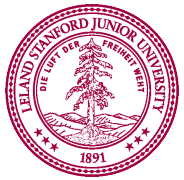
Learning Networking by Reproducing Network Results

Lisa Yan and Nick McKeown

Stanford University

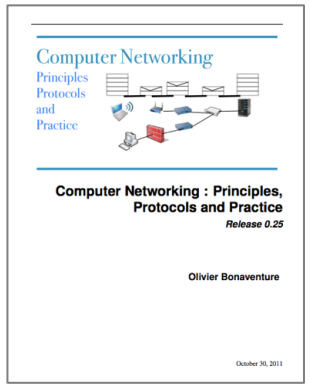


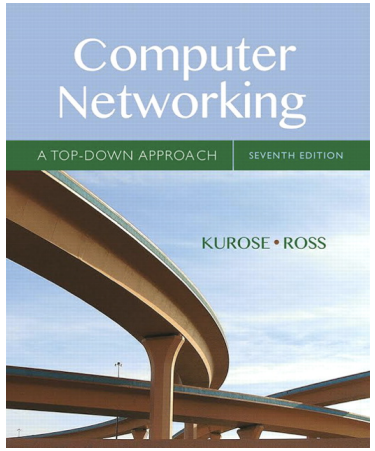
With help from Keith Winstein, Sachin Katti, Nikhil Handigol, Brandon Heller, and Bob Lantz

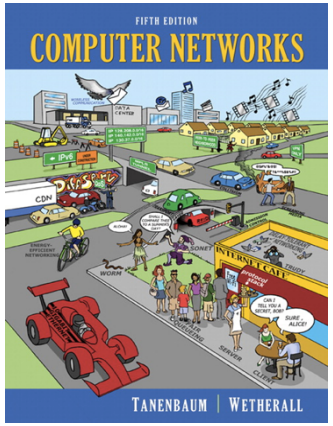
Teach…

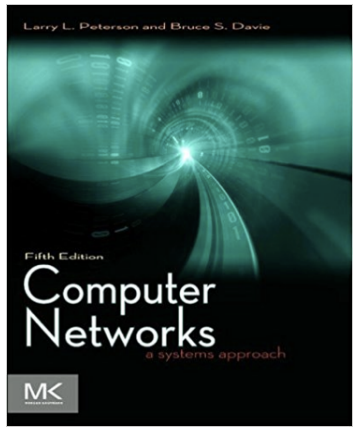
1. Introduction to Networking
2. Graduate Networking

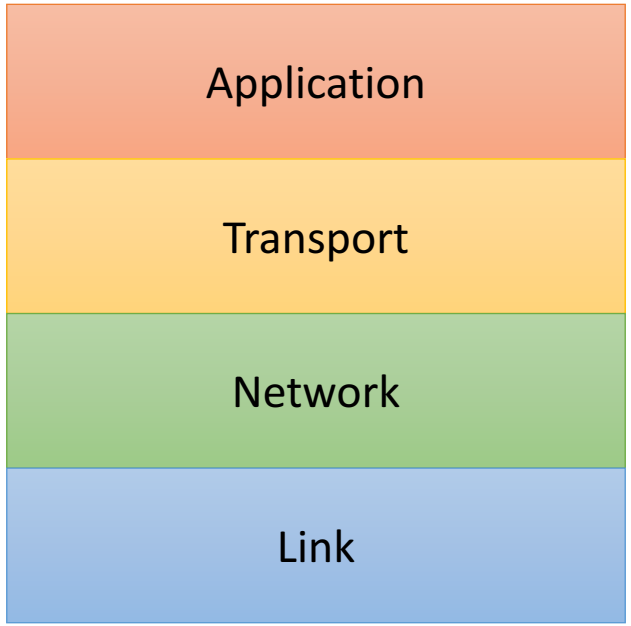
Introduction to Networking







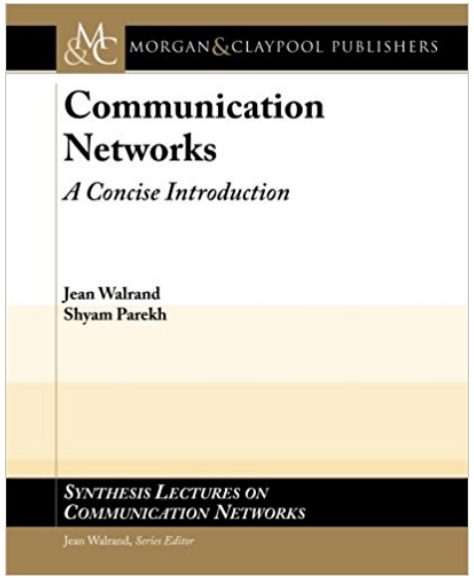




Introduction to Networking

Understand a fundamental field in order to become a better computer scientist or systems engineer.

