

DUE FRIDAY, MAY 18 at 12:30 PM

This exam comprises 7 questions totaling 60 semantically meaningless but incalculably precious points.

To turn in: deliver hardcopy to 4133 or email pdf files only to nspring@cs.umd.edu and lume@cs.umd.edu. (Emailing both prevents issues with lossy email).

I will answer questions sent to me by Wednesday, May 16 at noon. I don't want to feel guilty about not being around to answer late-night questions the night before the exam is due. So after Wednesday, you're on your own.

Cite sources if possible; it helps me track down the source of answers I think to be incorrect, usually I'll decide to accept an answer if it's a legitimate misunderstanding. Class material (papers, presentations) trump wikipedia or other sources of "truth." Each of the recall-type questions can (and should) be answered entirely using the readings in the class. The other questions (5, to some extent 6, 7) are a bit more creative.

1. (4 points) What prevents ubiquitous deployment of end-to-end quality-of-service guarantees?
2. (5 points) What does NIRA use to effect route selection? One word only.
3. (6 points) What is the central weakness of modeling the latency between hosts in the Internet using coordinates?
4. Clocks may differ from the ideal by being incorrect in a few ways; what is the term for the *difference between*:
 - (a) (1 point) the *value* of the clock and reality (or another clock),
 - (b) (1 point) the *rate* of the clock and the rate of actual time (or another clock),
 - (c) (1 point) the *derivative of the rate* of the clock and zero (or of another clock).
5. (12 points) How would you change PlanetLab? You have discretion over usage policies, hosting policies, and, say \$100,000 to spend. Note that "guarantees" of any form will almost certainly be considered (by me) a thoroughly incorrect (impractical, unfair, inappropriate, limiting) answer. What research would your change aid or enable?
6. Draw and annotate TCP sequence number plots (x-axis is time, y-axis is sequence number, points represent the transmission of a packet or receipt of an ack, as in homework 3) for the following TCP rate limiting factors:
 - (a) (5 points) application,
 - (b) (5 points) opportunity,
 - (c) (5 points) congestion.
7. Peer to peer overlay networks depend on nodes that are well-provisioned, well-positioned, or that have excess capacity. Some nodes are useless to others.

Let's pretend we're building a Detour overlay, in which overlay paths are chosen for being low latency to avoid the performance-ignorant BGP selection. But, we don't want to provide overlay forwarding service to nodes without getting something in return. Specifically, I don't want to have my desktop machine at school joining a network populated primarily by dial-up modem users, who will take advantage of UMD's plentiful bandwidth to more quickly download, uhm, completely legal material.

Sketch (at most one paragraph per sketch):

- (a) a scheme for allowing overlay network nodes to negotiate pairwise connections with each other without using micropayments, including rules for:
 - i. (2 points) finding similar, mutually-advantageous nodes to peer with,
 - ii. (2 points) establishing the rules for a pairwise peering, and
 - iii. (2 points) accounting for use of a session.
- (b) a scheme for allowing overlay nodes to negotiate service by advertising reachability in a market using micropayments, including:
 - i. (2 points) who sets the cost and (loosely) how,
 - ii. (2 points) finding nodes to relay traffic, and
 - iii. (2 points) how misbehavior (stealing) is policed.Assume that packets aren't sniffed or replayed (capabilities aren't required).
- (c) (3 points) Which of the two would you prefer to have and why?