System Programming

Week 7: Process Relationships

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06_process_rel

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introduction

This chapter covers following items

- Terminal Logins
- Sessions
- Controlling Terminal
- Job Control

Terminal Logins

Terminal

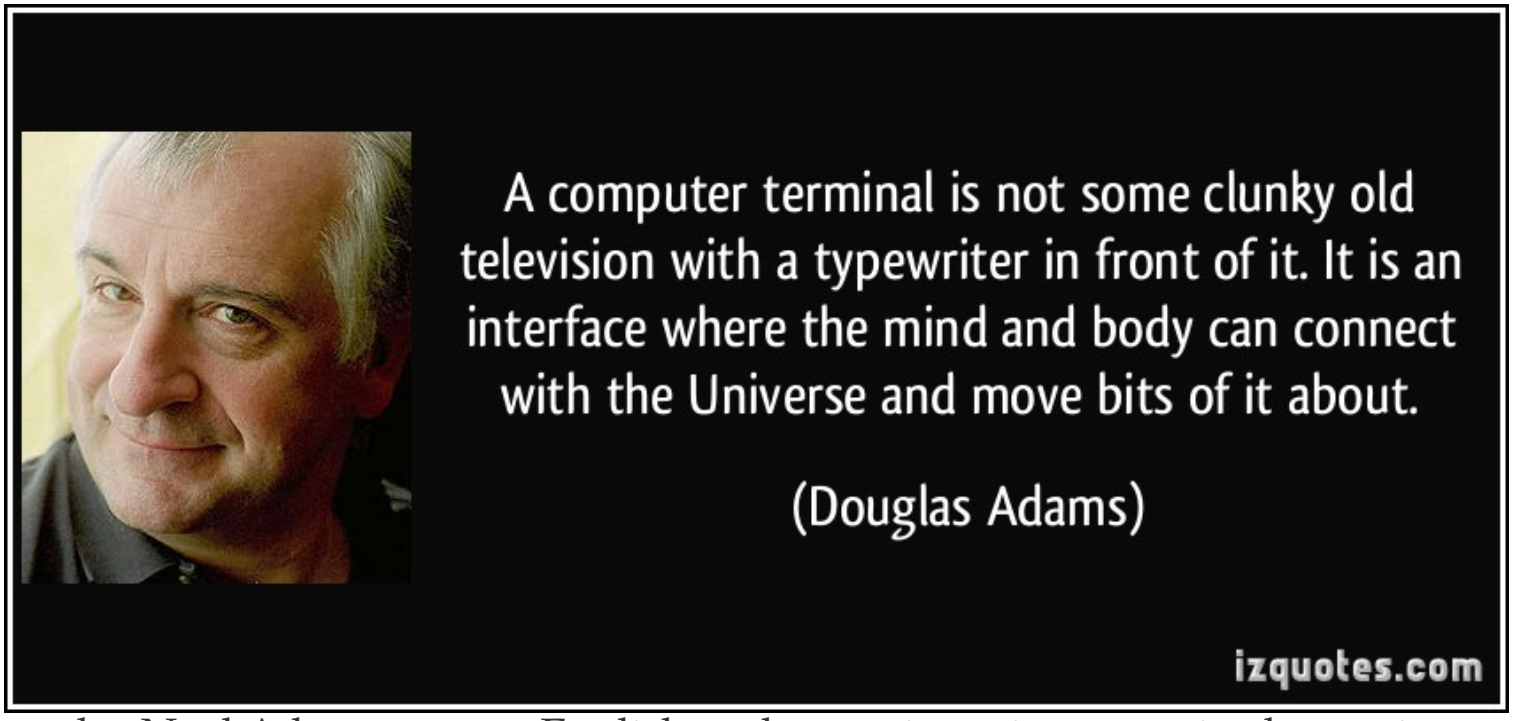

Figure: Douglas Noel Adams was an English author, scriptwriter, essayist, humorist, satirist and dramatist, best known as the author of The Hitchhiker's Guide to the Galaxy" 1978

