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Process Life Cycle Overview And Basic Commands

Unix

Process

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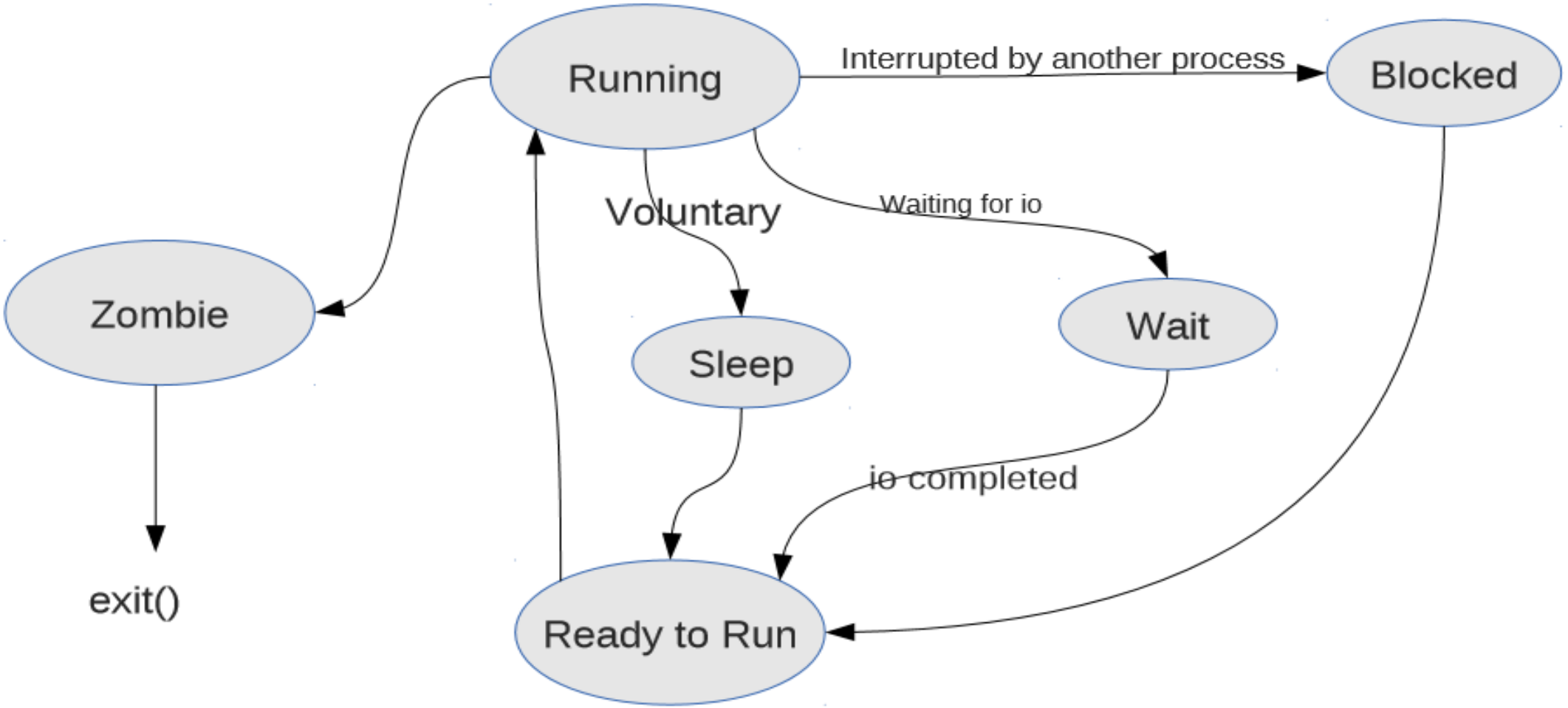
- A process is a name given to a program instance that has been loaded into memory and managed by the operating system
- A process is simply a program in execution: an instance of a program execution.
- Every process has a unique process identification number (PID).
- The kernel uses PIDs to track and manage their associated processes.
- The root user and regular users use PIDs to identify and control processes.
- There are several different ways you can obtain a list of the processes currently running on the system.
  - using the top command
  - using the ps command

Process states

- **New** : A process has been created but has not yet been admitted to the pool of executable processes.
- **Ready to run**: Processes that are prepared to run if given an opportunity. That is, they are not waiting on anything except the CPU availability.
- **Running**: The process that is currently being executed. (Assume single processor for simplicity.)
- **Blocked** : A process that cannot execute until a specified event such as an IO completion occurs.
- **Exit**: A process that has been released by OS either after normal termination or after abnormal termination (error).
- **Sleep** : voluntary sleep by programmer

