

哈尔滨工业大学

实验报告

实验（六）

题 目 TinyShell
微壳

专 业 计算机类

学 号 1170300817

班 级 1703008

学 生 林之浩

指 导 教 师 郑贵滨

实 验 地 点 G712

实 验 日 期 11.19

计算机科学与技术学院

目 录

第 1 章 实验基本信息	- 3 -
1.1 实验目的	- 3 -
1.2 实验环境与工具	- 3 -
1.2.1 硬件环境	- 3 -
1.2.2 软件环境	- 3 -
1.2.3 开发工具	- 3 -
1.3 实验预习	- 3 -
第 2 章 实验预习	- 4 -
2.1 进程的概念、创建和回收方法（5 分）	- 4 -
2.2 信号的机制、种类（5 分）	- 4 -
2.3 信号的发送方法、阻塞方法、处理程序的设置方法（5 分）	- 5 -
2.4 什么是 SHELL，功能和处理流程（5 分）	- 5 -
第 3 章 TINY SHELL 测试	- 6 -
3.1 TINY SHELL 设计	- 6 -
第 4 章 总结	- 20 -
4.1 请总结本次实验的收获	- 20 -
4.2 请给出对本次实验内容的建议	- 20 -
参考文献	- 22 -

第 1 章 实验基本信息

1.1 实验目的

理解现代计算机系统进程与并发的基本知识
掌握 linux 异常控制流和信号机制的基本原理和相关系统函数
掌握 shell 的基本原理和实现方法
深入理解 Linux 信号响应可能导致的并发冲突及解决方法
培养 Linux 下的软件系统开发与测试能力

1.2 实验环境与工具

1.2.1 硬件环境

X64 CPU; 2GHz; 2G RAM; 256GHD Disk 以上

1.2.2 软件环境

Windows7 64 位以上; VirtualBox/Vmware 11 以上

1.2.3 开发工具

Ubuntu 16.04 LTS 64 位/优麒麟 64 位

1.3 实验预习

上实验课前, 必须认真预习实验指导书 (PPT 或 PDF)
了解实验的目的、实验环境与软硬件工具、实验操作步骤, 复习与实验有关的理论知识。
了解进程、作业、信号的基本概念和原理
了解 shell 的基本原理
熟知进程创建、回收的方法和相关系统函数
熟知信号机制和信号处理相关的系统函数

第 2 章 实验预习

总分 20 分

2.1 进程的概念、创建和回收方法（5 分）

进程（Process）是计算机中的程序关于某数据集合上的一次运行活动，是系统进行资源分配和调度的基本单位，是[操作系统](#)结构的基础。在早期面向进程设计的计算机结构中，进程是程序的基本执行实体；在当代面向线程设计的计算机结构中，进程是线程的容器。程序是指令、数据及其组织形式的描述，进程是程序的实体。

每次用户通过向 shell 输入一个可知性目标文件的名字，运行程序是，shell 就会创建一个新的进程，然后在这个新进程的上下文中运行这个可执行文件。应用成徐也能欧创建新锦成，并且在这个新进程的上下文中运行它们自己的代码或其他应用程序。

可以通过调用 `fork()` 函数的方法来实现创建新进程。该函数返回值为若在子进程中则返回 0，父进程则返回子进程的 PID，如果出现错误就返回 -1。

可以通过调用 `waitpid()` 函数的方法来实现回收进程，当然，一个子进程可通过它的父进程回收也可通过内核安排 `init` 进程来回收。

2.2 信号的机制、种类（5 分）

软中断信号（signal，又简称为信号）用来通知进程发生了异步事件。在软件层次上是对中断机制的一种模拟，在原理上，一个进程收到一个信号与处理器收到一个中断请求可以说是一样的。信号是进程间通信机制中唯一的异步通信机制，一个进程不必通过任何操作来等待信号的到达，事实上，进程也不知道信号到底什么时候到达。进程之间可以互相通过系统调用 `kill` 发送软中断信号。内核也可以因为内部事件而给进程发送信号，通知进程发生了某个事件。信号机制除了基本通知功能外，还可以传递附加信息。

常见信号包括：

1) SIGHUP 2) SIGINT 3) SIGQUIT 4) SIGILL 5) SIGTRAP
6) SIGABRT 7) SIGBUS 8) SIGFPE 9) SIGKILL 10) SIGUSR1
11) SIGSEGV 12) SIGUSR2 13) SIGPIPE 14) SIGALRM 15) SIGTERM
16) SIGSTKFLT 17) SIGCHLD 18) SIGCONT 19) SIGSTOP 20) SIGTSTP
21) SIGTTIN 22) SIGTTOU 23) SIGURG 24) SIGXCPU 25) SIGXFSZ
26) SIGVTALRM 27) SIGPROF 28) SIGWINCH 29) SIGIO 30) SIGPWR
31) SIGSYS 34) SIGRTMIN 35) SIGRTMIN+1 36) SIGRTMIN+2 37) SIGRTMIN+3
38) SIGRTMIN+4 39) SIGRTMIN+5 40) SIGRTMIN+6 41) SIGRTMIN+7 42)
SIGRTMIN+8 43) SIGRTMIN+9 44) SIGRTMIN+10 45) SIGRTMIN+11

46) SIGRTMIN+12	47) SIGRTMIN+13		
48) SIGRTMIN+14	49) SIGRTMIN+15	50) SIGRTMAX-14	51)
SIGRTMAX-13	52) SIGRTMAX-12		
53) SIGRTMAX-11	54) SIGRTMAX-10	55) SIGRTMAX-9	56)
SIGRTMAX-8	57) SIGRTMAX-7		
58) SIGRTMAX-6	59) SIGRTMAX-5	60) SIGRTMAX-4	61)
SIGRTMAX-3	62) SIGRTMAX-2		
63) SIGRTMAX-1	64) SIGRTMAX		

2.3 信号的发送方法、阻塞方法、处理程序的设置方法（5 分）

发送方法

1. 用/bin/kill 指令向程序发送信号
2. 从键盘发送信号。当用户在键盘上输入一个 Ctrl+C 或者 Ctrl+Z 将会导致内核向前台作业发送信号。
3. 用 kill 函数发送信号。进程通过调用 kill 函数发送信号给其他进程（包括他们自己）
4. 进程可以通过调用 alarm 函数向他自己发送 SIGALRM 信号。

