

Name\_\_\_\_\_ Student ID\_\_\_\_\_ Department/Year\_\_\_\_\_

## **1st Examination**

Introduction to Computer Networks (Online)

Class#: EE 4020, Class-ID: 901E31110

Spring 2025

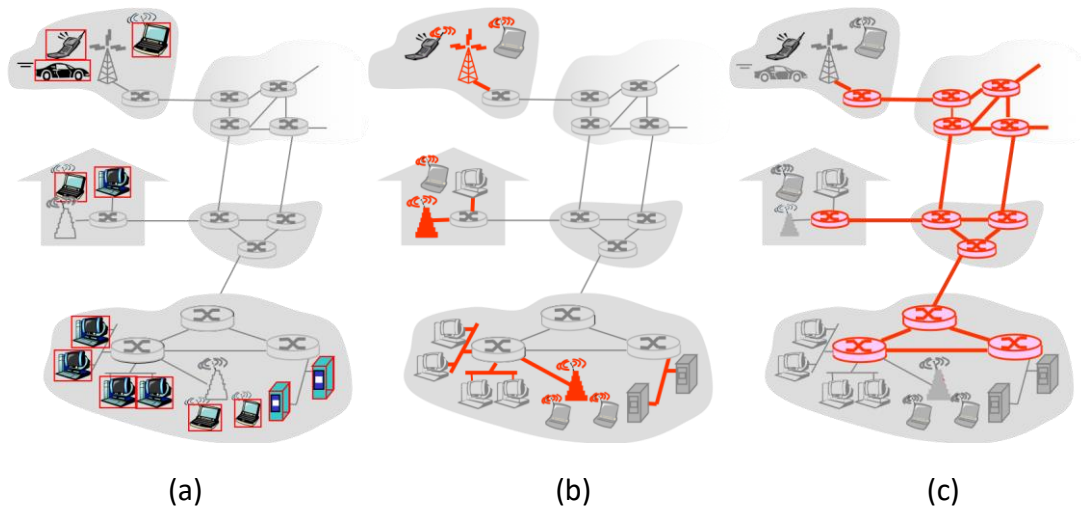
10:20-12:10 Wednesday

March 26, 2025

### **Cautions**

1. There are in total 100 points to earn. You have 90 minutes to answer the questions. Skim through all questions and start from the questions you are more confident with.
2. Use only English to answer the questions. Misspelling and grammar errors will be tolerated, but you want to make sure with these errors your answers will still make sense.

1. (ch11, 3pt) Consider the 3 figures below that highlight different parts of the mini-Internet we've seen several times in class.

