shlab-report

- 一、结果截图:
- 二、代码及注释:
 - 1、eval
 - 2、builtin cmd
 - 3、do_bgfg
 - 4、waitfg
 - 5、sigchld_handler
 - 6、sigint_handler
 - 7、sigtstp_handler

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一、结果截图:

左边是tsh, 右边是tshref。

```
eded caguountu:~/ICS/lab/shlab-handout$ make test01
./sdriver.pl -t trace01.txt -s ./tsh -a "-p"
#
                                                                                                                                                           talala@ubuntu:~/ICS/lab/shlab-handout$ make rtest01
./sdriver.pl -t trace01.txt -s ./tshref -a "-p"
t
# trace01.txt - Properly terminate on EOF.
                                                                                                                                                         "
# trace01.txt - Properly terminate on EOF.
                                                                                                                                                           ;
Lalala@ubuntu:~/ICS/lab/shlab-handout$ make rtest02
./sdriver.pl -t trace02.txt -s ./tshref -a "-p"
 #
lalala@ubuntu:~/ICS/lab/shlab-handout$ make test02
./sdriver.pl -t trace02.txt -s ./tsh -a "-p"
"
# trace02.txt - Process builtin quit command.
                                                                                                                                                          "
# trace02.txt - Process builtin quit command.
                                                                                                                                                           t
Lalala@ubuntu:~/ICS/lab/shlab-handout$ make rtest03
./sdriver.pl -t trace03.txt -s ./tshref -a "-p"
 "
|alala@ubuntu:~/ICS/lab/shlab-handout$ make test03
./sdriver.pl -t trace03.txt -s ./tsh -a "-p"
 tsn> quit
lalala@ubuntu:~/ICS/lab/shlab-handout$ make test04
./sdriver.pl -t trace04.txt -s ./tsh -a "-p"
                                                                                                                                                           csn> qutt
Lalala@ubuntu:~/ICS/lab/shlab-handout$ make rtest04
./sdriver.pl -t trace04.txt -s ./tshref -a "-p"
"
# trace04.txt - Run a background job.
                                                                                                                                                          ..
# trace04.txt - Run a background job.
 #
tsh> ./myspin 1 &
[1] (13597) ./myspin 1 &
lalala@ubuntu:~/ICS/lab/shlab-handout$ make test05
./sdriver.pl -t trace05.txt -s ./tsh -a "-p"
                                                                                                                                                         #
tsh> ./myspin 1 &
[1] (13354) ./myspin 1 &
lalala@ubuntu:~/ICS/lab/shlab-handout$ make rtest05
./sdriver.pl -t trace05.txt -s ./tshref -a "-p"
# trace05.txt - Process jobs builtin command.
                                                                                                                                                         "
# trace05.txt - Process jobs builtin command.
#
tsh> ./myspin 2 &
[1] (13603) ./myspin 2 &
tsh> ./myspin 3 &
[2] (13605) ./myspin 3 &
tsh> inhs
                                                                                                                                                         #
tsh> ./myspin 2 &
[1] (13360) ./myspin 2 &
tsh> ./myspin 3 &
[2] (13362) ./myspin 3 &
[2] (13603) Running ./myspin 2 &
[1] (13603) Running ./myspin 2 &
[2] (13605) Running ./myspin 3 &
                                                                                                                                                         [2] (13362) ./myspin 3 & tish- jobs
[1] (13360) Running ./myspin 2 &
[2] (13362) Running ./myspin 3 &
[alala@ubuntu:~/ICS/lab/shlab-handout$ make rtest06
./sdriver.pl -t trace06.txt -s ./tshref -a "-p"
  lalala@ubuntu:~/ICS/lab/shlab-handout$ make test06
./sdriver.pl -t trace06.txt -s ./tsh -a "-p"