Process State Life Cycle



Process States

- The ps command shows the **process identification number** (listed under PID) for each process you own, which is created after you type a command. This command also shows you the **terminal** from which it was started (TTY), the **cpu time** it has used so far (TIME), and the **command** it is performing (COMMAND).
- If you add the **-l** option to the ps command, the system displays other process information, including the **state** of each running process (listed under S). The following list defines the codes used to describe processes.
  - O – Process is running on a processor
  - S – Sleeping: Process is waiting for an event to complete
  - R - Runnable: Process is on run queue
  - I - Idle: Process is being create.
  - Z – Zombie state: Process terminated and parent not waiting
  - T – Traced: Process stopped by a signal because parent is tracing it
  - X – SXBRK state: Process is waiting for more primary memory.

The ps command

- The ps command enables you to check the status of the system's current processes and to obtain detailed information about them.
- The most commonly used command options used in combination with ps include
  - -a enables you to obtain a list of the most frequently requested processes.
  - -c option enables you to obtain a process formatted on the basis of the scheduler.
  - -G option enables you to obtain information about processes run by a specific user group.
  - -A option enables you to obtain a list of all current processes.
  - -f option enables you to obtain a comprehensive set of data about current processes that allows you, for example, to diagnose system bottlenecks and to determine which commands and applications are most commonly requested
  - -l option provides you with all information collected by the system about every current process.

The ps command examples

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- To see every process on the system using standard syntax:

  ps -e

  ps -ef

  ps -eF

  ps –ely

- To get info about threads:

  ps -eLf

- To see every process with a user-defined format:
- ps -eo pid,tid,class,rtprio,ni,pri,psr,pcpu,stat,wchan:14,comm
- ps axo stat,euid,ruid,tty,tpgid,sess,pgrp,ppid,pid,pcpu,comm
- ps -Ao pid,tt,user,fname,tmout,f,wchan
- To see every process running as root (real & effective ID) in user format:

  ps -U root -u root u

The ps command

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- The Process Manager displays several columns containing specific types of information relating to each current process. These types of information are
  - PID
  - process name
  - process owner
  - CPU percentage used
  - total memory used
  - total swap space used
  - time of process start
  - parent process
  - process command

ps command

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- In Unix/Linux, can effectively run many processes at once
- In fact, OS makes it appear as if many are running simultaneously
- OS runs one job at a time, but quickly switches between jobs
- OS Makes it appear that all jobs are running concurrently
- To view running processes, use ‘ps’

```
prompt$   ps
    PID          TTY          TIME         CMD
  14394          pts/0        00:00:00     bash
  14995          pts/0        00:00:00     ps
```

ps command

Outputs the following fields (by default)

- Process ID (PID)
- Terminal from which the process was started (TTY)
- CPU time of the process (TIME)
- The name of the command that started the process (CMD)

Prints the following processes (by default)

- Only processes that belong to you
- Only processes started during your current session

ps Options

- To print all processes use ‘ps -e’
  - Incl. those not in current session and those that don’t belong to you
- To display more fields use ‘ps -f’
  - Includes UID (username), PPID (parent PID), C (processor utilization), STIME (start time)
- To display a process tree use ‘ps -H’
- Of course, these can also be used together: ‘ps -efH’

Signals

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- You can control processes by using the kill command. This command sends a specific signal to the process. The signal results in one of the following:
  - a type of process death
  - the creation of a file called a “core dump” that contains a memory trace
  - OS incorporates a range of signal types. Each of these types is identified by a specific code.
  - For example, the SIGKILL signal, which is identified by the code 9, causes the relevant process to die immediately.
- This is the syntax of the kill command:

  # kill *signal-code PID*
- So, for example, to immediately kill the process assigned a PID of 300, you use this command:

  # kill -9 300
- Caution: **Kill** command is very sensitive command. You always need written approval from owner of the process to get it terminated using **kill** command.

Killing Processes

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- Sometimes, we need to kill an errant process
  - Use ‘kill’ command: ‘kill <pid>’
  - Can only kill processes that belong to you

```
prompt$ ps
  PID   TTY      TIME      CMD
16786   pts/0    00:00:00  errant_proc

prompt$ kill 16786
```

- In some cases, process won’t die with default kill
  - Need -9 option (-9 means *really* kill)

```
prompt$ kill -9 16786
```

top command

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- top command is used to show the Linux processes. It provides a dynamic real-time view of the running system. Usually, this command shows the summary information of the system and the list of processes or threads which are currently managed by the Linux Kernel. As soon as you will run this command it will open an interactive command mode where the top half portion will contain the statistics of processes and resource usage. And Lower half contains a list of the currently running processes.

