Advanced Programming in the UNIX Environment

Week 07, Segment 2:
Process Groups and Sessions

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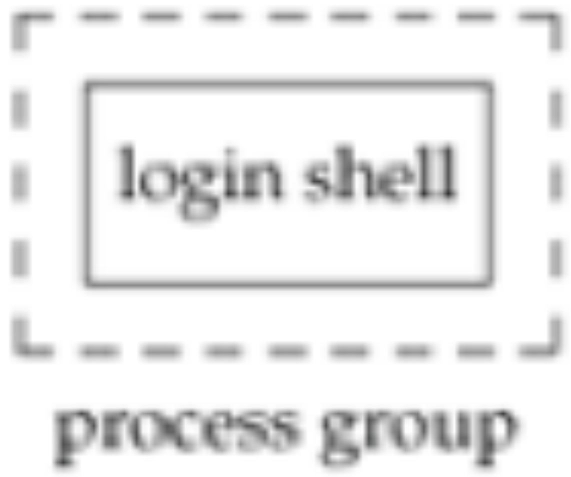
Process Groups

```
#include <unistd.h>

pid_t getpgrp(void);

pid_t getpgid(pid_t pid);
```

Returns: group-ID; -1 on error (getpgid(2) only)

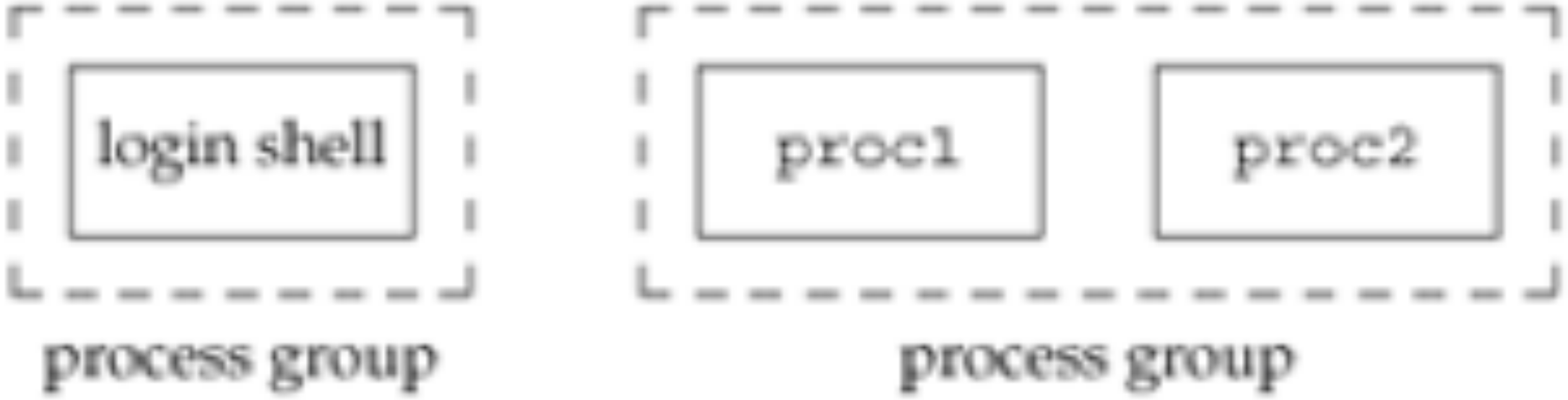
- in addition to having a PID, each process also belongs to a process group (a collection of processes associated with the same job/terminal)
- each process group has a unique process group ID
- process group IDs (like PIDs) are positive integers and can be stored in a `pid_t` data type
- each process group can have a process group leader
    - leader is identified by its process group ID == PID
    - leader can create a new process group, create processes in the group
- a process can set its (or its children's) process group using `setpgid(2)`