                                                                                                                                                         #
# trace06.txt - Forward SIGINT to foreground job.
# trace06.txt - Forward SIGINT to foreground job.
 tsh> ./myspin 4
Job [1] (13612) terminated by signal 2
                                                                                                                                                          tsh> ./myspin 4
Job [1] (13369) terminated by signal 2
```

```
alala@ubuntu:~/ICS/lab/shlab-handout$ make test07
/sdriver.pl -t trace07.txt -s ./tsh -a "-p"
                                                                                                                                                                                                                                                                                                                                                             alala@ubuntu:~/ICS/lab/shlab-handout$ make rtest07
/sdriver.pl -t trace07.txt -s ./tshref -a "-p"
       trace07.txt - Forward SIGINT only to foreground job.
                                                                                                                                                                                                                                                                                                                                                         "
# trace07.txt - Forward SIGINT only to foreground job.
#

tsh> ./myspin 4 &

[1] (13618) ./myspin 4 &

tsh> ./myspin 5

Job [2] (13620) terminated by signal 2

tsh> jobs

[1] (13618) Running ./myspin 4 &
                                                                                                                                                                                                                                                                                                                                                      #

tsh> ./myspin 4 &

[1] (13375) ./myspin 4 &

tsh> ./myspin 5

Job [2] (13377) terminated by signal 2

tsh> jobs

[1] (13375) Running ./myspin 4 &

lalalagubuntu:-/ICS/lab/shlab-handout$ make rtest08

./sdriver.pl -t trace08.txt -s ./tshref -a "-p"
    lalala@ubuntu:~/ICS/lab/shlab-handout$ make test08
./sdriver.pl -t trace08.txt -s ./tsh -a "-p"
#
 #
# trace08.txt - Forward SIGTSTP only to foreground job.
                                                                                                                                                                                                                                                                                                                                                         #
# trace08.txt - Forward SIGTSTP only to foreground job.
#
tsh> ./myspin 4 &
[1] (13627) ./myspin 4 &
tsh> ./myspin 5
Job [2] (13629) stopped by signal 20
                                                                                                                                                                                                                                                                                                                                                       #

tsh> ./myspin 4 &

[1] (13384) ./myspin 4 &

tsh> ./myspin 5

Job [2] (13386) stopped by signal 20

tsh> jobs

[1] (13384) Running ./myspin 4 &

[2] (13386) Stopped ./myspin 5

[2] (13386) Stopped ./myspin 5
    tsh> jobs
[1] (13627) Running ./myspin 4 &
[2] (13629) Stopped ./myspin 5
     lalalagubuntu:~/ICS/lab/shlab-handout$ make test09
./sdriver.pl -t trace09.txt -s ./tsh -a "-p"
                                                                                                                                                                                                                                                                                                                                                           lalala@ubuntu:~/ICS/lab/shlab-handout$ make rtest09
./sdriver.pl -t trace09.txt -s ./tshref -a "-p"
 "
# trace09.txt - Process bg builtin command
                                                                                                                                                                                                                                                                                                                                                         # trace09.txt - Process bg builtin command
                                                                                                                                                                                                                                                                                                                                                         #
tsh> ./myspin 4 &
[1] (13393) ./myspin 4 &
tsh> ./myspin 5
Job [2] (13395) stopped by signal 20
tsh> jobs
[1] (13393) Running ./myspin 4 &
[2] (13395) Stopped ./myspin 5
tsh bo %2
#
tsh> ./myspin 4 &
[1] (13636) ./myspin 4 &
tsh> ./myspin 5
Job [2] (13638) stopped by signal 20
tsh> jobs
[1] (13636) Running ./myspin 4 &
[2] (13638) Stopped ./myspin 5
                                                                                                                                                                                                                                                                                                                                                          . (15395) Stopped ./r
tsh> bg %2
[2] (13395) ./myspin 5
tsh> jobs
   19058) Stopped ./m
tsh> bg %2
[2] (13638) ./myspin 5
tsh> jobs
| 13636 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 | 1585 |
                                                                                                                                                                                                                                                                                                                                                          ./sdriver.pl -t trace10.txt -s ./tsh -a "-p"
                                                                                                                                                                                                                                                                                                          atatagubuntu:~/ICS/lab/shlab-handout$ make rtest10
/sdriver.pl -t trace10.txt -s ./tshref -a "-p"
```

```
trace10.txt - Process fg builtin command.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (13647) ./myspin 4 &
tsh> fg %1
Job [1] (13647) stopped by signal 20
tsh> jobs
[1] (13647) Stopped ./myspin 4 &
tsh> fg %1
tsh> jobs
Lala@aubunt::-/ICS/lab/shlab-handou
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   .
