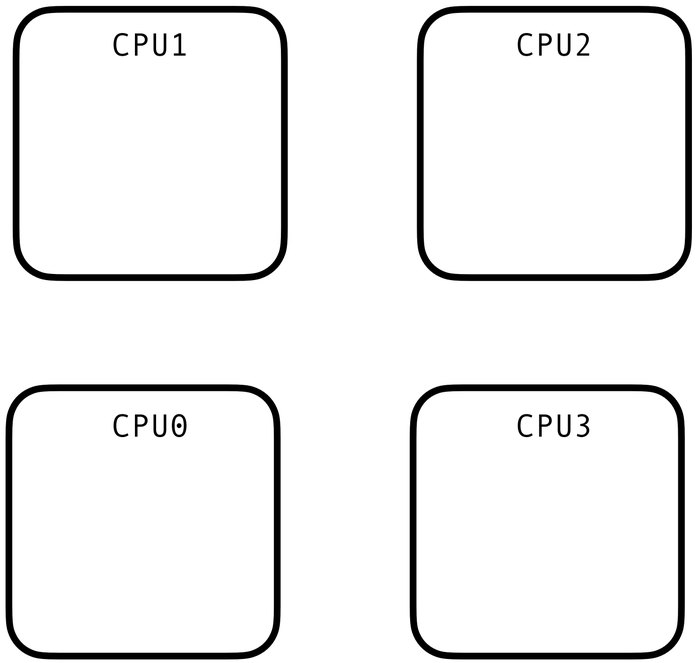
Advanced Programming in the UNIX Environment

Week 13, Segment 5:
Processor Affinity and CPU Sets

Department of Computer Science
Stevens Institute of Technology

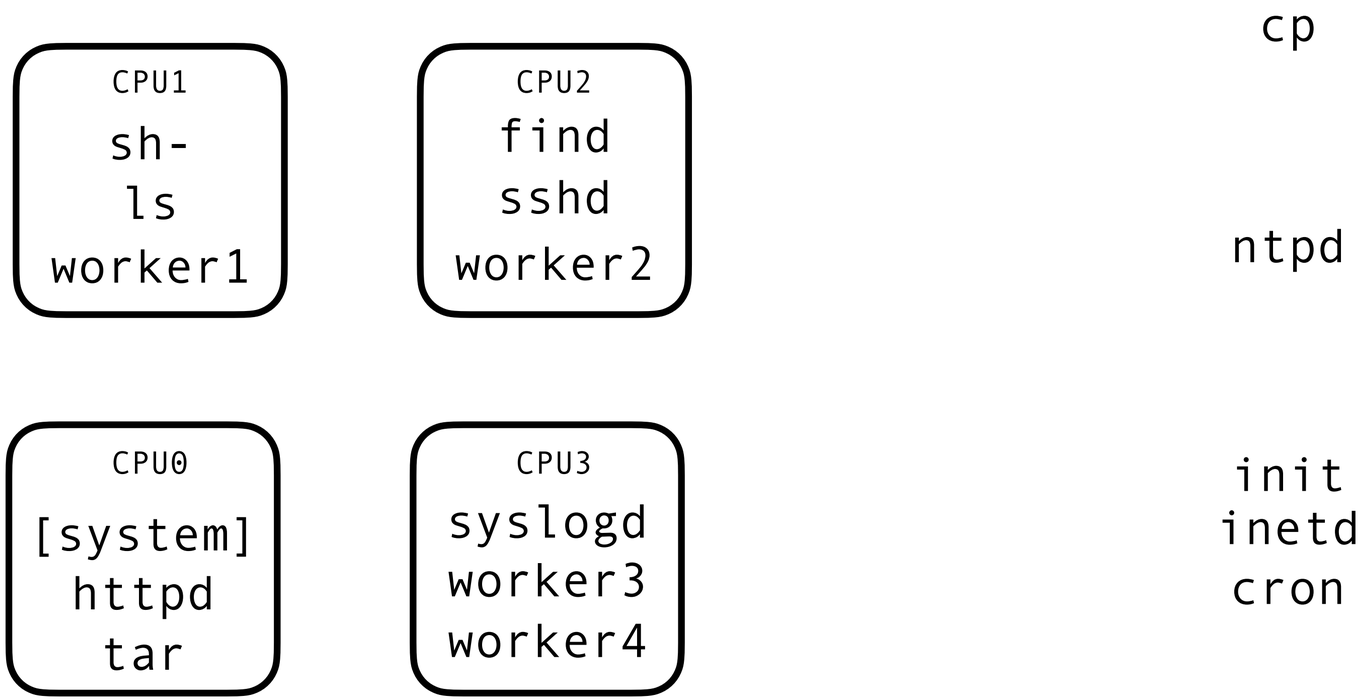
Jan Schaumann
jschauma@stevens.edu
https://stevens.netmeister.org/631/