阻塞方法：

1. 隐式阻塞机制。内核默认阻塞任何当前处理程序正在处理信号类型的待处理的信号。
2. 显式阻塞机制。应用程序可以使用 sigprocmask 函数和它的辅助函数明确地阻塞和解除阻塞选定的信号。

处理程序的设置方法

使用 signal 函数来对信号处理程序进行设置。

`sighandler_t signal(int signum, sighandler_t handler);`

handler 就是用户定义的函数的地址，这个函数被称为信号处理函数。

2.4 什么是 shell，功能和处理流程（5 分）

Shell 是一个交互型的应用级程序，它代表用户运行其他程序。

Shell 执行一系列的读/求值步骤然后终止。该步骤读取来自用户的一个命令行。调用 `parseline` 函数，通过这个函数解析以空格分隔的命令行参数，并构造最终会传递给 `execve` 的 `argv` 向量。

求值步骤读取来自用户的一个命令行，解析该命令行，并代表用户执行程序。在解析命令后，如果是内置命令，则解析指令并执行，否则就根据相关文件路径执行可执行目标文件。

第 3 章 TinyShell 的设计与实现

总分 45 分

3.1 设计

3.1.1 void eval(char *cmdline) 函数 (10 分)

(老师已提供答案)

函数功能：完成命令行对应的指令，也就是对命令行求值

参 数：char *cmdline, cmdline 数组，存放的是用户的输入，也就是要执行的指令

处理流程：

首先把 cmdline 数组传入 parseline 函数，这个函数处理命令行，将其分割成一个个参数，保存以供以后调用。

检测这个命令是不是 shell 的内置命令：

如果是，将通过 builtin_cmd 函数处理该指令，或调用具体的函数实现。

如果不是 shell 的内置指令，fork 一个新的进程，并在新的进程中 execve 命令行要求执行的命令。

在父进程中，向 jobs 数组中添加子进程的 pid，如果这个新的任务不在后台运行，那就等待它返回，否则输出该作业的 jid 和 pid 以及该句的 cmdline。

要点分析：

1.parseline 函数，会返回这个函数是不是在后台执行，如果是返回 1。我们将这个 1 保存在 bg 这个标记中。

2.在把 job 添加到 joblist 之前我们都要屏蔽 SIGCHLD, SIGINT, 和 SIGTSTP 信号，这样可以避免在向 joblist 添加新 job 时这些信号出现，产生很难处理的竞争。

```
if (sigemptyset(&mask) < 0)
    unix_error("sigemptyset error");
if (sigaddset(&mask, SIGCHLD))
    unix_error("sigaddset error");
if (sigaddset(&mask, SIGINT))
    unix_error("sigaddset error");
if (sigaddset(&mask, SIGTSTP))
    unix_error("sigaddset error");
if (sigprocmask(SIG_BLOCK, &mask, NULL) < 0)
    unix_error("sigprocmask error");
```

3.子进程会继承它的父进程的被阻塞集合，所以在 execve 之前要用 sigprocmask(SIG_UNBLOCK, &mask, NULL); 来解除之前被阻塞的信号。

4.同理，在父进程添加作业完成后，也要解除阻塞。

3.1.2 int builtin_cmd(char **argv) 函数 (5 分)

函数功能：该函数检查第一个命令行参数是不是一个内置的 shell 命令，如果是，分辨是哪一个，并且执行相应的指令。如果不是，返回 0。

参 数：

char **argv 指向储存输入的命令和参数的数组的指针

处理流程：

主要利用 if... else if 结构实现把命令和 "quit", "jobs", "bg", "fg" 这几个内置命令挨个比较。

如果是 quit 命令，直接退出。

如果是 jobs 命令，就输出当前的 joblist。

如果是 bg 或是 fg，就执行 do_bgfg(argv); 这个函数将具体实现前台后台运行命令。

如果不是内置 shell 指令，返回 0，让 eval 处理这个命令。

要点分析：

先判断第一个元素是不是空，是空直接返回，之所以要最早判断是因为如果是空指针，下面会产生空指针访问错误。

3.1.3 void do_bgfg(char **argv) 函数 (5 分)

(老师已提供答案)

函数功能：由 builtin_cmd 函数调用，用来执行内置的 bg 和 fg 指令

参 数：char **argv 指向储存输入的命令和参数的数组的指针

处理流程：

1. 分析命令，判断是 bg 还是 fg
2. 解析 PID 或 %JID 声明。
3. 如果是 bg，把作业的状态改为 BG，向进程组发送 SIGCONT 信号。
4. 如果是 fg，将该进程的状态修改为 FG，并使用 waitfg() 函数执行这个指令。

要点分析：

1. 开始时要检测输入的各项是否符合要求，包括空命令返回 command requires PID or jobid argument，如果没有这个 jobpid 输出 No such process，如果没有这个 jobjid 输出 No such job，其他 id 错误输出 argument must be a PID

or %%jobid

2. fg 命令中，需要调用 waitfg 函数等待前台进程进行。暂时停止 tsh。

3. 1.4 void waitfg(pid_t pid) 函数 (5 分)

函数功能：等待前台进程的完成

参 数：pid_t pid 等待的进程的 pid

处理流程：

执行这个函数之前，需要设置一个 volatile sig_atomic_t 类型的全局变量，利用这个变量来判断循环是否继续。在 waitfg 函数中将这个全局变量设置为 1，然后利用一个 while 循环来对其值进行检测。直到值清零。与此同时，在 sigchld_handler 处理函数中，当一个前台作业结束的时候，就将全局变量置为 0，

要点分析：全局变量可以设置成 volatile sig_atomic 类型，因为这个类型保证了对它的操作必须是一个原子操作，也就是说不能够被信号打断。这样就能够保证在运行时不会由于竞争而产生错误。

3. 1.5 void sigchld_handler(int sig) 函数 (10 分)

函数功能：SIGCHLD 信号的处理函数

参 数：int sig 待处理信号

处理流程：

1. 处理停止或终止的子进程。如果子进程正常终止，则先阻塞信号，删除进程，再恢复信号。
2. 如果子进程已经停止则打印信息。
3. 如果子进程是因一个信号终止，信号未被捕获，则打印信息，阻塞信号，删除进程后恢复信号。