tsh> ./myspin 4 &
[1] (13407) ./myspin 4 &
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   tsh> fg %1
fob [1] (13407) stopped by signal 20
tsh> jobs
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       sh> jobs
1] (13407) Stopped ./myspin 4 &
.sh> fg %1
.sh> jobs
        .alala@ubuntu:~/ICS/lab/shlab-handout$ make test11
/sdriver.pl -t trace11.txt -s ./tsh -a "-p"
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     .alala@ubuntu:~/ICS/lab/shlab-handout$ make rtest11
./sdriver.pl -t trace11.txt -s ./tshref -a "-p"
          trace11.txt - Forward SIGINT to every process in foreground process group
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        trace11.txt - Forward SIGINT to every process in foreground process group
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     traceII: LXX - Forward Stouth to the y process of the process of t
 th> ./mysplit 4

Job [3] (13657) terminated by signal 2

tsh> /bin/ps a

PID TTV STAT TIME COMMAND

1465 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

1468 tty2 Sl+ 0:35 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user/
13000/gdm/Kauthority -background none -noreset -keeptty -verbose 3

1520 tty2 Sl+ 0:00 /usr/libexec/gnome-session-binary --systemd --s
                                                                                                                                               0:00 /usr/bin/perl ./sdriver.pl -t trace11.txt -s ./tsh
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               0:00 /usr/bin/perl ./sdriver.pl -t trace11.txt -s ./tshr
             13654 pts/0 S+
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            13415 pts/1 S+ 0:00 /tshref -p
13415 pts/1 S+ 0:00 /tshref -p
13420 pts/1 R 0:00 /bin/ps a
             a - p
13655 pts/0 S+ 0:00 ./tsh - p
13660 pts/0 R 0:00 /bin/ps a
```

```
/sdriver.pl -t trace13.txt -s ./tsh -a "-p"
                                                                                                                                                                                                                                                                                                                                                              atatagubunt0:~/ICS/lab/shlab-handout$ make rtest13
/sdriver.pl -t trace13.txt -s ./tshref -a "-p"
                                                                                                                                                                                                                                                                                                                                                       # trace13.txt - Restart every stopped process in process group
                             trace13.txt - Restart every stopped process in process group
                            sh> ./mysplit 4
ob [1] (13676) stopped by signal 20
sh> iobs
                                                                                                                                                                                                                                                                                                                                                            :
:sh> ./mysplit 4
lob [1] (13436) stopped by signal 20
:sh> iobs
                       Job [1] (13436) stopped by signal 20
tsh- jobs
[1] (13436) Stopped ./mysplit 4
tsh- jobs [1] (13436) Stopped ./mysplit 4
tsh- jobs [1] star Time ComManD
1465 tty2 Ssl+ 0:00 /usr/llb/gdm3/gdm-x-session --run-script env GNOME_
SHELL_SESSION_NODE=ubuntut /usr/bin/gnome-session --systemd --session=ubuntu
1468 tty2 Rl+ 0:34 /usr/llb/xorg/Xorg vt2 -displayfd 3 -auth /run/user
/10800/gdm/Xauthority -background none -noreset -keeptty -verbos 3
1520 tty2 Sl+ 0:00 /usr/llbexec/gnome-session-binary --systemd --systemd --session=ubuntu
13324 pts/0 Ss+ 0:00 bash
13411 pts/1 S+ 0:00 make rtest13
13412 pts/1 S+ 0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref-a* '-p'
                                                                                                                                                                                                                                                                                                                                                                                                                                                 0:00 bash
0:00 bash
0:00 make rtest13
0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref
$67.