Process Groups



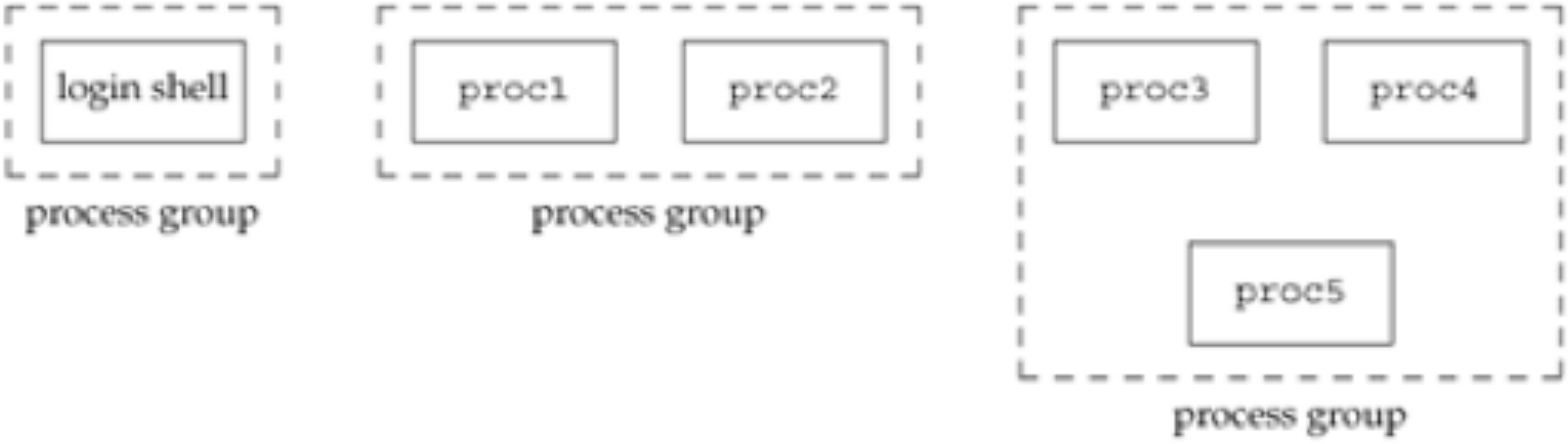
```
$
```

Process Groups



```
$ proc1 | proc2 &
[1] 10306
$
```

Process Groups



```
$ proc1 | proc2 &
[1] 10306
$ proc3 | proc4 | proc5
```

Sessions

```
#include <unistd.h>

pid_t setsid(void)
```

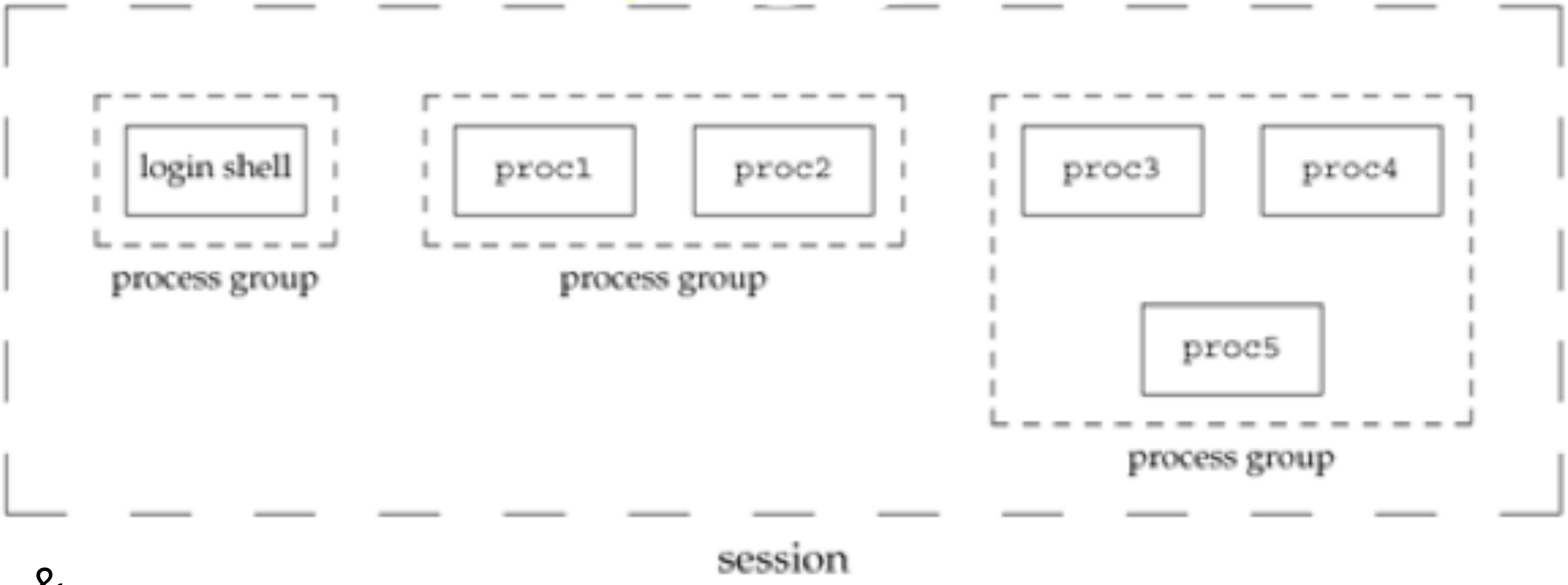
Returns: process group-ID if ok, -1 otherwise

