Learning Networking by Reproducing Network Results

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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

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

Week 2, Day 14
Intermediate report

Week 4, Day 23
Final report

Week 5, Days 29-31
Peer discussion

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

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

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

• 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)

What kinds of reproductions?

40+ papers

<table>
<thead>
<tr>
<th>Publication</th>
<th># student reproductions</th>
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<tbody>
<tr>
<td>TCP opt-ack attack</td>
<td>8</td>
</tr>
<tr>
<td>Increasing TCP init cwnd</td>
<td>7</td>
</tr>
<tr>
<td>TCP Fast Open</td>
<td>7</td>
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<tr>
<td>MPTCP</td>
<td>6</td>
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<td>DCTCP</td>
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<td>Hedera</td>
<td>4</td>
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<td>(24 other papers)</td>
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- Congestion control
- Topologies
- Security attacks
- Applications
5 years of student projects

40+ papers

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200+ students

Course offering:
- 2012: 8 successful, 17 unsuccessful
- 2013: 30 successful, 15 unsuccessful
- 2014: 15 successful, 10 unsuccessful
- 2015: 20 successful, 10 unsuccessful
- 2016: 25 successful, 5 unsuccessful

Number of student groups
- Unsuccessful
- Successful
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](cs244.stanford.edu/reproducibility)
Open sourcing the assignment

Reproducing Network Research
yanlisa edited this page an hour ago · 13 revisions

by Lisa Yan and Nick McKeown

With help from Sachin Katti, Keith Winston, 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.

Improve on it, reproduce it, give back to the community.
Thank you!

cs244.stanford.edu/reproducibility