ECE101: Exploring Digital Information Technologies **Fall 2023**
Week 5 Exercises **based on L9,L10; tested on Exam I**

Social Networks, File Systems

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 #6) 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.

Rather than using this version directly, we suggest that you use the version without solutions to solve the problems before looking at the answers. 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.

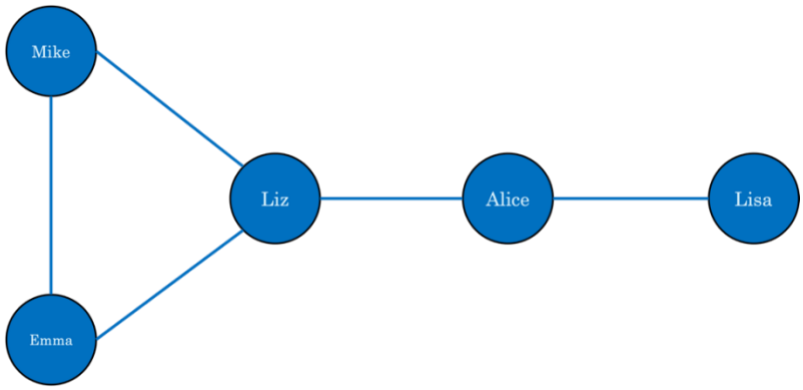
1. [L9] Alice and Jane are childhood friends. They both lived in the same city: Chicago. Alice often used to visit her cousin Emma who works as a software engineer at Adobe in the (San Francisco) Bay Area. Inspired by her, Alice decided to enroll in the Software Engineering program at UIUC, while her friend Jane chose to attend law school at the University of Chicago. In freshman year, Alice attended a new course offered by Prof. Lumetta on Digital Information Technologies. Viraj, a PhD student at UIUC and an intern at Adobe, served as assistant to Prof. Lumetta in the course. Here, Alice became friends with one of her classmates in Prof. Lumetta's course–Bob, also a freshman at UIUC. In one of their conversations, Bob mentioned his elder brother David, who is a professor of Law at the University of Chicago. Alice realizes that we indeed live in such an interconnected world!

   Draw a social graph based on the story in the previous paragraph. Remember that in a social graph, nodes represent people, places, or organizations such as universities/companies, while their relationships are described using arcs. For computers, such a representation is simpler and easier to understand than the textual description.

2. [L9] Alice recently joined a new social networking website called IlliniBook. She invited few of her classmates join and marked them as friends on the IlliniBook app.

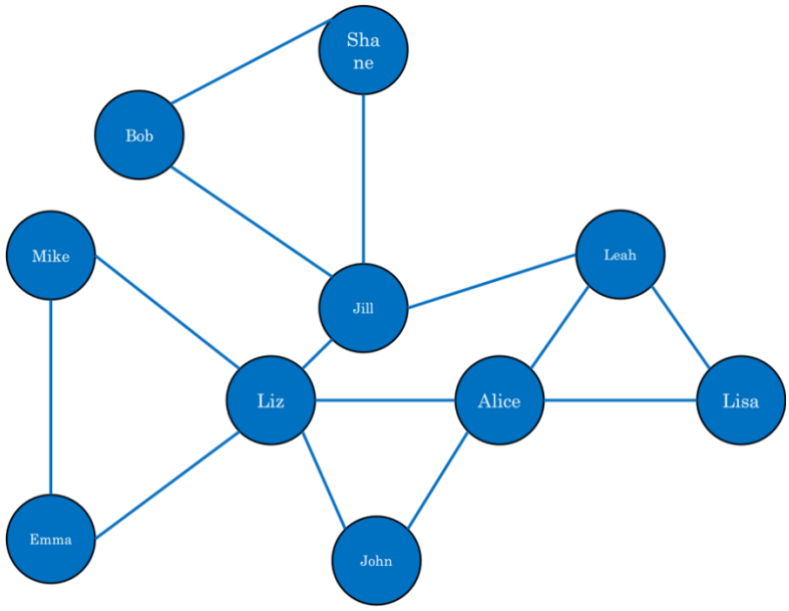
   A) The part of the IlliniBook social graph related to Alice appears to the right. What is the diameter of this graph?

   Hint: a graph's diameter is the longest distance between any pair of nodes.



B) Alice and her friends realized that they didn't have many friends on their new social networking app, so they asked more and more of their classmates to join the new app. After a while, their social network grew a lot, almost double than what it was previously. The new graph is shown to the right.

What is the diameter of the new graph?



C) The number of nodes and arcs doubled when the network grew. How did this growth impact the diameter of the graph? What property of social graphs (*hint: small world graphs*) can explain this observation?

3. [L9] In two or three sentences, explain how an attacker might use a social network to abuse a victim's existing trust relationships and/or sidestep a victim's natural deceit detection mechanisms.

4. [L9] Bob is supposed to move all of his stuff from his residence hall to a new apartment. He has 100 lbs. of stuff in total, but can comfortably carry only 22 lbs. Bob goes to a store to purchase moving containers. He has two options: purchase a large moving container of 100 lbs. capacity, or purchase multiple small containers, each of 20 lbs. capacity. What option should Bob choose? Facebook made an analogous decision in the design of their TAO architecture. Explain in one or two sentences.

5. [L9] Give an example of how human deceit detection mechanisms can backfire on a social networks.

6. [L10] With new technologies and tools being applied to the content of cloud storage systems every day, it becomes difficult to audit them for compliance with the law. Recently, a popular cloud storage system for photos was charged with violating Illinois state privacy laws. Search the Internet to find the story, then summarize it in one or two sentences.

7. [L10] Explain each of the following definitions in a sentence or two:
   A. consistent
   B. datacenter
   C. pull model