The midterm will cover material on the introduction, application layer, and transport layer from the course textbook (Kurose and Ross, *Computer Networking: A Top-Down Approach*, 7th ed., Addison Wesley, 2017). The textbook will be denoted [CNTDA]. I strongly suggest you buy a physical copy of [CNTDA] if you haven’t already; it’s easier to read on paper. The midterm material is mainly from Chapters 1–3 in [CNTDA], the corresponding lecture slides, and the applets on the companion website. Important material is in bold. Below, § means Section; §§ means Sections.

**Chap. 1: Introduction**
- What is the Internet? (§1.1)
- *Hosts, end systems*
- *Protocol*
- *Network edge* (§1.2)
- Wired vs. wireless media
- *Network core* (§1.3)
- Packets and packet switching
- Store-and-forward transmission
- Circuit switching and packet switching (§1.3.2)
- End-to-end principle (connections, systems)
- Circuit switching: FDMA, TDMA
- The Internet: a network of networks (*internetwork*)
- Delay, loss, throughput in packet-switched networks (§1.4)
- Types of delay: processing, queueing, transmission, propagation
- Average queueing delay vs. traffic intensity
- *Throughput in computer networks*
- Protocol layers (§1.5)
- Layering as an architectural principle, services provided by each layer, encapsulation/decapsulation
- *Layers in OSI, TCP/IP models*

**Chap. 2: Application Layer**
- Principles of network applications (§2.1)
- Client-server vs. P2P architectures
- Clients, servers, datacenters
- Communicating processes (§2.1.2)
- *Sockets, IP addresses, port numbers*
- Transport services: reliable vs. unreliable data transfer
- Network application requirements: data loss, throughput, timing
- The World Wide Web and HTTP (§2.2)
- Parallel, persistent, and non-persistent connections (§2.2.2)
- Request-response architecture (HTTP GET) (§2.2.3)
- HTTP cookies (§2.2.4)
- Web caching and performance (§2.2.5)
- Conditional GET (§2.2.6)
- FTP (§2.3)
- Email in the Internet (§2.4)

**Chap. 2: Application Layer (cont’d)**
- SMTP (§2.4.1)
- POP3, IMAP, Web mail (§2.4.4)
- DNS (§2.5)
- DNS architecture, hierarchy of name servers
- Iterative vs. recursive queries
- DNS resource records and messages
- P2P applications (§2.6)
- P2P file distribution vs. client-server (§2.6.1)
- BitTorrent
- Distributed Hash Tables (DHTs) (§2.6.2)
- Circular DHTs and shortcuts

**Chap. 3: Transport Layer**
- Transport-layer services (§3.1)
- *Logical end-to-end connection between processes*
- Multiplexing and demultiplexing (§3.2)
- Source & destination IP addresses, port numbers
- UDP (§3.3)
- Internet applications’ transport protocols
- UDP checksum (§3.3.2)
- Principles of reliable data transfer (RDT) (§3.4)
- RDT over channels with errors, losses
- Acknowledgments (ACKs), sequence numbers, timers
- Stop-and-wait vs. pipelined protocols
- Alternating-bit protocol
- Channel utilization
- Go-Back-N (GBN) (§3.4.3)
- Selective Repeat (§3.4.4)
- TCP (§3.5)
- Three-way handshake (connection establishment)
- Four-way handshake (connection teardown)
- TCP segment structure
- RTT estimation and timeout
- TCP state machine (client, server aspects)
- Principles of congestion control (§3.6)
- TCP congestion control (§3.7)
- Slow start, congestion avoidance, fast recovery
- TCP congestion: an AIMD protocol
- TCP throughput (macroscopic view)
- Average throughput of a connection
- TCP fairness