TXLF 2019

Linux Performance Tuning

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Agenda

- Intro
- What is performance tuning?
- Areas to tune
- Baseline
- Tools for tuning

Intro

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- Performance tuning is a science, not an art

Intro

- I'm Thomas!
- Been in IT since '93
- Been working with Linux since '95
- Performance tuning is a science, not an art
- Anyone who says different doesn't know how to do it right

What is performance tuning?

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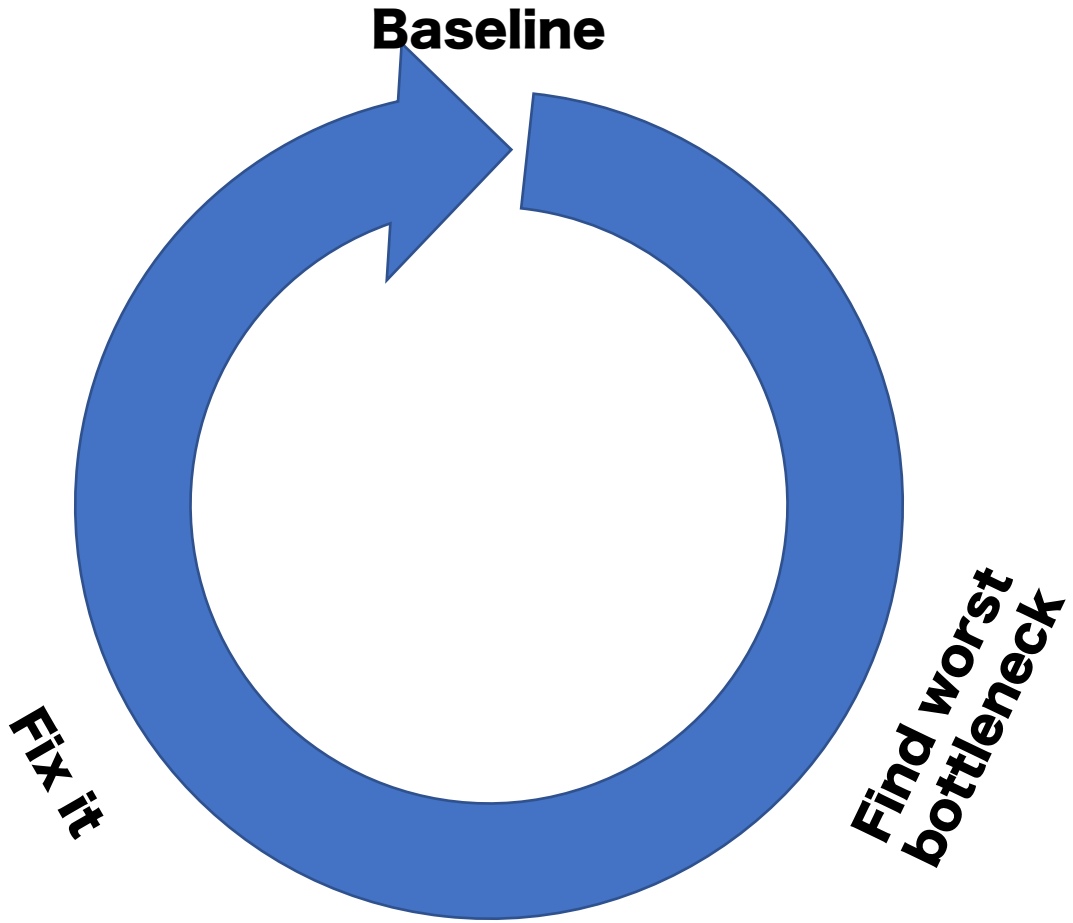
- Performance tuning is iterative
- You make a baseline
- You find the worst bottleneck
- You fix it
- You create a new baseline
- Lather, rinse, repeat


Baseline
Find worst bottleneck
Fix it

Areas to tune

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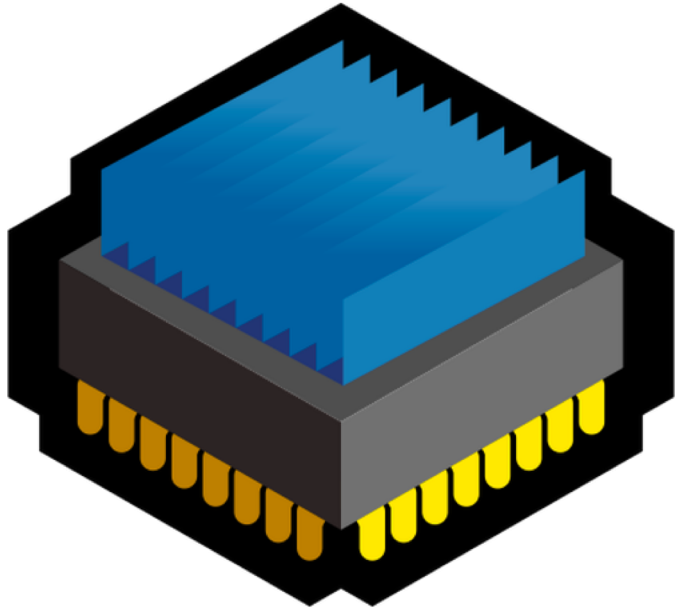
- Some we can fix through OS level changes
- Some are more hardware fixes than anything