要点分析：

1. 以 WNOHANG|WUNTRACED 参数调用 waitpid () 函数，该参数在等待集合中有一个停止或终止的子进程则返回 pid，没有则返回 0。
2. 通过 status，判断子进程的不同的返回状态。

3.2 程序实现 (tsh.c 的全部内容) (10 分)

重点检查代码风格：

- (1) 用较好的代码注释说明——5 分
- (2) 检查每个系统调用的返回值——5 分

第 4 章 TinyShell 测试

总分 15 分

4.1 测试方法

针对 tsh 和参考 shell 程序 tshref，完成测试项目 4.1-4.15 的对比测试，并将测试结果截图或者通过重定向保存到文本文件(例如：./sdriver.pl -t trace01.txt -s ./tsh -a "-p" > tshresult01.txt)。

4.2 测试结果评价

tsh 与 tshref 的输出在一下两个方面可以不同：

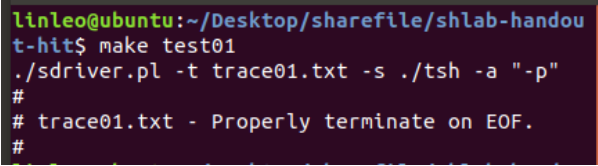
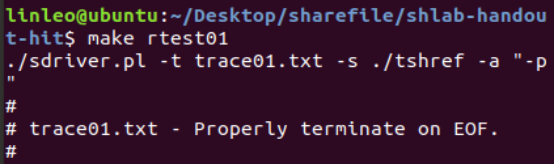
(1) PID

(2)测试文件 trace11.txt, trace12.txt 和 trace13.txt 中的/bin/ps 命令，每次运行的输出都会不同，但每个 mysplit 进程的运行状态应该相同。

除了上述两方面允许的差异，tsh 与 tshref 的输出相同则判为正确，如不同则给出原因分析。

4.3 自测试结果

4.3.1 测试用例 trace01.txt 的输出截图（1 分）

tsh 测试结果		tshref 测试结果	
			
测试结论	相同		

4.3.2 测试用例 trace02.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
----------	-------------

<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make test02 ./sdriver.pl -t trace02.txt -s ./tsh -a "-p" # # trace02.txt - Process builtin quit command. #</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make rtest02 ./sdriver.pl -t trace02.txt -s ./tshref -a "-p" # # trace02.txt - Process builtin quit command. #</pre>
测试结论	相同

4.3.3 测试用例 trace03.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make test03 ./sdriver.pl -t trace03.txt -s ./tsh -a "-p" # # trace03.txt - Run a foreground job. # tsh> quit</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make rtest03 ./sdriver.pl -t trace03.txt -s ./tshref -a "-p" # # trace03.txt - Run a foreground job. # tsh> quit</pre>
测试结论	相同

4.3.4 测试用例 trace04.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make test04 ./sdriver.pl -t trace04.txt -s ./tsh -a "-p" # # trace04.txt - Run a background job. # tsh> ./myspin 1 & [1] (2186) ./myspin 1 &</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make rtest04 ./sdriver.pl -t trace04.txt -s ./tshref -a "-p" # # trace04.txt - Run a background job. # tsh> ./myspin 1 & [1] (2623) ./myspin 1 &</pre>
测试结论	相同

4.3.5 测试用例 trace05.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
----------	-------------

<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-h it\$ make test05 ./sdriver.pl -t trace05.txt -s ./tsh -a "-p" # # trace05.txt - Process jobs builtin command. # tsh> ./myspin 2 & [1] (2214) ./myspin 2 & tsh> ./myspin 3 & [2] (2216) ./myspin 3 & tsh> jobs [1] (2214) Running ./myspin 2 & [2] (2216) Running ./myspin 3 &</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make rtest05 ./sdriver.pl -t trace05.txt -s ./tshref -a "-p" # # trace05.txt - Process jobs builtin command. # tsh> ./myspin 2 & [1] (2629) ./myspin 2 & tsh> ./myspin 3 & [2] (2631) ./myspin 3 & tsh> jobs [1] (2629) Running ./myspin 2 & [2] (2631) Running ./myspin 3 &</pre>
测试结论	相同

4.3.6 测试用例 trace06.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-h it\$ make test06 ./sdriver.pl -t trace06.txt -s ./tsh -a "-p" # # trace06.txt - Forward SIGINT to foreground job. # tsh> ./myspin 4 Job [1] (2223) terminated by signal 2</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make rtest06 ./sdriver.pl -t trace06.txt -s ./tshref -a "-p" # # trace06.txt - Forward SIGINT to foreground job. # tsh> ./myspin 4 Job [1] (2638) terminated by signal 2</pre>
测试结论	相同

4.3.7 测试用例 trace07.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-h it\$ make test07 ./sdriver.pl -t trace07.txt -s ./tsh -a "-p" # # trace07.txt - Forward SIGINT only to foreground job. # tsh> ./myspin 4 & [1] (2231) ./myspin 4 & tsh> ./myspin 5 Job [2] (2233) terminated by signal 2 tsh> jobs [1] (2231) Running ./myspin 4 &</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make rtest07 ./sdriver.pl -t trace07.txt -s ./tshref -a "-p" # # trace07.txt - Forward SIGINT only to foreground job. # tsh> ./myspin 4 & [1] (2644) ./myspin 4 & tsh> ./myspin 5 Job [2] (2646) terminated by signal 2 tsh> jobs [1] (2644) Running ./myspin 4 &</pre>
测试结论	相同

4.3.8 测试用例 trace08.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
----------	-------------

<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-h it\$ make test08 ./sdriver.pl -t trace08.txt -s ./tsh -a "-p" # # trace08.txt - Forward SIGTSTP only to foreground job. # tsh> ./myspin 4 & [1] (2240) ./myspin 4 & tsh> ./myspin 5 Job [2] (2242) stopped by signal 20 tsh> jobs [1] (2240) Running ./myspin 4 & [2] (2242) Stopped ./myspin 5</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make rtest08 ./sdriver.pl -t trace08.txt -s ./tshref -a "-p" # # trace08.txt - Forward SIGTSTP only to foreground job. # tsh> ./myspin 4 & [1] (2653) ./myspin 4 & tsh> ./myspin 5 Job [2] (2655) stopped by signal 20 tsh> jobs [1] (2653) Running ./myspin 4 & [2] (2655) Stopped ./myspin 5</pre>
测试结论	相同