Graduate Networking



Graduate Networking

Train and build experience in order to become a future networking researcher or networking engineer.

What kinds of systems should advanced students build?

Give them all the same project

A bit boring

or

Have them create their own project

Too risky

What kinds of systems should advanced students build?

Assignment goals

build a system

think critically about a system

Around 2012: the beginning of Mininet

N.Handigol, B. Heller, V. Jeyakumar, B. Lantz, N. McKeown. Reproducible network experiments using container-based emulation. CoNEXT 2012.

Reproduce someone else's research.*

*our sole novel contribution

Reproducing research

Educational benefit:

- Systems engineering skills
- Critical thinking
- Different results
  - Student incorrectly reproduce the experiment
  - Experiment had other assumptions

Side benefit:

- Reproducible form of the system can be put into the public domain for others to use

CS 244 Reproducibility Project

Week 1, Day 1
Project proposal

- Pick a paper and a key result to reproduce.
- Contact the original researchers

Week 2, Day 14
Intermediate report

- Preliminary work
- TA-student meeting to discuss next steps

Week 4, Day 23
Final report

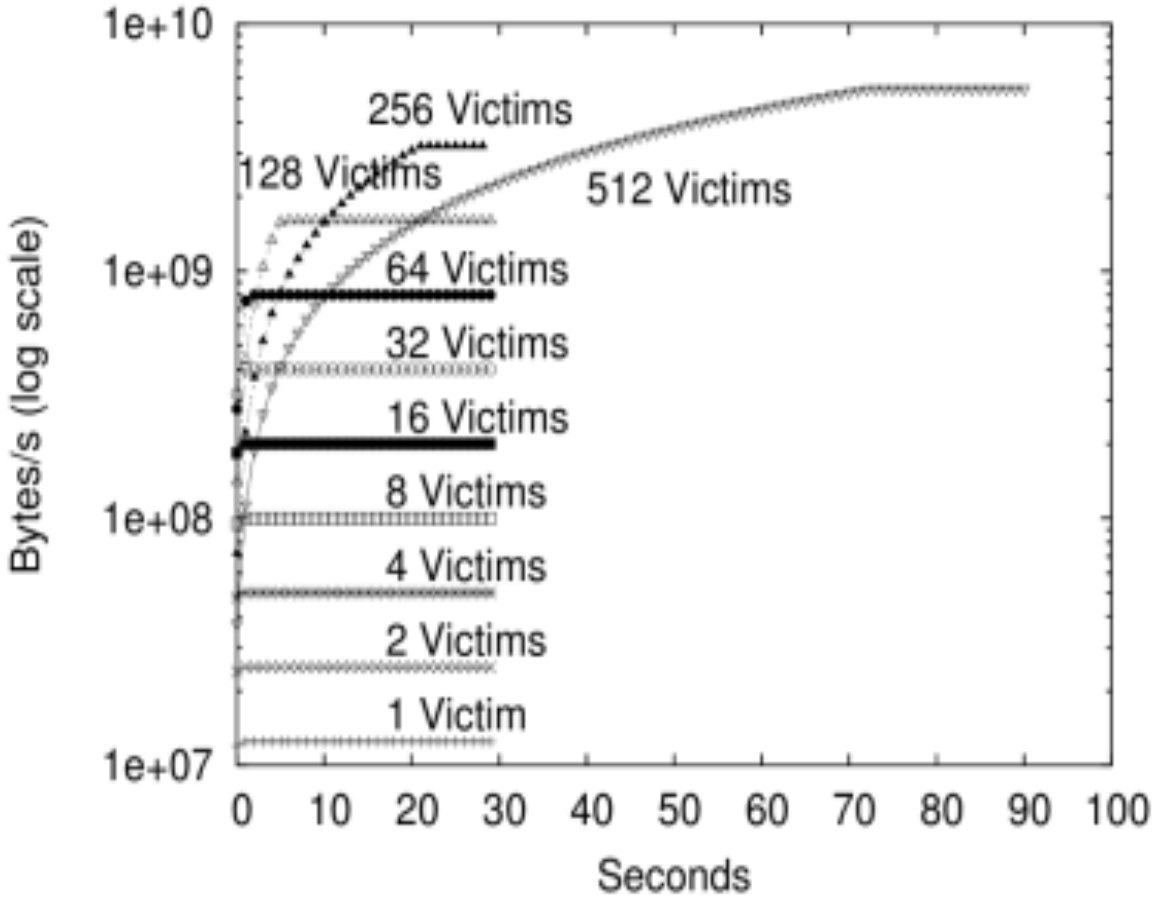
- Blog post reproducingnetworkresearch.wordpress.com
- Public source code and steps for reproducing