top command fields

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- PID: Shows task's unique process id.
- PR: The process's priority. The lower the number, the higher the priority.
- VIRT: Total virtual memory used by the task.
- USER: User name of owner of task.
- %CPU: Represents the CPU usage.
- TIME+: CPU Time, the same as 'TIME', but reflecting more granularity through hundredths of a second.
- SHR: Represents the Shared Memory size (kb) used by a task.
- %MEM: Shows the Memory usage of task.
- RES: How much physical RAM the process is using, measured in kilobytes.
- COMMAND: The name of the command that started the process.

top options

- Top –n (num) : Exit Top Command After Specific repetition. (Top output keeps refreshing until you press ‘q‘.)
- top –u username : Display processes by a specific user
- z : Highlight Running Process in Top: Press ‘z‘ option in running top command will display running process in color which may help you to identified running process easily Z
- c : Shows Absolute Path of Processes: Press ‘c‘ option in running top command, it will display absolute path of running processes.

Suspending Processes

- Sometimes, want to suspend rather than kill process And continue process later on
- An example:
  - Sorting a really large file
  - Assume it takes a few minutes to sort
  - May want to suspend, do some other work, and continue it later
  - Can do this by typing <ctrl>-z
  - Similar usage to <ctrl>-c

```
prompt$ sort really_large_file
[1]+  Stopped    sort really_large_file
```

‘[1]’ is the job number

Each suspended process gets a unique job number

Continuing the Process: fg

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- To restart the process use ‘fg’
  - Bring the process back to the foreground
  - ‘fg’ continues the most recently suspended process
  - Use ‘fg %<job number>’ to continue another process

```
prompt$ fg
sort really_large_file
```

- To list suspended processes use ‘jobs’

```
prompt$ jobs
[1]+  Stopped    sort really_large_file
```

  - ‘+’ indicates most recently suspended job
  - ‘-’ (not shown here) indicates next most recently suspended job

Processing in the Background

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- Usually, don't want to suspend, but to send to the background
  - Process still runs, but we can continue using the shell
  - Use '&'

```
prompt$ sort really_large_file &
[2] 21130
```

  - Notice that it gets a job number (just like with suspending)

```
prompt$ jobs
[1]+  Stopped    sort really_large_file
[2]-  Running    sort really_large_file &
```

  - Process run without '&' runs in the foreground
  - Only one process can run in foreground at a time

Moving to Background: bg

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- Sometimes, need to move from foreground to the background
  - For example, we forget to add ‘&’ to a long-running command

- Moving a process from foreground to background:
  - First, suspend the process
  - Then, use ‘bg’
  - Sends the most recent job to the background

```
prompt$ bg
[2]+ sort_really_large_file
```

  - To send a less recent job to the background use ‘bg %<job number>’

free command

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- Display the amount of free and used memory in the system
- free displays the total amount of free and used physical and swap memory in the system, as well as the buffers and caches used by the kernel. The information is gathered by parsing /proc/meminfo.

- The displayed columns are:
- total Total installed memory
  - (MemTotal and SwapTotal in /proc/meminfo)
- used Used memory
  - (calculated as total - free - buffers - cache)
- free Unused memory
  - (MemFree and SwapFree in /proc/meminfo)

free command

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- shared Memory used
  - (mostly) by tmpfs (Shmem in /proc/meminfo, available on kernels 2.6.32, displayed as zero if not available)
- buffers

  Memory used by kernel buffers (Buffers in /proc/meminfo)
- cache

  Memory used by the page cache and slabs (Cached and SReclaimable in /proc/meminfo)
- buff/cache

  Sum of buffers and cache
- available

  Estimation of how much memory is available for starting new applications, without swapping. Unlike the data provided by the cache or free fields, this field takes into account page cache and also that not all reclaimable memory slabs will be reclaimed due to items being in use

free command options

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- -b, --bytes : Display the amount of memory in bytes.
- -k, --kilo : Display the amount of memory in kilobytes. This is the default.
- -m, --mega : Display the amount of memory in megabytes.
- -g, --giga : Display the amount of memory in gigabytes.
- --tera : Display the amount of memory in terabytes.
- --peta : Display the amount of memory in petabytes.
- -h, --human : Show all output fields automatically scaled to shortest three-digit unit and display the units of print out.

free command options

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- -c, --count : It displays the output c number of times, and this option actually works with -s option. e.g., $free -s 3 -c 3 (display free stats every 3 seconds for total 3 times)
- -l, --lohi : It shows the detailed low and high memory statistics
- -o, --old : This option disables the display of the buffer adjusted line.
- -s, --seconds : This option allows you to display the output continuously after s seconds delay.
- -t, --total : It adds an additional line in the output showing the column totals.
- --help : It displays a help message.
- -V, --version : It displays command version info.

uptime command

- used to find out how long the system is active (running). This command returns set of values that involve, the current time, and the amount of time system is in running state, number of users currently logged into, and the load time for the past 1, 5 and 15 minutes respectively.