Processor Affinity and CPU Sets

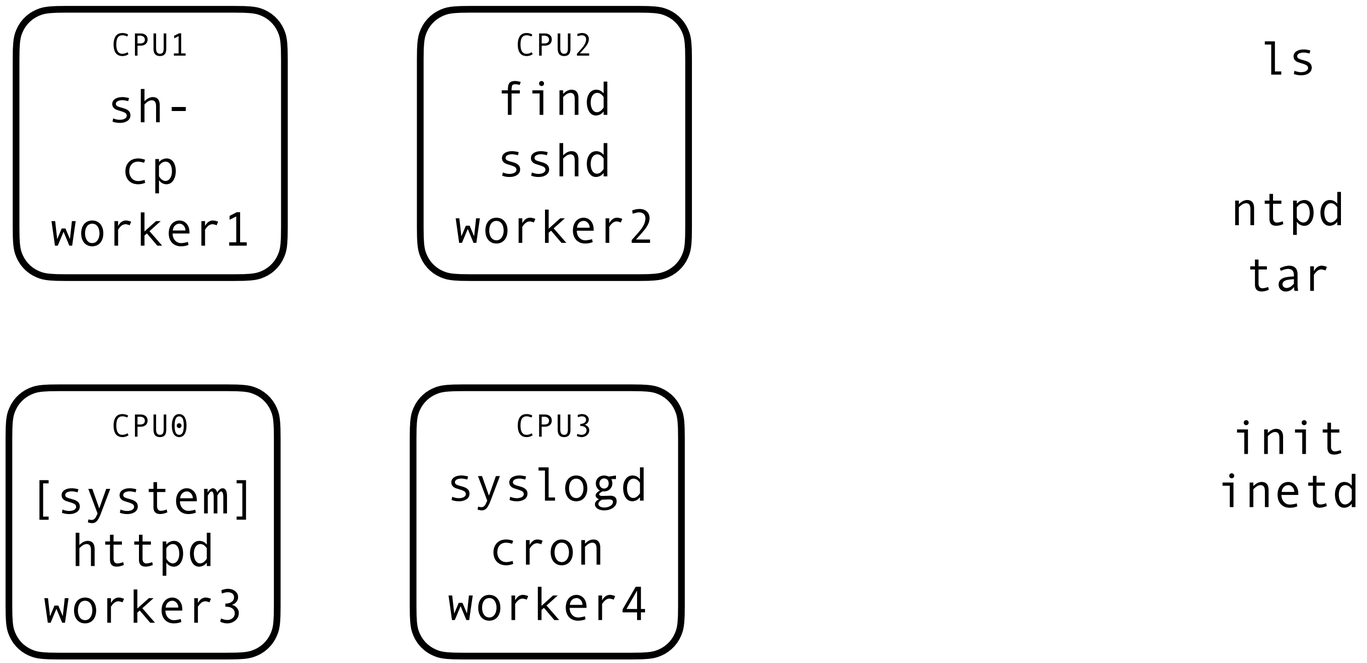


sh-
ls
cp
find
tar
httpd
ntpd
sshd
syslogd
[system]
init
inetd
cron
worker1
worker2
worker3
worker4

