

Shell lab 实验报告

一、eval:

思路:

- 1、解析命令行，判断是否是后台命令。
- 2、堵塞 SIGCHLD 信号，判断是否是内置命令，如果不是创建一个子进程。在子进程中改进进程的进程组，确保其和 tsh 不在一个进程组中，然后解除对 SIGCHLD 的堵塞，然后调用 execve 函数执行相关文件。
- 3、在父进程中，堵塞所有信号，调用 addjob 函数，然后再次堵塞 SIGCHLD 信号。
- 4、判断是否后台命令，如果是后台命令，堵塞所有信号，输出后台进程的信息；如果是前台命令，调用 waitfg 函数。
- 5、解除所有信号的堵塞。

二、builtin_cmd:

思路:

- 1、如果命令是“quit”，调用 exit (0)。
- 2、如果命令是“bg”或“fg”，调用 do_bgfg 函数，返回 1。
- 3、如果命令是“jobs”，先堵塞所有信号，然后调用 listjobs 函数，然后解除信号堵塞，返回 1。
- 4、其他情况返回 0。

三、do_bgfg:

思路:

- 1、判断命令的第一个参数是否为空，如果为空输出报错信息，结束函数。
- 2、先判断命令的第一个参数是否为“%”：
如果是“%”，先得到 jid，判断是否为 0，为 0 则输出报错信息，结束函数，否则堵塞所有信号，调用 getjobjid 函数得到对应 job，然后解除信号堵塞。进而判断得到的 job 是否为空，如果为空则输出报错信息，结束函数，否则得到对应 job 的 pid。
如果不是“%”，先得到 pid，判断是否为 0，为 0 则输出报错信息，结束函数，否则堵塞所有信号，调用 getjobpid 函数得到对应 job，然后解除信号堵塞。进而判断得到的 job 是否为空，如果为空则输出报错信息，结束函数。
- 3、然后判断命令是“bg”还是“fg”：
如果是 bg，判断得到的 job 的状态，是 ST 则改为 BG，发送 SIGCONT 信号，输出命令信息；是 BG 输出“Nothing need to do.”；是 FG 或 UNDEF 则输出报错信息。
如果是 fg，判断得到的 job 的状态，是 ST 则改为 fG，发送 SIGCONT 信号，调用 waitfg 函数；是 FG 输出“Nothing need to do.”；是 UNDEF 则输出报错信息；是 BG 则改为 fG，调用 waitfg 函数。

四、waitfg:

思路:

- 1、建立一个 while (1) 循环。
- 2、循环内部先调用 sigsuspend 函数等待信号中断。然后堵塞所有信号，调用 fgpid 函数判断前台是否含有进程在运行，如果没有解除信号堵塞结束循环，否则解除信号堵塞继续循环。

五、sigchld_handler:

思路:

- 1、保存原始的 errno。
- 2、堵塞所有信号，建立 while 循环，调用 waitpid 函数回收子进程，如果成功则继续循环，得到子进程的 pid，否则结束循环。
- 3、判断子进程的终止类型：正常终止删除 job 即可；收到信号终止输出终止信息并删除 job；收到信号停止输出停止信息，并将对应的 job 的状态改为 ST。
- 4、循环结束，解除信号堵塞。恢复 errno 为原始值。

六、sigint_handler:

思路:

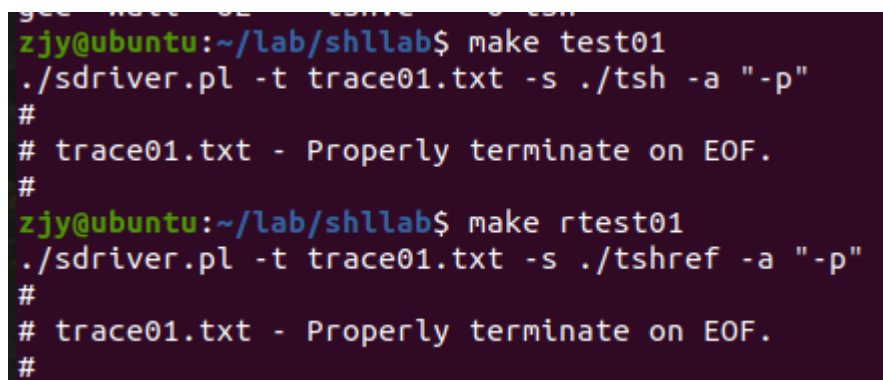
- 1、保存原始 errno 的值。
- 2、堵塞所有信号，调用 fgpid 函数得到进程的 pid，然后解除信号堵塞。
- 3、判断 pid 是否为 0，不为 0 则发送 SIGINT 信号。
- 4、恢复 errno 为原始值。

