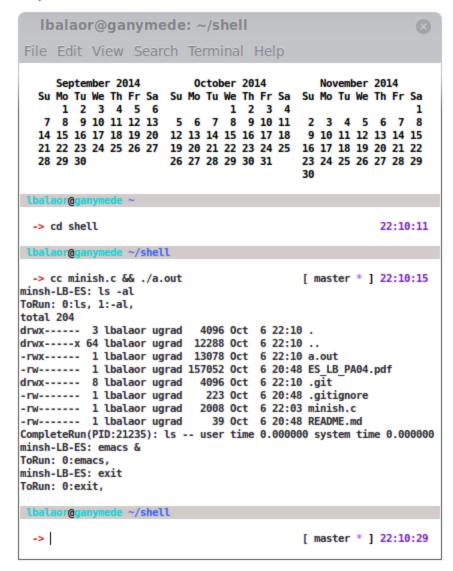# CS 481 Programming Assignment 04

Ezra Stallings & Luke Balaoro

10/06/2014

Implementation Details

We used a linked list to track our background processes so we could later terminate them. We also called *getrusage* twice per process: once when the child is executed and once afterwards, to get the user and system times for each child. Beyond that, it was relatively straightforward; parsing string input, forking, and calling execvp with the parsed arguments. There wasn'
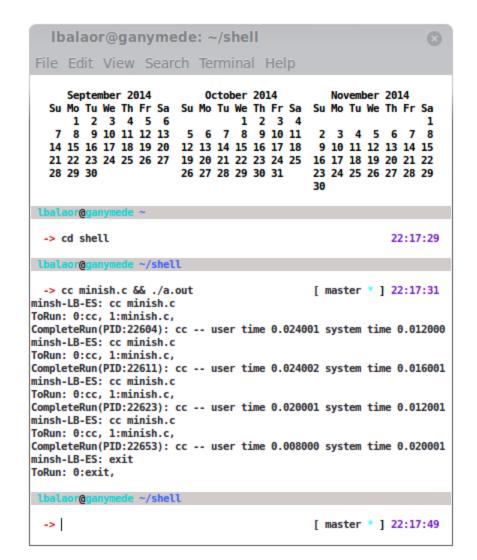
Snapshots

```
lbalaor@ganymede: ~/shell                           ⊗

File  Edit  View  Search  Terminal  Help

      September 2014         October 2014          November 2014
   Su Mo Tu We Th Fr Sa   Su Mo Tu We Th Fr Sa   Su Mo Tu We Th Fr Sa
       1  2  3  4  5  6             1  2  3  4                      1
    7  8  9 10 11 12 13    5  6  7  8  9 10 11    2  3  4  5  6  7  8
   14 15 16 17 18 19 20   12 13 14 15 16 17 18    9 10 11 12 13 14 15
   21 22 23 24 25 26 27   19 20 21 22 23 24 25   16 17 18 19 20 21 22
   28 29 30               26 27 28 29 30 31      23 24 25 26 27 28 29
                                                 30

lbalaor@ganymede ~

  -> cd shell                                          22:10:11

lbalaor@ganymede ~/shell

  -> cc minish.c && ./a.out              [ master * ] 22:10:15
minsh-LB-ES: ls -al
ToRun: 0:ls, 1:-al,
total 204
drwx------  3 lbalaor ugrad   4096 Oct  6 22:10 .
drwx-----x 64 lbalaor ugrad  12288 Oct  6 22:10 ..
-rwx------  1 lbalaor ugrad  13078 Oct  6 22:10 a.out
-rw-------  1 lbalaor ugrad 157052 Oct  6 20:48 ES_LB_PA04.pdf
drwx------  8 lbalaor ugrad   4096 Oct  6 22:10 .git
-rw-------  1 lbalaor ugrad    223 Oct  6 20:48 .gitignore
-rw-------  1 lbalaor ugrad   2008 Oct  6 22:03 minish.c
-rw-------  1 lbalaor ugrad     39 Oct  6 20:48 README.md
CompleteRun(PID:21235): ls -- user time 0.000000 system time 0.000000
minsh-LB-ES: emacs &
ToRun: 0:emacs,
minsh-LB-ES: exit
ToRun: 0:exit,

lbalaor@ganymede ~/shell

  -> |                                    [ master * ] 22:10:29
```