A session is a collection of one or more process groups.

If the calling process is not a process group leader, this function creates a new session. Three things happen:

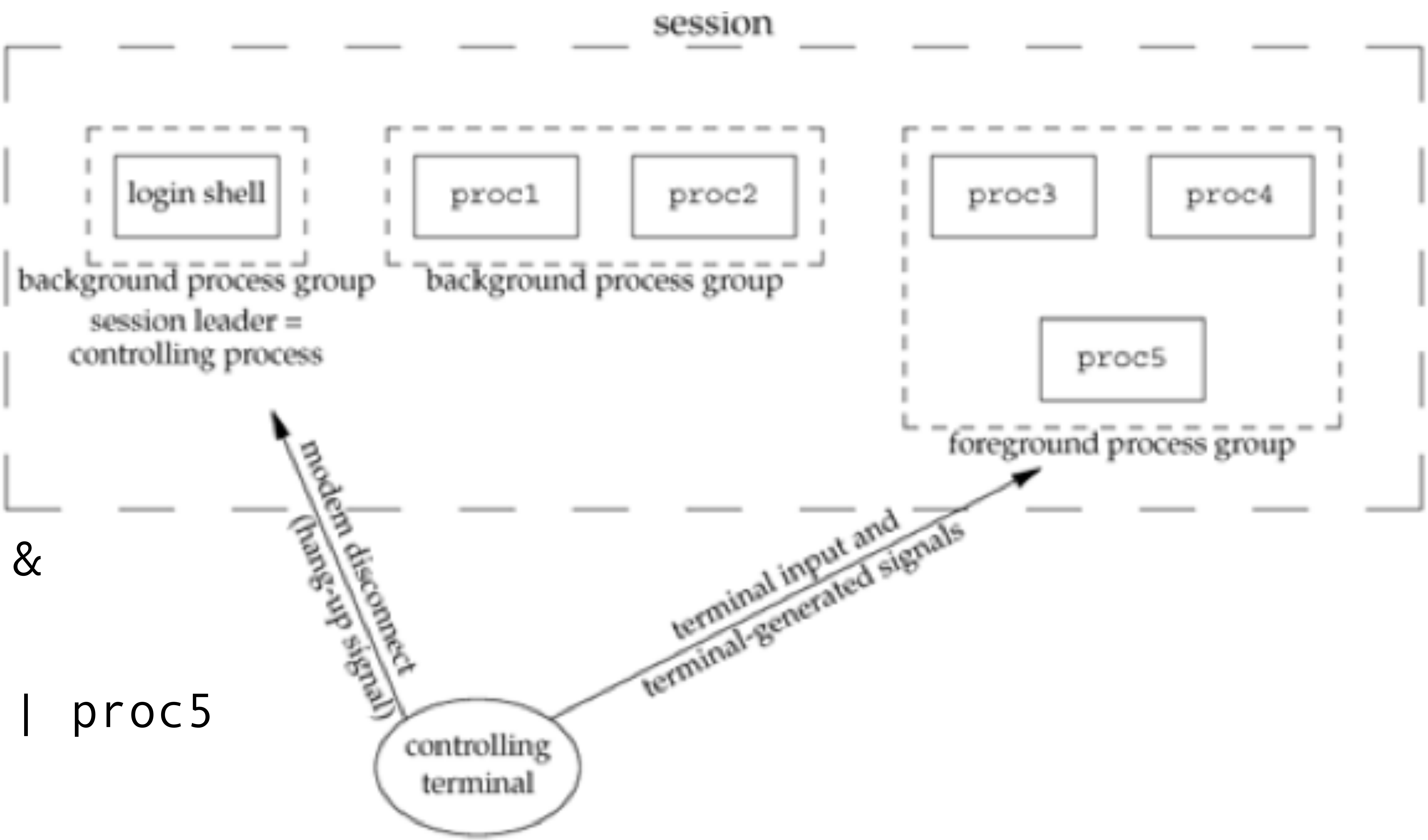
- the process becomes the session leader of this new session
- the process becomes the process group leader of a new process group
- the process has no controlling terminal