3672 pp
p
13673 pts/0
a -p
13674 pts/0
5+
13676 pts/0
13680 pts/0
T
1465 tty2
S1+
0:6
SHELL_SESSION_MODE=ubuntu
1468 tty2
S1+
0/1000/gdm/Xauthority -bag
1200 tty2
S1+
0/1000/gdm/Xauthority -bag
1220 tty2
S1+
0/1000/gdm/Xauthority -bag
1324 pts/0
S5+
0
S
                                                                                                                                                                                                                                                                                                                                                               13433 pts/1
                                                                                                                                                                                                                                                                                                                                                          13433 pts/1 5+ 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a -p  
13434 pts/1 5+ 0:00 ./tshref -p  
13434 pts/1 5+ 0:00 ./myspltt 4  
13437 pts/1 T 0:00 ./myspltt 4  
13437 pts/1 T 0:00 /hnyspltt 4  
13440 pts/1 R 0:00 /bin/ps a  
tsh- fg %1  
tsh- fg %1  
tsh- y fur y  
1465 tty2 Sal+ 0:00 /usr/tib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu  
1468 tty2 Sl+ 0:34 /usr/tib/xorg/Xorg vt2 -displayfd 3 -auth /run/user /1000/gdm/Xauthortty -background none -noreset -keeptty -verbose 3  
1520 tty2 Sl+ 0:00 /usr/tib/xorg/Xorg vt2 -displayfd 3 -auth /run/user /1000/gdm/Xauthortty -background none -noreset -keeptty -verbose 3  
1520 tty2 Sl+ 0:00 /usr/tib/xorg/Xorg vt2 -displayfd 3 -auth /run/user /1000/gdm/Xauthortty -background none -noreset -keeptty -verbose 3  
1520 tty2 Sl+ 0:00 bash  
13431 pts/1 S+ 0:00 make rtest13  
13432 pts/1 S+ 0:00 /bin/sh - ./sdriver.pl -t trace13.txt -s ./tshref -a "p"  
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                                                                                                                  0:00 ./tsh -p
0:00 ./mysplit 4
0:00 ./mysplit 4
0:00 /bin/ps a
                                                                                     STAT TIME COMMAND

SSl+ 0:00 /usr/lib/gdm3/gdm-x-session --run-script env GNOME_
DE=ubuntu /usr/bin/gnome-session --systemd --session=ubuntu
Sl+ 0:35 /usr/lib/xorg/Xorg vt2 -displayfd 3 -auth /run/user
ortty -background none -noreset -keeptty -verbose 3
Sl+ 0:00 /usr/libexec/gnome-session-binary --systemd --system
                                                                                                                 0:00 bash
0:00 bash
0:00 make test13
0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a
                                                                                                                                                                                                                                                                                                                                                                                                                                                  0:00 bash
0:00 bash
0:00 make rtest13
0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref
                                                                                                                                                                                                                                                                                                                                                              13
13433 pts/1
                              ·p"
13673 pts/0
                                                                                                                 0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh
                                                                                                                   0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a
                              13672 pts/0
                                                                                                                                                                                                                                                                                                                                                                                                                                                     0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshcef
                                                                                                                                                                                                                                                                                                                                                               a "-p"
13433 pts/1 S+
                              ·p¨
13673 pts/0 S+
                                                                                                                                                                                                                                                                                                                                                            a -p
13674 pts/0 S+ 0:00 //tsh -p
13683 pts/0 R 0:00 /btn/ps a
alala@uburu-/Tcs/lab/shlab-handout$ nake test14
/sdrlver.pl -t trace14.txt -s ./tsh -a "-p"
                            trace14.txt - Simple error handling
                                                                                                                                                                                                                                                                                                                                                            +
# trace14.txt - Simple error handling
                                                                                                                                                                                                                                                                                                                                                          :

./bogus: Command not found

.sh> ./myspin 4 &

[] (13451) ./myspin 4 &

tsh> fg

fg command requires PID or %jobid argument
                        ;
tsh> ./bogus
./bogus: Command not found
tsh> ./myspin 4 &
[] [33691] ./myspin 4 &
tsh> fg
fg command requires PID or %jobid argument
                         g command requires...