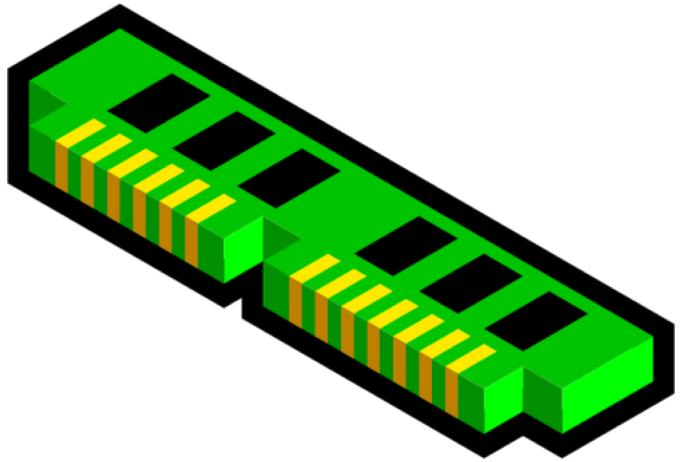
Areas to tune

- CPU



Areas to tune

- CPU
- Memory

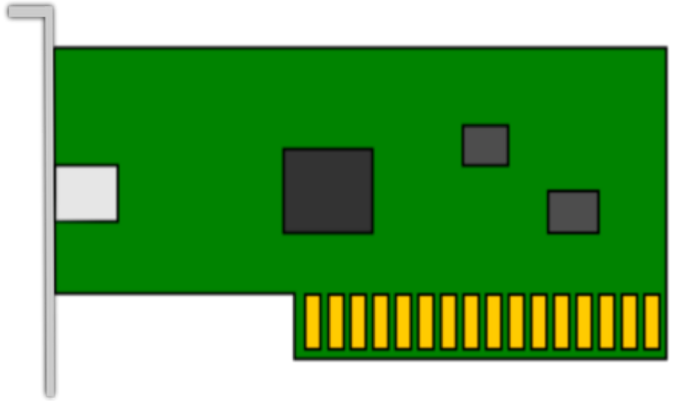


Areas to tune

- CPU
- Memory
- Disk

Areas to tune

- CPU
- Memory
- Disk
- Network



Make a baseline

Make a baseline

- Run the app or service normally

Make a baseline

- Run the app or service normally
- Gather metrics on how your system is performing