Sessions

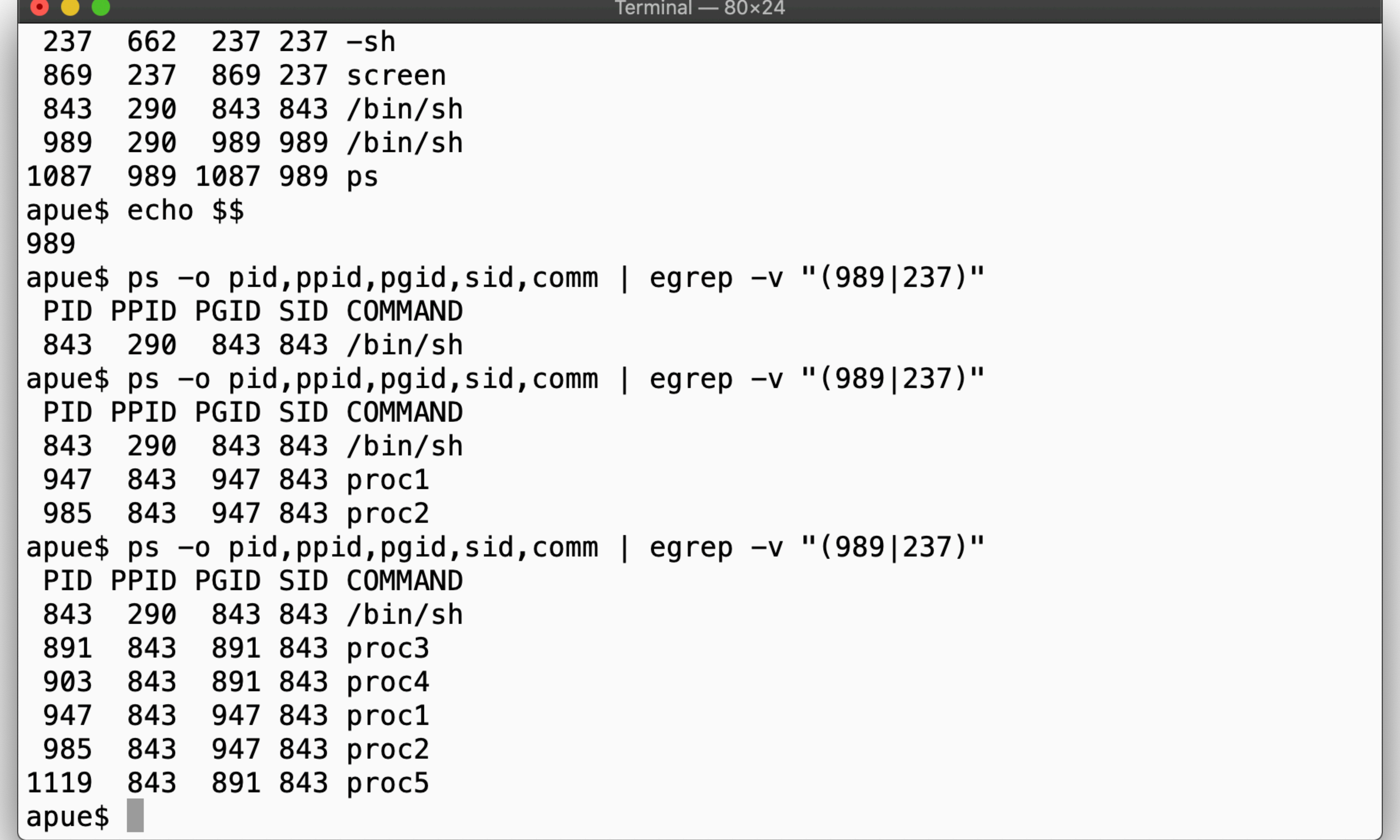


```
$ proc1 | proc2 &
[1] 10306
$ proc3 | proc4 | proc5
```