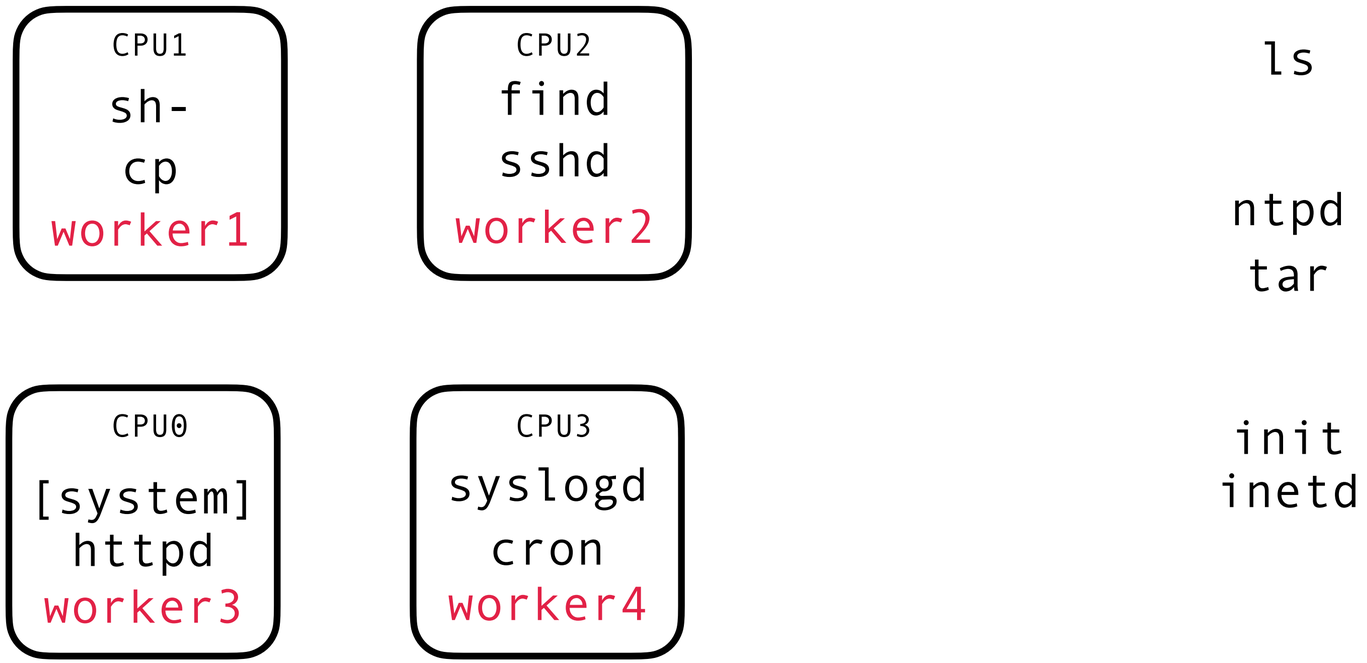
Processor Affinity and CPU Sets



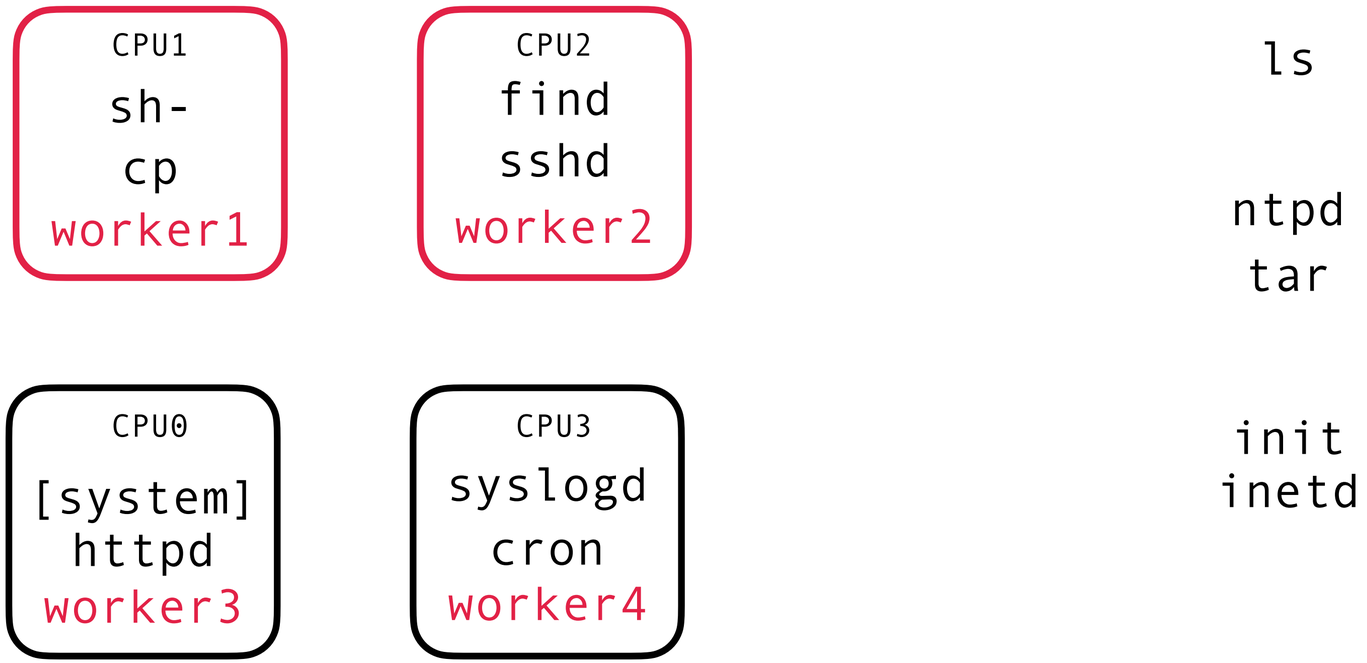
Processor Affinity and CPU Sets



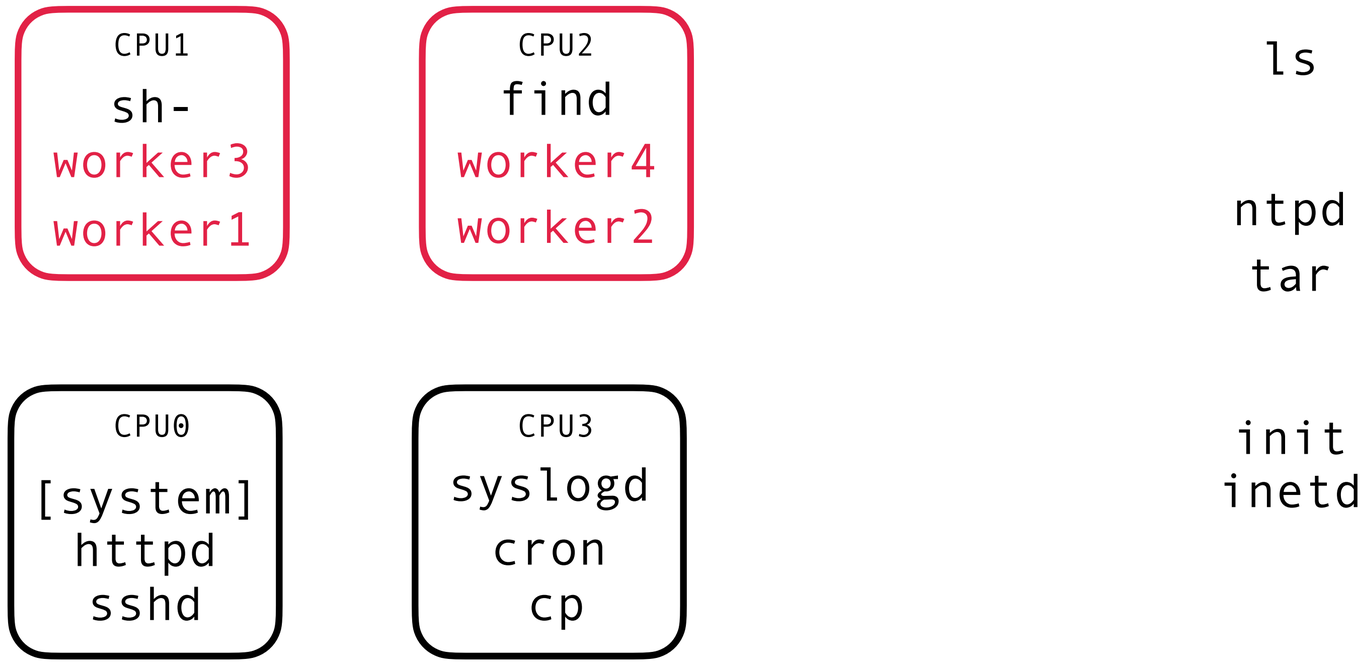
Processor Affinity and CPU Sets



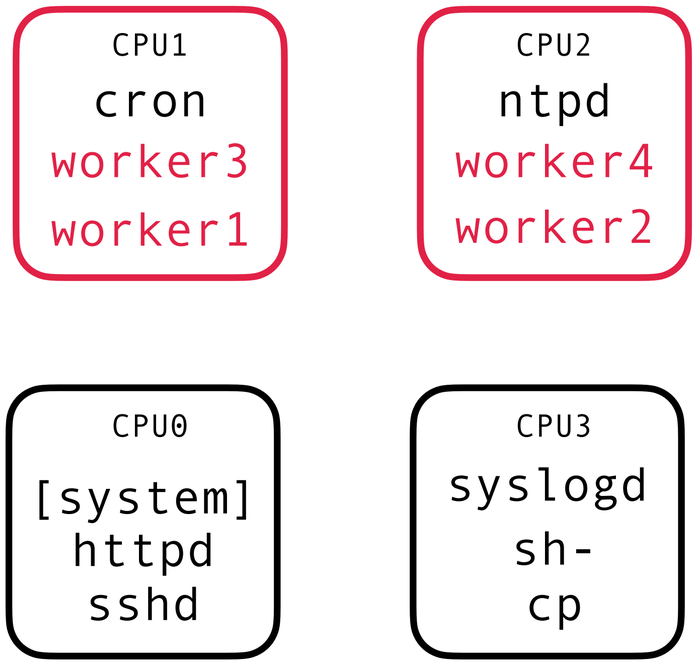
Processor Affinity and CPU Sets



Processor Affinity and CPU Sets



Processor Affinity and CPU Sets

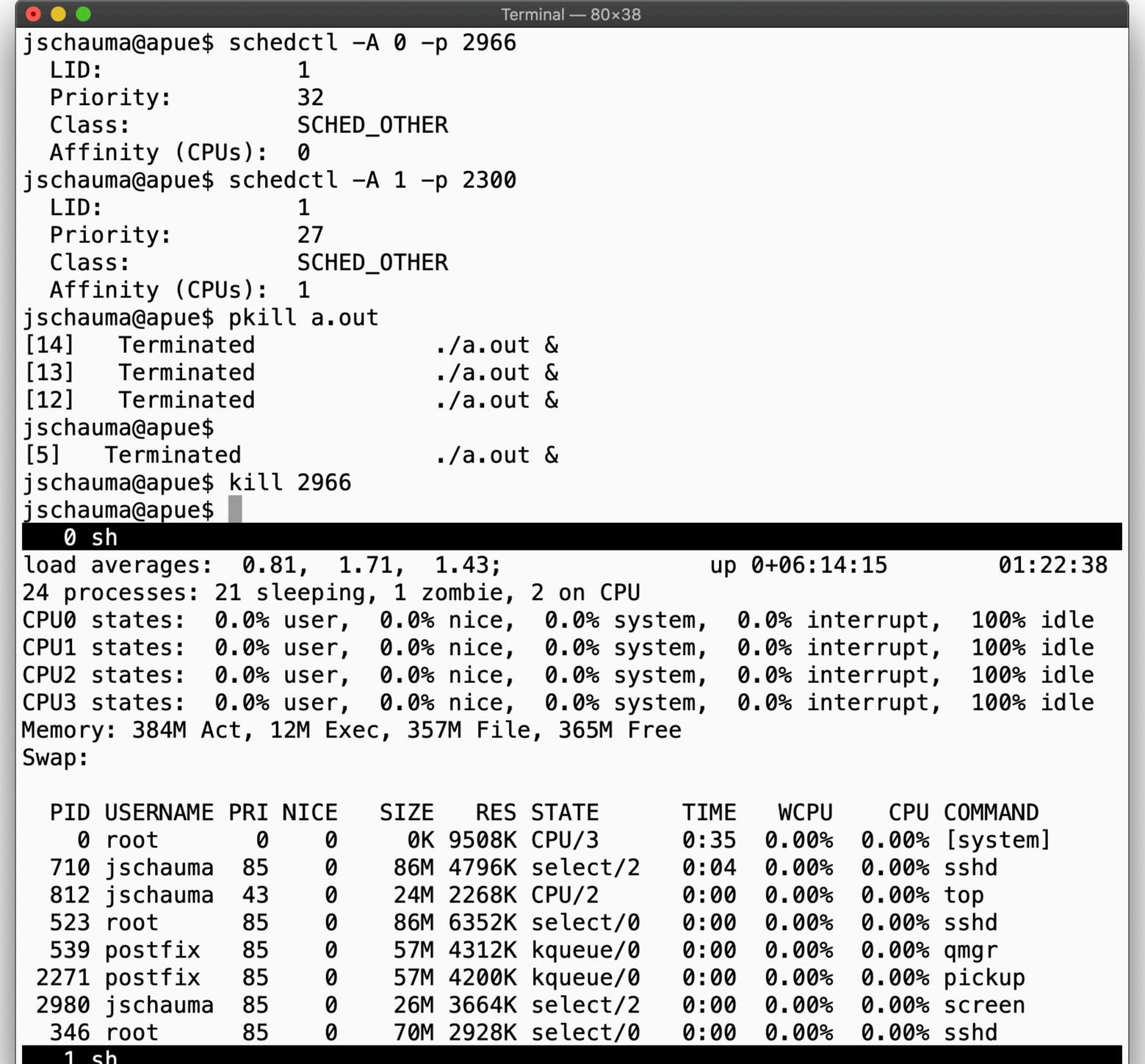


ls

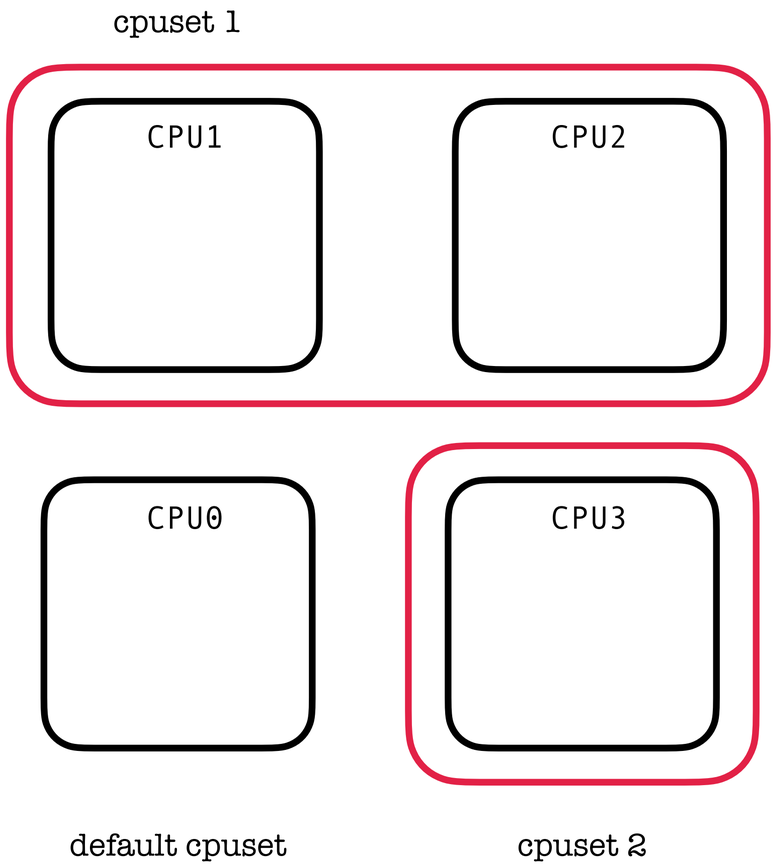
tar

find

init
inetd


Terminal — 80×38
jschauma@apue$ schedctl -A 0 -p 2966
LID: 1
Priority: 32
Class: SCHED_OTHER
Affinity (CPUs): 0
jschauma@apue$ schedctl -A 1 -p 2300
LID: 1
Priority: 27
Class: SCHED_OTHER
Affinity (CPUs): 1
