

# Systems Programming (Fall, 2021)

## Hand-written Assignment 2 (Due on 11/3)

1. **Directories and files.** Given a UNIX file system, in which
  - (a) an i-node has 12 direct pointers, 1 singly-indirect pointer, 1 doubly-indirect pointer, and 1 triply-indirect pointer,
  - (b) a disk block is 4096 bytes long,
  - (c) a block pointer is 4 bytes long, and
  - (d) all of the directories are a single disk block long,how many i-nodes and disk blocks would need to be accessed if we want to read the entire file of `/home/user/alice.txt`? Suppose `alice.txt` is 5242880 bytes long. Explain your calculation.
  
2. **Soft and hard links.** Alice and Bob propose a method to share files securely. Each of them creates two directories `OutBox` and `InBox` in their home directories. `OutBox` is the place to store the files to be shared; `InBox` is the place to store the links pointing to the shared files. For example, if Alice wants to share her file `hw` with Bob, she can just put the file in `~Alice/OutBox` and then create a link pointing to `~Alice/OutBox/hw` in `~Bob/InBox`. For security issue, no one is able to traverse both of `OutBox` and `InBox` except the owner. Only the owner can remove his/her own files from `OutBox`. Assume Alice and Bob belong to different groups and they both have no superuser privilege. Please answer the following questions.
  - (a) What is the advantage of creating a link in `InBox` over copying a file to `InBox`?
  - (b) Alice can put a symbolic link or a hard link in Bob's `InBox`. Which choice is better? Explain your answer.
  - (c) What minimum access rights (i.e., read, write and execute) should be used for the following directories? Only consider the others class. Your answer should be in the form of `"rwx"`, `"r-x"`, or the like.
    - Directory `InBox`:
    - Directory `OutBox` (if hard links are adopted):
    - Directory `OutBox` (if symbolic links are adopted):
  - (d) If a file put in Bob's `InBox` is owned by Alice and its permission is `"r-- --- ---"`, can Bob remove the file from his `InBox` directory? Why?