Terminal Logins

In early UNIX systems

- Users logged in using dumb terminals that were connected to the host with hard-wired connections

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- Users login through a terminal device driver in the kernel
- A host had a fixed number of terminal devices

  type `who` in the shell

```
James    console  Oct 12 15:36
James    ttys000  Oct 13 22:02
James    ttys001  Oct 13 22:08
```

BSD Terminal Logins

Mac OS X and Linux login procedure follows essentially the same steps as the BSD

The system administrator creates `/etc/ttys`, `ttys(5)`, that has one line per terminal device

Each line specifies the name of the device and other parameters that are passed to the `getty(8)` program

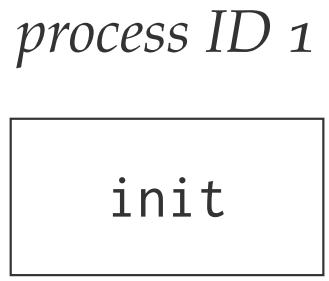
BSD Terminal Logins cont'd

process ID 1

1. the kernel creates process ID 1, the `init` process

BSD Terminal Logins cont'd

1. the kernel creates process ID 1, the `init` process
2. the `init` process reads the file `/etc/ttys`
3. creates empty environment



BSD Terminal Logins cont'd

1. the kernel creates process ID 1, the `init` process
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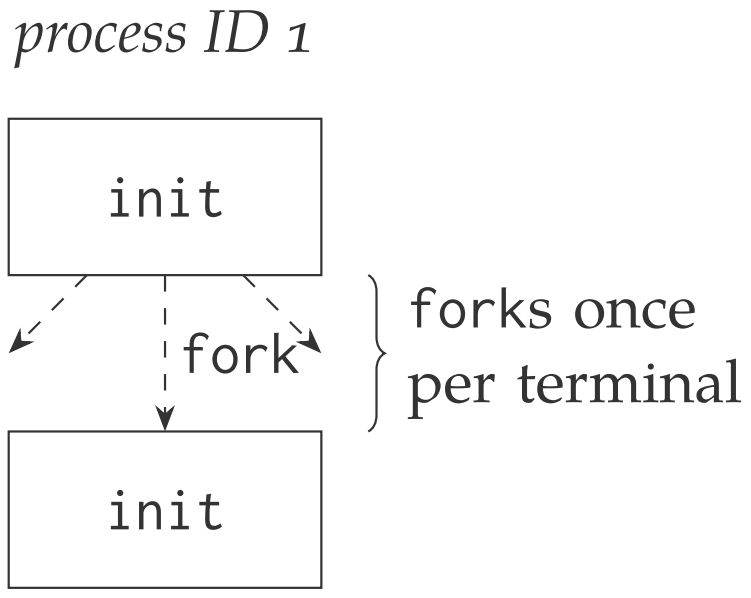
3. creates empty environment
4. `forks` for every terminal device



