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

Illegal. The process needs to be instead in the READY state instead of directly transitioning to the RUNNING state. The process needs to be scheduled after the currently running process.

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

Legal. Once the process is executed, it might need another I/O operation, so it would go back to the waiting state.

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

Illegal. The WAIT state can only transition to the READY state because once the I/O input is completed the READY state is able to be scheduled to run. The READY state cannot go back to waiting for an I/O operation.

1. Write a program that opens a file (with the open () system call) and then calls fork () to create a new process. openSysCall.c

Can both the child and parent access the file descriptor returned by open ()?

They share the same file descriptor and file offset.

What happens when they are writing to the file concurrently, i.e., at the same time?

Because they share the same file offset, their writes can collide with each other. Depending on how the OS schedules whether the parent or child goes first, the results would vary.

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?

forkWithoutWait.c

Yes. The child can go first by issuing the command sleep in the parent process so that the child can have the right of way.

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?

stdoutFileNo.c

The child process does not print.

1. 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

Main

Fork();

Parent Child

Fork();

Parent Child | Parent Child

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.

closh.cpp. Used helloTest.cpp as the test program.  
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:

1. The number of copies (processes) of the program to run. This is an  
   integer from 1 to 9.
2. 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.