ssh> bg
an command requires PID or %jobid argument
                                                                                                                                                                                                                                                                                                                                                             g command requires 1.5
.sh> bg
up command requires PID or %jobid argument
                    og command reputer Fib of Ajobtu ary
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] (13691) stopped by signal 20
tsh> bg %2
%2: No such job
tsh> bg %2
%2: No such job
tsh> bg %1
[1] (13691) /myspin 4 &
tsh> jobs
[1] (13691) /myspin 4 &
tsh> jobs
[1] (13691) /myspin 4 &
tsh> jobs
[1] (13691) /myspin 4 &
                                       ormand
fg a
argument must be a PID or %jobid
                                                                                                                                                                                                                                                                                                                                                                          fg a
argument must be a PID or %jobid
                                                                                                                                                                                                                                                                                                                                                               : argument must be a F19
ih- bg a
is argument must be a PID or %jobid
ih> fg 999999)
in o such process
ih> bg 999999
in o such process
ih> fg %2
is No such job
in fg %1
                                                                                                                                                                                                                                                                                                                                                                        > fg %1
[1] (13451) stopped by signal 20
> bg %2
                                                                                                                                                                                                                                                                                                                                                                       > bg %2
No such job
> bg %1
(13451) ./myspin 4 &
                       tsh> jobs
[1] (13691) Running ./myspin 4 &
                                                                                                                                                                                                                                                                                                                                                              sh> Jobs
1] (13451) Running ./myspin 4 &
                         tatalagubuntu:-/ICS/lab/shlab-handout$ make test15
./sdriver.pl -t trace15.txt -s ./tsh -a "-p"
#
                                                                                                                                                                                                                                                                                                                                                                                 ./sdriver.pl -t trace15.txt -s ./tshref -a "-p"
                                                                                                                                                                                                                                                                                                                                                                           ./sdrver.pl -t tracels.txt -s ./tshref #
# tracel5.txt - Putting it all together #
tsh> ./bogus: Command not found tsh> ./myspin 10
Job [1] (13470) terminated by signal 2 tsh> ./myspin 3 &
[1] (13472) ./myspin 3 &
tsh> ./myspin 4 &
[2] (13474) ./myspin 4 &
tsh> jobs
(1) [2] (13472) ./myspin 4 &
tsh> jobs
                      # trace15.txt - Putting it all together
                       [2] (13474) ./myspin 4 & tsh> jobs [1] (13472) Running ./myspin 3 & [2] (13474) Running ./myspin 4 & tsh> fg %] [2] (13474) Running ./myspin 4 & tsh> fg %] [3] (13472) stopped by signal 20 tsh> jobs [1] (13472) Stopped ./myspin 3 & [2] (13474) Running ./myspin 4 & tsh> bg %] [3] (13472) Stopped ./myspin 4 & tsh> bg %] [3] (13472) ./myspin 3 & tsh> bg %]
                        tsh> jobs
[1] (13712) Stopped ./myspin 3 & [2] (13714) Running ./myspin 4 & tsh> bg %3 & [3] (13714) Running ./myspin 4 & tsh> bg %1 & [3] (13712) ./myspin 3 & tsh> bg %1 & [3] (13712) ./myspin 3 & tsh> jobs
                         tsh> jobs
[1] (13712) Running ./myspin 3 &
[2] (13714) Running ./myspin 4 &
tsh> fg %1
tsh> quit
                                                                                                                                                                                                                                                                                                                                                                                 tsh> jobs
[1] (13472) Running ./myspin 3 &
[2] (13474) Running ./myspin 4 &
tsh> fg %1
tsh> quit
                            .alala@ubuntu:~/ICS/lab/shlab-handout$ make test16
/sdriver.pl -t trace16.txt -s ./tsh -a "-p"
                                                                                                                                                                                                                                                                                                                                                                                   allalagubuntu:~/ICS/lab/shlab-handout$ 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.
