Systems Programming (Fall, 2017)
Hand-written Assignment 4 (Due on 11/15, R302)

1. **Process control & IPC**. Please implement function double_fork() with the prototype:
   pid_t double_fork()
   Your code should follow the rules:
   (1) Call both fork() and vfork(). Each is invoked exactly once. Do not call fork() twice.
   (2) Return 0 in the child. Return the process ID of the grandchild in the parent.
   (3) Use a pipe and unbuffered I/O in blocking mode to avoid a race condition.
   (4) Cannot produce any zombie processes.
   (5) Close all of the unused file descriptors.
   The errors returned from system calls can be ignored.

2. **Directories and files.** Alice and Bob propose a method to share files securely. Each of them creates two directories OutBox and InBox in her/his home directory. OutBox is the place to store the files to be shared; InBox is the place to store the links pointing to the shared files. 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 privileges. 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.
   (1) Directory InBox
   (2) Directory OutBox if hard links are adopted
   (3) 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?