七、sigstsp_handler:

思路:

- 1、保存原始 errno 的值。
- 2、堵塞所有信号，调用 fgpid 函数得到进程的 pid，然后解除信号堵塞。
- 3、判断 pid 是否为 0，不为 0 则发送 SIGTSTP 信号。
- 4、恢复 errno 为原始值。

测试截图:



```
zjy@ubuntu:~/lab/shllab$ make test01
./sdriver.pl -t trace01.txt -s ./tsh -a "-p"
#
# trace01.txt - Properly terminate on EOF.
#
zjy@ubuntu:~/lab/shllab$ make rtest01
./sdriver.pl -t trace01.txt -s ./tshref -a "-p"
#
# trace01.txt - Properly terminate on EOF.
#
```

```
zjy@ubuntu:~/lab/shllab$ make test02
./sdriver.pl -t trace02.txt -s ./tsh -a "-p"
#
# trace02.txt - Process builtin quit command.
#
zjy@ubuntu:~/lab/shllab$ make rtest02
./sdriver.pl -t trace02.txt -s ./tshref -a "-p"
#
# trace02.txt - Process builtin quit command.
#
```

```
zjy@ubuntu:~/lab/shllab$ make test03
./sdriver.pl -t trace03.txt -s ./tsh -a "-p"
#
# trace03.txt - Run a foreground job.
#
tsh> quit
zjy@ubuntu:~/lab/shllab$ make rtest03
./sdriver.pl -t trace03.txt -s ./tshref -a "-p"
#
# trace03.txt - Run a foreground job.
#
tsh> quit
```

```
zjy@ubuntu:~/lab/shllab$ make test04
./sdriver.pl -t trace04.txt -s ./tsh -a "-p"
#
# trace04.txt - Run a background job.
#
tsh> ./myspin 1 &
[1] (3274) ./myspin 1 &
zjy@ubuntu:~/lab/shllab$ make rtest04
./sdriver.pl -t trace04.txt -s ./tshref -a "-p"
#
# trace04.txt - Run a background job.
#
tsh> ./myspin 1 &
[1] (3280) ./myspin 1 &
```

```

zjy@ubuntu:~/lab/shllab$ make test05
./sdriver.pl -t trace05.txt -s ./tsh -a "-p"
#
# trace05.txt - Process jobs builtin command.
#
tsh> ./myspin 2 &
[1] (3300) ./myspin 2 &
tsh> ./myspin 3 &
[2] (3302) ./myspin 3 &
tsh> jobs
[1] (3300) Running ./myspin 2 &
[2] (3302) Running ./myspin 3 &
zjy@ubuntu:~/lab/shllab$ make rtest05
./sdriver.pl -t trace05.txt -s ./tshref -a "-p"
#
# trace05.txt - Process jobs builtin command.
#
tsh> ./myspin 2 &
[1] (3309) ./myspin 2 &
tsh> ./myspin 3 &
[2] (3311) ./myspin 3 &
tsh> jobs
[1] (3309) Running ./myspin 2 &
[2] (3311) Running ./myspin 3 &

```

```

[2] (3311) Running ./myspin 3 &
zjy@ubuntu:~/lab/shllab$ make test06
./sdriver.pl -t trace06.txt -s ./tsh -a "-p"
#
# trace06.txt - Forward SIGINT to foreground job.
#
tsh> ./myspin 4
job [1] (3318) terminated by signal 2
zjy@ubuntu:~/lab/shllab$ make rtest06
./sdriver.pl -t trace06.txt -s ./tshref -a "-p"
#
# trace06.txt - Forward SIGINT to foreground job.
#
tsh> ./myspin 4
Job [1] (3324) terminated by signal 2

```

```

zjy@ubuntu:~/lab/shllab$ make test07
./sdriver.pl -t trace07.txt -s ./tsh -a "-p"
#
# trace07.txt - Forward SIGINT only to foreground job.
#
tsh> ./myspin 4 &
[1] (3331) ./myspin 4 &
tsh> ./myspin 5
job [2] (3333) terminated by signal 2
tsh> jobs
[1] (3331) Running ./myspin 4 &
zjy@ubuntu:~/lab/shllab$ make rtest07
./sdriver.pl -t trace07.txt -s ./tshref -a "-p"
#
# trace07.txt - Forward SIGINT only to foreground job.
#
tsh> ./myspin 4 &
[1] (3340) ./myspin 4 &
tsh> ./myspin 5
Job [2] (3342) terminated by signal 2
tsh> jobs
[1] (3340) Running ./myspin 4 &