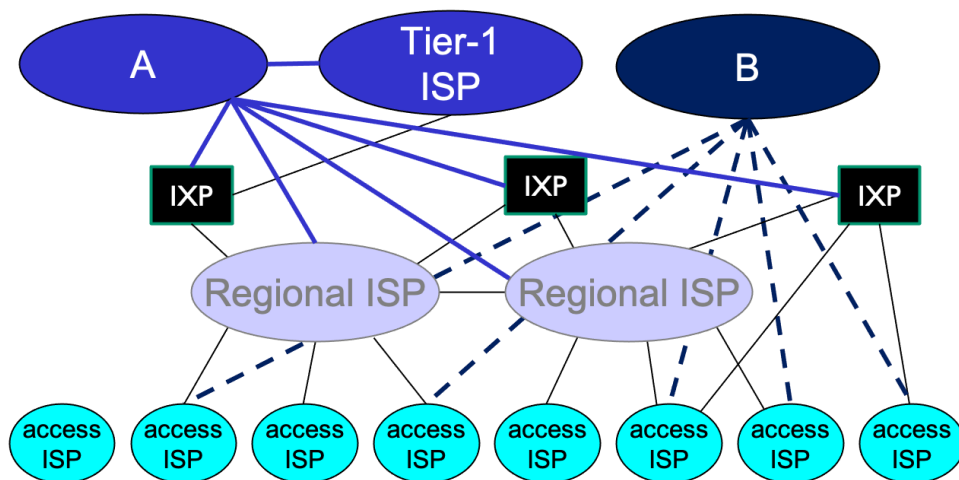


- (1) Which highlights the end system part of the mini-Internet? (1pt)
  - (2) Which highlights the access network part of the mini-Internet? (1pt)
  - (3) Which highlights the core part of the mini-Internet? (1pt)
2. (ch12, 4pt) Consider these access network technologies: (a) ADSL, (b) Cable Modem, (c) FTTH, and (d) WiFi. Some of them share or dedicate the bandwidth among multiple subscribers and some of them offer symmetric or asymmetric bandwidth. Grading policy: -1pt per wrong choice till 0pt.
  - (1) Which one(s) offer dedicated and asymmetric bandwidth? (1pt)
  - (2) Which one(s) offer shared and asymmetric bandwidth? (1pt)
  - (3) Which one(s) offer dedicated and symmetric bandwidth? (1pt)
  - (4) Which one(s) offer shared and symmetric bandwidth? (1pt)
3. (ch13, 4pt) Recall the packet switching and circuit switching principle, select the keywords that are characteristics of a packet switched network. (a) Virtual circuit, (b) Store and forward, (c) Queuing delay, (d) Packet drop, (e) Call setup. Grading policy: -1pt per wrong choice till 0pt.
4. (ch13, 6pt) We have used the car and train network as examples of a packet switched and circuit switched (cart) network, and the bucket passing and pipeline streaming as examples of a packet switched and circuit switched (water) network. Give another set of examples to contrast a packet switched and circuit switched network.
  - (1) Another example of a packet switched network (1pt)

- (2) Justify your choice in (1) (2pt)
- (3) Another example of a circuit switched network (1pt)
- (4) Justify your choice in (3) (2pt)

5. (ch13, 6pt) Take a look at the network of networks below.

- (1) Is A more likely a tier-1 ISP or a content provider network? (1pt)
- (2) Justify your answer in (1). (2pt)
- (3) Is B more likely a tier-1 ISP or a content provider network? (1pt)
- (4) Justify your answer in (3). (2pt)



6. (ch14, 8pt) `traceroute` allows investigation of the route to reach a remote machine. The way it works is very simple – sending 3 requests to each of the routers along the way to the remote machine. One can see the number of hops it takes to reach the remote machine and the round-trip time to each of the routers on the way. Let's `traceroute` to this machine – 140.112.254.4.

- (1) Login to the PA workstation with your exam account. Create a directory “exam1” and move to the directory. (1pt)
- (2) `traceroute` to 140.112.254.4 and create a file `traceroute.txt` to contain the output as below.

```
$ traceroute 140.112.254.4 > traceroute.txt
```

You should see the route to reach 140.112.254.4 and 3 RTTs from the source to each of the routers in the middle. Leave the `traceroute.txt` file there for grading (2pt).

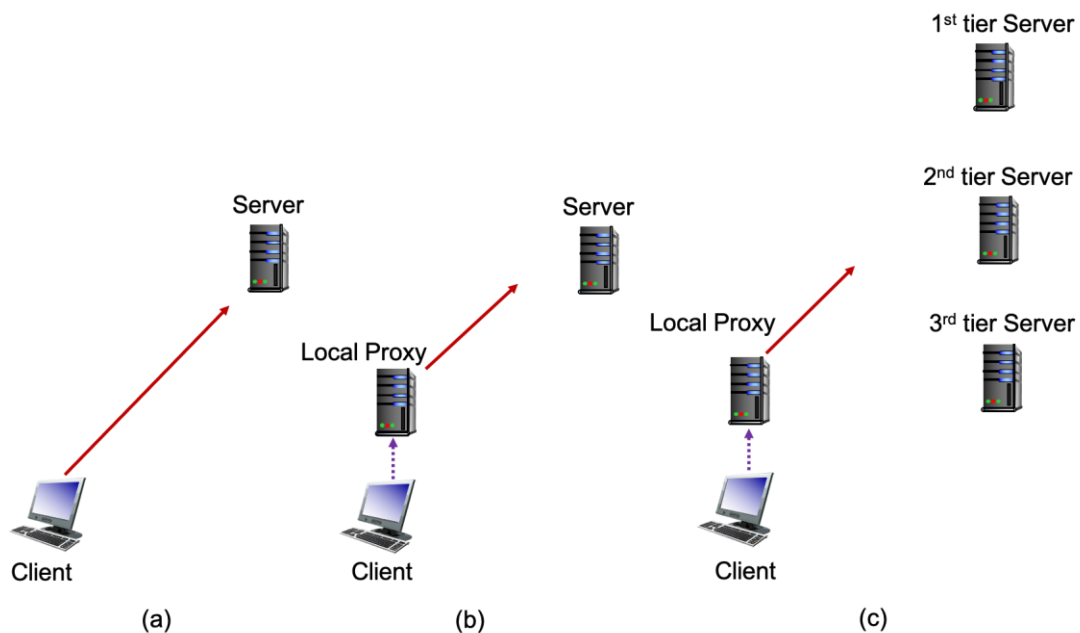
- (3) Tell the number of hops from the PA workstation to reach 140.112.254.4. (1pt).

