



## **Lab1** **Simple Shell**

### **Objectives:**

1. Familiarity with system calls in Unix environment.
2. Introducing processes and their nesting.

### **Problem Statement:**

It is required to implement a Unix shell program. A shell is simply a program that conveniently allows you to run other programs. Read up on your favorite shell to see what it does. Your shell must support the following:

#### **1. The internal shell command "exit" which terminates the shell**

- Concepts: shell commands, exiting the shell.
- System calls: exit()

#### **2. A command with no arguments**

- Example: ls, cp, rm ...etc
- Details: Your shell must block until the command completes and, if the return code is abnormal, print out a message to that effect.
- Concepts: Forking a child process, waiting for it to complete and synchronous execution.
- System calls: fork(), execvp(), exit(), wait()

#### **3. A command with arguments**

- Example: ls -l
- Details: Argument 0 is the name of the command.
- Concepts: Command-line parameters.

#### **4. A command, with or without arguments, executed in the background using &.**

- a. Example: firefox &
- b. Details: In this case, your shell must execute the command and return immediately, not blocking until the command finishes.
- c. Concepts: Background execution, signals, signal handlers, processes and asynchronous execution.
- d. Requirements: You have to show that the opened process will be nested as a child process to the shell program via opening the task manager found in the operating system like in Figure 1. Additionally you have to write in a log file when a child process is terminated (main application will be interrupted by a SIGCHLD signal). So you have to implement an interrupt handler to handle this interrupt and do the corresponding action to it.

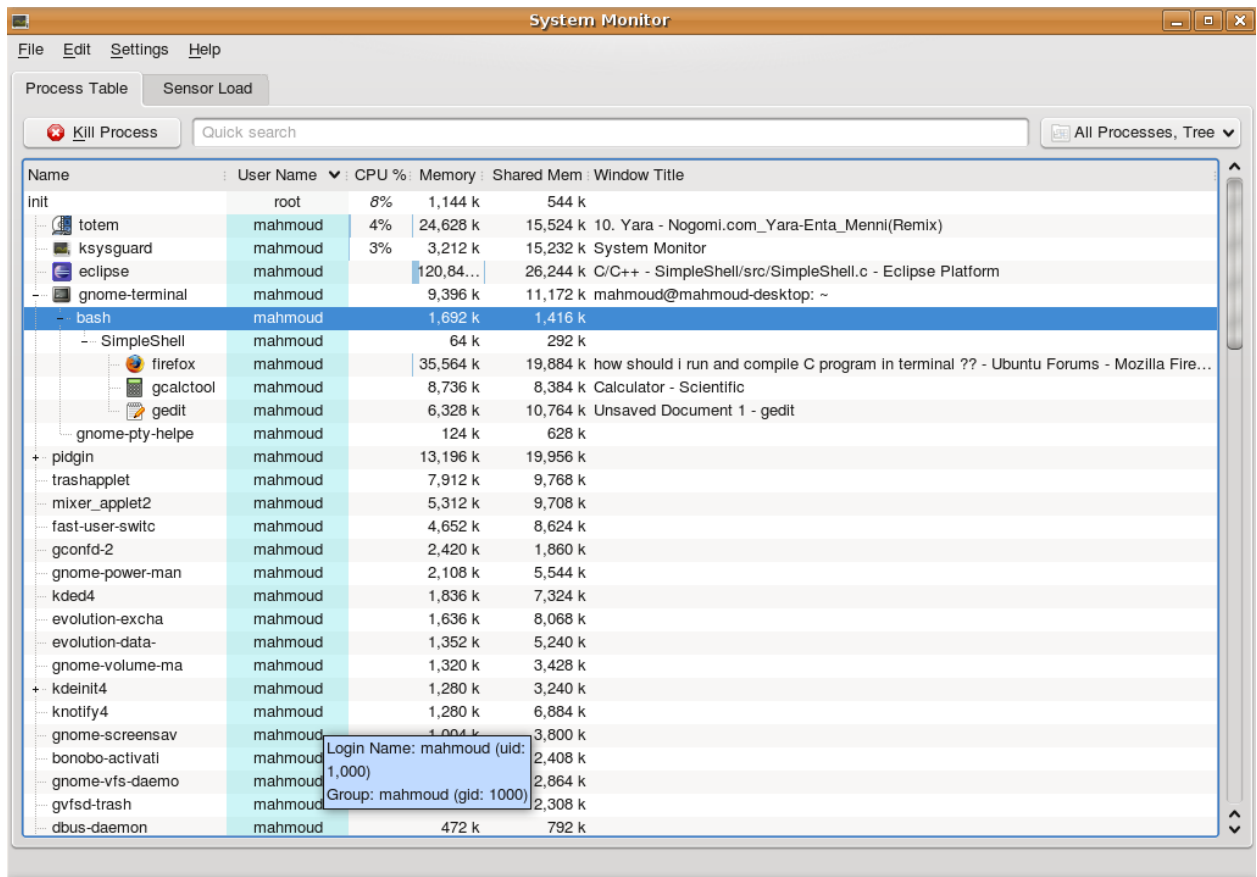


Figure 1 Firefox, Calculator and Gedit are child processes to the SimpleShell process

### **Description:**

To process the user command, do the following:

- Step 1: Your command shell should take the user command and its parameter(s), i.e., “ls” and “-l” in this example, and convert them into C strings. (Recall that a C string terminates with a null string, i.e., \0.)
- Step 2: The command shell should create a child process via fork ().
- Step 3: The child process passes the C strings—the command and parameter(s)—to execvp ().
- Step 4: The parent process, i.e., the command shell, should wait, via wait (), for the child process to finish.
- Step 5: The command shell gets the next command and repeats the above steps. The command shell terminates itself when the user types exit.

In case a user wants to execute the command in background (i.e. as a background process), he/she writes & at the end of the command. For example, a user command can be:

```
Shell > firefox &
```

In this case, your command shell should not wait for the child by skipping the Step 4.

You should keep a log file for your shell program such that whenever a child process terminates, the shell program appends the line “Child process was terminated” to the log file. To do this, you have to write a signal handler that appends the line to the log file when the SIGCHLD signal is received.

**Hint:**

- When a child dies, the parent process receives SIGCHLD (or SIGCLD) signal.
- To see the set of all signals supported on your system, type, kill -l
- Use a process monitor package to monitor your processes. Provide a screenshot for your shell parent process and some child processes spawned as background processes.
- Suggested packages: KSysguard or Gnome-System-Monitor.

**Deliverables:**

- Complete source code, commented thoroughly and clearly.
- Object Code.
- A report that includes:
  - A description of the overall organization of your code and the major functions.
  - Sample runs.
  - Screenshots for the processes hierarchy in KSysguard (or any similar package) during the execution of your shell program.

**Notes:**

- Languages used: C/C++.
  - Students will work individually.
  - *Revise the academic integrity note found on the class web page.*
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