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

A: **Illegal.** A process in the WAIT (blocked) state cannot transition directly to RUNNING. It must first be moved to the READY state when the event it is waiting for occurs, and then the scheduler selects it for execution.

* 1. Change from thread state RUNNING to thread state WAIT

A: **Legal.** This transition happens when a process makes a system call that requires waiting for an event (e.g., I/O operation). The process is placed in the WAIT state until the event is completed.

* 1. Change from thread state READY to thread state WAIT

A: Illegal. A process in the READY state is waiting for the CPU but is not performing any operations that would require waiting. It must first enter RUNNING before it can transition to WAIT.

1. 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?

A: Yes, both the child and parent processes inherit the same file descriptor when using fork(). Since they share the same open file description, concurrent writes can result in interleaved or mixed output due to race conditions.

1. 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?

A: To ensure the child prints first without using wait(), we can use sleep() in the parent. Using fflush(stdout) after printing can also help enforce order.

1. 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?

A: If the child closes standard output (STDOUT\_FILENO), printf () will have no effect because it writes to a closed descriptor.

1. Consider the following piece of C code:

void main ( ) {

fork ().

fork ().

exit ().

}

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

A: The first fork () creates one child process. The second fork () runs in both parent and child, creating two more processes. Total child processes = 3 (one from the first fork (), two from the second fork ()).

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.

<https://github.com/Abernard13/Midterm-Assignment>