Final Exam Review Guideline

CS204: Advanced Computer Networks

Fall 2023

Overview

- Final Exam:
  - 12/11, Monday, WCH 138
  - Closed book but 1 cheat sheet (US letter size, both sides) allowed
  - A sample final has been posted
  - Important to understand “why”

- This guide: Highlight the important concepts covered by this class
  - If any of them appear in the final, I’ll assume you are familiar with its definition, pros/cons, usages, …
  - For anything not mentioned in this guide, I will introduce it if it does appear
  - Use this guide to make best use of the cheat sheet

Week 1: Network Basics

- What is the layered design in networking? What are major layers for the today's Internet?
- What is a network protocol?
- Internet Architecture: edge (Hosts, …), access network (communication links, …), core (routers, …)
- Different types of access networks
- Packet switching vs circuit switching
- Internet structure: Networks of networks (ISP, IXP, etc.)

Week 1: Design Principles

- Internet protocol suite; how packet travels
- Narrow waist of IP
- Control vs. Data Plane (Also Management Plane)
- Internet: Packet switching and best-effort delivery
- Design philosophy: Inter networking
- Key principles of the Internet design

Week 2: HTTP

- Why latency is important for Web
- General strategies to reduce HTTP latency
  - Connection based and content based
- Evolution from HTTP/1.1 -> 2 (SPDY)
- Drawbacks in HTTP/1.1
- SPDY design: Design principles, details, especially how it addressed latency issues
- Mobile SPDY: Issues of running SPDY in cellular networks

Week 2: P2P

- Biggest challenge for P2P: Where to find contents
- Main approaches: How they are designed to address the challenge
  - Central directory (Napster)
  - Query Flooding (Gnutella)
  - Hierarchical overlay (Kazaa)
  - Distributed hash table (Bittorrent)
- Distributed hash table: how it's used for P2P
  - Chord: How it handles lookup, join, and churn
- BitTorrent: Strategy to request chunks

Week 3: TCP and Beyond

- TCP basics: congestion window control
- Multi-Path TCP
  - Design idea and intuition
  - Connection establishment procedure (negotiation, handle middlebox, …)
  - Securely adding new subflows
  - Consideration on sequence numbers and retransmission
- TCP CUBIC: Design idea and how it achieves fairness
- BBR: Design idea and how to find optimal point
  - Definition and usage of Bandwidth-Delay Product

Week 5: IP and BGP

- NAT, how it works, why it helps address IPV4 depletion, pros and cons
- IPv6 basics
- Strategies to enable transition from v4 to v6
  - Tunneling, translation, dual-stack
- Inter-AS routing and intra-AS routing
- How BGP works
- Economic policies in BGP
  - Peering vs. transit; whether an ISP will announce another ISP

Week 6: Wireless

- Wireless networks: Basic architecture, choices, benefits
  - Challenges to enable wireless
  - Cross-layer design: Benefits and disadvantages
- WiFi: From CSMA/CD to CSMA/CA
  - Ideas of CD and why that doesn't work for WiFi
  - Hidden and exposed terminal problems
  - How DCF works for WiFi MAC
- Cellular basic architecture: major components and protocols
  - Device power-on procedure and control plane state
  - Voice service
  - Mobility: Low Level (BS) vs. high level (Controller), idle-state vs. active-state

Week 8: Emerging

- Datacenter networking
  - Challenges in datacenter design and implications
  - North-South vs. east-west traffic
  - Bisection bandwidth and why conventional tree design is no good
  - Fat-tree topology and 2-level lookups
- Edge computing
  - Basic concept and benefits
  - Mobile cloud computing; how MEC is integrated in cellular infrastructure

Week X: Your paper

- Understand what your paper is about (high level)
- Benefits and limitation of the technology mentioned in paper
- Whether technology would be used in a certain scenario