实验日志 2.11

【60%】比较 trace09~10 执行不同结果，编程实现内建命令 bg 和 fg 的 do_bgfg()处理函数

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make test09
./sdriver.pl -t trace09.txt -s ./tsh -a "-p"
#
# trace09.txt - Process bg builtin command
#
tsh> ./myspin 4 &
[1] (2920) ./myspin 4 &
tsh> ./myspin 5
Job [2] (2922) stopped by signal 20
tsh> jobs
[1] (2920) Running ./myspin 4 &
[2] (2922) Stopped ./myspin 5
tsh> bg %2
tsh> jobs
[1] (2920) Running ./myspin 4 &
[2] (2922) Stopped ./myspin 5
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make rtest09
./sdriver.pl -t trace09.txt -s ./tshref -a "-p"
#
# trace09.txt - Process bg builtin command
#
tsh> ./myspin 4 &
[1] (2932) ./myspin 4 &
tsh> ./myspin 5
Job [2] (2934) stopped by signal 20
tsh> jobs
[1] (2932) Running ./myspin 4 &
[2] (2934) Stopped ./myspin 5
tsh> bg %2
[2] (2934) ./myspin 5
tsh> jobs
[1] (2932) Running ./myspin 4 &
[2] (2934) Running ./myspin 5
```

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make test10
./sdriver.pl -t trace10.txt -s ./tsh -a "-p"
#
# trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (2945) ./myspin 4 &
tsh> fg %1
tsh> jobs
[1] (2945) Running ./myspin 4 &
tsh> fg %1
tsh> jobs
[1] (2945) Running ./myspin 4 &
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make rtest10
./sdriver.pl -t trace10.txt -s ./tshref -a "-p"
#
# trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (2955) ./myspin 4 &
tsh> fg %1
Job [1] (2955) stopped by signal 20
tsh> jobs
[1] (2955) Stopped ./myspin 4 &
tsh> fg %1
tsh> jobs
```

（1）比较 trace09 执行不同结果

Trace09 中，tsh 没有执行 bg 命令，而参考 tsh-ref 的结果中，有内建命令 bg %2 的执行示。

（2）比较 trace10 执行不同结果

Trace10 中，tsh 中没有找到 fg 命令，tsh-ref 中，可以看到找到了 fg 命令，并有停止进程。

（3）编程实现内建命令 bg 和 fg 的 do_bgfg()处理函数

```
void do_bgfg(char **argv)
{
    int bg = 0;
    int jid;
    pid_t pid;
    struct job_t *job;
    char *arg = argv[1];
    if(!arg || arg[0]=='&'){
        printf("%s command requires PID or %%jobid argument\n", argv[0]);
        return;
    }
    if(arg[0]!='%' && (arg[0]<'0' || arg[0]>'9')){
        printf("%s: argument must be a PID or %%jobid\n", argv[0]);
        return;
    } //get job
    if(arg[0]=='%'){jid = atoi(++arg);
        if(!jid){
            printf("%s: No such job\n", argv[1]);
            return;
        }job = getjobjid(jobs, jid);
        if(!job){
            printf("%s: No such job\n", argv[1]);
            return;
        }
        pid = job->pid;
    }else{pid = atoi(arg);
        job = getjobpid(jobs, pid);
        if(!job){
            printf("(%d): No such process\n", pid);
            return;
        }
    }//do bg or fg
    if(!strcmp(argv[0],"bg")){
        bg = 1;
    }
    if(bg){Kill(-pid, SIGCONT);
        job->state = BG;
        printf("[%d] (%d) %s", job->jid, job->pid, job->cmdline);
    }else{Kill(-pid, SIGCONT);
        job->state = FG;
        waitfg(pid);
    }
    return;
}
```