- Options:
- -p, --pretty show uptime in pretty format
- -h, --help display this help and exit
- -s, --since system up since
- -V, --version output version information and exit

w command

- w - Show who is logged on and what they are doing.
- w displays information about the users currently on the machine, and their processes. The header shows, in this order, the current time, how long the system has been running, how many users are currently logged on, and the system load averages for the past 1, 5, and 15 minutes.

- The following entries are displayed for each user: login name, the tty name, the remote host, login time, idle time, JCPU, PCPU, and the command line of their current process.

w command options

- -h, --no-header Don't print the header.
- -u, --no-current Ignores the username while figuring out the current process and cpu times. To demonstrate this, do a "su" and do a "w" and a "w -u".
- -s, --short Use the short format. Don't print the login time, JCPU or PCPU times.
- -f, --from Toggle printing the from (remote hostname) field. The default as released is for the from field to not be printed, although your system administrator or distribution maintainer may have compiled a version in which the from field is shown by default.
- --help Display help text and exit.
- -i, --ip-addr Display IP address instead of hostname for from field.
- user Show information about the specified user only.

cp command

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- cp stands for copy. This command is used to copy files or group of files or directory. It creates an exact copy of a file on a disk with different file name. cp command requires at least two filenames in its arguments.
- cp [OPTION] Source Destination
- cp [OPTION] Source Directory
- cp [OPTION] Source-1 Source-2 Source-3 Source-n Directory
- First and second syntax is used to copy Source file to Destination file or Directory.
- Third syntax is used to copy multiple Sources(files) to Directory.

cp Options

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- -i, --interactive : prompt before overwrite
- -n, --no-clobber : do not overwrite an existing file
- -R, -r, --recursive : copy directories recursively
- -l, --link : hard link files instead of copying
- -s, --symbolic-link : make symbolic links instead of copying
- -b, --backup : make a backup of each existing destination file
- -p : preserves the time of the last data modification and the time of the last access, the ownership (only if it has permissions to do this), and the file permission-bits.

mv command

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- mv stands for move. mv is used to move one or more files or directories from one place to another in a file system like UNIX. It has two distinct functions:
- (i) It renames a file or folder.
- (ii) It moves a group of files to a different directory.
- No additional space is consumed on a disk during renaming. This command normally works silently, means no prompt for confirmation.

- Syntax:
- mv [Option] source destination

mv options:

- -i, --interactive : prompt before overwrite
- -n, --no-clobber : do not overwrite an existing file
- -b, --backup : make a backup of each existing destination file
- -S : change suffix for backup

head command

- As the name implies, print the top N number of data of the given input. By default, it prints the first 10 lines of the specified files. If more than one file name is provided then data from each file is preceded by its file name.

- Syntax:
- head [OPTION]... [FILE]...

head options

- -c, --bytes=[-]K
- print the first K bytes of each file; with the leading '-',
- print all but the last K bytes of each file

- -n, --lines=[-]K
- print the first K lines instead of the first 10;with the lead-
- ing '-', print all but the last K lines of each file

- -q, --quiet, --silent
- never print headers giving file names

- -v, --verbose
- always print headers giving file names

tail command

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- It is the complementary of head command.The tail command, as the name implies, print the last N number of data of the given input. By default it prints the last 10 lines of the specified files. If more than one file name is provided then data from each file is precedes by its file name.

- Syntax:
- tail [OPTION]... [FILE]...

tail options:

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- -c, --bytes=[-]K
- print the first K bytes of each file; with the leading '-',
- print all but the last K bytes of each file

- -n, --lines=[-]K
- print the first K lines instead of the first 10;with the lead-
- ing '-', print all but the last K lines of each file

- -q, --quiet, --silent
- never print headers giving file names

- -v, --verbose
- always print headers giving file names

lsof command

- lsof command stands for List Of Open File. This command provides a list of files that are opened. Basically, it gives the information to find out the files which are opened by which process. With one go it lists out all open files in output console.

- Syntax:
- $lsof [option][user name]

lsof options:

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- In the absence of any options, lsof lists all open files belonging to all active processes.
- lsof –u username : To find a list of files that are opened by a specific user
- lsof -u ^username : List all files which are opened by everyone except a specific user
- lsof -c processname : List all open files by a particular Process
- lsof -p PID : List all open files by a particular Process
- lsof –R : List files opened by parent process IDs
- lsof -D directorypath : List open files from a particular directory