BSD Terminal Logins cont'd

1. the kernel creates process ID 1, the `init` process
2. the `init` process reads the file `/etc/ttys`
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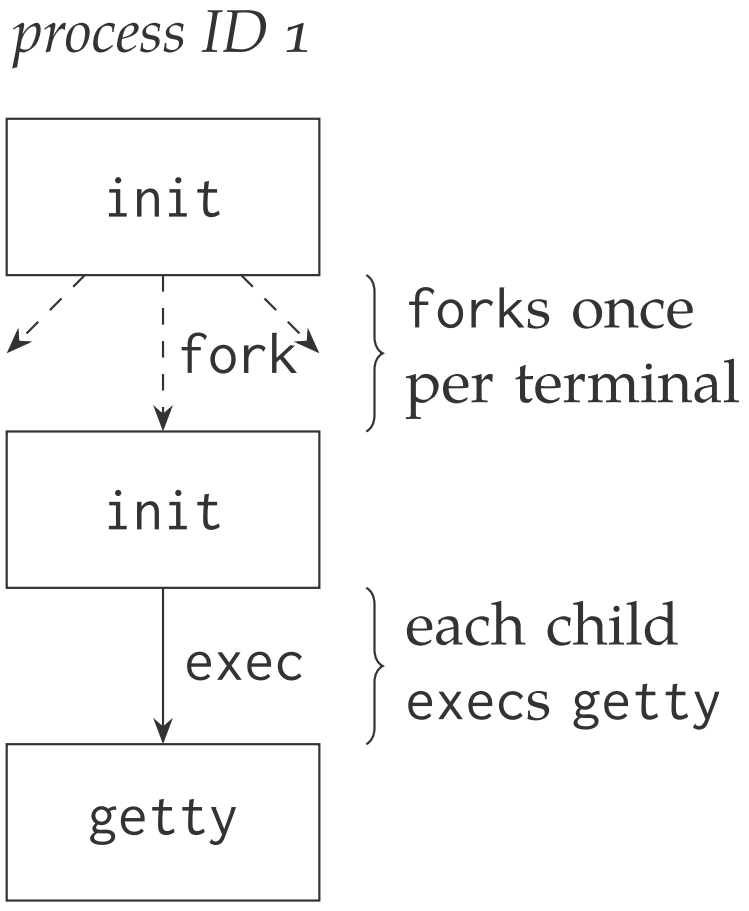
5. followed by `exec` of the program `getty`
6. opens terminal device (fd 0, 1, 2)
7. reads user name
8. initial environment set



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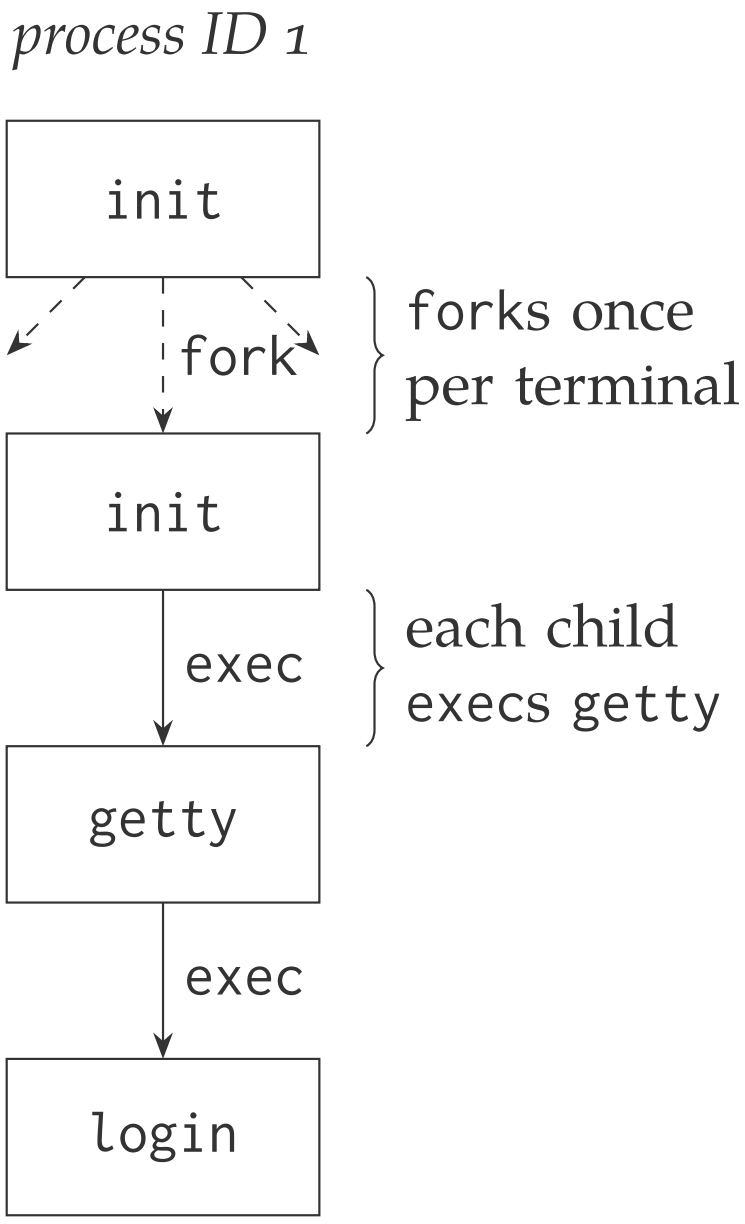
9. followed by `exec` of the program `login`