【10%】验证 trace09~10

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make test09
./sdriver.pl -t trace09.txt -s ./tsh -a "-p"
#
# trace09.txt - Process bg builtin command
#
tsh> ./myspin 4 &
[1] (3305) ./myspin 4 &
tsh> ./myspin 5
Job [2] (3307) stopped by signal 20
tsh> jobs
[1] (3305) Running ./myspin 4 &
[2] (3307) Stopped ./myspin 5
tsh> bg %2
[2] (3307) ./myspin 5
tsh> jobs
[1] (3305) Running ./myspin 4 &
[2] (3307) Running ./myspin 5
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make rtest09
./sdriver.pl -t trace09.txt -s ./tshref -a "-p"
#
# trace09.txt - Process bg builtin command
#
tsh> ./myspin 4 &
[1] (3316) ./myspin 4 &
tsh> ./myspin 5
Job [2] (3318) stopped by signal 20
tsh> jobs
[1] (3316) Running ./myspin 4 &
[2] (3318) Stopped ./myspin 5
tsh> bg %2
[2] (3318) ./myspin 5
tsh> jobs
[1] (3316) Running ./myspin 4 &
[2] (3318) Running ./myspin 5
```

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make test10
./sdriver.pl -t trace10.txt -s ./tsh -a "-p"
#
# trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (3327) ./myspin 4 &
tsh> fg %1
Job [1] (3327) stopped by signal 20
tsh> jobs
[1] (3327) Stopped ./myspin 4 &
tsh> fg %1
tsh> jobs
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ make rtest10
./sdriver.pl -t trace10.txt -s ./tshref -a "-p"
#
# trace10.txt - Process fg builtin command.
#
tsh> ./myspin 4 &
[1] (3337) ./myspin 4 &
tsh> fg %1
Job [1] (3337) stopped by signal 20
tsh> jobs
[1] (3337) Stopped ./myspin 4 &
tsh> fg %1
tsh> jobs
```

【30%】验证 trace11~15 并解释与记录

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ 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] (3351) terminated by signal 2
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:05 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3346 pts/0    S+     0:00 make test11
 3347 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace11.txt -s ./tsh -a "-p"
 3348 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace11.txt -s ./tsh -a -p
 3349 pts/0    S+     0:00 ./tsh -p
 3354 pts/0    R      0:00 /bin/ps a
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ 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] (3360) terminated by signal 2
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:05 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3355 pts/0    S+     0:00 make rtest11
 3356 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace11.txt -s ./tshref -a "-p"
 3357 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace11.txt -s ./tshref -a -p
 3358 pts/0    S+     0:00 ./tshref -p
 3363 pts/0    R      0:00 /bin/ps a
```

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ 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] (3370) stopped by signal 20
tsh> jobs
[1] (3370) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:05 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3365 pts/0    S+     0:00 make test12
 3366 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace12.txt -s ./tsh -a "-p"
 3367 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tsh -a -p
 3368 pts/0    S+     0:00 ./tsh -p
 3370 pts/0    T      0:00 ./mysplit 4
 3371 pts/0    T      0:00 ./mysplit 4
 3374 pts/0    R      0:00 /bin/ps a
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ 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] (3381) stopped by signal 20
tsh> jobs
[1] (3381) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:05 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3376 pts/0    S+     0:00 make rtest12
 3377 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace12.txt -s ./tshref -a "-p"
 3378 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace12.txt -s ./tshref -a -p
 3379 pts/0    S+     0:00 ./tshref -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
```

（1）验证 trace11

验证 sigint_handler 以及是否回收僵死进程。

./mysplit 4 的进程被终止，使用命令行“/bin/ps a”查看当前所有进程的状态，发现运行“./myspilt 4”的进程以及其创建的子进程均未被显示，表明进程组终止，并成功回收僵死。

（2）验证 trace12

验证 sigstp，如图，./mysplit 4 被停止，进程（4977）（4978）均停止。

（3）验证 trace13

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ 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] (3398) stopped by signal 20
tsh> jobs
[1] (3398) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:06 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3393 pts/0    S+     0:00 make test13
 3394 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a "-p"
 3395 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh -a -p
 3396 pts/0    S+     0:00 ./tsh -p
 3398 pts/0    T      0:00 ./mysplit 4
 3399 pts/0    T      0:00 ./mysplit 4
 3402 pts/0    R      0:00 /bin/ps a
tsh> fg %1
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:06 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3393 pts/0    S+     0:00 make test13
 3394 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tsh -a "-p"
 3395 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tsh -a -p
 3396 pts/0    S+     0:00 ./tsh -p
 3405 pts/0    R      0:00 /bin/ps a
```