Grading policy: 1pt given when the `traceroute.txt` file exists and the data support your answer.

- (4) One sees often the 3 RTTs to an intermediate router are not quite the same. Give 2 possible causes to the differences. (2pt)
- (5) One sees from time to time the RTTs to a closer router longer than those to a farther router. Give 2 possible causes to the counterintuitive result. (2pt)
7. (ch15, 3pt) Internet protocols are sorted into layers and people refer to this as a layered service model.
- (1) Give the 2 benefits of the layered model. (2pt)
  - (2) Give 1 drawback of the layered model. (1pt)
8. (ch21, 4pt) Based on what you have learned about (a) TCP, (b) UDP, and (c) TLS, which of them address(es) the following QoS requirement better than the others.
- (1) Data integrity (1pt)
  - (2) Timing (1pt)
  - (3) Throughput (1pt)
  - (4) Security (1pt)
9. (ch22, 9pt) Consider these connection modes one can implement in HTTP –
- (a) non-persistent + no parallel connections
  - (b) non-persistent + 2 parallel connections max
  - (c) persistent connection without pipelining + no parallel connections
  - (d) persistent connection without pipelining + 2 parallel connections max
  - (e) persistent connection with pipelining + no parallel connections
  - (f) persistent connection with pipelining + 2 parallel connections max
- Let's download a Web page of 1 base html and 3 reference objects. In that, the base html is in one server, 1 of the reference objects in another server, and the remaining 2 reference objects in yet another server. Assume the transmission time is negligible and the RTT to these 3 servers are the same for simplicity.
- (1) Tell the response time in RTT and show the derivation using mode (a). (1pt)
  - (2) Tell the response time in RTT and show the derivation using mode (b). (2pt)
  - (3) Tell the response time in RTT and show the derivation using mode (c). (1pt)
  - (4) Tell the response time in RTT and show the derivation using mode (d). (2pt)
  - (5) Tell the response time in RTT and show the derivation using mode (e). (1pt)
  - (6) Tell the response time in RTT and show the derivation using mode (f). (2pt)
10. (ch22, 3pt) Recall the lecture on "Why Web caching". Tell which of the following are benefits of implementing Web cache. (a) lower origin server load, (b) lower response time, (c) lower traffic load to the origin server, (d) enhanced data availability, (e) lower

cost. Grading policy: -1pt per wrong choice till Opt.

11. (ch22-24, 4pt) These are the major design choices of an application layer protocol – the architecture, the socket type, and the message formats. Among the 3 system architectures we have observed so far (depicted below) – (a) client-server model without expansion, (b) client-server model with client-end expansion, (c) client-server model with both client- and server-end expansion, which one is used by the following protocols:



- (1) HTTP without proxy server (1pt)
  - (2) HTTP with proxy server (1pt)
  - (3) SMTP (1pt)
  - (4) DNS (1pt)
12. (ch22-24, 4pt) Continue from Problem Set 11. Compare and contrast the benefit and drawback of the 3 system architectures – (a) client-server model without expansion, (b) client-server model with client-end expansion, (c) client-server model with both client- and server-end expansion.
- (1) Tell 1 benefit of going from architecture (a) to (b).
  - (2) Tell 1 drawback of going from architecture (a) to (b).
  - (3) Tell 1 benefit of going from architecture (b) to (c).
  - (4) Tell 1 drawback of going from architecture (b) to (c).
13. (ch24, 4pt) You are introduced 4 types of DNS resource records (RRs) in the lectures – (a) A, (b) MX, (c) NS, and (d) CNAME. We know smtp.gmail.com is the mail server of