4.3.9 测试用例 trace09.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make test09 ./sdriver.pl -t trace09.txt -s ./tsh -a "-p" # # trace09.txt - Process bg builtin command # tsh> ./myspin 4 & [1] (2896) ./myspin 4 & tsh> ./myspin 5 Job [2] (2898) stopped by signal 20 tsh> jobs [1] (2896) Running ./myspin 4 & [2] (2898) Stopped ./myspin 5 tsh> bg %2 [2] (2898) ./myspin 5 tsh> jobs [1] (2896) Running ./myspin 4 & [2] (2898) Running ./myspin 5</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make rtest09 ./sdriver.pl -t trace09.txt -s ./tshref -a "-p" # # trace09.txt - Process bg builtin command # tsh> ./myspin 4 & [1] (2663) ./myspin 4 & tsh> ./myspin 5 Job [2] (2665) stopped by signal 20 tsh> jobs [1] (2663) Running ./myspin 4 & [2] (2665) Stopped ./myspin 5 tsh> bg %2 [2] (2665) ./myspin 5 tsh> jobs [1] (2663) Running ./myspin 4 & [2] (2665) Running ./myspin 5</pre>
测试结论	相同

4.3.10 测试用例 trace10.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make test10 ./sdriver.pl -t trace10.txt -s ./tsh -a "-p" # # trace10.txt - Process fg builtin command. # tsh> ./myspin 4 & [1] (2908) ./myspin 4 & tsh> fg %1 Job [1] (2908) stopped by signal 20 tsh> jobs [1] (2908) Stopped ./myspin 4 & tsh> fg %1 tsh> jobs</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout -hit\$ make rtest10 ./sdriver.pl -t trace10.txt -s ./tshref -a "-p" # # trace10.txt - Process fg builtin command. # tsh> ./myspin 4 & [1] (2675) ./myspin 4 & tsh> fg %1 Job [1] (2675) stopped by signal 20 tsh> jobs [1] (2675) Stopped ./myspin 4 & tsh> fg %1 tsh> jobs</pre>
测试结论	相同

4.3.11 测试用例 trace11.txt 的输出截图 (1 分)

tsh 测试结果	tshref 测试结果
<pre> lnleogubuntu:/Desktop/sharefile/shlab-handout-blt5 make test11 ./driver.pl -t trace11.txt -s ./tsh -a "-p" # # trace11.txt - Forward SIGINT to every process in foreground process group # tsh> ./mysplit 4 Job [1] (2931) terminated by signal 2 tsh> /bin/ps a PID TTY STAT TIME COMMAND 824 tty1 Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autos tart /usr/share/gdm/greeter/autostart 832 tty1 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr/share/gdm/greeter/autostart 880 tty1 Sl+ 0:00 /usr/bin/gnome-shell 1024 tty1 Sl+ 0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx - core -listen 4 -listen 5 -displayfd 6 1211 tty1 Sl 0:00ibus-daemon -xtn --panel disable 1214 tty1 Sl 0:00 /usr/lib/ibus/ibus-dconf 1218 tty1 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1241 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-ally-settings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1247 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1249 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1251 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1252 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1253 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1259 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1260 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1264 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1265 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1269 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1272 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1385 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL SESSION_MODE=ubuntu gnome-session -session=ubuntu 0/gdm/Authority -background none -norest -keeppty -verbose 3 1398 tty2 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --sessionnu buntu 1502 tty2 Sl+ 0:38 /usr/bin/gnome-shell 1536 tty2 Sl 0:00ibus-daemon -xtn --panel disable 1540 tty2 Sl 0:00 /usr/lib/ibus/ibus-dconf 1542 tty2 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1612 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1615 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1618 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1619 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1620 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1622 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1625 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1629 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1632 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1648 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1649 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1650 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-ally-settings 1651 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1652 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1657 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1661 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1666 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1669 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer 1713 tty2 Sl+ 0:03 nautilus-desktop 1715 tty2 Sl+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify 1723 tty2 Sl+ 0:02 /usr/bin/vmtoolsd -n vmusr -blockfd 3 1764 tty2 Sl 0:00 /usr/lib/ibus/ibus-engine-stmple 1881 tty2 Sl+ 0:00 update-notifier 1883 tty2 Sl+ 0:03 /usr/bin/gnome-software -gapplication-service 1888 tty2 Z+ 0:00 [livepatch-notif] <default> 1889 tty2 Z+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 1890 tty2 Z+ 0:00 [livepatch-notif] <default> 1982 tty2 Sl+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 2883 pts/0 S+ 0:00 bash 2926 pts/0 S+ 0:00 make test11 2927 pts/0 S+ 0:00 /bin/sh -c ./driver.pl -t trace11.txt -s ./tsh -a "-p" 2928 pts/0 S+ 0:00 /usr/bin/perl ./driver.pl -t trace11.txt -s ./tsh -a "-p" </pre>	<pre> lnleogubuntu:/Desktop/sharefile/shlab-handout-blt5 make rtest11 ./driver.pl -t trace11.txt -s ./tshref -a "-p" # # trace11.txt - Forward SIGINT to every process in foreground process group # tsh> ./mysplit 4 Job [1] (2994) terminated by signal 2 tsh> /bin/ps a PID TTY STAT TIME COMMAND 824 tty1 Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autos tart /usr/share/gdm/greeter/autostart 832 tty1 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr/share/gdm/greeter/autostart 880 tty1 Sl+ 0:04 /usr/bin/gnome-shell 1024 tty1 S+ 0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx - core -listen 4 -listen 5 -displayfd 6 1211 tty1 Sl 0:00ibus-daemon -xtn --panel disable 1214 tty1 Sl 0:00 /usr/lib/ibus/ibus-dconf 1218 tty1 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1241 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-ally-settings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1249 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1251 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1252 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1253 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1259 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1260 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1264 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1265 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1269 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1272 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1291 tty1 Sl+ 0:00 /usr/lib/ibus/ibus-engine-simple 1385 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL SESSION_MODE=ubuntu gnome-session -session=ubuntu 0/gdm/Authority -background none -norest -keeppty -verbose 3 1387 tty2 Sl+ 0:20 /usr/lib/Xorg/Xorg vt2 -displayfd 3 -auth /run/user/100 0/gdm/Authority -background none -norest -keeppty -verbose 3 1398 tty2 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --sessionnu buntu 1502 tty2 Sl+ 0:50 /usr/bin/gnome-shell 1536 tty2 Sl 0:00ibus-daemon -xtn --panel disable 1540 tty2 Sl 0:00 /usr/lib/ibus/ibus-dconf 1542 tty2 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1612 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1615 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1618 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1619 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1620 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1622 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1625 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1629 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1632 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1648 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1649 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1650 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-ally-settings 1651 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1652 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1657 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1661 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1666 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1669 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer 1713 tty2 Sl+ 0:04 nautilus-desktop 1715 tty2 Sl+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify 1723 tty2 Sl+ 0:03 /usr/bin/vmtoolsd -n vmusr -blockfd 3 1764 tty2 Sl 0:00 /usr/lib/ibus/ibus-engine-simple 1881 tty2 Sl+ 0:00 update-notifier 1883 tty2 Sl+ 0:03 /usr/bin/gnome-software -gapplication-service 1890 tty2 Z+ 0:00 [livepatch-notif] <default> 1982 tty2 Sl+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 2883 pts/0 S+ 0:00 bash 2926 pts/0 S+ 0:00 make test11 2927 pts/0 S+ 0:00 /bin/sh -c ./driver.pl -t trace11.txt -s ./tshref -a "-p" 2928 pts/0 S+ 0:00 /usr/bin/perl ./driver.pl -t trace11.txt -s ./tshref -a "-p" 2991 pts/0 S+ 0:00 /usr/bin/perl ./driver.pl -t trace11.txt -s ./tshref -a "-p" 2992 pts/0 S+ 0:00 /usr/lib/per .driver.pl -t trace11.txt -s ./tshref -a "-p" 2997 pts/0 R 0:00 /bin/ps a </pre>
测试结论	相同