```
zhangjiwei@zhangjiwei-virtual-machine:~/shlab-handout$ 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] (3411) stopped by signal 20
tsh> jobs
[1] (3411) Stopped ./mysplit 4
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:06 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3406 pts/0    S+     0:00 make rtest13
 3407 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref -a "-p"
 3408 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a -p
 3409 pts/0    S+     0:00 ./tshref -p
 3411 pts/0    T      0:00 ./mysplit 4
 3412 pts/0    T      0:00 ./mysplit 4
 3415 pts/0    R      0:00 /bin/ps a
tsh> fg %1
tsh> /bin/ps a
  PID TTY      STAT   TIME COMMAND
 1176 tty4     Ss+    0:00 /sbin/getty -8 38400 tty4
 1184 tty5     Ss+    0:00 /sbin/getty -8 38400 tty5
 1203 tty2     Ss+    0:00 /sbin/getty -8 38400 tty2
 1204 tty3     Ss+    0:00 /sbin/getty -8 38400 tty3
 1215 tty6     Ss+    0:00 /sbin/getty -8 38400 tty6
 1273 tty7     Ss+    0:06 /usr/bin/X :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch -background none
 1643 tty1     Ss+    0:00 /sbin/getty -8 38400 tty1
 2545 pts/0    Ss     0:00 bash