                         *
# 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] (13488) stopped by signal 20
tsh> jobs
[1] (13488) Stopped ./mystop 2
                      "stsh> ./mystop 2
Job [1] (13728) stopped by signal 20
tsh> jobs
[1] (13728) Stopped ./mystop 2
                        tsh> ./myint 2
Job [2] (13731) terminated by signal 2
                                                                                                                                                                                                                                                                                                                                                                                              ./myint 2[2] (13491) terminated by signal
```

二、代码及注释:

1, eval

```
void eval(char *cmdline)
 2
    {
 3
        char* argv[MAXLINE];
 4
        char buf[MAXLINE];
 5
        int bg;
 6
        pid_t pid;
 7
 8
        sigset_t mask_all, mask_one, prev;
 9
        if(sigfillset(&mask_all) < 0)//设置阻塞集合,mask_all阻塞所有信号
10
            unix_error("sigset error");
11
        if(sigemptyset(&mask_one) < 0)</pre>
            unix_error("sigset error");
12
13
        if(sigaddset(&mask_one, SIGCHLD) < 0)//mask_one阻塞SIGCHLD信号
            unix_error("sigset error");
14
15
16
        strcpy(buf, cmdline);
17
        bg = parseline(buf, argv);//得到argv,并判断是否是后台作业,得到bg
18
        if(argv[0] == NULL)//忽略空命令
19
            return;
20
21
        if(!builtin_cmd(argv))//执行内部命令,如果非内部命令执行以下代码
22
23
            if(sigprocmask(SIG_BLOCK, &mask_one, &prev) < 0)//阻塞SIGCHLD信号, 防
    止addjob时出现不一致
24
                unix_error("sigset error");
25
            if((pid = fork()) < 0)
26
               unix_error("fork error");
27
            if(pid == 0)//子进程
28
29
                if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)//解除子进程对SIGCHLD
    的阻塞
30
                   unix_error("sigset error");
31
               if(execve(argv[0], argv, environ) < 0)//调用可执行程序
32
33
                   printf("%s: Command not found\n",argv[0]);//出错
34
                   exit(0);//子进程退出结束
               }
35
36
            }
37
            //主进程
38
            if(sigprocmask(SIG_BLOCK, &mask_all, NULL) < 0)//阻塞所有信号
39
                unix_error("sigset error");
40
            if(setpgid(pid, 0) < 0)//将该进程单独添加到一个进程组
41
                unix_error("setpid group error");
42
            addjob(jobs, pid, bg + 1, buf);//添加到工作集
43
            if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)//解除阻塞
44
                unix_error("sigset error");
45
46
            if(!bg)//前台作业,显式等待作业结束
47
               waitfg(pid);
48
            else
49
                printf("[%d] (%d) %s",pid2jid(pid), pid, buf);//后台作业,打印相关
    信息
50
        }
51
        return;
52
    }
```

2. builtin cmd

```
int builtin_cmd(char **argv)
1
2
3
        sigset_t mask, prev;
        if(sigemptyset(&mask) < 0)//设置阻塞集合
4
            unix_error("sigset error");
6
        if(sigaddset(&mask, SIGCHLD) < 0)//设置阻塞集合
7
            unix_error("sigset error");
        if(!strcmp(argv[0], "quit"))//quit command
8
9
10
            for(int i = 0; i < MAXJOBS; i++)</pre>
11
                if(jobs[i].pid)
12
                    kill(-jobs[i].pid, SIGKILL);//结束所有子进程