Tools for baseline

Tools for baseline

- There are a number of tools you can use

Tools for baseline

- There are a number of tools you can use
- We'll go over a few of them

Tools for baseline

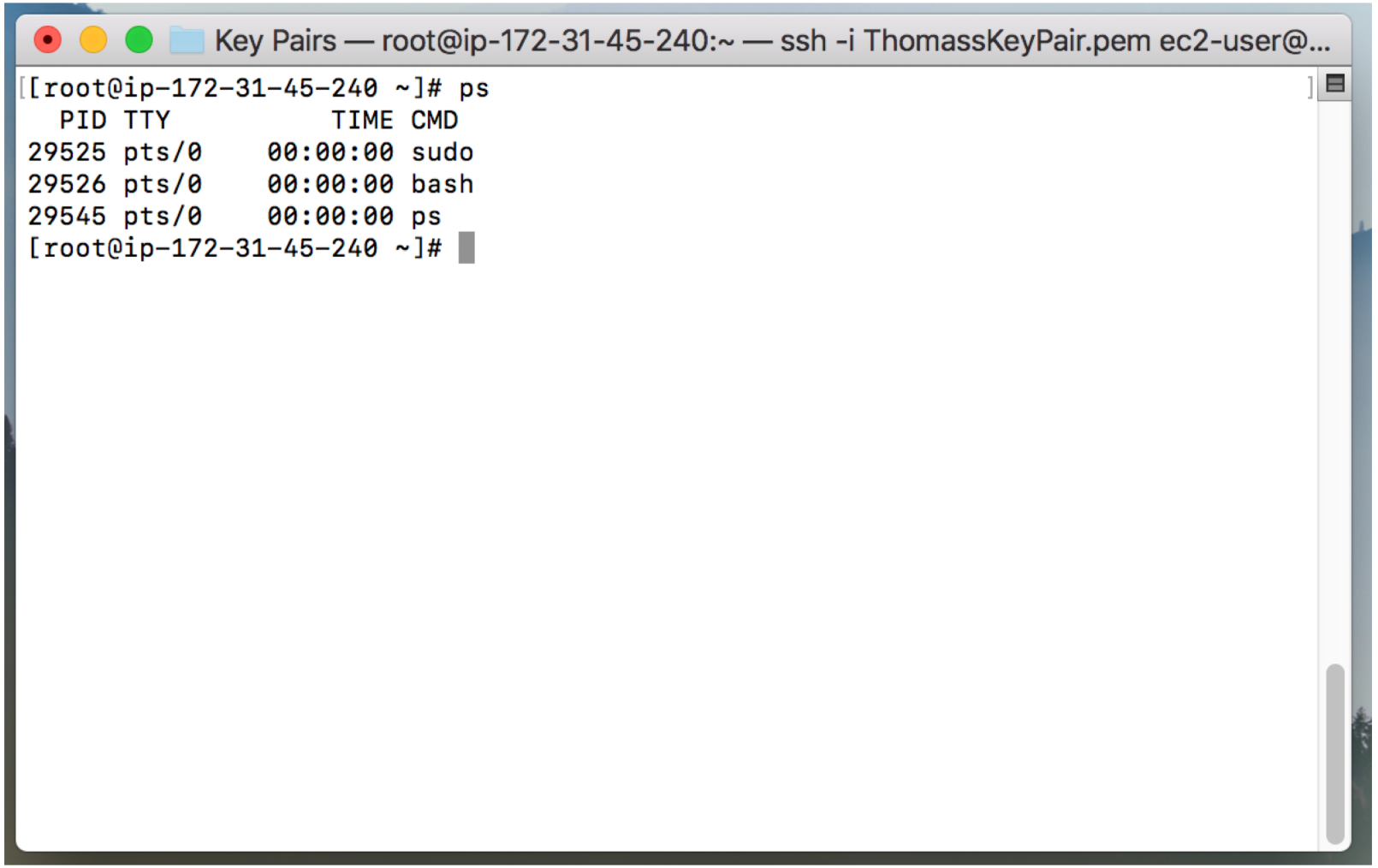
- ps

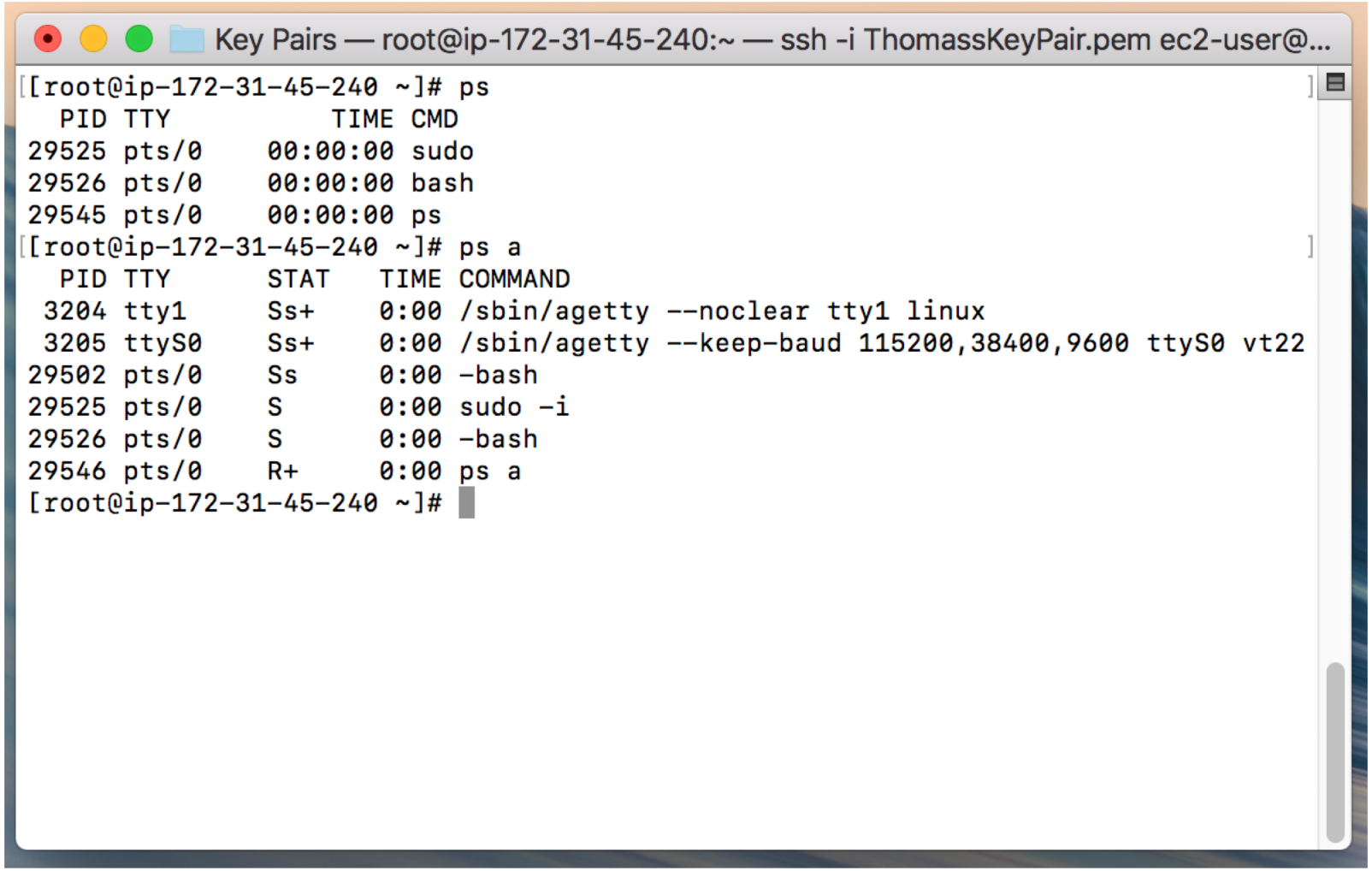
Tools for baseline

- ps
  - Don’t underestimate this little utility!

Tools for baseline

- ps
  - Don’t underestimate this little utility!
  - Use this to see how many and what processes are running