4.3.12 测试用例 trace12.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
----------	-------------


```

lin@leobuntu:~/Desktop/sharefile$ shlab-handout-hits make test12
./sdriver.pl -t trace12.txt -s ./tshf -a "-p"
#
# trace12.txt - Forward SIGTSTP to every process in foreground process group

tsh> ./mysplit 4
Job [1] (3381) stopped by signal 20
tsh> jobs
[1] (3381) Stopped ./mysplit 4
tsh> /bin/ps a
PID TTY STAT TIME COMMAND
824 ttty Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autostart
./usr/share/gdm/greeter/autostart
832 ttty Ssl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr
r/share/gdm/greeter/autostart
880 ttty Ssl+ 0:04 /usr/bin/gnome-shell
1010 ttty S+ 0:00 /usr/bin/Xwayland:1024 -rootless -terminate -accessx -core
-listen 4 -listen 5 -displayfd 0
1211 ttty Ssl+ 0:00 /bus-daemon -xln -panel disable
1214 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-dconf
1218 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-x11 -kill-daemon
1241 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
1245 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
1246 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clippboard
1247 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color
1249 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
1251 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
1252 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
1253 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
1255 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
1257 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power
1259 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
1260 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
1264 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
1265 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
1269 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
1272 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound
1276 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
1291 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-engine-simple
1385 ttty Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SE
SSION_MODE=ubuntu gnome-session --session=ubuntu
L SESSION_MODE=ubuntu gnome-session --session=ubuntu
1385 ttty Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL
L SESSION_MODE=ubuntu gnome-session --session=ubuntu
0/gdm/Authority -background none -noreset -keeptry -verbose 3 -auth /run/user/1000/gd
1398 ttty Ssl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubunt
u
1502 ttty Ssl+ 1:02 /usr/bin/gnome-shell
1536 ttty Ssl+ 0:00 /bus-daemon -xln -panel disable
1540 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-dconf
1542 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-x11 -kill-daemon
1612 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power
1615 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
1618 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
1619 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
1620 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
1622 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
1625 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound
1629 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
1632 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
1648 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clippboard
1649 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color
1650 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
1651 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
1652 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
1657 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
1661 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
1662 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
1669 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer
1713 ttty Ssl+ 0:04 nautilus-desktop
1715 ttty Ssl+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
1723 ttty Ssl+ 0:04 /usr/bin/vmtoolsd -n vmusr -blockfd 3
1764 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-engine-simple
1881 ttty Ssl+ 0:00 update-notifier
1883 ttty Ssl+ 0:03 /usr/bin/gnome-software --application-service
1890 ttty Z+ 0:00 [liveratch-notif] <defunct>
1982 ttty Ssl+ 0:00 /usr/lib/deja-dup/deja-dup-monitor
2883 pts/0 S+ 0:00 bash
3376 pts/0 S+ 0:00 make test12
3377 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace12.txt -s ./tshf -a "-p"
3378 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tshf -a "-p"

3378 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tshf -a "-p"
3379 pts/0 S+ 0:03 /usr/bin/sh ./tshf -p
3381 pts/0 T 0:00 ./mysplit 4
3382 pts/0 T 0:00 ./mysplit 4
3385 pts/0 R 0:00 /bin/ps a

lin@leobuntu:~/Desktop/sharefile$ shlab-handout-hits make rtest12
./sdriver.pl -t trace12.txt -s ./tshrf -a "-p"
#
# trace12.txt - Forward SIGTSTP to every process in foreground process group

tsh> ./mysplit 4
Job [1] (3806) stopped by signal 20
tsh> jobs
[1] (3806) Stopped ./mysplit 4
tsh> /bin/ps a
PID TTY STAT TIME COMMAND
824 ttty Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autos
tart /usr/share/gdm/greeter/autostart
832 ttty Ssl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart
./usr/share/gdm/greeter/autostart
880 ttty Ssl+ 0:04 /usr/bin/gnome-shell
1010 ttty S+ 0:00 /usr/bin/Xwayland:1024 -rootless -terminate -accessx -
core-listen 4 -listen 5 -displayfd 0
1211 ttty Ssl+ 0:00 /bus-daemon -xln -panel disable
1214 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-dconf
1218 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-x11 -kill-daemon
1241 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
1245 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
1246 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clippboard
1247 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color
1249 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
1251 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
1252 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
1253 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
1255 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
1257 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power
1259 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
1260 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
1264 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
1265 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
1269 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
1272 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound
1276 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
1291 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-engine-simple
1385 ttty Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL
L SESSION_MODE=ubuntu gnome-session --session=ubuntu
1385 ttty Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL
L SESSION_MODE=ubuntu gnome-session --session=ubuntu
0/gdm/Authority -background none -noreset -keeptry -verbose 3 -auth /run/user/100
1398 ttty Ssl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubun
tu
1502 ttty Ssl+ 1:02 /usr/bin/gnome-shell
1536 ttty Ssl+ 0:00 /bus-daemon -xln -panel disable
1540 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-dconf
1542 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-x11 -kill-daemon
1612 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power
1615 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications
1618 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill
1619 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy
1620 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing
1622 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard
1625 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound
1629 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings
1632 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom
1648 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clippboard
1649 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color
1650 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings
1651 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping
1652 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard
1657 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime
1661 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse
1662 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys
1669 ttty Ssl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer
1713 ttty Ssl+ 0:04 nautilus-desktop
1715 ttty Ssl+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify
1723 ttty Ssl+ 0:03 /usr/bin/vmtoolsd -n vmusr -blockfd 3
1764 ttty Ssl+ 0:00 /usr/lib/ibus/ibus-engine-simple
1881 ttty Ssl+ 0:00 update-notifier
1883 ttty Ssl+ 0:03 /usr/bin/gnome-software --application-service
1890 ttty Z+ 0:00 [liveratch-notif] <defunct>
1982 ttty Ssl+ 0:00 /usr/lib/deja-dup/deja-dup-monitor
2883 pts/0 S+ 0:00 bash
3002 pts/0 S+ 0:00 make rtest12
3002 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace12.txt -s ./tshrf -a "-
-p"
3003 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tshrf -a "-
-p"
3003 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tshrf -a "-
-p"

3004 pts/0 S+ 0:00 ./tshrf -p
3006 pts/0 T 0:00 ./mysplit 4
3007 pts/0 T 0:00 ./mysplit 4
30
```