BSD Terminal Logins

`init(8)` PID 1 PPID 0 EUID 0

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`login(1)` PID N PPID 0 EUID 0

`getpass(3)`, encrypt, compare with `getpwnam(3)`

register login in system database

read/display vaious files

`initgroups(3)/setgid(2)`, initialize environment

`chdir(2)` to home directory

`chown(2)` terminal device

`setuid(2)` to user's uid, `exec(3) shell`

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`$SHELL`	PID N	PPID 0	EUID U
`ls(1)`	PID M	PPID N	EUID U

Process Groups and Sessions

Process Groups

Each process belongs to a process group

- it is a collection of one or more processes
- usually associated with the same job
- the group has a unique process group ID
- the process group exist as long as one process is in the group

```
#include <unistd.h>
pid_t getpgrp(void);
// Returns: process group ID of calling process
```

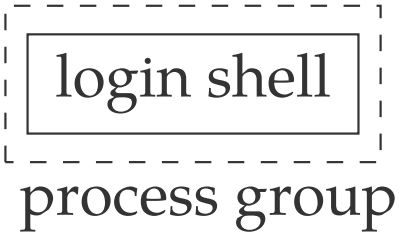
Process group cont'd

A process joins an existing process group or creates a new process group by calling `setpgid`

```
#include <unistd.h>
int setpgid(pid_t pid, pid_t pgid);
// Returns: 0 if OK, 1 on error
```

- sets the process group ID to *pgid* in the process whose process ID equals to pid
- if `pgid` == `pid`, then `pid` == process group leader
- if `pid` == 0, caller process ID is used
- if `pgid` == 0, group ID == `pid`
- A porcess can set the process group ID of itself or its children

Sessions



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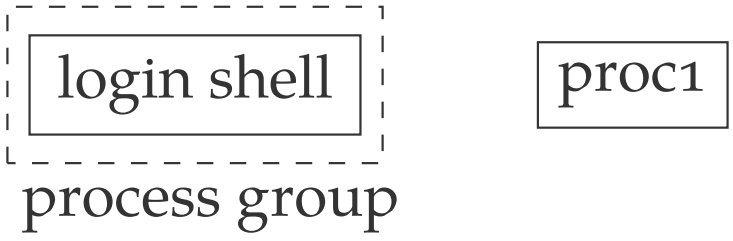

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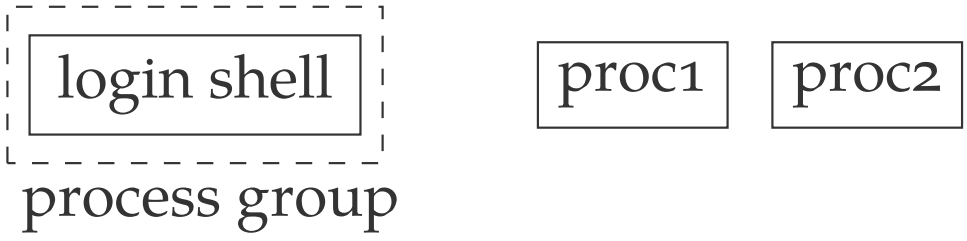
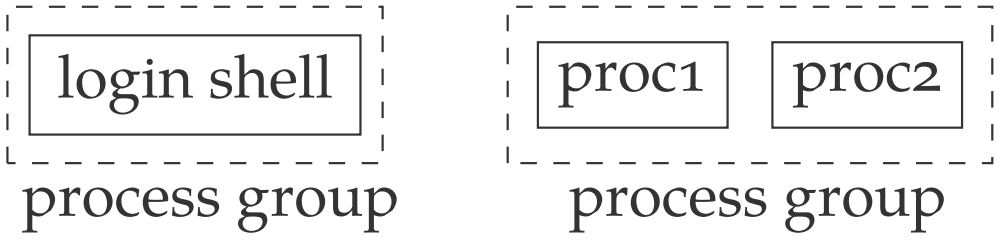