Process Groups



```
$ proc1 | proc2 &
[1] 10306
$ proc3 | proc4 | proc5
```



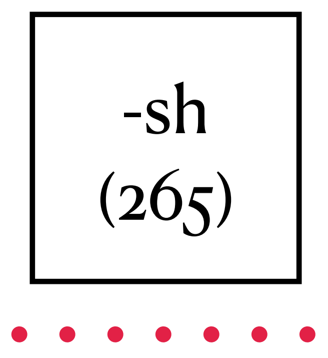
```
 237  662  237 237 -sh
 869  237  869 237 screen
 843  290  843 843 /bin/sh
 989  290  989 989 /bin/sh
1087  989 1087 989 ps
apue$ echo $$
989
apue$ ps -o pid,ppid,pgid,sid,comm | egrep -v "(989|237)"
 PID PPID PGID SID COMMAND
 843  290  843 843 /bin/sh
apue$ ps -o pid,ppid,pgid,sid,comm | egrep -v "(989|237)"
 PID PPID PGID SID COMMAND
 843  290  843 843 /bin/sh
 947  843  947 843 proc1
 985  843  947 843 proc2
apue$ ps -o pid,ppid,pgid,sid,comm | egrep -v "(989|237)"
 PID PPID PGID SID COMMAND
 843  290  843 843 /bin/sh
 891  843  891 843 proc3
 903  843  891 843 proc4
 947  843  947 843 proc1
 985  843  947 843 proc2
1119  843  891 843 proc5
apue$ 
```