4.3.13 测试用例 trace13.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
----------	-------------

计算机系统实验报告

<pre> lin@ubuntu:~/Desktop/sharefile/shlab-handout-hits\$ make test13 ./sdriver.pl -t trace13.txt -s ./tsh -a "p" # # trace13.txt - Restart every stopped process in process group # tsh> ./mysplit 4 Job [1] (3199) stopped by signal 20 tsh> jobs [1] (3199) Stopped ./mysplit 4 tsh> /bin/ps a PID TTY STAT TIME COMMAND 824 tty1 Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autostart /usr/share/gdm/greeter/autostart 832 tty1 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr/share/gdm/greeter/autostart 880 tty1 Sl+ 0:04 /usr/bin/gnome-shell 1010 tty1 S+ 0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx -core -listen 4 -listen 5 -display 6 1211 tty1 Sl 0:00 ibus-daemon --xim --panel disable 1214 tty1 Sl 0:00 /usr/lib/ibus/ibus-dconf 1218 tty1 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1241 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1245 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1247 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1249 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1251 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1252 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1253 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1255 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1259 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1260 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1264 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1265 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1269 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1272 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1291 tty1 Sl 0:00 /usr/lib/ibus/ibus-engine-simple 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1291 tty1 Sl+ 0:00 /usr/lib/ibus/ibus-engine-simple 1385 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SE SSION_MODE=ubuntu gnome-session --session=ubuntu n/Xauthority -background none -noretset -keeppty -verbose 3 1398 tty2 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubuntu 1502 tty2 Sl+ 0:58 /usr/bin/gnome-shell 1536 tty2 Sl 0:00 ibus-daemon --xim --panel disable 1540 tty2 Sl 0:00 /usr/lib/ibus/ibus-dconf 1542 tty2 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1612 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1615 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1618 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1619 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1620 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1622 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1625 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1629 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1632 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1648 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1649 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1650 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1651 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1652 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1657 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1661 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1666 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1689 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer 1713 tty2 Sl+ 0:04 nautilus-desktop 1715 tty2 Sl+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify 1723 tty2 Sl+ 0:04 /usr/bin/vmtoolsd -n vmusr -blockfd 3 1764 tty2 Sl+ 0:00 /usr/lib/ibus/ibus-engine-simple 1881 tty2 Sl+ 0:00 update-notifier 1883 tty2 Ssl+ 0:03 /usr/bin/gnome-software --gapplication-service 1890 tty2 Z+ 0:00 [livepatch-notif] <defunct> 1982 tty2 Sl+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 2883 pts/0 Ss 0:00 bash 3194 pts/0 Ss 0:00 make test13 3195 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a "p" 3196 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh -a "p" 3197 pts/0 S+ 0:00 ./tsh -p 3199 pts/0 T 0:00 ./mysplit 4 3200 pts/0 T 0:00 ./mysplit 4 3203 pts/0 R 0:00 /bin/ps a tsh> fg %1 tsh> /bin/ps a PID TTY STAT TIME COMMAND 824 tty1 Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autostart /usr/share/gdm/greeter/autostart 832 tty1 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr/share/gdm/greeter/autostart 880 tty1 Sl+ 0:04 /usr/bin/gnome-shell 1010 tty1 S+ 0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx -core -listen 4 -listen 5 -display 6 1211 tty1 Sl 0:00 ibus-daemon --xim --panel disable 1214 tty1 Sl 0:00 /usr/lib/ibus/ibus-dconf 1218 tty1 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1241 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1245 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1247 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1249 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1251 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1252 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1253 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1255 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1259 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1260 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1264 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1265 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1269 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1272 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1291 tty1 Sl 0:00 /usr/lib/ibus/ibus-engine-simple 1385 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SE SSION_MODE=ubuntu gnome-session --session=ubuntu n/Xauthority -background none -noretset -keeppty -verbose 3 1387 tty2 Sl+ 0:29 /usr/lib/Xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gd n/Xauthority -background none -noretset -keeppty -verbose 3 </pre>	<pre> lin@ubuntu:~/Desktop/sharefile/shlab-handout-hits\$ make rtest13 ./sdriver.pl -t trace13.txt -s ./tshref -a "p" # # trace13.txt - Restart every stopped process in process group # tsh> ./mysplit 4 Job [1] (3215) stopped by signal 20 tsh> jobs [1] (3215) Stopped ./mysplit 4 tsh> /bin/ps a PID TTY STAT TIME COMMAND 824 tty1 Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autostart /usr/share/gdm/greeter/autostart 832 tty1 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr/share/gdm/greeter/autostart 880 tty1 Sl+ 0:04 /usr/bin/gnome-shell 1010 tty1 S+ 0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx -core -listen 4 -listen 5 -display 6 1211 tty1 Sl 0:00 ibus-daemon --xim --panel disable 1214 tty1 Sl 0:00 /usr/lib/ibus/ibus-dconf 1218 tty1 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1241 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1245 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1247 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1249 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1251 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1252 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1253 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1255 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1259 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1260 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1264 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1265 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1269 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1272 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1291 tty1 Sl 0:00 /usr/lib/ibus/ibus-engine-simple 1385 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SE SSION_MODE=ubuntu gnome-session --session=ubuntu n/Xauthority -background none -noretset -keeppty -verbose 3 1502 tty2 Sl+ 1:00 /usr/bin/gnome-shell 1540 tty2 Sl 0:00 ibus-daemon --xim --panel disable 1542 tty2 Sl 0:00 /usr/lib/ibus/ibus-dconf 1612 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1615 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1619 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1620 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1622 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1625 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1632 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1648 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1649 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1650 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1651 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1652 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1657 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1661 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1666 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1689 tty2 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer 1713 tty2 Sl+ 0:04 nautilus-desktop 1715 tty2 Sl+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify 1723 tty2 Sl+ 0:04 /usr/bin/vmtoolsd -n vmusr -blockfd 3 1764 tty2 Sl 0:00 update-notifier 1881 tty2 Sl+ 0:00 /usr/bin/gnome-software --gapplication-service 1890 tty2 Z+ 0:00 [livepatch-notif] <defunct> 1982 tty2 Sl+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 2883 pts/0 Ss 0:00 bash 3210 pts/0 S+ 0:00 make rtest13 3211 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref -a "p" 3212 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a "p" 3213 pts/0 S+ 0:00 ./tshref -p 3215 pts/0 T 0:00 ./mysplit 4 3216 pts/0 T 0:00 ./mysplit 4 3219 pts/0 R 0:00 /bin/ps a tsh> fg %1 tsh> /bin/ps a PID TTY STAT TIME COMMAND 824 tty1 Ssl+ 0:00 /usr/lib/gdm3/gdm-wayland-session gnome-session --autostart /usr/share/gdm/greeter/autostart 832 tty1 Sl+ 0:00 /usr/lib/gnome-session/gnome-session-binary --autostart /usr/share/gdm/greeter/autostart 880 tty1 Sl+ 0:04 /usr/bin/gnome-shell 1010 tty1 S+ 0:00 /usr/bin/Xwayland :1024 -rootless -terminate -accessx -core -listen 4 -listen 5 -display 6 1211 tty1 Sl 0:00 ibus-daemon --xim --panel disable 1214 tty1 Sl 0:00 /usr/lib/ibus/ibus-dconf 1218 tty1 Sl 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1241 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1245 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1246 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1247 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1249 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1251 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1252 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1253 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1255 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1257 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1259 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1260 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1264 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1265 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1269 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1272 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1275 tty1 Sl+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1291 tty1 Sl 0:00 /usr/lib/ibus/ibus-engine-simple 1385 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SE SSION_MODE=ubuntu gnome-session --session=ubuntu n/Xauthority -background none -noretset -keeppty -verbose 3 </pre>
---	---