Sessions

The processes in a process group are usually placed ther by a shell pipeline

```
proc1 | proc2 &
```



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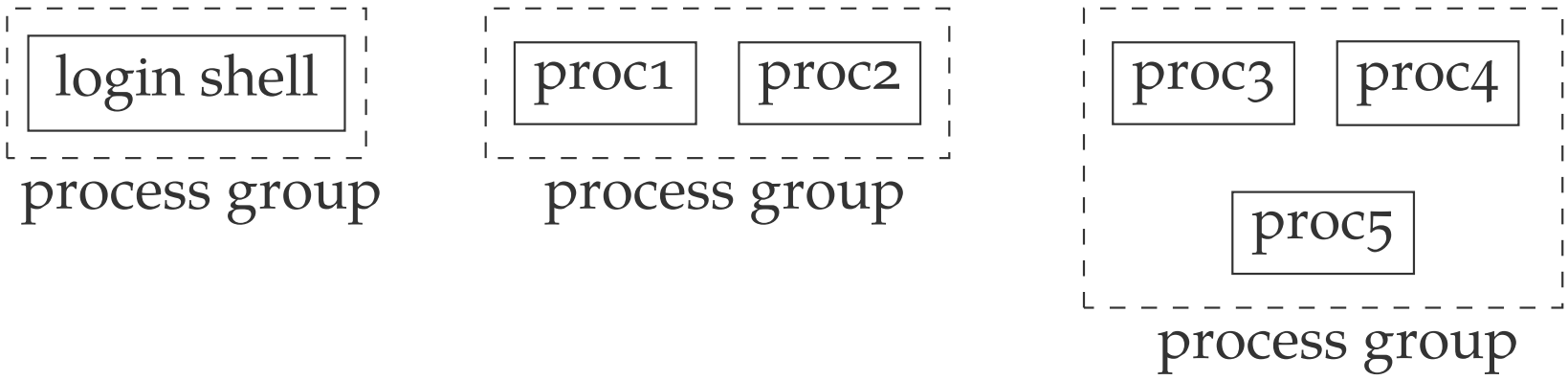
```
proc1 | proc2 &
proc3 | proc4 | proc5
```



