CSE 5031 Operating Systems
2019/20 Fall Term

Project: 3 – Part 3

Topic: Process Management

Date: 18.11 - 22.11.2019

Objectives:

- to implement command concatenation
- to experiment with IPC and I/O redirection

References:

- **Linux System Programming 2d ed., Robert Love, O'Reilly 2013** (course web site, or http://pdf-ebooks-for-free.blogspot.com.tr/2015/01/oreilly-linux-system-programming.html
- **The GNU C Library Reference Manual** (course web site, or http://www.gnu.org/software/libc/manual/pdf/libc.pdf)

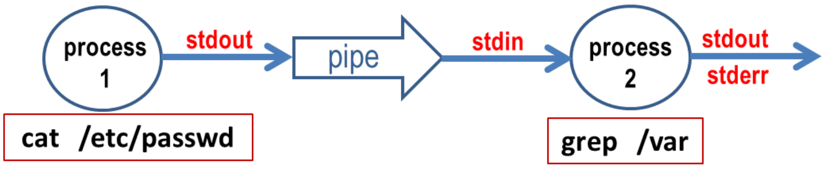
Section I. Implementing Command Concatenation

In this section you are asked to develop a multiprocess application that sketches the implementation of **UNIX/Linux command concatenation** process using the "|" operator.

To eliminate the command line analysis complexity and focus on **process management**, **IPC** and **redirection** of **standard I/O streams**, you will implement a specific application that runs the following concatenated commands:

"cat /etc/passwd | grep /var"

The **IPC** framework established by this application, depicted here after, shows that processes running the **concatenated commands** "**cat**" and "**grep**" are connected via an **ordinary pipe**.



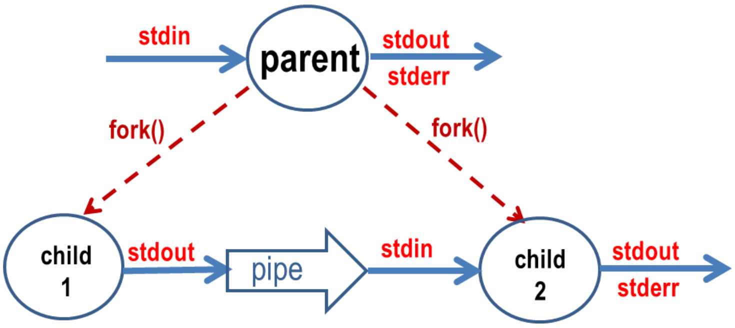
Note that "**cat**" and "**grep**" commands are programmed to write to and to read from standard I/O streams: the **stdout** and the **stdin** respectively**.** The only way to channel data flow from **process 1** to **process 2**, without reprogramming and compiling these two commands, is to **redirect** during the execution:

- ✓ process 1 "**stdout**" stream to **pipe's write end** ; and
- ✓ process 2 "**stdin**" stream to to **pipe's read end** .

The redirections implemented with the "**dup2**" call **overwrite** process' **File Descriptor Table** entry definitions:

- ✓ **stdout** entry of the **FDT** of the process running "**cat**" is redirected to **pipe's write end**; and
- ✓ **stdin** entry of the **FDT** of the process running "**grep**" is redirected to **pipe's read end.**

The **process tree** and the **IPC framework** generated by the application are depicted in the schematics here after.



Note that:

- ✓ **Parent** process should first create the communication channel (pipe), then child processes. It has to **close** both ends of the **pipe** and **wait** for the termination of its **children**.
- ✓ **Child** processes are expected to **close** unused end of their **pipe**, **redirect** related **standard I/O stream** before loading and executing the command.
- ✓ The use of "**execlp**" command to load and execute the predefined commands seems to be a reasonable choice.

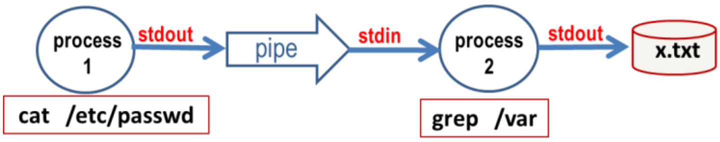
Section II. Redirecting the Output to an Ordinary File

Once the first step is operational, you will extend the application to store its output in an **ordinary file,** the "**x.txt**"**.** This is achieved by the use of **UNIX/Linux I/O redirection** operator "**>**", as shown here after.

"cat /etc/passwd | grep /var > x.txt"

The **IPC** framework of the application, depicted in the drawing here after, is now updated to include the "**>**" redirection;

- ✓ **stdout** entry of the **FDT** of the process running "**grep**" is redirected to the "**x.txt**" file.



Note that, **process** 2 should perform the following additional operations prior to loading and executing "grep":

- ✓ **open** the "**x.txt**" file;
- ✓ **redirect stdout** entry of the **FDT** to the "**x.txt**" file;
- ✓ **close** the original "**x.txt**" file handle.

Section III. Project-3 Part 3 Report

Do not submit a result if your program does not work as specified. Perform the following to prepare your submission:

- ✓ add a comment line to your program consisting of your name and student-id**;** and store it in the "**Prj3-Part3**" folder, located at the course web site under the tab **CSE5031-X/Assignment**; where "**X**" stands for (A,B,C,D) your laboratory session group you are registered;
- ✓ if **phase 2** is operational store also the **x.txt** file.

Warning

You are encouraged to discuss the implementation procedures and general concepts behind the projects with your fellow students. However, **plagiarism is strictly forbidden**! Submitted report should be the result of **your personal work**!

Be advised that you are **accountable** of your submission not only for this project, but also for the mid-term, and final examinations. Your project grade may be reevaluated retrospectively, had you fail to answer correctly the same or a similar examination questions that you have solved with success in your submissions.