<pre> n/Authority -background none -noreset -keeppty -verbose 3 1398 tty2 S+ 0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubuntu 1502 tty2 S+ 0:58 /usr/bin/gnome-shell 1536 tty2 S+ 0:00 /usr/bin/gnome-shell --panel disable 1540 tty2 S+ 0:00 /usr/lib/ibus/ibus-dconf 1542 tty2 S+ 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1612 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1615 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1618 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1619 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1620 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1622 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1625 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1629 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1632 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1648 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1649 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1650 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1651 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1652 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1657 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1661 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1666 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1689 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer 1713 tty2 S+ 0:04 nautilus-desktop 1715 tty2 S+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify 1723 tty2 S+ 0:04 /usr/bin/vmtoolsd -n vmusr -blockFd 3 1764 tty2 S+ 0:00 /usr/lib/ibus/ibus-engine-simple 1881 tty2 S+ 0:00 update-notifier 1883 tty2 S+ 0:03 /usr/bin/gnome-software --gapplication-service 1890 tty2 S+ 0:00 [livepatch-notif] <default> 1982 tty2 S+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 2083 pts/0 Ss 0:00 bash 3194 pts/0 S+ 0:00 make test13 3195 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a "-p" 3196 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh -a "-p" 3197 pts/0 S+ 0:00 ./tsh -p 3206 pts/0 R 0:00 /bin/ps a linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit5 </pre>		<pre> 1398 tty2 S+ 0:00 /usr/lib/gnome-session/gnome-session-binary --session=ubuntu 1502 tty2 S+ 1:00 /usr/bin/gnome-shell 1536 tty2 S+ 0:00 /usr/bin/gnome-shell --panel disable 1540 tty2 S+ 0:00 /usr/lib/ibus/ibus-dconf 1542 tty2 S+ 0:00 /usr/lib/ibus/ibus-x11 --kill-daemon 1612 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-power 1615 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-print-notifications 1618 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-rfkill 1619 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-screensaver-proxy 1620 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sharing 1622 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-smartcard 1625 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-sound 1629 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-xsettings 1632 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-wacom 1648 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-clipboard 1649 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-color 1650 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-a11y-settings 1651 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-housekeeping 1652 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-keyboard 1657 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-datetime 1661 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-mouse 1666 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-media-keys 1689 tty2 S+ 0:00 /usr/lib/gnome-settings-daemon/gsd-printer 1713 tty2 S+ 0:04 nautilus-desktop 1715 tty2 S+ 0:00 /usr/lib/gnome-disk-utility/gsd-disk-utility-notify 1723 tty2 S+ 0:04 /usr/bin/vmtoolsd -n vmusr -blockFd 3 1764 tty2 S+ 0:00 /usr/lib/ibus/ibus-engine-simple 1881 tty2 S+ 0:00 update-notifier 1883 tty2 S+ 0:03 /usr/bin/gnome-software --gapplication-service 1890 tty2 S+ 0:00 [livepatch-notif] <default> 1982 tty2 S+ 0:00 /usr/lib/deja-dup/deja-dup-monitor 2083 pts/0 Ss 0:00 bash 3210 pts/0 S+ 0:00 make rtest13 3211 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref -a "-p" 3212 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a "-p" 3213 pts/0 S+ 0:00 ./tshref -p 3223 pts/0 R 0:00 /bin/ps a </pre>	
测试结论	相同		

