Operating System Midterm exam

1. For each of the following process state transition, say whether the transition is legal and how the transition occurs or why it cannot.
   1. Change from thread state WAIT to thread state RUNNING
      1. **Illegal**
      2. **Would go from WAIT to READY to RUNNING**
      3. **A process that is blocked from running has to reach the READY state before being able to be RUNNING**
   2. Change from thread state RUNNING to thread state WAIT
      1. **Legal**
      2. **Would go from RUNNING to WAIT whenever the I/O operation is initiated**
   3. Change from thread state READY to thread state WAIT
      1. **Illegal**
      2. **Would go from READY to RUNNING to WAIT**
      3. **A READY program cannot be waiting because it is not being run. All operations for the program in the READY state have already been completed, so there is nothing to wait for.**
2. Write a program that opens a file (with the open () system call) and then calls fork () to create a new process. Can both the child and parent access the file descriptor returned by open ()? What happens when they are writing to the file concurrently, i.e., at the same time?
   1. **Yes, they can both access the file descriptor, since they are both shown to be reading it.**
   2. **However, since they are reading and writing at the same time and they start at the same position in the file, they may read over each other and write over each other. This is why my file returns random letters or sometimes nothing when reading the file; the two run concurrently.**
3. Write another program using a fork (). The child process should print “hello”; the parent process should print “goodbye”. You should try to ensure that the child process always prints first; can you do this without calling wait () in the parent?
   1. **Yes you can! Use the sleep() function in the parent to make it pause for a certain amount of seconds. I used a 1 second delay to ensure the child always runs first.**
4. Write a program that creates a child process, and then in the child closes standard output (STDOUT FILENO). What happens if the child calls printf () to print some output after closing the descriptor?
   1. **The output will no longer print because it is closed. Anything finished before this is closed will be printed, else it is terminated.**
5. Consider the following piece of C code:

void main ( ) {

fork ( );

fork ( );

exit ( );

}

How many child processes are created upon execution of this program?

**3 child processes. The first fork() results in one child and one parent, then the second fork() results in two more children, one from the child and one from the parent. This makes three child process in total.**

1. An interactive shell program such as bash shell (terminal in Linux and Mac) or PowerShell or CMD prompt in Windows takes command line input from the user and then execute the command/program specified by the user. In this exercise, you will implement closh (Clone Shell), a simple shell-like program designed to run multiple copies of a program at once.  
   Like any other shell, closh takes as input the name of the program to run (e.g.,  
   hello world). However, closh also takes two additional inputs:
2. The number of copies (processes) of the program to run. This is an  
   integer from 1 to 9.
3. Whether the processes should be executed concurrently or  
   sequentially, in sequential execution, the shell should wait for every  
   time a program is executed. In case concurrent execution, the shell  
   does not need to wait for the program to complete execution.

Closh executes the given program, the specified number of times, then  
returns to the prompt once all processes have either completed. Here is a  
simple example of using closh

(italic is user input and hello.exe is the hello world as in previous question):  
mint@mint:~$ ./closh  
closh> ./hello.exe  
count> 3  
[p]arallel or [s]equential> p  
hello world  
hello world  
hello world  
closh>

To write such a shell in C++, refer to the process lecture. As noted in the slide, you can use “execvp()” to create a new child process and have it execute a command. Use also the “waitpid” in the parent process to wait for the child process to finish in case  
sequential execution is selected.  
For simplicity, assume that the user specifies the full path name for any  
command/executable that they wish to execute. Thus, you do not need to deal  
with path name completion issues. You can test your shell on programs you  
write in C++ (after compiling to machine language).

Create a GitHub repository and upload this document with answers to question 1 and 6 with all your .cpp or .c programs. Copy the repository link and paste it in Canvas assignment.