This summary does not cover all materials discussed in this course but gives a guide for study. The final exam will be based on Chapters 1-7 (Notes 1-7) of the textbook and lectures on data communications and wireless networks (Note6). Most of the final exam will be on the part after the midterm test, however, you should also be familiar with the fundamentals covered before the midterm test. The materials were not uniformly discussed; some parts were discussed in details with extra contents/examples and other parts were not. Please refer to the course notes 1-7 posted at CourseCentral and the notes taken at class for details. I expect your comprehensive understanding of the materials listed in the summary.

• **Chapter 1 Introduction (Note 1)**
  Components in internet, Internet services, Internet structure
  Network classification, broadcast networks, switched networks, circuit switching, packet switching
  Performance of networks, delay, throughput, error rate, delay in packet switched network, queuing delay, bottleneck link
  Protocols, layered structure of protocols, layers in TCP/IP and OSI.

• **Chapter 2 Application Layer (Note 2)**
  Application program models, client-server model, P2P model
  Application program interface (API)
  Service required by application, service from transport layer (TCP and UDP)
  Web and HTTP, non-persistent and persistent HTTP, response time for non-persistent and persistent HTTP, web cache
  DNS, domain name for hosts
  File delivery times in client-server model and P2P model
  Content distribution networks.

• **Chapter 3 Transport Layer (Note 3)**
  Transport layer service
  Transport layer protocols, multiplexing, UDP, TCP
  Reliable data transfer (ACK and retransmission), stop and wait, pipelined reliable transfer, go-back-N, selective repeat, sliding window
  TCP, TCP/UDP port, TCP segment, TCP sliding window, TCP reliable data transfer, retransmission timer, TCP flow control, TCP connection establishment and termination

• **Chapters 4 and 5 Network Layer (Note 4)**
  Property of service, virtual circuit networks and datagram networks
  Key network layer functions (forwarding at data plane and routing at control plane)
  Destination base datagram forwarding, routing table, table look up (longest prefix matching)
IP layer protocols, IPv4, IPv4 addressing, CIDR address, special IPv4 addresses, DHCP, assign network IP addresses, network address translation, IPv6, IPv6 addressing

Generalized forwarding and software defined network (SDN)
Graph for internet, link-state routing algorithm, distance vector routing algorithm, hierarchical routing, autonomous system (AS), interior gateway protocols (RIP, OSPF), exterior gateway protocol (BGP).

- **Chapter 6 Link Layer and Local Area Network (Note 5)**
  Link layer service, access to link, MAC address
  Reliable data delivery, error detection and correction, parity check, checksum, cyclic redundancy check, error correction code
  Media access control (MAC) protocols, access to shared link, random access, coordinated access, CSMA/CD, coordinated MAC
  MAC address and ARP, routing from network to network
  Ethernet, link layer switch, self-learning algorithm and switch table
  Point-to-point protocol.

- **Data Communications (Note 6)**
  Data transmission, data and signals
  Signals (periodic, discrete), time and frequency domains of signals, fundamental frequency and components, spectrum and bandwidth
  Signal strength, difference of signal strengths in decibels
  Bandwidth and data rate, noise free channel capacity, Nyquist formula, noise channel capacity, Shannon formula
  Data encoding, digital data and digital signal, two level binary signals, multilevel binary signals, biphase signals, modulation rate, digital data and analog signal, ASK, FSK, PSK, QAM (quadrature amplitude modulation), analog data and digital signal, PCM (pulse code modulation), Delta modulation; analog data and analog signal
  Multiplexing, FDM, TDM, statistical TDM, discrete multitone.

- **Wireless and Mobile Networks (Chapter 7 of text book and Note 7)**
  Wireless networks with and without infrastructure, wireless link characteristics, signal to noise ratio and bit error rate, hidden terminal problem, code division multiplexing access
  IEEE802.11 wireless LAN, 802.11 media access, reliable data delivery, two frame protocols, four frame protocols, media access control, 802.11 frame, 802.11 advanced capability
  Cellular wireless network, cellular network organization, cell pattern, frequency reuse, cellular network operation, cellular network channels, main features of 1G/2G/3G/4G networks
  Addressing mobility, indirect routing, direct routing, mobility registration, mobile IP, mobility in cellular networks.