Study Guide for the Final Exam

CS118

Spring 2019

Rules for Final Exam

- Closed book, closed notes
- No calculators/laptops/desktops & Internet access would be allowed

- You can bring in 2 pages of “cheat sheets” to the final exam
  - Page size: 8x11; can be double-sided
  - Whatever font size you’d like

Major Breakdowns

- Materials covered after the midterm: 80%
  - Chapters 4-8
  - 7th edition (Chapter 4, Chapter 5.1-5.4, Chapter 5.6, Chapter 6.1, 6.2.3, 6.3.1~5.3.3, 6.4, 6.5, 6.6, 6.7, Chapter 7.1~7.2, 7.3.1~7.3.4, 7.5, 7.6, Chapter 8.1~8.4 (excluding crypto algorithms), 8.9)
  - Lecture slides, posted RFC on course webpage
- Materials covered in the midterm: 20%
  - Reliable data transfer
  - TCP retransmission timeout, TCP congestion control, TCP connection management
  - (possibly) also a couple of short Q&A

Materials to Be Covered

- Lecture notes as the focus
  - (also check for the referred textbook chapters in the previous slide)
  - The followup slides can serve as study guide when you review such materials
- 2 Programming Projects
- Homeworks
- Posted RFC

Reliable Data Transfer

- Can you enumerate all the basic mechanisms needed to ensure reliable data transfer?
- How to handle the following scenarios (if any exists) using Stop-and-Wait, Go-back-N, or selective repeat?
  - Packet loss
  - Packet corruption
  - Corrupted ACK
  - Lost ACK
  - duplicate packets
  - Out-of-order packet delivery

TCP Protocol

- TCP round-trip estimation and timeout
  - Is the SampleRTT computed for a segment that has been retransmitted? Why?
- What is the negative effect if the timeout value is set too small, or too big?
- Why does sampleRTT fluctuate?
- how does TCP readjust its timer? (see lecture slides)
  - When receiving a new ACK
  - When receiving a duplicate ACK?
  - When the current timer expires for N times?

TCP Connection Management

- What is 3-way handshake?
  - How are the initial seq, ACK #, etc. decided?
- Are the TCP connection setup and teardown identical?
  - Why are they different?
  - Why do you need so many states in the FSM model for TCP connection?

TCP Congestion Control (slides & RFC)

- how many components are there in TCP congestion control?
- how does each work? slow start, congestion avoidance, fast rexmit/fast recovery.
- how are cwnd and ssthresh adjusted in each phase?

Chapters 4&5 Network Layer

- What is the Internet service model?
- Comparing VC and datagram networks
- How does a router decide which next hop to forward when a packet arrives?
- What is the rationale for each field in the IP packet header?
- IP fragmentation & reassembly
- What is subset? What is CIDR?
- How does NAT work? What about DHCP?
- What fields exist in IPv4 but not in IPv6? What exist in IPv6 but not in IPv4? What exist in both?

Chapters 4&5

- How does the tunneling technique work?
  - When you plan to deploy a new network technology on the global Internet, how do you address the issue of incremental deployment?
- Compare link state routing and distance vector routing
- Given a network topology, apply link-state routing or distance vector routing algorithm to compute the minimum-cost path
- What kind of info is propagated/collected in link state routing or distance vector routing? How many messages are propagated in each?
- What is a potential problem with distance vector routing? How to address it?

Chapters 4&5

- Why does RIP limit the maximum hop count as 16? Can it fully address the count-to-inf problem?
- Can OSPF compute multiple same-cost paths?
- Why intra-AS and inter-AS routing protocols are different?
  - Can BGP always compute the shortest path route?
  - Does the path vector in BGP include any router's IP address? Why?
- What is the difference between hierarchical OSPF and BGP inter-domain routing?
- What is longest prefix matching rule?
- Compare SDN routing and the current Internet routing
- Compare SDN and router-based data forwarding

Chapters 4&5

- How do iBGP and eBGP work?
- How is the path vector computed?
- Given a topology, how does the BGP advertise the path vector?
  - Look at the example in the lecture notes
- Can BGP lead to routing loop? Why?
- How does BGP work with intra-AS routing?
  - How is the BGP reachability info propagated within an AS and across Ases?
- What is hot potato routing? How does it play in the Internet routing in reality?

Chapter 6 Link Layer

- Why do you need a new link-layer header (frame header) in addition to IP header?
  - Can you merge IP header with the frame header?
- Can an error-detection algorithm detect packet errors with 100% accuracy?
- Comparing the cons and pros of channel partitioning MAC, random access MAC, and taking-turns MAC
- Given a few scenarios, choose the best possible MACs (channel-partitioning, random access, or token-based) and justify your answer

Chapter 6

- The detailed operations of CSMA and CSMA/CD
- Can CSMA/CD completely avoid collisions?
  - Identify two cases when collision still occurs
- How does the binary exponential backoff work?
- How does ARP work? Is it using soft-state (i.e., maintaining timers for its state information)?
- Compare the efficiency of CSMA/CD, ALOHA and slotted ALOHA?
  - Where does the saving come from in CSMA/CD?

Chapter 6

- Given a network scenario, explain how the packet is delivered from the sending host to the receiving host (that is located on a different subnet) step-by-step. (see lecture nodes)
  - How many protocols are used in the delivery process?
  - What are the IP header and frame header as the IP data packet is being delivered at each step?
  - How is the next hop found out?
- Is DHCP a soft-state protocol? Why?
- Can ARP work in point-to-point link, rather than broadcast medium?

Chapter 6

- What is the difference between a switch and a router?
- Which device can isolate collision domains?
- Given a scenario, use the appropriate devices (hub, switch, and router) to interconnect hosts to form a large network.
- How does the self-learning algorithm work?
- What protocols are used in web browsing, file transfer or email checking?
  - Which service is accessed first, DNS or DHCP?
  - How do you find out the DNS server via DHCP?
  - For the UDP/TCP segments, can arbitrary source/destination ports be selected?
  - How many times is ARP used? Can ARP messages propagate to different subnets across routers?

Chapter 7 Wireless & Mobile Networks

- Which catergory of MAC does CDMA belong to?
- The detailed operations of CSMA/CA.
  - What components are the same, or different between CSMA/CA and CSMA/CD?
- Why does not 802.11 MAC implement collision detection but uses collision avoidance?
- What is the purpose to use link-layer acknowledgment in 802.11 MAC?
  - Can TCP ACK replace it? Can MAC ACK replace TCP ACK?
- What is the mechanism to handle hidden terminals?

Chapter 7

- How to handle mobility in the same IP subnet ?
- How to do routing to a mobile host?
- How is mobility supported across different subnets?
  - Operations of home agent, foreign agent,
- How to avoid triangle routing (i.e., indirect routing where packets are forwarded to the home network, then the visited network of the mobile host) in mobility support?
- How can you know a mobile host's current location?
- How does a mobile host update its location?

Chapter 8

- Compare public key based encryption and symmetric key based encryption
  - You do NOT need to study the crypto algorithms (but only the basic concepts)
- Using the public key/private key of users as the initial building blocks, how can you offer the following security functions:
  - Encryption
  - Authentication
  - Digital signature
  - Message integrity

Chapter 8

- What are the security mechanisms to defend against the following network attacks? How do they work?
  - Data sniffing & interception
  - IP address spoofing
  - Replay attack
  - Man in the middle attack
  - Email spam
  - Illegal access to UCLA campus network