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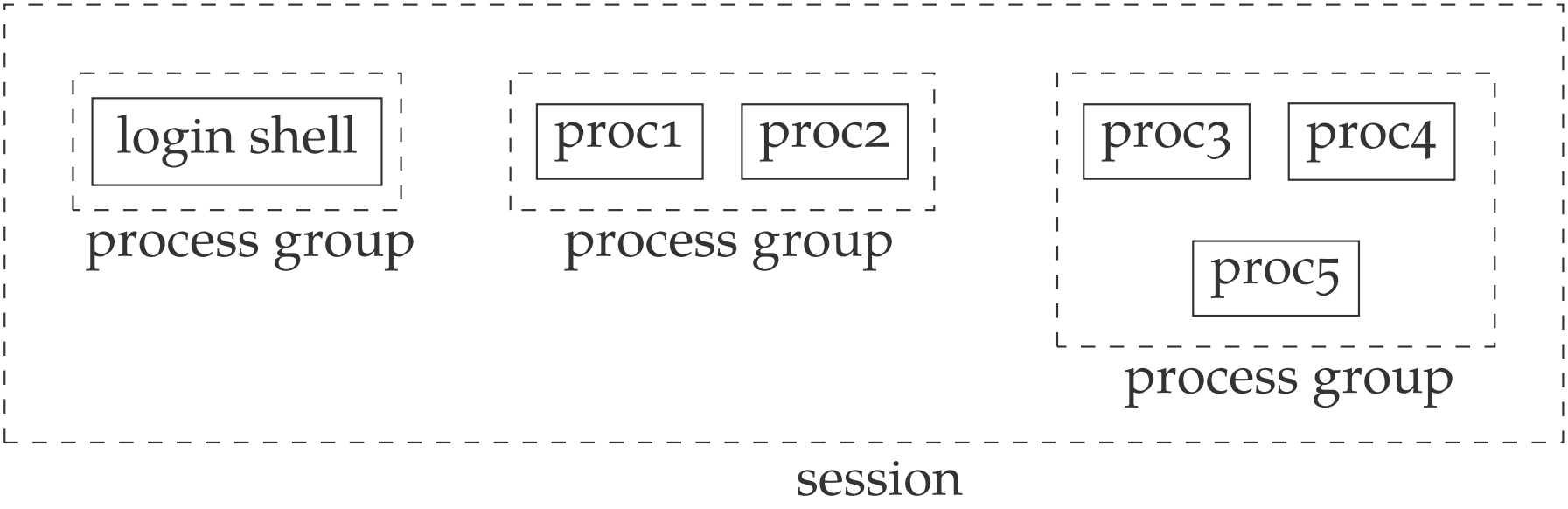

Session is a collection of one or more process groups

Sessions cont'd

A process establishes a new session by calling the `setsid` function

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#include <unistd.h>
pid_t setsid(void);
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If the calling process is not a process group leader, this fuction creates a new session. Three things happen

Sessions cont'd

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2. the process becomes the process group leader (`pgid` ==`pid`)
   - if the caller is already a process group leader, then returns an error

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2. the process becomes the process group leader (`pgid` ==`pid`)
   - if the caller is already a process group leader, then returns an error
3. No contorlling terminal

Sessions cont'd

`getsid` function returns the process group ID of a process's session leader

```
#include <unistd.h>
pid_t getsid(pid_t pid);
// Returns: session leader's process group ID if OK, 1 on error
```

