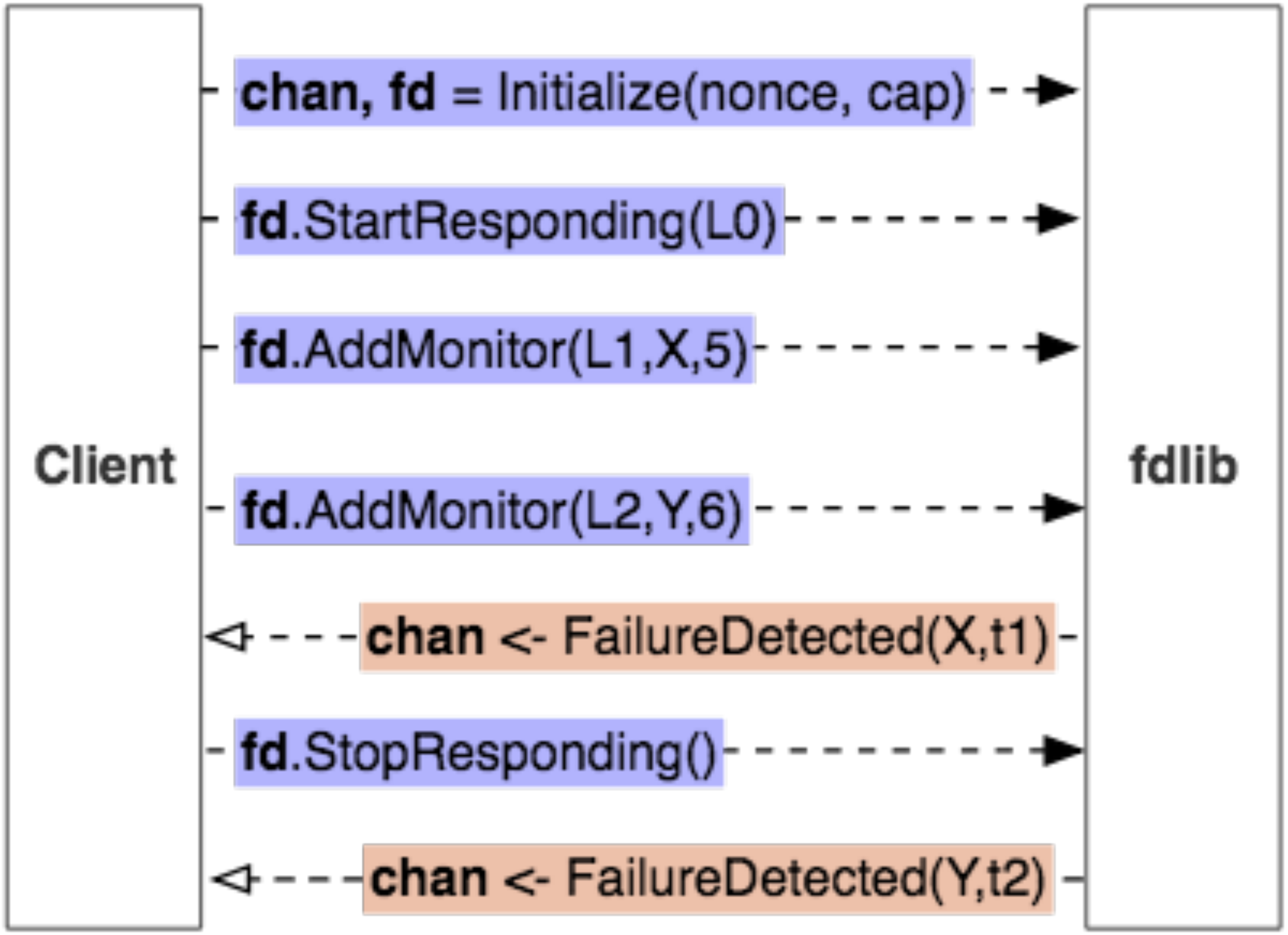
Assignment 1: Failure detector lib

- Two protocols/APIs: client to fdlib and fdlib to fdlib



Assignment 1: Failure detector lib

- Two fdlib capabilities: responding & monitoring



Assignment 1 note

- Last last year’s 416 TA rant:

TEST YOUR CODE ON THE UGRAD MACHINES!!!!!!!!!!!!!!!!!!!

YOU WILL GET ZERO IF IT DOESN'T RUN OR COMPILE. WE HAVE NO SYMPATHY FOR THESE TYPES OF ERRORS.

… you’ve been warned

Zoom zoom out

- What are some examples of distributed systems?
- What makes a system *distributed*?
- Why not a distributed *application*?

Distributed system examples

- YouTube
  - Videos are **replicated** (multiple machines host the same video)
  - **Scalable** wrt. client requests for videos (internally **elastic** — can throw more machines at the service to have it scale out further)

Distributed system examples

- DropBox (or google drive)
  - **Replicated** content across personal devices
    - Supports **disconnected operation** (can work while disconnected, and synchronize when re-connected)
    - Maintaining data **consistent** across devices
  - Supports sharing; **access control** policies (security!)

Distributed system examples

- NASDAQ
  - **Transactions** (e.g., ACID semantics from databases). Many DBMS concepts apply to distributed systems!
  - Strong **consistency** and **security** guarantees (otherwise people would not trust it with money)

Some D.S. challenges

- Synchronizing multiple machines (protocol complexity)
- Performance (how do you define/measure it?)
- Maintaining consistency: strong models (linearizable) to weak models (eventual) of consistency
- Failures: machine failures (range: failure stop to byzantine); network failures (just a few: disconnections/loss/corruption/delay/partitioning)
- Security (how to prevent malicious control of a single host in a system escalating into control of the entire system?)

For Monday

- Install Go on your personal machine
- Work through Tour of Go! and other tutorials.
- **Practice Go!**