Process Groups

```
$ ps -o pid,ppid,pgid,sid,comm | ./cat1 | ./cat2
```

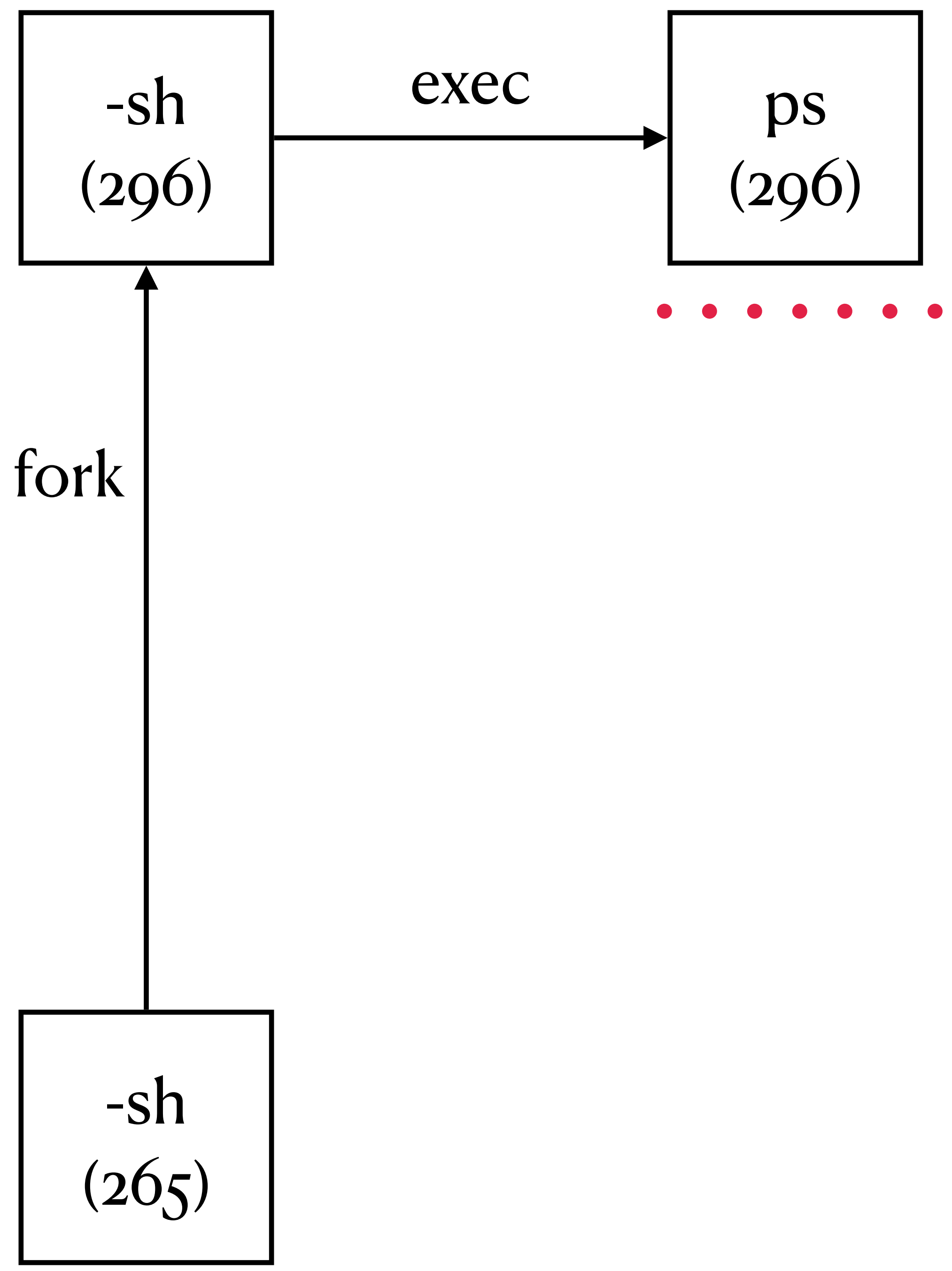
Process Groups

```
$ ps -o pid,ppid,pgid,sid,comm | ./cat1 | ./cat2
PID PPID PGID SID COMMAND
265  586  265 265 -sh
```