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# ps
PID TTY TIME CMD
29525 pts/0 00:00:00 sudo
29526 pts/0 00:00:00 bash
29545 pts/0 00:00:00 ps
[root@ip-172-31-45-240 ~]#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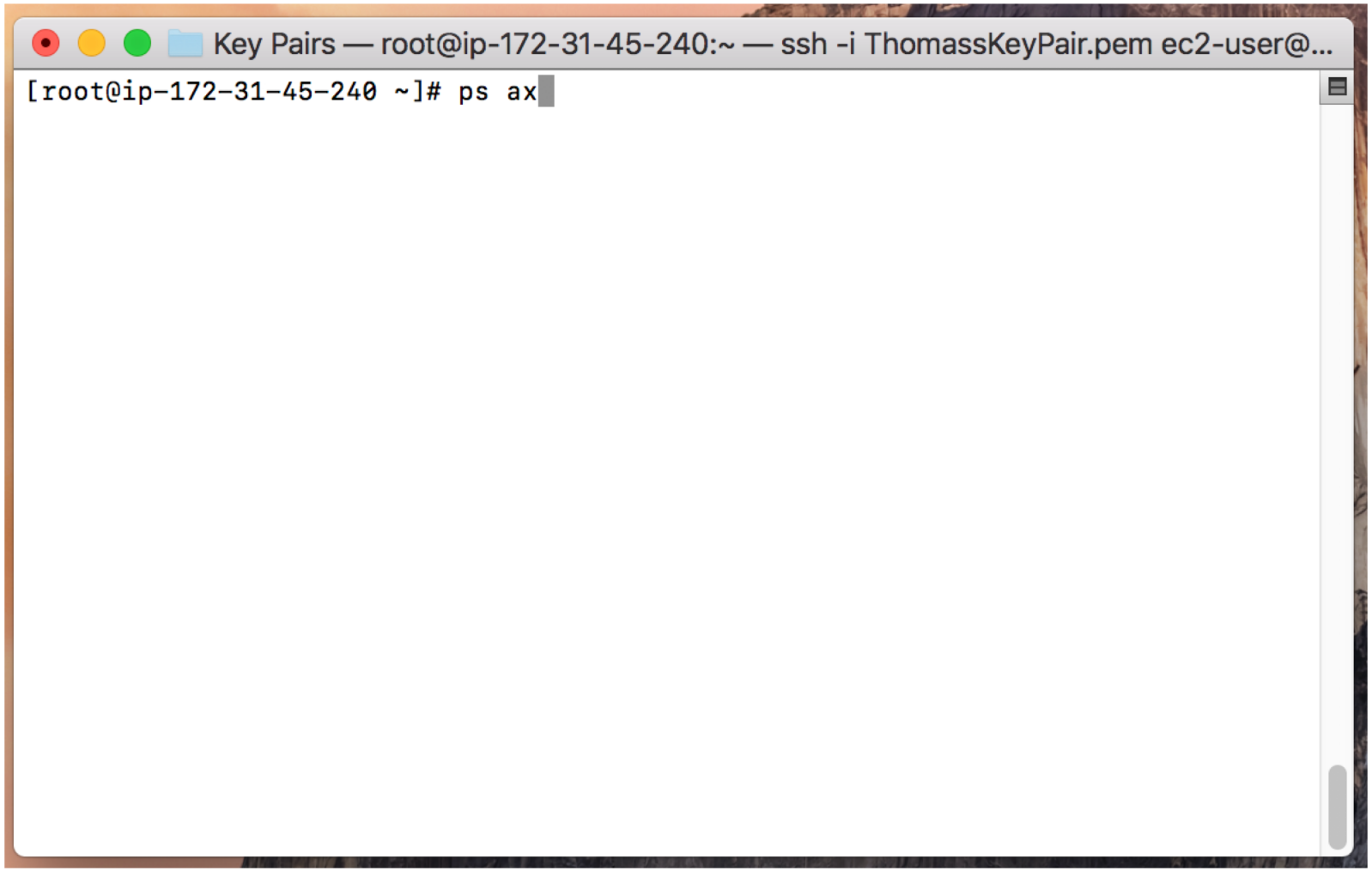