4.3.14 测试用例 trace14.txt 的输出截图（1 分）

<p>tsh 测试结果</p> <pre> linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit5 make test14 ./sdriver.pl -t trace14.txt -s ./tsh -a "-p" # # trace14.txt - Simple error handling # tsh> ./bogus ./bogus: Command not found tsh> ./myspin 4 & [1] (3251) ./myspin 4 & tsh> fg fg command requires PID or %jobid argument tsh> bg bg command requires PID or %jobid argument tsh> fg a fg: argument must be a PID or %jobid tsh> bg a bg: argument must be a PID or %jobid tsh> fg 9999999 (9999999): No such process tsh> bg 9999999 (9999999): No such process tsh> fg %2 %2: No such job tsh> fg %1 Job [1] (3251) stopped by signal 20 tsh> bg %2 %2: No such job tsh> bg %1 [1] (3251) ./myspin 4 & tsh> jobs [1] (3251) Running ./myspin 4 & </pre>		<p>tshref 测试结果</p> <pre> linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit5 make rtest14 ./sdriver.pl -t trace14.txt -s ./tshref -a "-p" # # trace14.txt - Simple error handling # tsh> ./bogus ./bogus: Command not found tsh> ./myspin 4 & [1] (3232) ./myspin 4 & tsh> fg fg command requires PID or %jobid argument tsh> bg bg command requires PID or %jobid argument tsh> fg a fg: argument must be a PID or %jobid tsh> bg a bg: argument must be a PID or %jobid tsh> fg 9999999 (9999999): No such process tsh> bg 9999999 (9999999): No such process tsh> fg %2 %2: No such job tsh> fg %1 Job [1] (3232) stopped by signal 20 tsh> bg %2 %2: No such job tsh> bg %1 [1] (3232) ./myspin 4 & tsh> jobs [1] (3232) Running ./myspin 4 & </pre>	
测试结论	相同		

4.3.15 测试用例 trace15.txt 的输出截图（1 分）

tsh 测试结果	tshref 测试结果
----------	-------------

<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make test15 ./sdriver.pl -t trace15.txt -s ./tsh -a "-p" # # trace15.txt - Putting it all together # tsh> ./bogus ./bogus: Command not found tsh> ./myspin 10 Job [1] (3270) terminated by signal 2 tsh> ./myspin 3 & [1] (3272) ./myspin 3 & tsh> ./myspin 4 & [2] (3274) ./myspin 4 & tsh> jobs [1] (3272) Running ./myspin 3 & [2] (3274) Running ./myspin 4 & tsh> fg %1 Job [1] (3272) stopped by signal 20 tsh> jobs [1] (3272) Stopped ./myspin 3 & [2] (3274) Running ./myspin 4 & tsh> bg %3 %3: No such job tsh> bg %1 [1] (3272) ./myspin 3 & tsh> jobs [1] (3272) Running ./myspin 3 & [2] (3274) Running ./myspin 4 & tsh> fg %1 tsh> quit</pre>	<pre>linleo@ubuntu:~/Desktop/sharefile/shlab-handout-hit\$ make rtest15 ./sdriver.pl -t trace15.txt -s ./tshref -a "-p" # # trace15.txt - Putting it all together # tsh> ./bogus ./bogus: Command not found tsh> ./myspin 10 Job [1] (3290) terminated by signal 2 tsh> ./myspin 3 & [1] (3292) ./myspin 3 & tsh> ./myspin 4 & [2] (3294) ./myspin 4 & tsh> jobs [1] (3292) Running ./myspin 3 & [2] (3294) Running ./myspin 4 & tsh> fg %1 Job [1] (3292) stopped by signal 20 tsh> jobs [1] (3292) Stopped ./myspin 3 & [2] (3294) Running ./myspin 4 & tsh> bg %3 %3: No such job tsh> bg %1 [1] (3292) ./myspin 3 & tsh> jobs [1] (3292) Running ./myspin 3 & [2] (3294) Running ./myspin 4 & tsh> fg %1 tsh> quit</pre>
测试结论	相同

4.4 自测试评分

根据节 4.3 的自测试结果，程序的测试评分为： 15 。

第 4 章 总结

4.1 请总结本次实验的收获

深入了解了 shell 执行程序，处理信号的过程。

4.2 请给出对本次实验内容的建议

无

注：本章为酌情加分项。

参考文献

为完成本次实验你翻阅的书籍与网站等

- [1] 林来兴. 空间控制技术[M]. 北京：中国宇航出版社，1992：25-42.
- [2] 辛希孟. 信息技术与信息服务国际研讨会论文集：A 集[C]. 北京：中国科学出版社，1999.
- [3] 赵耀东. 新时代的工业工程师[M/OL]. 台北：天下文化出版社，1998 [1998-09-26]. <http://www.ie.nthu.edu.tw/info/ie.newie.htm>（Big5）.
- [4] 湛颖. 空间交会控制理论与方法研究[D]. 哈尔滨：哈尔滨工业大学，1992：8-13.
- [5] KANAMORI H. Shaking Without Quaking[J]. Science, 1998, 279 (5359): 2063-2064.
- [6] CHRISTINE M. Plant Physiology: Plant Biology in the Genome Era[J/OL]. Science , 1998 , 281 : 331-332[1998-09-23]. <http://www.sciencemag.org/cgi/collection/anatmorp>.