Week 5, Days 29-31
Peer discussion

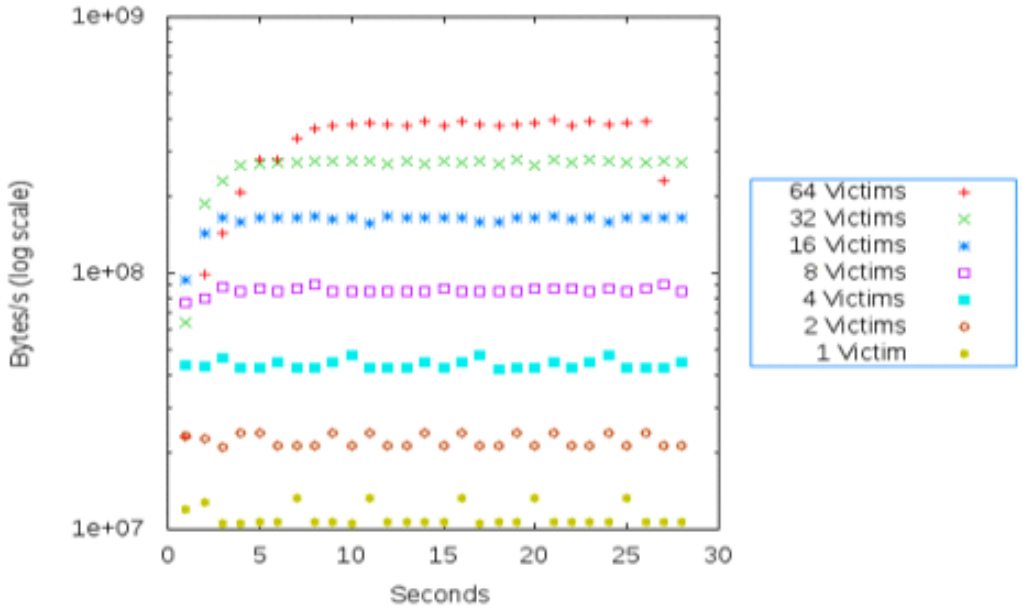
- In-class presentations
- **Peer validation** of another group's project

Reproduced TCP opt-ack attack

Original result from paper



Alexander and Trey's reproduced result ([blog post](#))



R. Sherwood, B. Bhattacharjee, and R. Braud. Misbehaving TCP receivers can cause internet-wide congestion collapse. CCS 2005.

What kinds of reproductions?

40+ papers

Publication	# student reproductions
TCP opt-ack attack	8
Increasing TCP init cwnd	7
TCP Fast Open	7
MPTCP	6
DCTCP	5
Hedera	4
pFabric	3
Sprout	3
(24 other papers)	30