```

```

zjy@ubuntu:~/lab/shllab$ make test08
./sdriver.pl -t trace08.txt -s ./tsh -a "-p"
#
# trace08.txt - Forward SIGTSTP only to foreground job.
#
tsh> ./myspin 4 &
[1] (3349) ./myspin 4 &
tsh> ./myspin 5
job [2] (3351) stopped by signal 127
tsh> jobs
[1] (3349) Running ./myspin 4 &
[2] (3351) Stopped ./myspin 5
zjy@ubuntu:~/lab/shllab$ make rtest08
./sdriver.pl -t trace08.txt -s ./tshref -a "-p"
#
# trace08.txt - Forward SIGTSTP only to foreground job.
#
tsh> ./myspin 4 &
[1] (3358) ./myspin 4 &
tsh> ./myspin 5
Job [2] (3360) stopped by signal 20
tsh> jobs
[1] (3358) Running ./myspin 4 &
[2] (3360) Stopped ./myspin 5

```

```

[2] (3369) stopped ./myspin 5
zjy@ubuntu:~/lab/shllab$ make test09
./sdriver.pl -t trace09.txt -s ./tsh -a "-p"
#
# trace09.txt - Process bg builtin command
#
tsh> ./myspin 4 &
[1] (3367) ./myspin 4 &
tsh> ./myspin 5
job [2] (3369) stopped by signal 127
tsh> jobs
[1] (3367) Running ./myspin 4 &
[2] (3369) Stopped ./myspin 5
tsh> bg %2
[2] (3369) ./myspin 5
tsh> jobs
[1] (3367) Running ./myspin 4 &
[2] (3369) Running ./myspin 5
zjy@ubuntu:~/lab/shllab$ make rtest09
./sdriver.pl -t trace09.txt -s ./tshref -a "-p"
#
# trace09.txt - Process bg builtin command
#
tsh> ./myspin 4 &
[1] (3378) ./myspin 4 &
tsh> ./myspin 5
Job [2] (3380) stopped by signal 20
tsh> jobs
[1] (3378) Running ./myspin 4 &
[2] (3380) Stopped ./myspin 5
tsh> bg %2
[2] (3380) ./myspin 5
tsh> jobs
[1] (3378) Running ./myspin 4 &
[2] (3380) Running ./myspin 5

```

```

zjy@ubuntu:~/lab/shllab$ make test10
./sdriver.pl -t trace10.txt -s ./tsh -a "-p"
#
# trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (3391) ./myspin 4 &
tsh> fg %1
job [1] (3391) stopped by signal 127
tsh> jobs
[1] (3391) Stopped ./myspin 4 &
tsh> fg %1
tsh> jobs
zjy@ubuntu:~/lab/shllab$ make rtest10
./sdriver.pl -t trace10.txt -s ./tshref -a "-p"
#
# trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (3401) ./myspin 4 &
tsh> fg %1
Job [1] (3401) stopped by signal 20
tsh> jobs
[1] (3401) Stopped ./myspin 4 &
tsh> fg %1
tsh> jobs

```

```

zjy@ubuntu:~/lab/shllab$ make test11
./sdriver.pl -t trace11.txt -s ./tsh -a "-p"
#
# trace11.txt - Forward SIGINT to every process in foreground process group
#
tsh> ./mysplit 4
job [1] (3411) terminated by signal 2
tsh> /bin/ps a
  PID TTY          STAT TIME COMMAND
 1858 tty2      Ssl+  0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
 1861 tty2      Sl+   0:07 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
 1875 tty2      Sl+   0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
 3205 pts/0     Ss    0:00 bash
 3406 pts/0     S+    0:00 make test11
 3407 pts/0     S+    0:00 /bin/sh -c ./sdriver.pl -t trace11.txt -s ./tsh -a "-p"
 3408 pts/0     S+    0:00 /usr/bin/perl ./sdriver.pl -t trace11.txt -s ./tsh -a -p
 3409 pts/0     S+    0:00 ./tsh -p
 3414 pts/0     R     0:00 /bin/ps a
zjy@ubuntu:~/lab/shllab$ make rtest11
./sdriver.pl -t trace11.txt -s ./tshref -a "-p"
#
# trace11.txt - Forward SIGINT to every process in foreground process group
#
tsh> ./mysplit 4
job [1] (3420) terminated by signal 2
tsh> /bin/ps a
  PID TTY          STAT TIME COMMAND
 1858 tty2      Ssl+  0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
 1861 tty2      Sl+   0:07 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
 1875 tty2      Sl+   0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
 3205 pts/0     Ss    0:00 bash
 3415 pts/0     S+    0:00 make rtest11
 3416 pts/0     S+    0:00 /bin/sh -c ./sdriver.pl -t trace11.txt -s ./tshref -a "-p"
 3417 pts/0     S+    0:00 /usr/bin/perl ./sdriver.pl -t trace11.txt -s ./tshref -a -p
 3418 pts/0     S+    0:00 ./tshref -p
 3423 pts/0     R     0:00 /bin/ps a