Running ls with multiple arguments, and emacs as a background process.

```
          September 2014           October 2014           November 2014
     Su Mo Tu We Th Fr Sa    Su Mo Tu We Th Fr Sa    Su Mo Tu We Th Fr Sa
         1  2  3  4  5  6              1  2  3  4                        1
      7  8  9 10 11 12 13     5  6  7  8  9 10 11     2  3  4  5  6  7  8
     14 15 16 17 18 19 20    12 13 14 15 16 17 18     9 10 11 12 13 14 15
     21 22 23 24 25 26 27    19 20 21 22 23 24 25    16 17 18 19 20 21 22
     28 29 30                26 27 28 29 30 31        23 24 25 26 27 28 29
                                                     30
```

lbalaor@ganymede ~

```
 -> cd shell                                        22:12:45
```

lbalaor@ganymede ~/shell

```
 -> cc minish.c && ./a.out              [ master * ] 22:12:51
minsh-LB-ES: ls
ToRun: 0:ls,
a.out  ES_LB_PA04.pdf  minish.c  README.md
CompleteRun(PID:21925): ls -- user time 0.000000 system time 0.000000
minsh-LB-ES: cc minish.c -o minish
ToRun: 0:cc, 1:minish.c, 2:-o, 3:minish,
CompleteRun(PID:21926): cc -- user time 0.024001 system time 0.016001
minsh-LB-ES: ls
ToRun: 0:ls,
a.out  ES_LB_PA04.pdf  minish  minish.c  README.md
CompleteRun(PID:21932): ls -- user time 0.000000 system time 0.000000
minsh-LB-ES: ./minish
ToRun: 0:./minish,
minsh-LB-ES: echo "meta-minish"
ToRun: 0:echo, 1:"meta-minish",
"meta-minish"
CompleteRun(PID:21935): echo -- user time 0.000000 system time 0.00000
0
minsh-LB-ES: ps
ToRun: 0:ps,
  PID TTY          TIME CMD
21798 pts/4     00:00:00 zsh
21924 pts/4     00:00:00 a.out
21934 pts/4     00:00:00 minish
21936 pts/4     00:00:00 ps
CompleteRun(PID:21936): ps -- user time 0.004000 system time 0.008000
minsh-LB-ES: exit
ToRun: 0:exit,
CompleteRun(PID:21934): ./minish -- user time 0.004000 system time 0.0
08000
minsh-LB-ES: ps
ToRun: 0:ps,
  PID TTY          TIME CMD
21798 pts/4     00:00:00 zsh
21924 pts/4     00:00:00 a.out
21937 pts/4     00:00:00 ps
CompleteRun(PID:21937): ps -- user time 0.004001 system time 0.008001
minsh-LB-ES: exit
ToRun: 0:exit,
```

lbalaor@ganymede ~/shell

```
 -> |                                   [ master * ] 22:13:32
```

Running ls, compiling and running minish.c inside of minish, and running ps inside of both the meta-minish and minish.

```
lbalaor@ganymede: ~/shell                        ⊗

File  Edit  View  Search  Terminal  Help

    September 2014        October 2014        November 2014
 Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa  Su Mo Tu We Th Fr Sa
     1  2  3  4  5  6            1  2  3  4                     1
  7  8  9 10 11 12 13   5  6  7  8  9 10 11   2  3  4  5  6  7  8
 14 15 16 17 18 19 20  12 13 14 15 16 17 18   9 10 11 12 13 14 15
 21 22 23 24 25 26 27  19 20 21 22 23 24 25  16 17 18 19 20 21 22
 28 29 30              26 27 28 29 30 31      23 24 25 26 27 28 29
                                              30

lbalaor@ganymede ~

 -> cd shell                                        22:17:29

lbalaor@ganymede ~/shell

  -> cc minish.c && ./a.out            [ master * ] 22:17:31
minsh-LB-ES: cc minish.c
ToRun: 0:cc, 1:minish.c,
CompleteRun(PID:22604): cc -- user time 0.024001 system time 0.012000
minsh-LB-ES: cc minish.c
ToRun: 0:cc, 1:minish.c,
CompleteRun(PID:22611): cc -- user time 0.024002 system time 0.016001
minsh-LB-ES: cc minish.c
ToRun: 0:cc, 1:minish.c,
CompleteRun(PID:22623): cc -- user time 0.020001 system time 0.012001
minsh-LB-ES: cc minish.c
ToRun: 0:cc, 1:minish.c,
CompleteRun(PID:22653): cc -- user time 0.008000 system time 0.020001
minsh-LB-ES: exit
ToRun: 0:exit,

lbalaor@ganymede ~/shell

 -> |                                  [ master * ] 22:17:49
```

User and system times of running cc on minish.c