jschauma@apue$ pkill a.out
[14] Terminated ./a.out &
[13] Terminated ./a.out &
[12] Terminated ./a.out &
jschauma@apue$
[5] Terminated ./a.out &
jschauma@apue$ kill 2966
jschauma@apue$
0 sh
load averages: 0.81, 1.71, 1.43; up 0+06:14:15 01:22:38
24 processes: 21 sleeping, 1 zombie, 2 on CPU
CPU0 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
CPU1 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
CPU2 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
CPU3 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
Memory: 384M Act, 12M Exec, 357M File, 365M Free
Swap:
PID USERNAME PRI NICE SIZE RES STATE TIME WCPU CPU COMMAND
0 root 0 0 0K 9508K CPU/3 0:35 0.00% 0.00% [system]
710 jschauma 85 0 86M 4796K select/2 0:04 0.00% 0.00% sshd
812 jschauma 43 0 24M 2268K CPU/2 0:00 0.00% 0.00% top
523 root 85 0 86M 6352K select/0 0:00 0.00% 0.00% sshd
539 postfix 85 0 57M 4312K kqueue/0 0:00 0.00% 0.00% qmgr
2271 postfix 85 0 57M 4200K kqueue/0 0:00 0.00% 0.00% pickup
2980 jschauma 85 0 26M 3664K select/2 0:00 0.00% 0.00% screen
346 root 85 0 70M 2928K select/0 0:00 0.00% 0.00% sshd
1 sh

CPU Sets




```
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ntpd
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syslogd
[system]
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inetd
cron
worker1
worker2
worker3
worker4
```
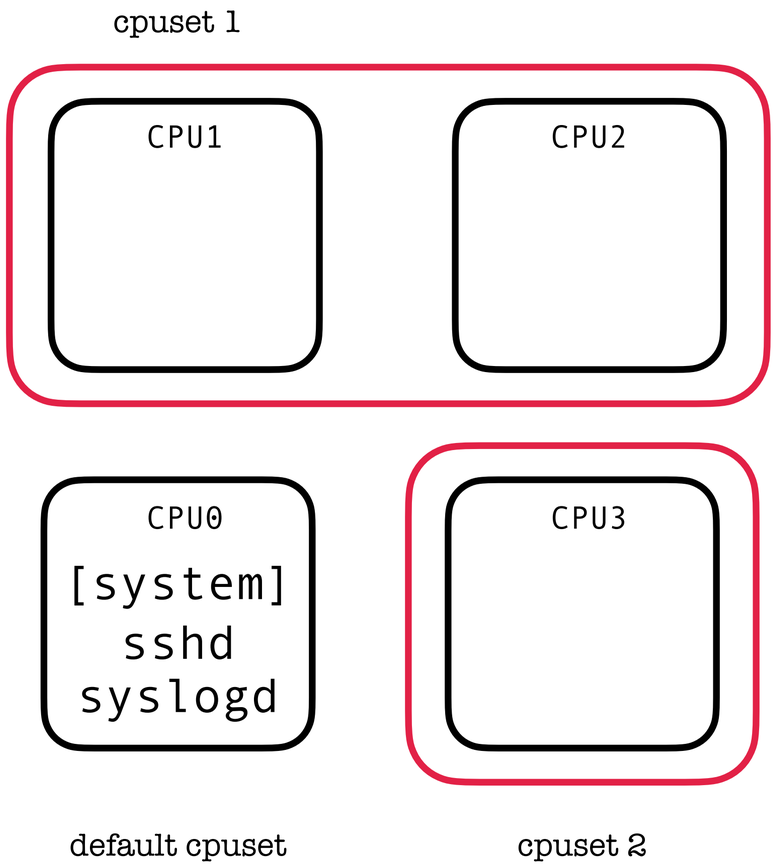