```

```

zjy@ubuntu:~/lab/shllab$ make test12
./sdriver.pl -t trace12.txt -s ./tsh -a "-p"
#
# trace12.txt - Forward SIGTSTP to every process in foreground process group
#
tsh> ./mysplit 4
job [1] (3431) stopped by signal 127
tsh> jobs
[1] (3431) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY          STAT TIME COMMAND
 1858 tty2      Ssl+  0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
 1861 tty2      Sl+   0:07 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
 1875 tty2      Sl+   0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
 3205 pts/0     Ss    0:00 bash
 3426 pts/0     S+    0:00 make test12
 3427 pts/0     S+    0:00 /bin/sh -c ./sdriver.pl -t trace12.txt -s ./tsh -a "-p"
 3428 pts/0     S+    0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tsh -a -p
 3429 pts/0     S+    0:00 ./tsh -p
 3431 pts/0     T     0:00 ./mysplit 4
 3432 pts/0     T     0:00 ./mysplit 4
 3435 pts/0     R     0:00 /bin/ps a
zjy@ubuntu:~/lab/shllab$ make rtest12
./sdriver.pl -t trace12.txt -s ./tshref -a "-p"
#
# trace12.txt - Forward SIGTSTP to every process in foreground process group
#
tsh> ./mysplit 4
job [1] (3441) stopped by signal 20
tsh> jobs
[1] (3441) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY          STAT TIME COMMAND
 1858 tty2      Ssl+  0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
 1861 tty2      Sl+   0:07 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
 1875 tty2      Sl+   0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
 3205 pts/0     Ss    0:00 bash
 3436 pts/0     S+    0:00 make rtest12
 3437 pts/0     S+    0:00 /bin/sh -c ./sdriver.pl -t trace12.txt -s ./tshref -a "-p"
 3438 pts/0     S+    0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tshref -a -p
 3439 pts/0     S+    0:00 ./tshref -p
 3441 pts/0     T     0:00 ./mysplit 4
 3442 pts/0     T     0:00 ./mysplit 4
 3445 pts/0     R     0:00 /bin/ps a

```

```

zjy@ubuntu:~/lab/shllab$ 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] (3494) stopped by signal 127
tsh> jobs
[1] (3494) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY          STAT TIME COMMAND
 1858 tty2      Ssl+  0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
 1861 tty2      Sl+   0:00 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
 1875 tty2      Sl+   0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
 3205 pts/0     Ss    0:00 bash
 3489 pts/0     S+    0:00 make test13
 3490 pts/0     S+    0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a "-p"
 3491 pts/0     S+    0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh -a -p
 3492 pts/0     S+    0:00 ./tsh -p
 3494 pts/0     T     0:00 ./mysplit 4
 3495 pts/0     T     0:00 ./mysplit 4
 3498 pts/0     R     0:00 /bin/ps a
tsh> fg %1
tsh> /bin/ps a
  PID TTY          STAT TIME COMMAND
 1858 tty2      Ssl+  0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
 1861 tty2      Sl+   0:00 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
 1875 tty2      Sl+   0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
 3205 pts/0     Ss    0:00 bash
 3489 pts/0     S+    0:00 make test13
 3490 pts/0     S+    0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a "-p"
 3491 pts/0     S+    0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh -a -p
 3492 pts/0     S+    0:00 ./tsh -p
 3501 pts/0     R     0:00 /bin/ps a

```



```

zjy@ubuntu:~/lab/shllab$ 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] (3507) stopped by signal 20
tsh> jobs
[1] (3507) Stopped ./mysplit 4
tsh> /bin/ps a
PID TTY STAT TIME COMMAND
1858 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
1861 tty2 Sl+ 0:00 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
1875 tty2 Sl+ 0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
3205 pts/0 Ss 0:00 bash
3502 pts/0 S+ 0:00 make rtest13
3503 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref -a "-p"
3504 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a -p
3505 pts/0 S+ 0:00 ./tshref -p
3507 pts/0 T 0:00 ./mysplit 4
3508 pts/0 T 0:00 ./mysplit 4
3511 pts/0 R 0:00 /bin/ps a
tsh> fg %1
tsh> /bin/ps a
PID TTY STAT TIME COMMAND
1858 tty2 Ssl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
1861 tty2 Sl+ 0:00 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/1000/gdm/Xauthority -background none -noreset -keeptty -verbose 3
1875 tty2 Sl+ 0:00 /usr/libexec/gnome-session-binary --systemd --systemd --session=ubuntu
3205 pts/0 Ss 0:00 bash
3502 pts/0 S+ 0:00 make rtest13
3503 pts/0 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref -a "-p"
3504 pts/0 S+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a -p
3505 pts/0 S+ 0:00 ./tshref -p
3514 pts/0 R 0:00 /bin/ps a