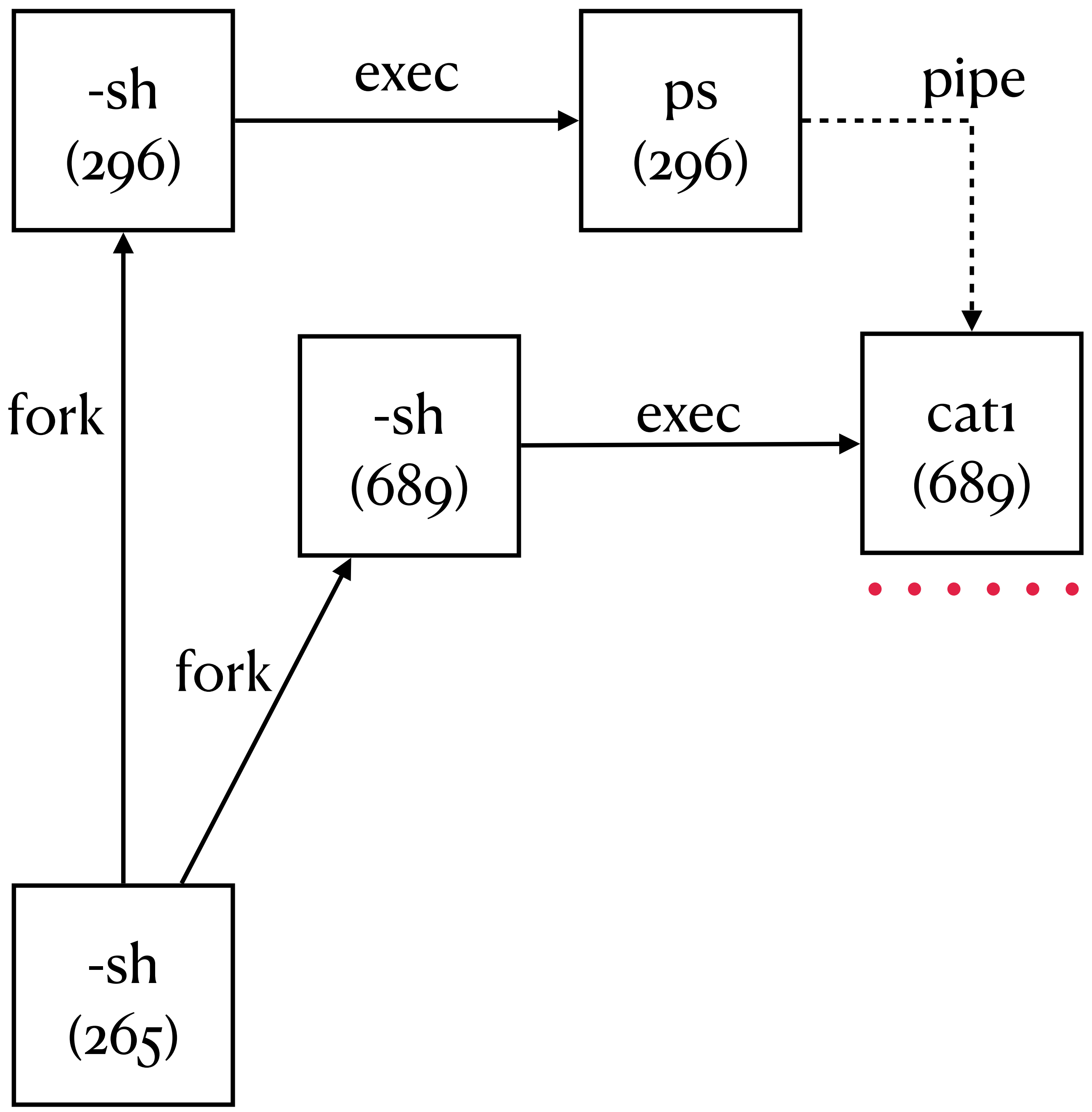
Process Groups

```
$ ps -o pid,ppid,pgid,sid,comm | ./cat1 | ./cat2
PID PPID PGID SID COMMAND
265  586  265 265 -sh
296  265  296 265 ps
```