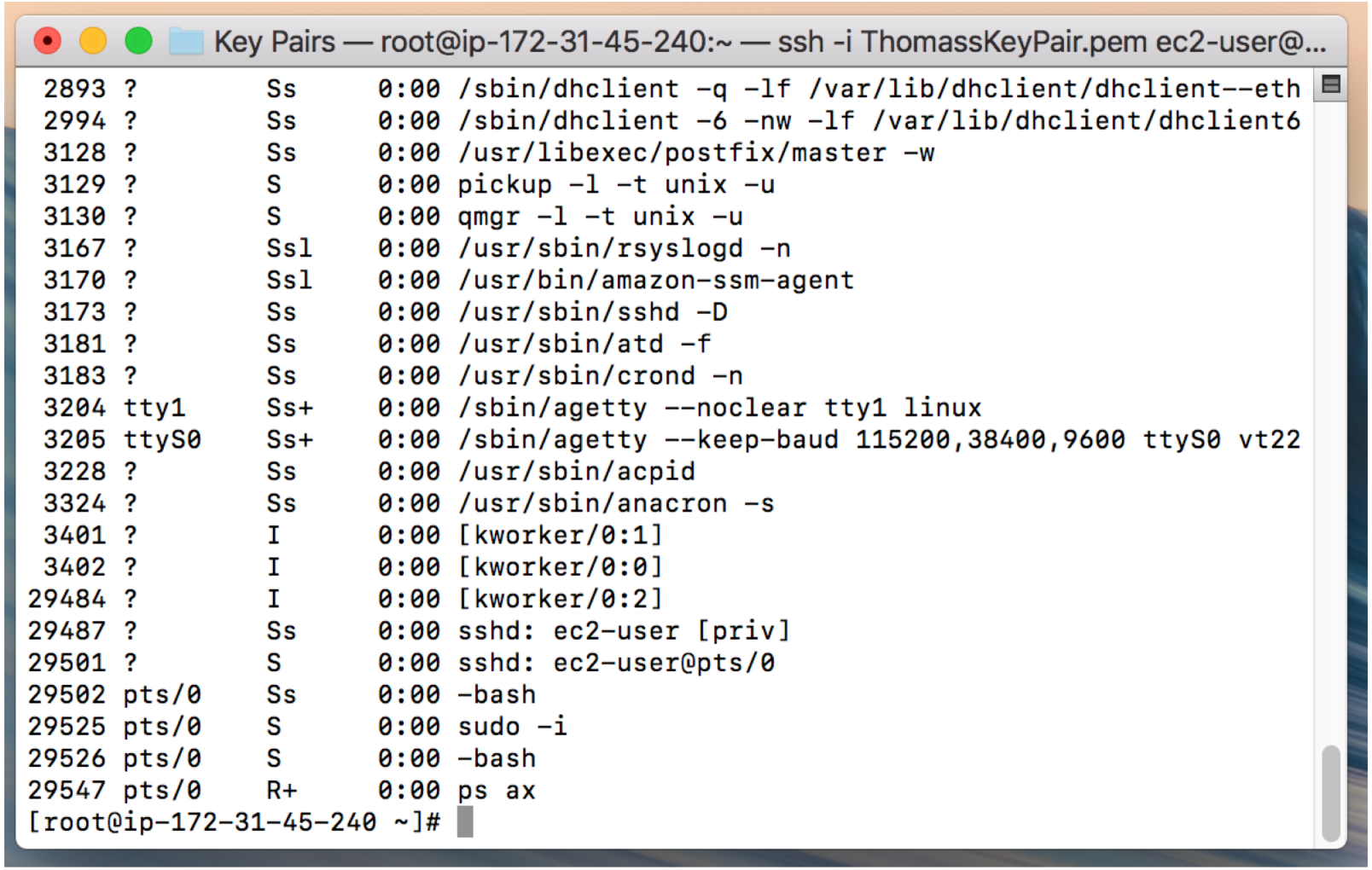
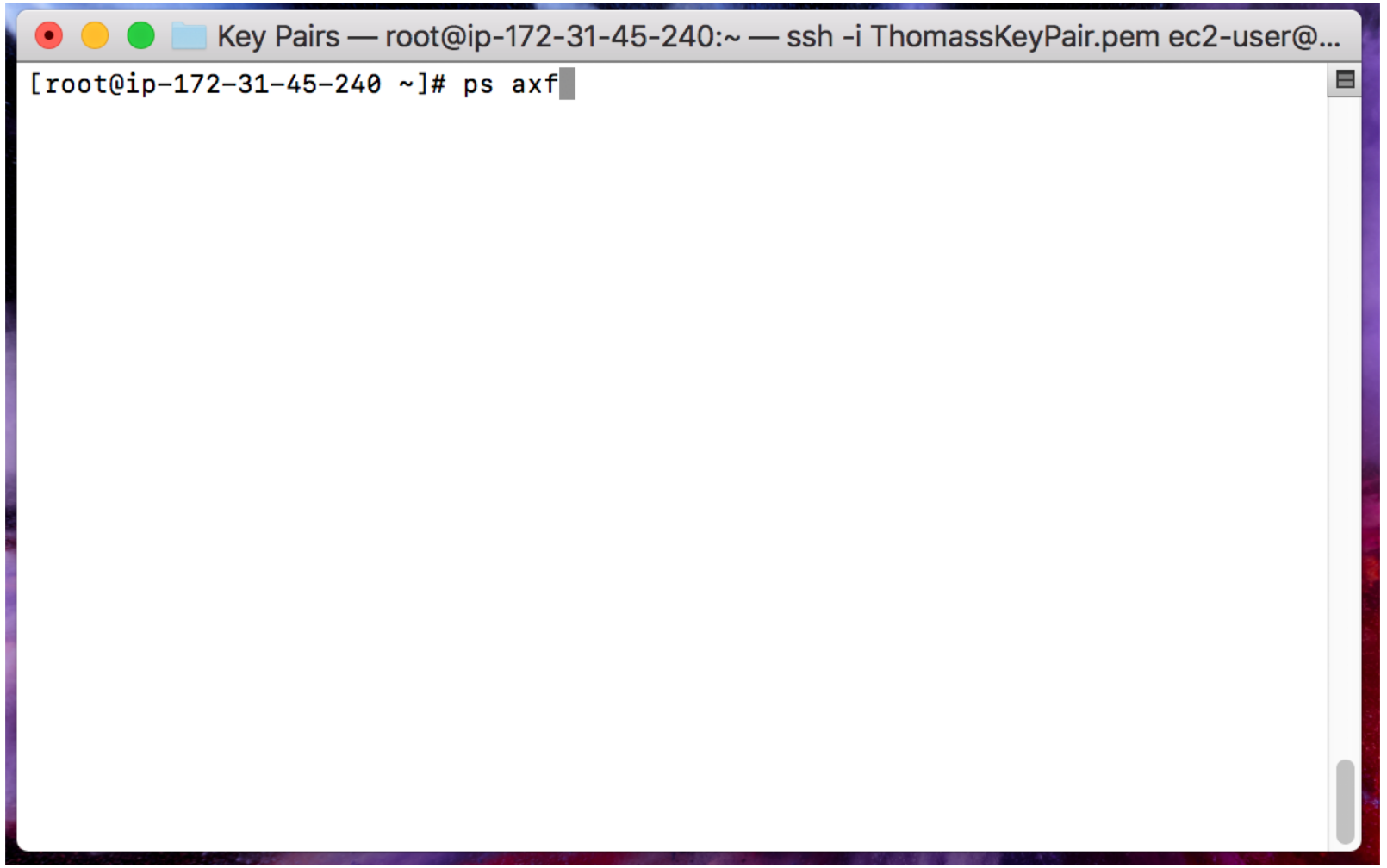
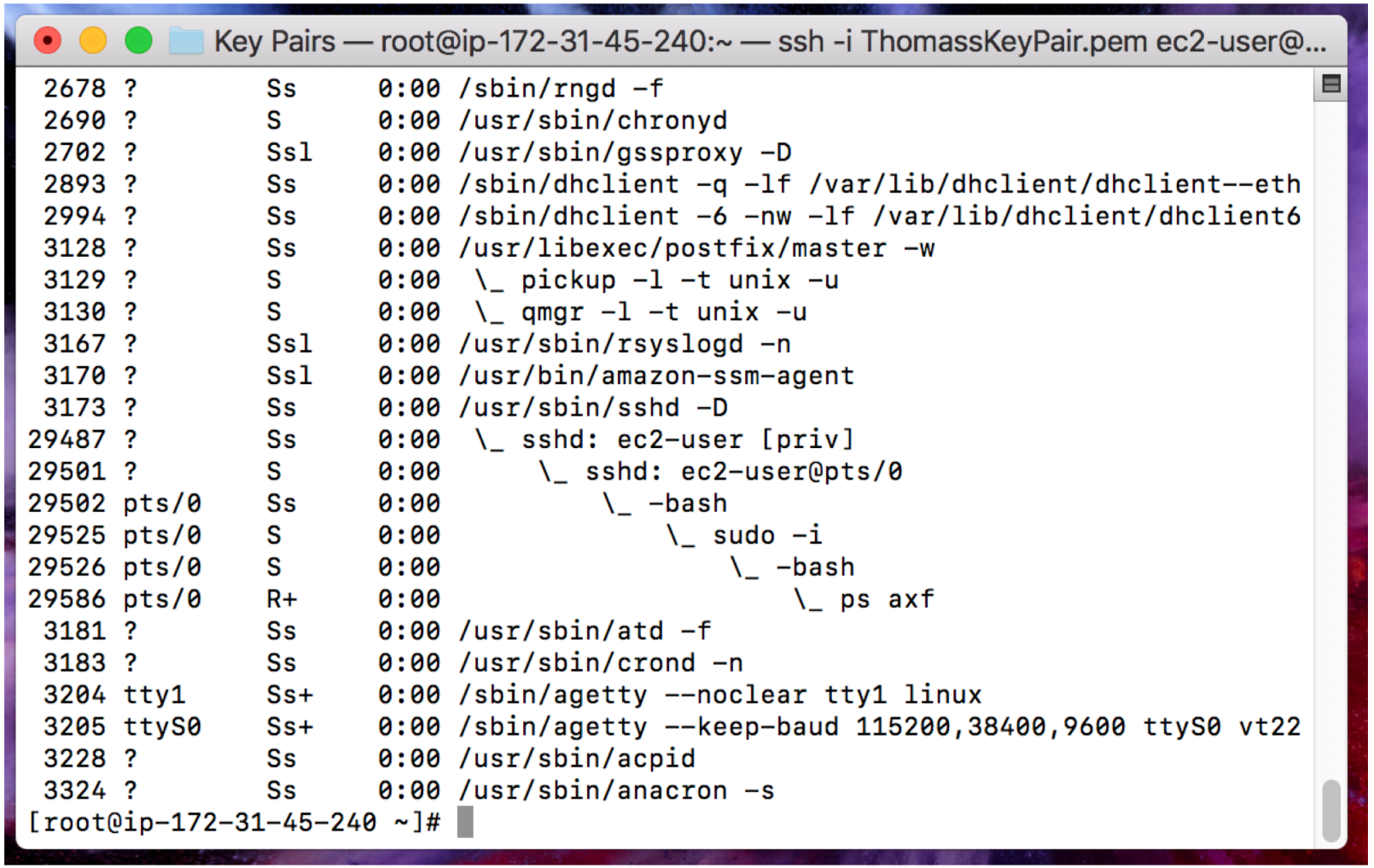
[root@ip-172-31-45-240 ~]# ps
PID TTY TIME CMD
29525 pts/0 00:00:00 sudo
29526 pts/0 00:00:00 bash
29545 pts/0 00:00:00 ps
[root@ip-172-31-45-240 ~]# ps a
PID TTY STAT TIME COMMAND
3204 tty1 Ss+ 0:00 /sbin/agetty --noclear tty1 linux
3205 ttyS0 Ss+ 0:00 /sbin/agetty --keep-baud 115200,38400,9600 ttyS0 vt22
29502 pts/0 Ss 0:00 -bash
29525 pts/0 S 0:00 sudo -i
29526 pts/0 S 0:00 -bash
29546 pts/0 R+ 0:00 ps a
[root@ip-172-31-45-240 ~]#


