

## CS 356 Fall 2017 (Lam)

Bring a calculator and one page of notes (printed or handwritten on one side of paper). *You can use the calculator in your cell phone but you must abide by the UT-Austin Student Honor Code. More specifically, you must not use the phone for any other purpose, such as accessing information stored in the phone or on the Internet.*

Review homework solutions

**Note:** Following lists of major topics for your reference only. It is possible to have exam questions on materials covered in my lectures that are not in the following lists.

### Chapter 1 topics

Modulation and demodulation, FDM/TDM/WDM, Shannon Theorem, and Sampling Theorem

Circuit switching, message switching, packet switching, virtual circuit packet switching; Internet structure, IXP, POP

Four components of delay in packet switching; bottleneck and throughput; traffic intensity and server utilization; packet loss

Little's Law, mean value and second moment formulas of a random variable

M/G/1 waiting time and delay formulas (and two special cases), justification of packet switching over circuit switching

Internet layered architecture, protocol stack, encapsulation, de-encapsulation

### Chapter 2 topics

Client-server vs P2P architecture

Addressing processes - IP address and port number

Application needs vs transport protocol services

HTTP, SMTP, DNS, P2P:

Stateful vs stateless protocol, complexity at the network's edge

HTTP - client-server delay in terms of round-trip times, persistent vs, nonpersistent, cookies and proxy cache, conditional GET

SMTP - using ascii characters only, MIME, base 64 encoding

Various DNS servers and various DNS records

File distribution delay analysis to show why P2P is more scalable than client-server (with just 1 server)

Sockets for TCP and UDP; welcome, connection, and datagram sockets

Video streaming - DASH (server, client), Content Distribution Networks (enter deep servers, bring home servers), third-party CDN uses DNS redirect

### **Chapter 3 topics**

IP address and port numbers, multiplexing/demultiplexing, connection socket identified by 4-tuple

Services provided by TCP and UDP

Internet checksum,

Protocol design for Lossy FIFO channel and Lossy, Reordering, and Duplicative (LRD) channel

Alternating-bit protocol, pipelined protocols

sliding window protocol (general principles and implementation in TCP), cumulative acks, selective ACK, selective nack

ARQ, sliding window (including selective repeat, and go-back-N) performance analysis

TCP timeout estimation algorithms, retransmission and timer management (3 dup acks ~ selective nack)

TCP three-way handshake protocol, connection close protocol (timed wait)

TCP flow control, TCP congestion control (Reno versus Tahoe, slow start, threshold, 3 duplicate acks, fast retransmission, fast recovery), TCP throughput, additive increase multiplicative decrease (AIMD), throughput formula (limited by loss rate)