

Operating Systems 1

Lecture 6

Lecturer

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Processes Introduction

- A process is a running program, each process has a code segment for its instructions and data segment for its data.
- Linux is multiprocessing operating system where many processes run on the CPU by switching between them with help from the OS scheduler.
- The process can be in many states:
 - Running: The process is currently running in CPU or ready to run.
 - Waiting: The process is waiting for a requested resource to be available or waiting for input.
 - Stopped: The process stopped running because it finished or it is being debugged.

Processes Introduction

- Each process has an identifier to identify the process.
- Each process has a user ID (UID) and Group ID (GID) to be used in determining permissions when accessing files.
- Each process has a parent process except the first process with PID of 1.
- You can use `ps` command to see the process tree.
- Each process has a file table which contains information about each file opened by the process and its mode (read, write).

proc file system

- procfs is a virtual file system used to expose information about the kernel and running processes, it is usually mounted to /proc at boot time.
- Each process has a subdirectory in /proc named after the Process ID e.g. /proc/4561
- /proc/self is a symlink to the current running process.
- /proc/PID/cmdline contains the command line for the process with ID of PID.
- /proc/PID/cwd is a symlink to the process's current working directory.

proc file system

- `/proc/PID/environ` contains the environment variables defined in the process.
- `/proc/PID/exe` is a symlink to the process's executable file.
- `/proc/PID/fd` is a directory containing a symlink for each open file.
- `/proc/PID/maps` is a file which contain information about the process's memory.
- `/proc/PID/status` contains information about the process's status.

Process Memory Maps

- The `/proc/PID/maps` file contains information about each memory region for the process.
- It has the following format
- `address perms offset dev inode path`
- The first column is the start and end address of the memory region.
- The second one describes the permissions for the region (p means private memory and s means shared memory).
- The third column is the offset in the file if the region was loaded from a file.

Process Memory Maps

- The fourth column is the device number where the file was loaded from.
- The fifth column is the file number in the file system.
- The last one is the path to the file in the system.
- There are some special regions with names like [heap], [stack], [vvar], [vdso] etc

Listing Processes

- Use the `ps` command to list current running processes in the terminal.
- Its output has three columns, process ID, TTY (the terminal connected to the process), TIME the amount of time consumed by the process in the CPU, the last column is the process's command.
- `ps -f` prints extra information such as parent process and start time
- `ps -e` prints information about all running processes.

Jobs

- A Job is a any process running in the current terminal.
- jobs command is used to list current jobs.
- We can run a job in background by adding & to the end of the command.
- We can bring a job from background to foreground with the fg command.
- Use fg %2 to bring the second job to foreground if multiple jobs exist in background.