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# ps ax


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
2893 ? Ss 0:00 /sbin/dhclient -q -lf /var/lib/dhclient/dhclient--eth
2994 ? Ss 0:00 /sbin/dhclient -6 -nw -lf /var/lib/dhclient/dhclient6
3128 ? Ss 0:00 /usr/libexec/postfix/master -w
3129 ? S 0:00 pickup -l -t unix -u
3130 ? S 0:00 qmgr -l -t unix -u
3167 ? Ssl 0:00 /usr/sbin/rsyslogd -n
3170 ? Ssl 0:00 /usr/bin/amazon-ssm-agent
3173 ? Ss 0:00 /usr/sbin/sshd -D
3181 ? Ss 0:00 /usr/sbin/atd -f
3183 ? Ss 0:00 /usr/sbin/crond -n
3204 tty1 Ss+ 0:00 /sbin/agetty --noclear tty1 linux
3205 ttyS0 Ss+ 0:00 /sbin/agetty --keep-baud 115200,38400,9600 ttyS0 vt22
3228 ? Ss 0:00 /usr/sbin/acpid
3324 ? Ss 0:00 /usr/sbin/anacron -s
3401 ? I 0:00 [kworker/0:1]
3402 ? I 0:00 [kworker/0:0]
29484 ? I 0:00 [kworker/0:2]
29487 ? Ss 0:00 sshd: ec2-user [priv]
29501 ? S 0:00 sshd: ec2-user@pts/0
29502 pts/0 Ss 0:00 -bash
29525 pts/0 S 0:00 sudo -i
29526 pts/0 S 0:00 -bash
29547 pts/0 R+ 0:00 ps ax
[root@ip-172-31-45-240 ~]#