CPU Sets




```
sh-
ls
cp
find
tar
httpd
ntpd
```

```
init
inetd
cron
worker1
worker2
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worker4
```
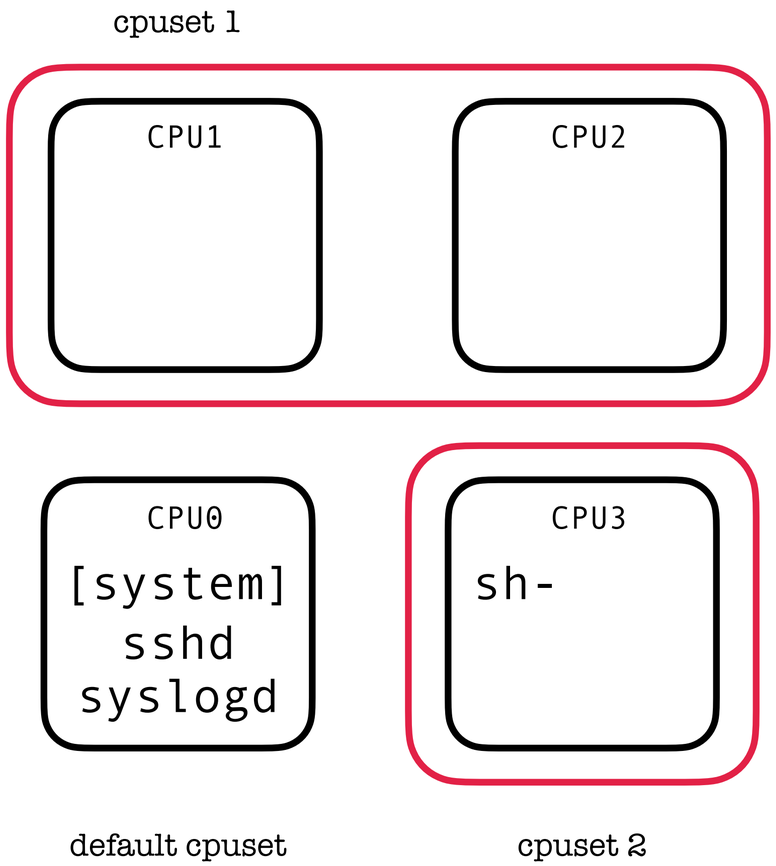

CPU Sets




```
ls
cp
find
tar
httpd
ntpd
```

```
init
inetd
cron
worker1
worker2
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worker4
```
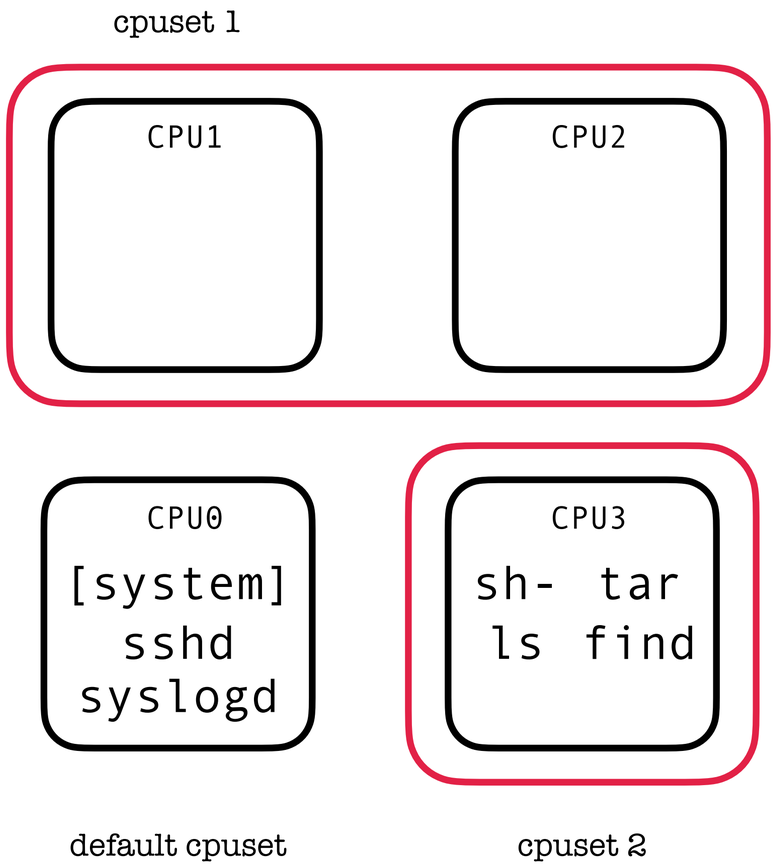