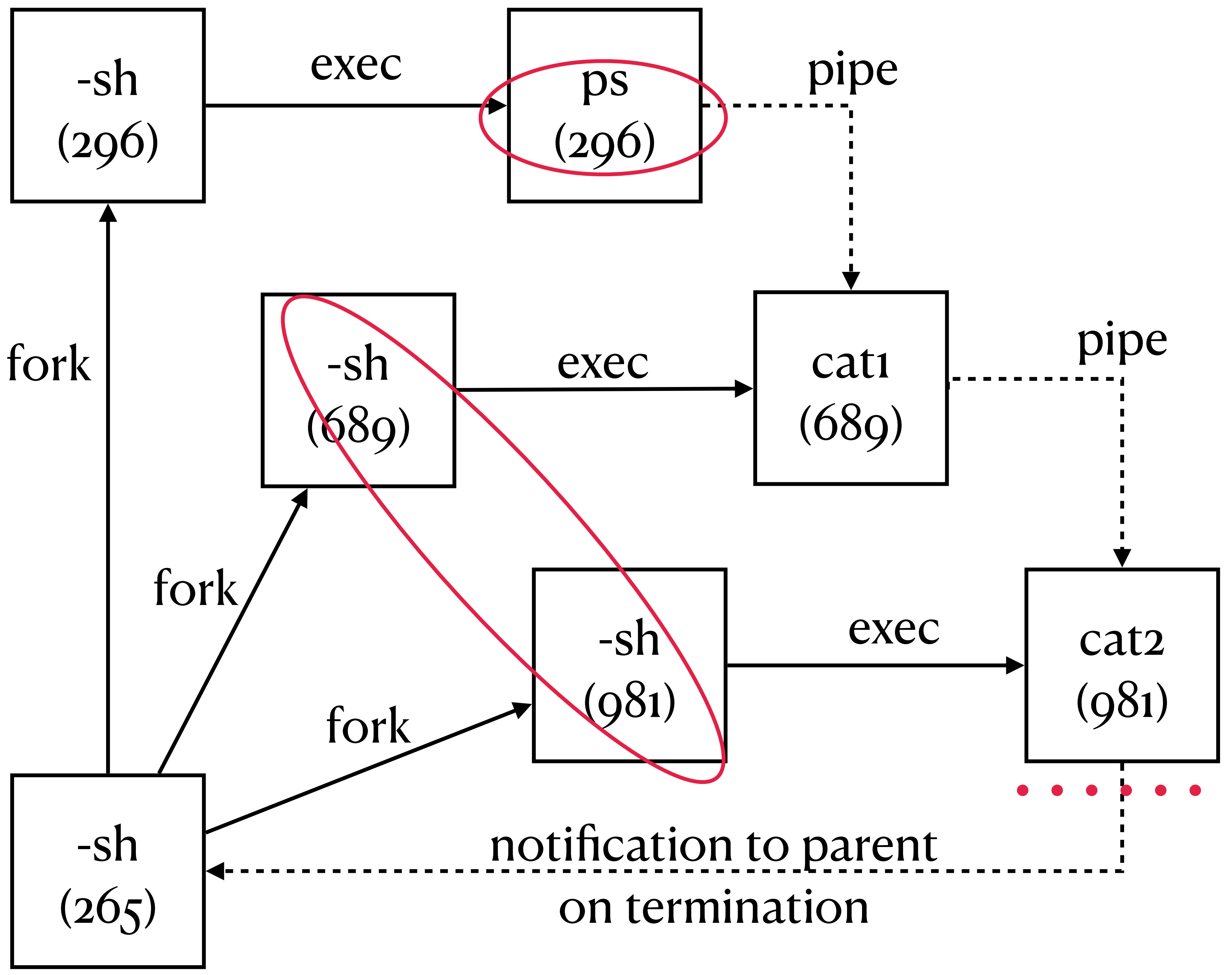
Process Groups

```
$ ps -o pid,ppid,pgid,sid,comm | ./cat1 | ./cat2
PID PPID PGID SID COMMAND
265  586  265 265 -sh
296  265  296 265 ps
689  265  296 265 -sh
```



Process Groups

```
$ ps -o pid,ppid,pgid,sid,comm | ./cat1 | ./cat2
PID PPID PGID SID COMMAND
265  586  265 265 -sh
296  265  296 265 ps
689  265  296 265 -sh
981  265  296 265 -sh
$ echo $$
265
```



Process Groups and Sessions

- each process belongs to a process group
- a session is a collection of one or more process groups
- process groups are used for distribution of (keyboard generated) signals

- process groups are used to implement job control in a shell:
    - processes that have the same process group as the terminal are foreground and may read
    - more on job control and signals in our next videos