 3406 pts/0    S+     0:00 make rtest13
 3407 pts/0    S+     0:00 /bin/sh -c ./sdriver.pl -t trace13.txt -s ./tshref -a "-p"
 3408 pts/0    S+     0:00 /usr/bin/perl ./sdriver.pl -t trace13.txt -s ./tshref -a -p
 3409 pts/0    S+     0:00 ./tshref -p
 3418 pts/0    R      0:00 /bin/ps a
```

验证 fg，bg 的内建命令，重启进程。

用命令行“./bin/ps a”查看当前所有进程的状态，发现前台作业运行完毕，进程被回收。

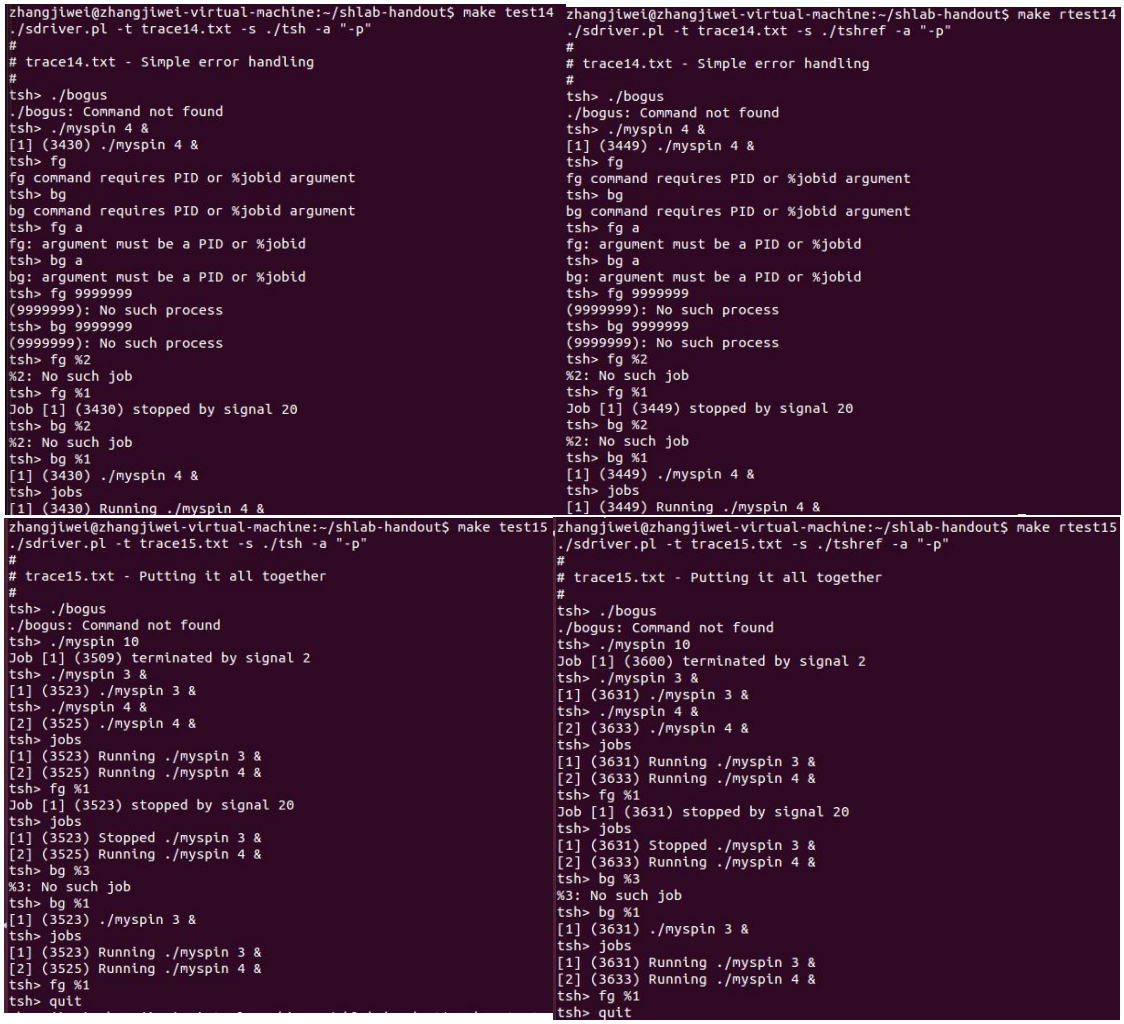
表明命令“fg %1”成功重启停止的进程组为前台运行，内建命令 fg 实现成功。

（4）验证 trace14

验证 tsh 对常见错误的处理并产生相应的提示信息。

（5）验证 trace15

验证 tsh 和 tsh-ref 的结果是否相同。



实验报告 2.3

1、实验目标：

编写程序掌握过程与信号的概念，通过与 tsh-ref 对比，验证是否正确。

2、实验资源：Linux 系统、Ubuntu、个人电脑、shell lab 实验包。

3、实验步骤：

（1）掌握操作方法，如何编译并验证测试文件。

（2）实现简单的函数命令：quit 内建命令，了解 eval,execve 函数的执行流程,fork 函数的多进程运行方式。

（3）实现后台作业的部分功能，以及测试文件中的符号意义。

（4）实现 jobs 内建命令，学习进程，作业，前台后台等相关概念。

（5）实现信号函数，并对信号功能进行学习理解。

（6）处理 fg，bg 的内建命令，实现相关操作函数。

（7）验证 tsh 的完整功能。

4、实验结果

通过对每一个测试文件的功能测试，并与 tsh-ref 的运行结果对比，了解了 tsh 各个函数的功能，以及对信号的意义解释和说明，对进程的运行方式进行说明并测试。

5、实验总结

（1）对实验的说明文件进行学习时，了解了进程的概念和子进程的运行，对作业的运行方式和要求展示出来的部分，都很好的帮助我理解了实验的目的和基本操作。

（2）在进行实验时，遇到了很多理解和实现方面的问题，对每个函数的关联需要更加谨慎的理解与编写，以便于实现不同的功能，使测试文件结果正确，并展示出来。

（3）与同学的交流和学习讨论中，对实验的理解更加透彻，对原理的学习和结果的展示都有了提高。