Network Transport Protocols
Course Overview

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The Importance of Transport Protocols

- Transport protocols carry nearly all of Internet traffic
  - They make the job of writing distributed Internet applications fairly simple
    - Socket interface, data stream abstraction, reliability, flow-control, congestion-control, ...
  - The types we will study in this course, carry more than 90% of Internet traffic!
    - Web traffic
    - Streaming video
    - Large software downloads
    - P2P transfers

- Their dominance implies:
  - They fundamentally govern performance of Internet applications
  - They are excellent candidates for attacks
Growing Number of Protocols in Use

- Growing diversity in the types of protocols deployed and used
  - NewReno
  - CUBIC (default in Linux)
  - Compound (default in Windows Vista)
  - DCTCP (used in Microsoft Azure)
  - ??? in Google data centers!
    - Larger initial congestion-windows for transfers to clients

- Many can be described as experimental at best
  - How do they perform for different application/usage scenarios?
  - How do they interact with each other in the shared Internet?
  - How vulnerable are they?

Performance Evaluation of Protocols

- Several subtleties in how protocol mechanisms impact an application’s performance
  - Studying a closed-loop control system
  - When millions are using instances of it
  - Where the instances interact with each other

- Most protocols are designed first and studied later
  - How to even study it for such large-scale usage?
    - Evaluation methodologies?
  - What’s a good protocol (what should it be doing)?
    - Performance metrics?
    - Vulnerabilities?
Topics/Logistics

- Topics:
  - Initially, each of a few prominent transport protocols
  - Then, analysis and evaluations of individual protocols throughout the semester

- Focus: performance-related issues
  - Protocol mechanisms
  - Metrics and evaluation methodologies
  - Efficiency
    - Fairness
    - Stability/equilibrium
  - Security vulnerabilities

- If you’d like specific topics covered, let me know asap

Course Structure

- Initial set of lectures (only a few, by me):
  - Will cover background material and high-level overview of transport protocol designs

- Review of relevant publications (rest of the semester)
  - Paper presentations (by you)
  - Critical reviews (by you)

- Semester-long projects
  - Open topic (investigating, designing something new)
    - Experimental study, formal analysis, design and evaluation of new mechanism
  - Preferably on one of the focus topics for this course
    - Unless motivated by strong interest in other topics
  - Groups of 2 allowed (and encouraged)
Paper Presentations

- ~3 papers presented by each student over the semester
  - Your turn comes every 5-6 weeks
- Initial list up on the course web-page
  - Will keep adding to it over the next couple of days
  - If you're keen on a given paper, let me know asap!
- The first set of papers (transport protocols) will be covered quite soon
  - Make your selections and send me email
  - Papers assigned on a first-come-first-served basis
- Subsequent papers
  - Will try to cover just one set of papers per week

Paper Presentation Formats

- Presenter responsible for thoroughly reading paper (and related papers) in detail, and presenting in class
  - Pretty thorough presentation (unlike other courses)
    - Including discussion of background
    - Related work
    - Main insights
    - Strengths, weaknesses
    - Comparison to other papers read, open issues, ...
    - Discussion points
  - Plan for 1.5-2 hours, leaving enough time for discussion
  - First draft of slides should be sent to me at least 1 week before your presentation
    - Start selecting papers and signing up for slots asap
    - Start reading papers asap
Critical Reviews

- Everyone else required to submit a critical review of the paper to be discussed
  - Can skip at most 3 papers in the semester
  - Bonus for not skipping any

- Format:
  - Summary of the paper
    - Do NOT cut and paste from abstract/intro
  - Main insights used in the paper (no more than 3)
  - Main strengths of the paper
  - Main weaknesses of the paper
  - Open issues left unaddressed in the paper
    - Again, don’t cut-and-paste what the paper itself mentions
  - How does the paper fit in with respect to other papers / your project / etc?

Projects

- Must work on an open problem (find / model / study something not known)

- Types of projects:
  - Empirical evaluations of protocols (lab-based, ns-2 based)
  - Mechanism redesign (and evaluation)
  - Vulnerability analysis
  - Formal analysis

- Candidate list of projects up on the course web-page
  - Talk to me if you’re very interested in a topic not listed

- Groups of 2 encouraged
Project Expectations

- Must work on an open problem (find/model/study something not known)
  - Ideally: you will do novel work and publish it
  - Pessimistically: you will only do novel work

- Past (seminar) course-projects based publications
  - [NP2-2003], [IMC-2003], [Best'-2003], [PAM-2004], [IMC-2004], [JSAC-2006]
    - Nearly 250 citations to date across these papers
  - [IMC-2003]
    - 127 citations to date
    - Measurement study
  - [IMC-2004], [JSAC-2006]
    - Enhanced to a journal submission

Project Deliverables

- Deliverables:
  - Weekly progress report
    - Yes, one report EVERY Friday
      - Even if it says, “I couldn’t work on the project this week, but here is how I plan to make up for that next week…”
    - Remember, students expected to spend at least 10-12 hours outside classroom on each course
  - Project presentations
    - Initial project proposal (end January)
    - Mid-project progress/issues (possibly 2 of these)
    - Final project presentations
  - Final project report

- Project proposals (well-defined) are due in about 2.5 weeks, so please start thinking about this TODAY
Project Proposals

- Project proposals (well-defined) are due in about 2.5 weeks, so please start thinking about this TODAY
  - Project objective,
  - Proposed methodology,
  - What you expect to accomplish over the semester,
  - A weekly milestones timeline
    - Can be refined once you get started

Course Grading

- Paper Presentations: 20%
- Critical Reviews: 20%
- Projects:
  - Progress: 50%
  - Presentation + report: 10%
- Class Participation:
  - Will be used to potentially bump up (or down) half a grade
- No exams, no homeworks
- All percentage points above are flexible by 5-10%
QUESTIONS?

Course web-page: ntp.web.unc.edu

My email: jasleen@cs.unc.edu