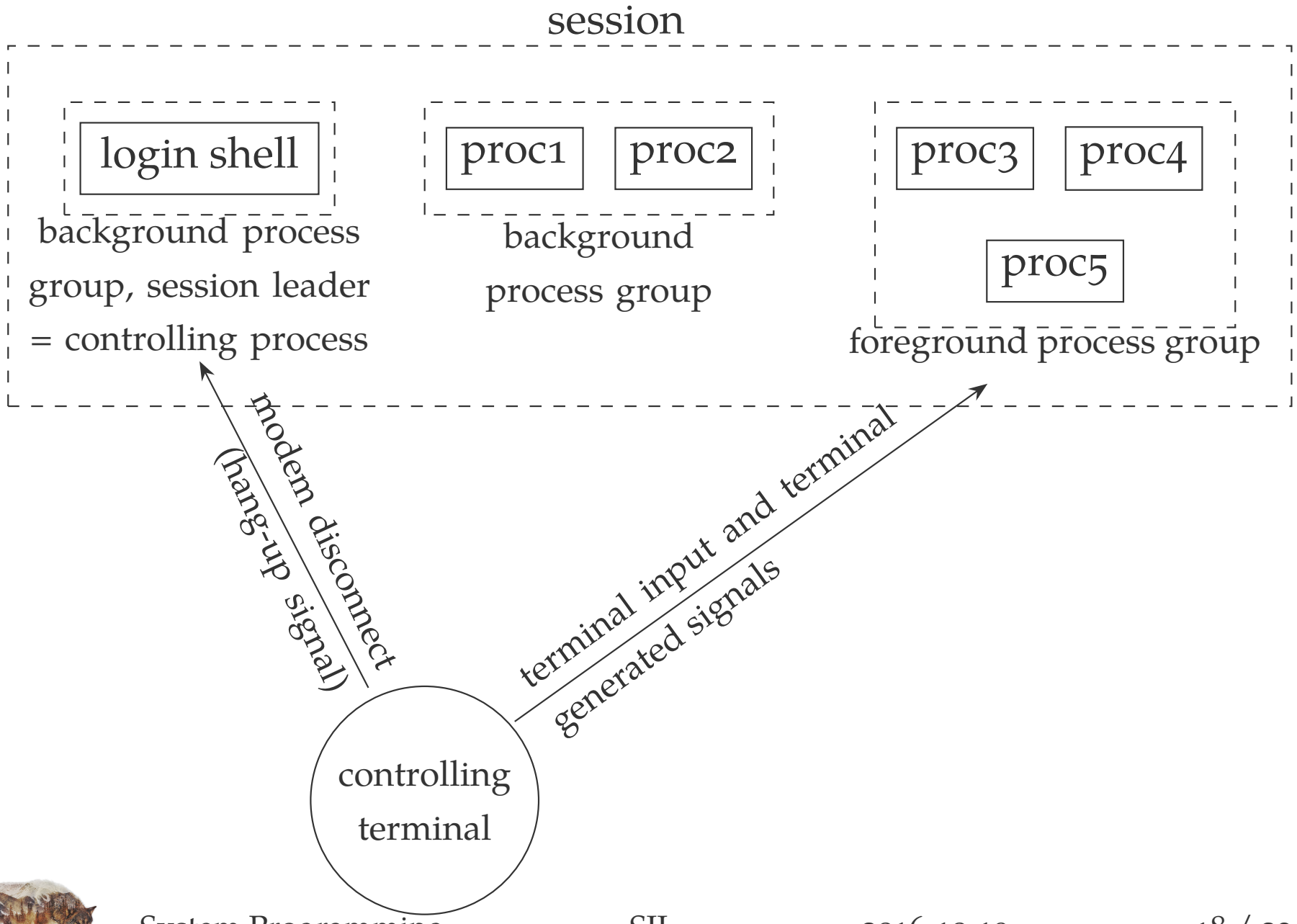
if `pid` == 0, it returns the `pgid` of calling process's session leader

Controlling Terminal and Job Controls

Controlling terminal

- Session can have a single controlling terminal
- session leader that connects to controlling terminal is *controlling process*
- process groups are divided into a single *forground process group* and one or more *background process groups*
- interrupt signals are sent to foreground process group

Controlling Terminal



Job Control

We can start a job in either the forground or the background

foreground `vi main.c` starts a job in the foreground

background `make all &` start a job in the background

```
$ make all > Make.out &
[1] 1475
$ pr *.c | lpr &
[2] 1490
$                    just press RETURN
[2] +  Done          pr *.c | lpr &
[1] +  Done          make all > Make.out &
```

Job Control cont'd

The foreground jobs are affected by some special characters, which generate signals

- Interrupt character (typically DELETE or Control-C) generates SIGINT
- Quit character (typically Control-bashslash) generates SIGQUIT
- Suspend character (typically Control-Z) generatea SIGTSTP

Job Control cont'd

```
1 $ cat > temp.foo &
   [1] 1681
2 $
   [1] + Stopped (SIGTTIN) cat > temp.foo &
3 $ fg %1
4 cat > temp.foo
5 hello, world
6 ^D
7 $ cat temp.foo
   hello, world
```

1. start in background, but it'll read from standard input
2. we press RETURN
3. bring job number 1 into the foreground
4. the shell tells us which job is now in the foreground
5. enter one line
6. type the end-of-file character
7. check that the one line was put into the file

Last Words

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- Read chapter 10