13
            exit(0);//退出shell
14
        }
        if(!strcmp(argv[0], "jobs"))//jobs command
15
16
17
            if(sigprocmask(SIG_BLOCK, &mask, &prev) < 0)//在调用listjobs时阻塞
    SIGCHLD信号,防止调用过程中接收到SIGCHLD信号而发生不一致
18
                unix_error("sigset error");
19
            listjobs(jobs);
20
            if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)</pre>
                unix_error("sigset error");
21
22
            return 1;
23
        }
        if(!strcmp(argv[0], "fg") || !strcmp(argv[0], "bg"))//fg bg command
24
25
            do_bgfg(argv);//执行处理bg、fg的函数
26
27
            return 1;
28
        }
29
        return 0;
                    /* not a builtin command */
30
   }
```

3, do_bgfg

```
void do_bgfg(char **argv)
1
2
    {
3
        pid_t pid = 0;//fg或bg作用的pid
4
        struct job_t *job;//相应pid的job
5
        sigset_t mask, prev;
6
        if(argv[1] == NULL)//如果第二个参数为空,输出提示
7
            printf("%s command requires PID or %%jobid argument\n", argv[0]);
8
9
            return;
10
        }
       if(argv[1][0] == '%')//如果是jid
11
12
13
           int jid = atoi(argv[1] + 1);//得到jid
           if(jid == 0)//如果参数有错误,打印信息
14
15
            {
16
               printf("%s: argument must be a PID or %%jobid\n",argv[0]);
17
                return;
18
           job = getjobjid(jobs, jid);//得到相应的job
19
```

```
20
            if(job == NULL)//jid不存在
21
            {
                printf("%s: No such job\n", argv[1]);
22
23
                return;
24
25
            pid = job->pid;
26
        }
27
        else
28
        {
29
            pid = atoi(argv[1]);//得到pid
            if(pid == 0)//如果参数有错误,打印信息
30
31
32
                printf("%s: argument must be a PID or %%jobid\n",argv[0]);
33
                return;
34
            job = getjobpid(jobs, pid);//得到相应的job
35
36
            if(job == NULL)//pid不存在
37
38
                printf("(%s): No such process\n", argv[1]);
39
                return;
40
            }
41
42
        if(sigemptyset(&mask) < 0)//设置阻塞集合
43
            unix_error("sigset error");
44
        if(sigaddset(&mask, SIGCHLD) < 0)//设置阻塞集合
45
            unix_error("sigset error");
46
        if(sigprocmask(SIG_BLOCK, &mask, &prev) < 0)//在发送SIGCONT时阻塞SIGCHLD信
    号,防止调用过程中接收到SIGCHLD信号而发生不一致
47
            unix_error("sigset error");
48
        if(kill(-pid, SIGCONT) < 0)//发送SIGCONT信号
49
            unix_error("kill error");
50
        if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)</pre>
51
            unix_error("sigset error");
52
        if(!strcmp(argv[0], "bg"))//如果是bg命令
53
        {
54
            job->state = BG;//修改状态为BG
55
            printf("[%d] (%d) %s",job->jid, pid, job->cmdline);//打印相应信息
56
        }
57
        else//fg命令
58
        {
59
            job->state = FG;//修改状态为fg
60
            waitfg(pid);//等待运行结束
61
        }
62
        return;
63
   }
```

4, waitfg

```
1 void waitfg(pid_t pid)
2 {
3 sigset_t mask, prev;
4
5 if(sigemptyset(&mask) < 0)//设置mask
6 unix_error("sigset error");
7 if(sigaddset(&mask, SIGCHLD) < 0)
8 unix_error("sigset error");
9 if(sigprocmask(SIG_BLOCK, &mask, &prev) < 0)//阻塞SIGCHLD信号
```

```
10
           unix_error("sigset error");
11
12
        while(fgpid(jobs) == pid)//循环等待前台进程结束
13