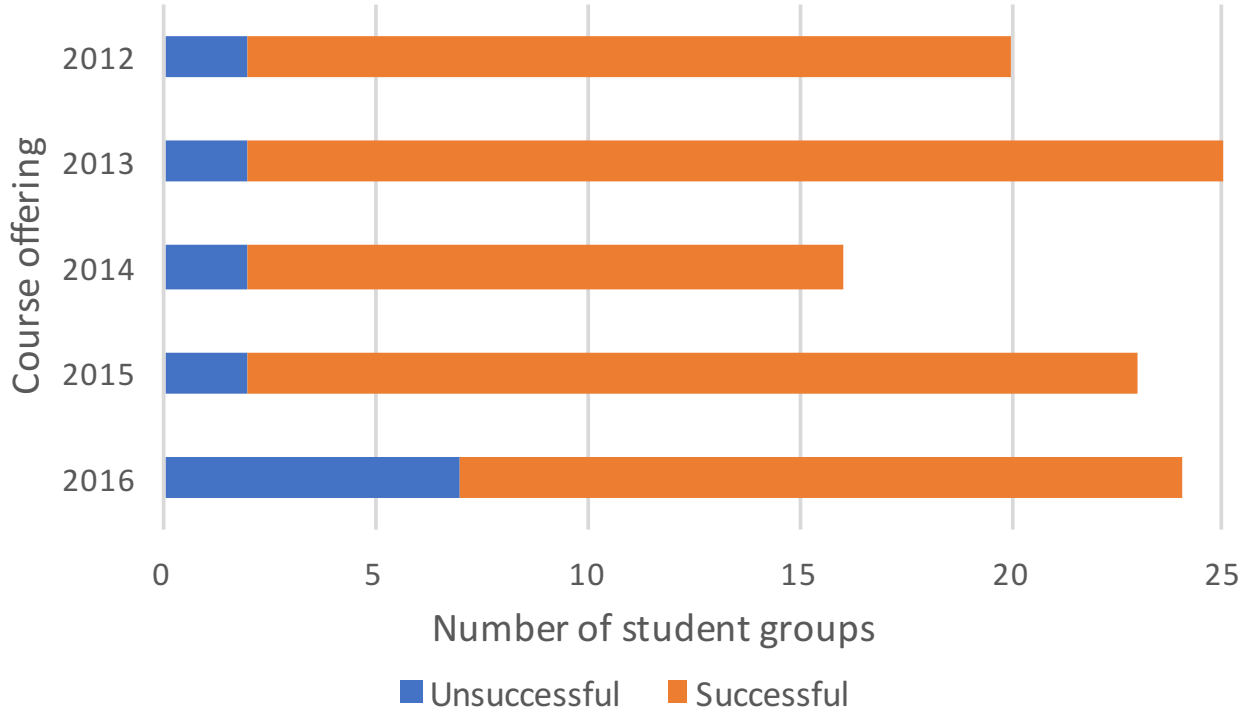
- Congestion control
- Topologies
- Security attacks
- Applications

5 years of student projects

40+ papers

Publication	# student reproductions
TCP opt-ack attack	8
Increasing TCP init cwnd	7
TCP Fast Open	7
MPTCP	6
DCTCP	5
Hedera	4
pFabric	3
Sprout	3
(24 other papers)	30

200+ students



Unsuccessful reproductions

Usually due to students' overambitious engineering

- "We spent our last week trying to find a mixed LP optimizer." (reproduction of FastMPC, SIGCOMM 2015)

Sometimes due to emulator restrictions

- "We scaled down all load generation parameters, but we still couldn't achieve target latencies when emulating on a single machine." (reproduction of QJump, NSDI 2015)

What did we learn?

These projects…

- Spark discussions between researchers and students.
- Give students more tools to use in their own research.
- Jumpstart careers in networking.

Help future researchers by providing a fully reproducible project in the public domain.