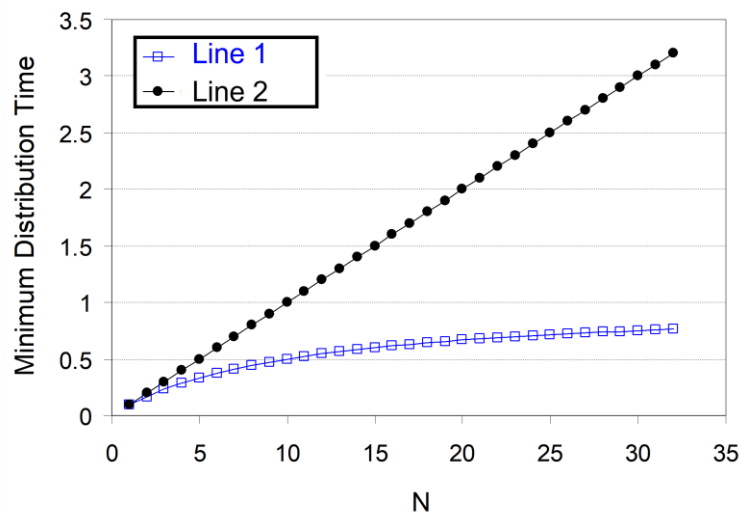
gmail.com and ns1.google.com is the authoritative DNS server for google.com. Tell which type each of the following RRs is.

- (1) (gmail.com, smtp.gmail.com) (1pt)
- (2) (smtp.gmail.com, tsa01s11-in-f4.1e100.net) (1pt)
- (3) (google.com, ns1.google.com) (1pt)
- (4) (ns1.google.com, 216.239.32.10) (1pt)

14. (ch24, 4pt) A local DNS server is often configured to cache the hostname-IP mappings for some time and the interval is called Time-To-Live (TTL).

- (1) Tell the issue of setting TTL to a long duration. (2pt)
- (2) Tell the issue of setting TTL to a short duration. (2pt)

15. (ch25, 4pt) Recall the plot comparing the minimum time distributing a large file to N users in client-server mode vs. in peer-to-peer mode.



- (1) Which line is the result of client-server distribution? (1pt)
- (2) Continue from (1). Why do you think so? (1pt)
- (3) Which line is the result of peer-to-peer distribution? (1pt)
- (4) Continue from (3). Why do you think so? (1pt)

16. (PA2, 15pt) Please go on the PA workstation and work under the exam1 directory for this problem set. Create the exam1 directory if you have not yet done so. Grading policy: pts for latter sub-problems will be given only when the formers are completed.

- (1) You should see a text file in your home directory unix-test.txt. Move the file to the exam1 directory. (1pt)
- (2) Make a copy of unix-test.txt and name it new-test.txt in your exam1 directory. (1pt)
- (3) Develop exam1-p16-1.go such that it (1) prompts the user for a filename, (2) reads

- the file and (3) prints the file size on screen. (3pt)
- (4) Develop exam1-p16-2.go such that it (1) prompts the user for a filename, (2) reads the file and (3) prints the exact file on screen. (3pt)
- (5) Develop exam1-p16-3.go such that it (1) prompts the user for a filename, (2) reads the file and (3) prints the file characters by shifting each of the English alphabets to the next one on screen. That is A is shifted to B, B to C, and Z back to A. Similarly, a to b, b to c, and z back to a. Ignore the numbers and special characters. (4pt)
- (6) Develop exam1-p16-4.go such that it (1) prompts the user for a filename, (2) reads the file, (3) prints the file characters by shifting each of the English alphabets as in (5) to a new file named whatever.txt. (3pt)
17. (PA3, 15pt) Please go on the PA workstation and work under the exam1 directory for this problem set. Create the exam1 directory if you have not yet done so. Grading policy: pts for latter sub-problems will be given only when the formers are completed.
- (1) Develop exam1-p17-1.go such that it connects to the server running on port 11991 and then close the connection. (2pt)
- (2) Develop exam1-p17-2.go such that it connects to the server running on port 11992, sends "50\n" (a number in 1-100) and then closes the connection. (3pt)
- (3) Develop exam1-p17-3.go such that it connects to the server running on port 11993, sends "50\n" (a number in 1-100), prints the response from the server, and then closes the connection. (4pt)
- (4) Run your exam1-p17-3.go again. Send another number in 1-100, say "80\n" this time. Tell the response from the server. (3pt)
- (5) Run your exam1-p17-3.go again. Send yet another number in 1-100 until you figure out what the server on port 11993 is doing. Tell what the server on port 11993 is doing. (3pt)