

### Client-Server, Distribution, and Streaming

These exercises are intended to help you master and remember the material discussed in lectures and explored in labs. In future semesters, we may make some or all of these exercises required, but for now they remain optional. We suggest that you do them as we go over the material, but you may also want to use them to review concepts before the exam.

Please note also that some of the exercises are meant to be done with a calculator, while in exams, we just want you to be able to set up the equations correctly. Also, some of the exercises (such as #2) are meant to help you to explore a topic and learn more about it using sources from the Internet and thus won't appear on exams.

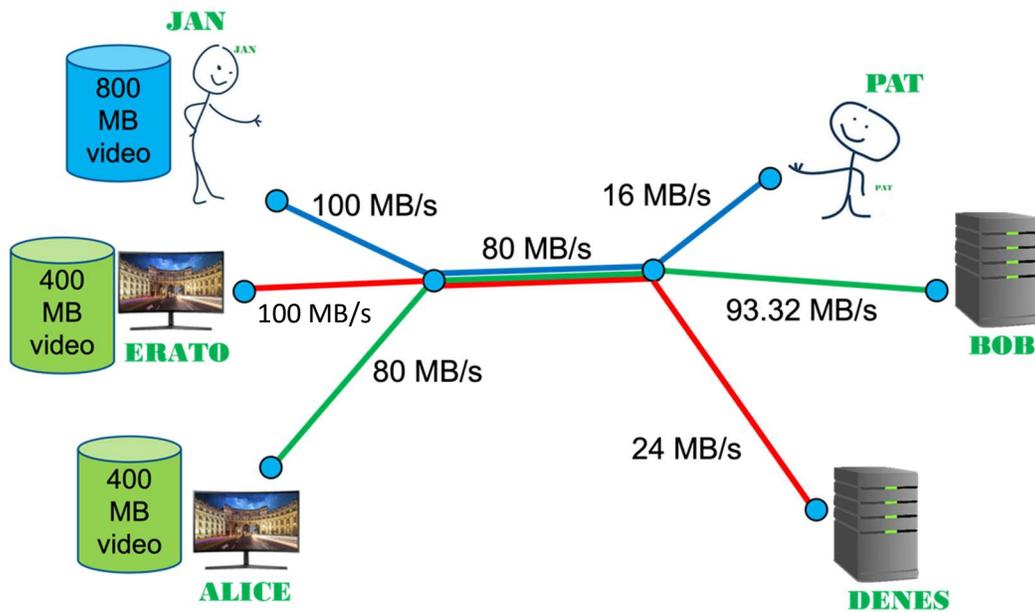
We suggest that you use this version rather than the version without solutions to solve the problems before looking at the version with solutions. Many studies have shown that people often trick themselves into believing that they know how to solve a problem if they are presented with the answer before they try to solve the problem themselves.

- [L7] In the Internet, a computer can act both as a client and as a server, depending on the service in question. For each scenario below, describe the service being provided over the Internet and state whether the computer mentioned is acting as a client, as a server, or as both.
  - a computer accepting responses for the Google Form service
  - a self-service kiosk at the airport
  - a point-of-sale device to receive a payment from credit cards
  - a computer receiving the photos to be stored in Apple Photos
  - a computer that routes the requests from the Illinois mobile app to UIUC's central data server
  - web browser (Chrome, Safari, and so forth)
- [L7] Glitches/mistakes in software programs are typically referred as 'bugs'.
  - How was the term "bug" coined? Try to search on the Internet to track the origins of the word. It indeed is an interesting story.
  - As mentioned in class, commercial software typically has a bug for every 100 to 1,000 lines of code. The latest version of Microsoft Windows has roughly 50 million lines of code. Using these numbers, estimate how many bugs are likely to be present in Windows.
  - Can you recall any famous story where a software bug led to a major problem worldwide? (*Hint: search on the Internet to read some of them.*)
  - In the early era of computers, what was the main challenge that kept engineers from working on bugs in the OS?
- [L7] What are the two major challenges that cloud computing tries to overcome? Discuss some of the major issues with cloud computing and their remedies.
- [L8] A student at the UIUC campus came up with the ambitious idea of launching an emergency service system that is based on smartphone messaging apps such as WhatsApp or Messenger. In case of an emergency, instead of dialing 911, users can now send a message to the local police department through WhatsApp. What are some major concerns/challenges in the above plan? Remember that WhatsApp and Messenger use Internet services internally.

5. [L8] Consider the picture shown below, in which three pairs of users are trying to send videos simultaneously through a part of the Internet.
- Jan wants to send a 800 MB video to Pat (along the BLUE line),
  - Alice wants to send a 400 MB video to Bob (along the GREEN line), and
  - Erato wants to send a 400 MB video to Denes (along the RED line).

Their routes share links as shown.

Assume for all questions that TCP is able to reach the rates shown on the links, and that link sharing is fair unless one of the connections is limited by another link along its route.



Calculating fractions is not required.

- At what rate can Jan send to Pat? \_\_\_\_\_ MB/s  
How long does it take? \_\_\_\_\_ seconds
- At what rate can Alice send to Bob? \_\_\_\_\_ MB/s  
How long does it take? \_\_\_\_\_ seconds
- At what rate can Erato send to Denes? \_\_\_\_\_ MB/s  
How long does it take? \_\_\_\_\_ seconds