- Other researchers can build upon it
- Eases technology transfer

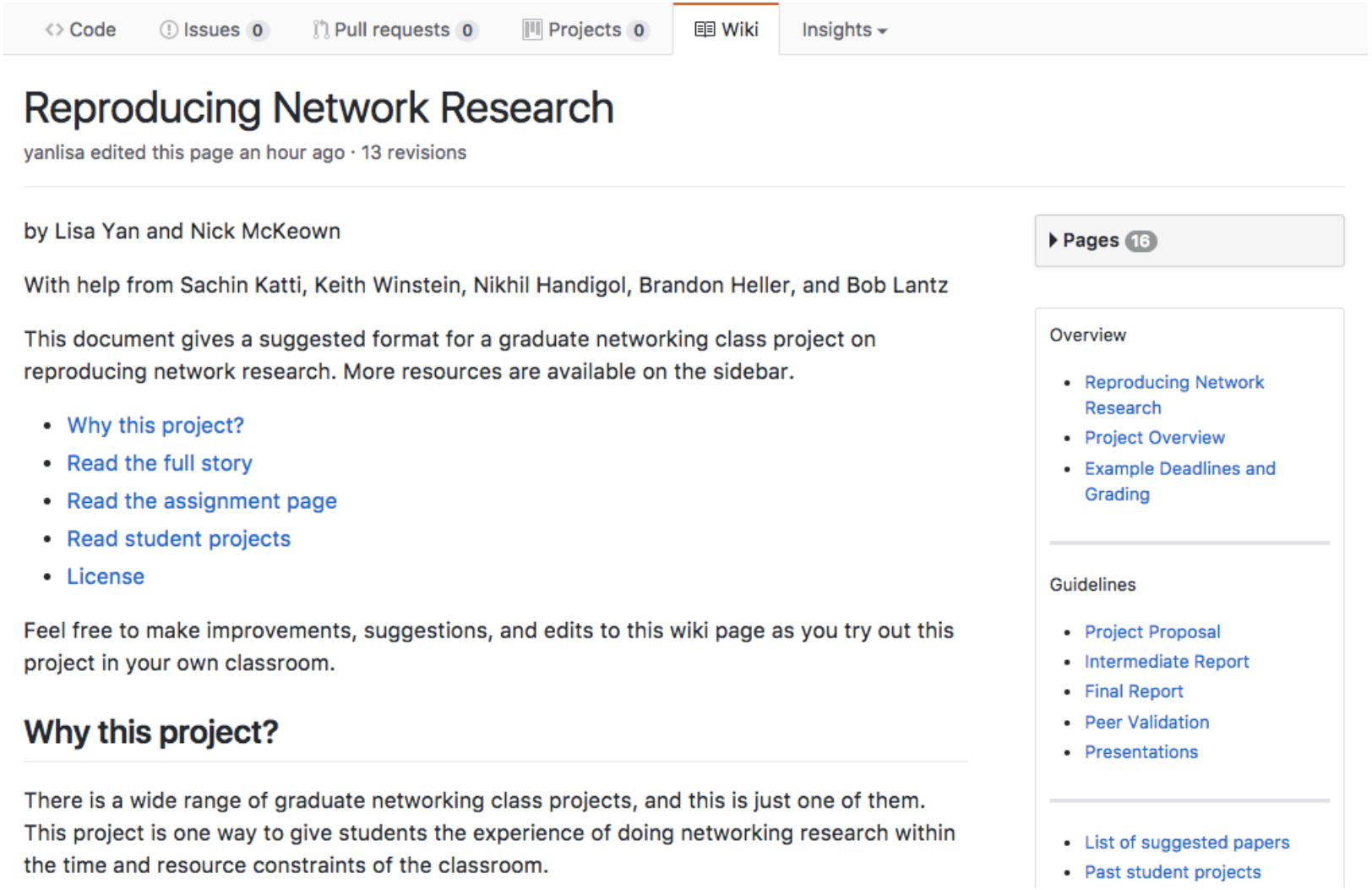
Why are we telling you this?

We thought you might like to try this in your class, too.

We've made this assignment reproducible:

cs244.stanford.edu/reproducibility

Open sourcing the assignment



Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Insights

Reproducing Network Research

yanlisa edited this page an hour ago · 13 revisions

by Lisa Yan and Nick McKeown

With help from Sachin Katti, Keith Winstein, Nikhil Handigol, Brandon Heller, and Bob Lantz

This document gives a suggested format for a graduate networking class project on reproducing network research. More resources are available on the sidebar.

- Why this project?
- Read the full story
- Read the assignment page
- Read student projects
- License

Feel free to make improvements, suggestions, and edits to this wiki page as you try out this project in your own classroom.

Why this project?

There is a wide range of graduate networking class projects, and this is just one of them. This project is one way to give students the experience of doing networking research within the time and resource constraints of the classroom.

Pages 16

Overview

- Reproducing Network Research
- Project Overview
- Example Deadlines and Grading

Guidelines

- Project Proposal
- Intermediate Report
- Final Report
- Peer Validation
- Presentations

- List of suggested papers
- Past student projects

Improve on it, reproduce it, give back to the community.

Thank you!

cs244.stanford.edu/reproducibility

L. Yan and N. McKeown. Learning Networking by Reproducing Research Results. CCR April 2017. article