```

```

zjy@ubuntu:~/lab/shllab$ 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] (3522) ./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 PID or %jobid.
tsh> bg a
bg:argument must be 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] (3522) stopped by signal 127
tsh> bg %2
2:no such job.
tsh> bg %1
[1] (3522) ./myspin 4 &
tsh> jobs
[1] (3522) Running ./myspin 4 &

```



```
jy@ubuntu:~/lab/shllab$ make rtest14
/sdriver.pl -t trace14.txt -s ./tshref -a "-p"
#
# trace14.txt - Simple error handling
#
sh> ./bogus
/bogus: Command not found
sh> ./myspin 4 &
[1] (3541) ./myspin 4 &
sh> fg
fg command requires PID or %jobid argument
sh> bg
bg command requires PID or %jobid argument
sh> fg a
fg: argument must be a PID or %jobid
sh> bg a
bg: argument must be a PID or %jobid
sh> fg 9999999
(9999999): No such process
sh> bg 9999999
(9999999): No such process
sh> fg %2
%2: No such job
sh> fg %1
Job [1] (3541) stopped by signal 20
sh> bg %2
%2: No such job
sh> bg %1
[1] (3541) ./myspin 4 &
sh> jobs
[1] (3541) Running ./myspin 4 &
```

```

zjy@ubuntu:~/lab/shllab$ 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] (3562) terminated by signal 2
tsh> ./myspin 3 &
[1] (3564) ./myspin 3 &
tsh> ./myspin 4 &
[2] (3566) ./myspin 4 &
tsh> jobs
[1] (3564) Running ./myspin 3 &
[2] (3566) Running ./myspin 4 &
tsh> fg %1
job [1] (3564) stopped by signal 127
tsh> jobs
[1] (3564) Stopped ./myspin 3 &
[2] (3566) Running ./myspin 4 &
tsh> bg %3
3:no such job.
tsh> bg %1
[1] (3564) ./myspin 3 &
tsh> jobs
[1] (3564) Running ./myspin 3 &
[2] (3566) Running ./myspin 4 &
tsh> fg %1
tsh> quit

```

```

zjy@ubuntu:~/lab/shllab$ 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] (3582) terminated by signal 2
tsh> ./myspin 3 &
[1] (3584) ./myspin 3 &
tsh> ./myspin 4 &
[2] (3586) ./myspin 4 &
tsh> jobs
[1] (3584) Running ./myspin 3 &
[2] (3586) Running ./myspin 4 &
tsh> fg %1
Job [1] (3584) stopped by signal 20
tsh> jobs
[1] (3584) Stopped ./myspin 3 &
[2] (3586) Running ./myspin 4 &
tsh> bg %3
%3: No such job
tsh> bg %1
[1] (3584) ./myspin 3 &
tsh> jobs
[1] (3584) Running ./myspin 3 &
[2] (3586) Running ./myspin 4 &
tsh> fg %1
tsh> quit

```

```
zjy@ubuntu:~/lab/shllab$ make test16
./sdriver.pl -t trace16.txt -s ./tsh -a "-p"
#
# trace16.txt - Tests whether the shell can handle SIGTSTP and SIGINT
#      signals that come from other processes instead of the terminal.
#
tsh> ./mystop 2
job [1] (3601) stopped by signal 127
tsh> jobs
[1] (3601) Stopped ./mystop 2
tsh> ./myint 2
job [2] (3604) terminated by signal 2
zjy@ubuntu:~/lab/shllab$ make rtest16
./sdriver.pl -t trace16.txt -s ./tshref -a "-p"
#
# trace16.txt - Tests whether the shell can handle SIGTSTP and SIGINT
#      signals that come from other processes instead of the terminal.
#
tsh> ./mystop 2
Job [1] (3610) stopped by signal 20
tsh> jobs
[1] (3610) Stopped ./mystop 2
tsh> ./myint 2
Job [2] (3613) terminated by signal 2
zjy@ubuntu:~/lab/shllab$
```