

Programming Assignment (PA) – 1
(Shell Command Execution Simulation in C)

CS 307 – Operating Systems

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Command Selection and Argument Justification

For the purpose of this assignment, I selected the ping command with a focus on the -4, -D, and -U flags. The ping command is a network administration utility used to test the reachability of a host on an Internet Protocol (IP) network and to measure the round-trip time for messages sent from the originating host to a destination computer. The flags -4, -D, and -U are used for forcing the use of IPv4, enabling the SO_DEBUG option on the socket being used, and printing a timestamp before each line, respectively.

The reason I selected the *ping* command with the mentioned flags is, pinging a destination host is a very important operation in software development, mainly to confirm network connectivity between two hosts.

The whole command is as follows:

```
man ping | grep -e -4 -e -D -e -U > output.txt
```

The command extracts information about the specific flags of the ping command from its manual page, which could be useful for users who want to understand these options in more detail. The details of the flags I have used are:

-4: Use IPv4 only.

-D: Print timestamp (unix time + microseconds as in gettimeofday) before each line.

-U: Print full user-to-user latency (the old behaviour). Normally ping prints network round trip time, which can be different f.e. due to DNS failures.

Process Hierarchy and Concurrency

My program is considered as 2a according to the Assignment document. The man and grep processes have a sibling relationship because they are both directly forked by the initial shell

process, making them children of the same parent. They can run concurrently because once the man process is forked and starts executing, the shell process immediately forks the grep process without waiting for the man process to finish. This concurrency is facilitated by the use of a pipe that connects the standard output of the man process to the standard input of the grep process, allowing grep to start processing data as soon as it becomes available.

Implementation Details

The implementation involves creating a pipe and forking two child processes. The first child executes the man command with ping as an argument, and its output is redirected to the write end of the pipe. The second child executes the grep command with a regular expression pattern to search for the -4, -D, and -U options within the man ping output, and its input is taken from the read end of the pipe. The output of grep is then redirected to a file named output.txt.

Both child processes are created to run concurrently, with the grep process starting its execution without waiting for the man process to finish, thus enabling a streaming filter of the man ping output.