CPU Sets

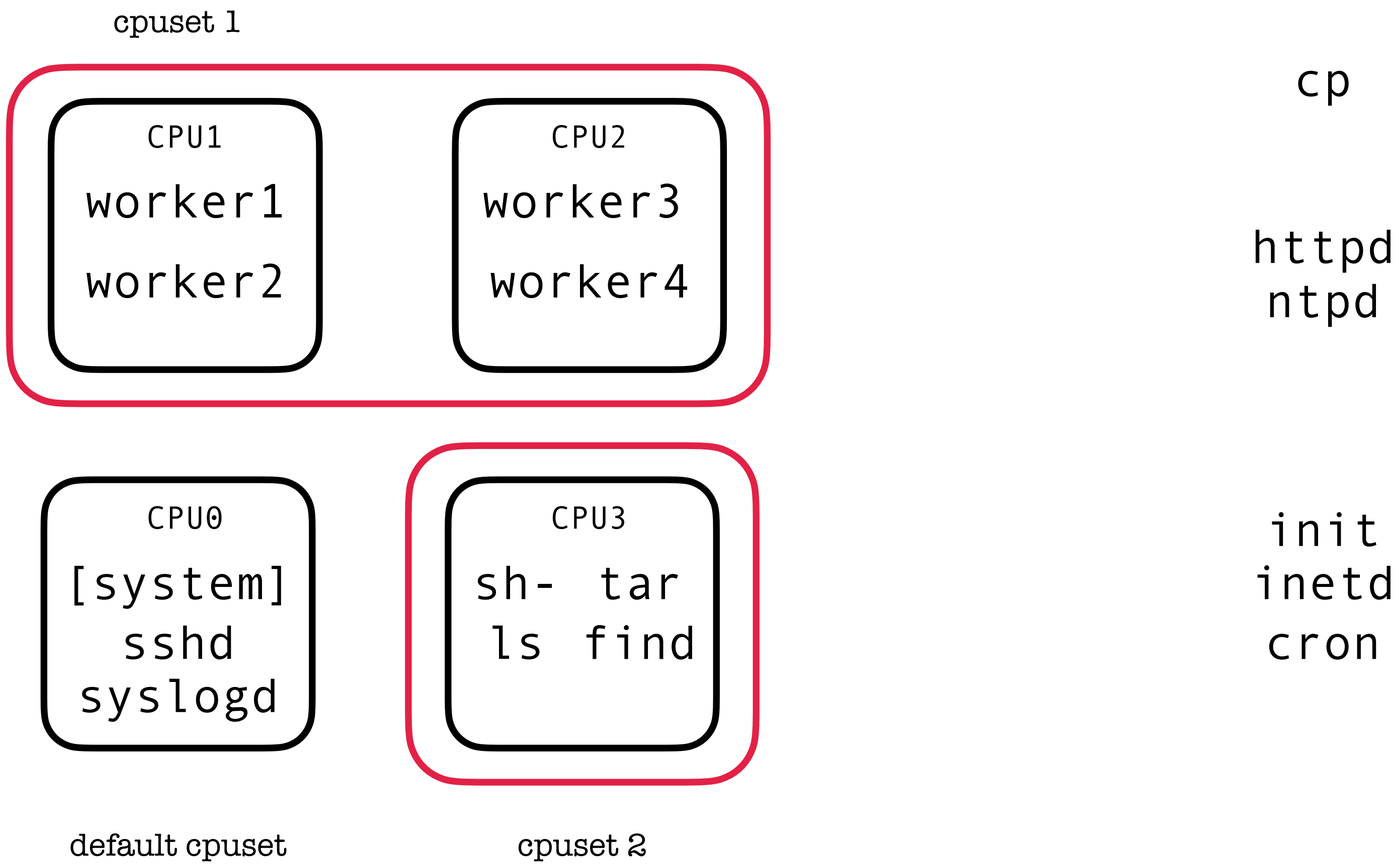


cp

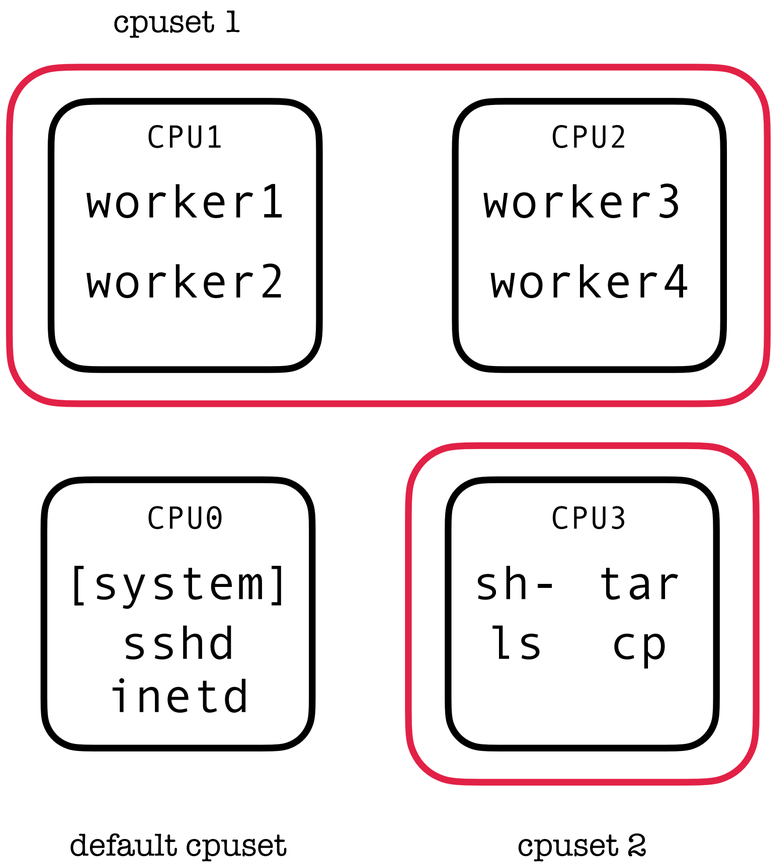
httpd
ntpd

init
inetd
cron
worker1
worker2
worker3
worker4

CPU Sets


cpuset 1
CPU1
worker1
worker2
CPU2
worker3
worker4
CPU0
[system]
sshd
syslogd
CPU3
sh- tar
ls find
default cpuset
cpuset 2
cp
httpd
ntpd
init
inetd
cron