            sigsuspend(&prev);
14
15
        if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)//还原调用前的阻塞集合
16
            unix_error("sigset error");
17
18
        return;
19
```

5. sigchld_handler

```
1
   void sigchld_handler(int sig)
2
3
       int olderrno = errno;//保存之前的错误信息
4
       sigset_t mask, prev;
5
       int status;
6
       pid_t pid;
7
       if(sigfillset(&mask) < 0)//设置阻塞集合
8
9
           unix_error("sigset error");
10
11
       while((pid = waitpid(-1, &status, WNOHANG | WUNTRACED)) > 0)//循环检查所有
    终止或停止的子进程
12
       {
13
           if(sigprocmask(SIG_BLOCK, &mask, &prev) < 0)//阻塞所有信号
               unix_error("sigset error");
14
15
           if(WIFEXITED(status))//子进程正常结束退出,删除其job
               deletejob(jobs, pid);
16
17
           else if(WIFSIGNALED(status))//因为未捕获的信号结束,打印信息并删除job
18
19
               printf("Job [%d] (%d) terminated by signal %d\n",pid2jid(pid),
    pid, WTERMSIG(status));
20
               deletejob(jobs, pid);
21
22
           else if(WIFSTOPPED(status))//子进程停止
23
24
               printf("Job [%d] (%d) stopped by signal %d\n",pid2jid(pid), pid,
   WSTOPSIG(status));
               struct job_t* job = getjobpid(jobs, pid);
25
26
               job->state = ST;
27
28
           if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)//恢复阻塞集合
29
               unix_error("sigset error");
30
31
       if(errno != olderrno && errno != ECHILD)//检查waitpid返回负值的原因是不是因为
    没有终止或停止子进程了
           unix_error("waitpid error");
32
33
       errno = olderrno;//恢复之前的错误信息
34
35
       return;
36
```

6、sigint_handler

```
void sigint_handler(int sig)
2
    {
3
        int olderrno = errno;//保存之前的错误信息
4
        sigset_t mask, prev;
5
        pid_t pid = fgpid(jobs);//找到前台进程
6
7
        if(pid > 0)//如果存在前台作业
8
9
            if(sigemptyset(&mask) < 0)//设置mask
                unix_error("sigset error");
10
            if(sigaddset(&mask, SIGCHLD) < 0)</pre>
11
                unix_error("sigset error");
12
13
            if(sigprocmask(SIG_BLOCK, &mask, &prev) < 0)//阻塞SIGCHLD信号
                unix_error("sigset error");
14
            if(kill(-pid, SIGINT) < 0)//发送SIGINT信号
15
                unix_error("kill error");
16
17
            if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)//恢复阻塞集合
18
                unix_error("sigset error");
19
        }
20
21
        errno = olderrno;//恢复之前的错误信息
22
        return;
23
   }
```

7、sigtstp_handler

```
void sigtstp_handler(int sig)
1
2
    {
 3
        int olderrno = errno;//保存之前的错误信息
4
        sigset_t mask, prev;
5
        pid_t pid = fgpid(jobs);//找到前台进程
6
        if(pid > 0)//如果存在前台作业
7
8
        {
9
            if(sigemptyset(&mask) < 0)//设置mask
                unix_error("sigset error");
10
            if(sigaddset(&mask, SIGCHLD) < 0)</pre>
11
12
                unix_error("sigset error");
13
            if(sigprocmask(SIG_BLOCK, &mask, &prev) < 0)//阻塞SIGCHLD信号
14
                unix_error("sigset error");
15
            if(kill(-pid, SIGTSTP) < 0)//发送SIGTSTP信号
                unix_error("kill error");
16
17
            if(sigprocmask(SIG_SETMASK, &prev, NULL) < 0)//恢复阻塞集合
18
                unix_error("sigset error");
19
        }
20
21
        errno = olderrno;//恢复之前的错误信息
22
        return;
23
   }
```