CPU Sets

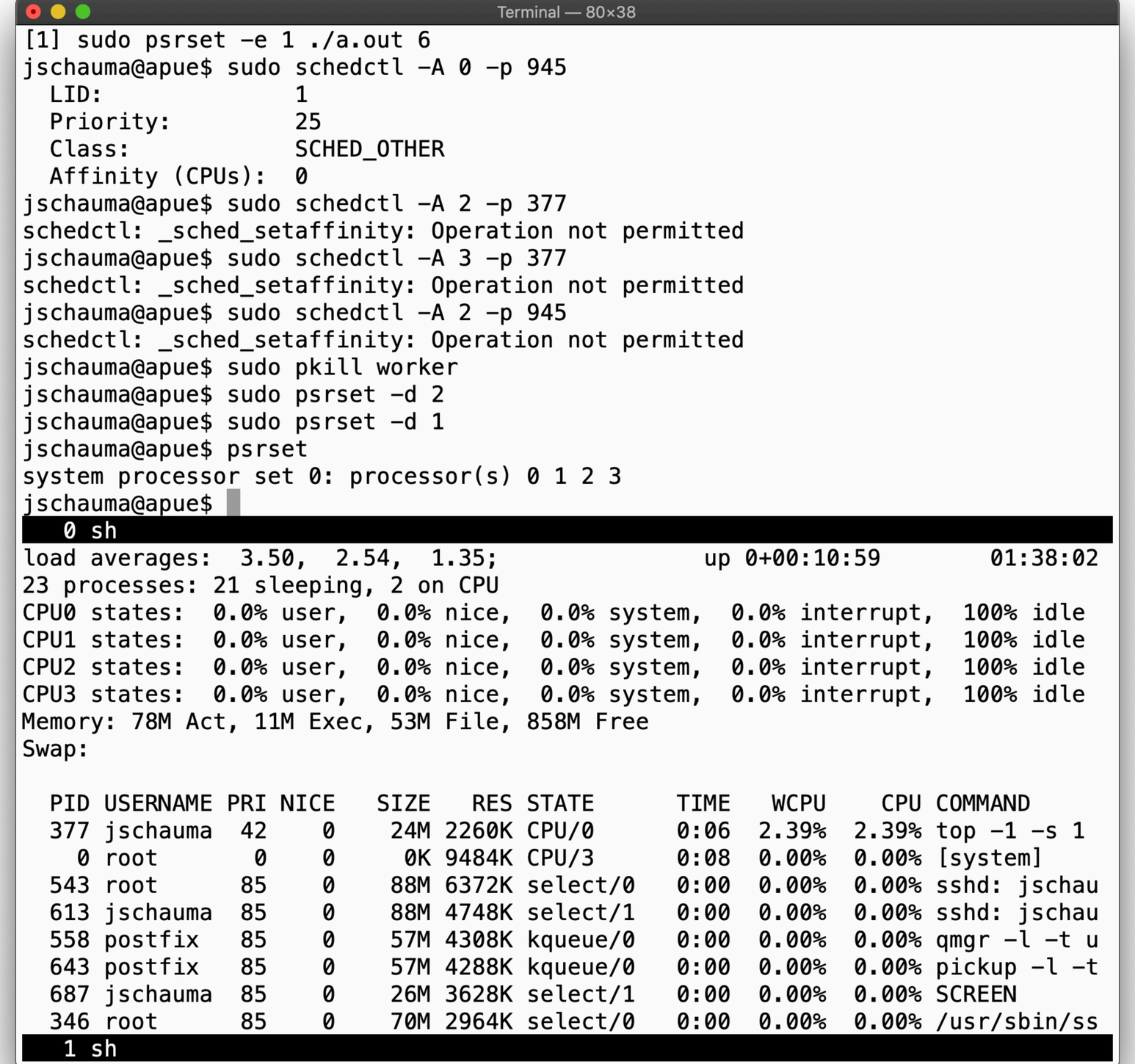


httpd
ntpd

syslogd
init

cron

find


Terminal — 80×38
[1] sudo psrset -e 1 ./a.out 6
jschauma@apue$ sudo schedctl -A 0 -p 945
LID: 1
Priority: 25
Class: SCHED_OTHER
Affinity (CPUs): 0
jschauma@apue$ sudo schedctl -A 2 -p 377
schedctl: _sched_setaffinity: Operation not permitted
jschauma@apue$ sudo schedctl -A 3 -p 377
schedctl: _sched_setaffinity: Operation not permitted
jschauma@apue$ sudo schedctl -A 2 -p 945
schedctl: _sched_setaffinity: Operation not permitted
jschauma@apue$ sudo pkill worker
jschauma@apue$ sudo psrset -d 2
jschauma@apue$ sudo psrset -d 1
jschauma@apue$ psrset
system processor set 0: processor(s) 0 1 2 3
jschauma@apue$
0 sh
load averages: 3.50, 2.54, 1.35; up 0+00:10:59 01:38:02
23 processes: 21 sleeping, 2 on CPU
CPU0 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
CPU1 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
CPU2 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
CPU3 states: 0.0% user, 0.0% nice, 0.0% system, 0.0% interrupt, 100% idle
Memory: 78M Act, 11M Exec, 53M File, 858M Free
Swap:
PID USERNAME PRI NICE SIZE RES STATE TIME WCPU CPU COMMAND
377 jschauma 42 0 24M 2260K CPU/0 0:06 2.39% 2.39% top -1 -s 1
0 root 0 0 0K 9484K CPU/3 0:08 0.00% 0.00% [system]
543 root 85 0 88M 6372K select/0 0:00 0.00% 0.00% sshd: jschau
613 jschauma 85 0 88M 4748K select/1 0:00 0.00% 0.00% sshd: jschau
558 postfix 85 0 57M 4308K kqueue/0 0:00 0.00% 0.00% qmgr -l -t u
643 postfix 85 0 57M 4288K kqueue/0 0:00 0.00% 0.00% pickup -l -t
687 jschauma 85 0 26M 3628K select/1 0:00 0.00% 0.00% SCREEN
346 root 85 0 70M 2964K select/0 0:00 0.00% 0.00% /usr/sbin/ss
1 sh

Processor Affinity and CPU Sets

- Pinning a process (group) to a CPU can improve performance by *e.g.,* reducing CPU cache misses.
- "*Processor Affinity*" or "*CPU pinning*" lets you assign a process to a specific CPU, but other processes may still be placed on that CPU.
- Processor Affinity is inherited by a child process from its parent, but changing a parents affinity does not affect running children.
- "*CPU Sets*" let you reserve CPUs for specific processes; no other processes can be placed on those CPUs.
- Processor Affinity and CPU sets are not standardized; different OS implement them differently or using different tools.