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# ps axf


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
2678 ? Ss 0:00 /sbin/rngd -f
2690 ? S 0:00 /usr/sbin/chronyd
2702 ? Ssl 0:00 /usr/sbin/gssproxy -D
2893 ? Ss 0:00 /sbin/dhclient -q -lf /var/lib/dhclient/dhclient--eth
2994 ? Ss 0:00 /sbin/dhclient -6 -nw -lf /var/lib/dhclient/dhclient6
3128 ? Ss 0:00 /usr/libexec/postfix/master -w
3129 ? S 0:00 _ pickup -l -t unix -u
3130 ? S 0:00 _ qmgr -l -t unix -u
3167 ? Ssl 0:00 /usr/sbin/rsyslogd -n
3170 ? Ssl 0:00 /usr/bin/amazon-ssm-agent
3173 ? Ss 0:00 /usr/sbin/sshd -D
29487 ? Ss 0:00 _ sshd: ec2-user [priv]
29501 ? S 0:00 _ sshd: ec2-user@pts/0
29502 pts/0 Ss 0:00 _ -bash
29525 pts/0 S 0:00 _ sudo -i
29526 pts/0 S 0:00 _ -bash
29586 pts/0 R+ 0:00 _ ps axf
3181 ? Ss 0:00 /usr/sbin/atd -f
3183 ? Ss 0:00 /usr/sbin/crond -n
3204 tty1 Ss+ 0:00 /sbin/agetty --noclear tty1 linux
3205 ttyS0 Ss+ 0:00 /sbin/agetty --keep-baud 115200,38400,9600 ttyS0 vt22
3228 ? Ss 0:00 /usr/sbin/acpid
3324 ? Ss 0:00 /usr/sbin/anacron -s
[root@ip-172-31-45-240 ~]#

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-219-197-165.us-east-2.compute.amazonaws.com — 202×56

```
[root@ip-172-31-45-240 ~]# ps alx
F   UID   PID  PPID PRI  NI    VSZ   RSS WCHAN  STAT TTY        TIME COMMAND
4     0     1     0  20   0  43524  5220 SyS_ep Ss   ?          0:01 /usr/lib/systemd/systemd --switched-root --system --deserialize 22
1     0     2     0  20   0      0     0 -      S    ?          0:00 [kthreadd]
1     0     4     2   0 -20      0     0 -      I<   ?          0:00 [kworker/0:0H]
1     0     5     2  20   0      0     0 -      I    ?          0:00 [kworker/u30:0]
1     0     6     2   0 -20      0     0 -      I<   ?          0:00 [mm_percpu_wq]
1     0     7     2  20   0      0     0 -      S    ?          0:00 [ksoftirqd/0]
1     0     8     2  20   0      0     0 rcu_gp I    ?          0:00 [rcu_sched]
1     0     9     2  20   0      0     0 -      I    ?          0:00 [rcu_bh]
1     0    10     2 -100  -      0     0 -      S    ?          0:00 [migration/0]
5     0    11     2 -100  -      0     0 -      S    ?          0:00 [watchdog/0]
1     0    12     2  20   0      0     0 -      S    ?          0:00 [cpuhp/0]
5     0    13     2  20   0      0     0 -      S    ?          0:00 [kdevtmpfs]
1     0    14     2   0 -20      0     0 -      I<   ?          0:00 [netns]
1     0    15     2  20   0      0     0 -      I    ?          0:00 [kworker/u30:1]
1     0    20     2  20   0      0     0 -      S    ?          0:00 [xenbus]
1     0    21     2  20   0      0     0 -      S    ?          0:00 [xenwatch]
1     0   171     2  20   0      0     0 watchd S    ?          0:00 [khungtaskd]
1     0   172     2  20   0      0     0 -      S    ?          0:00 [oom_reaper]
1     0   173     2   0 -20      0     0 -      I<   ?          0:00 [writeback]
1     0   175     2  20   0      0     0 -      S    ?          0:00 [kcompactd0]
1     0   176     2  25   5      0     0 -      SN   ?          0:00 [ksmd]
1     0   177     2  39  19      0     0 -      SN   ?          0:00 [khugepaged]
1     0   178     2   0 -20      0     0 -      I<   ?          0:00 [crypto]
1     0   179     2   0 -20      0     0 -      I<   ?          0:00 [kintegrityd]
1     0   181     2   0 -20      0     0 -      I<   ?          0:00 [kblockd]
1     0   534     2   0 -20      0     0 -      I<   ?          0:00 [md]
1     0   537     2   0 -20      0     0 -      I<   ?          0:00 [edac-poller]
1     0   542     2   0 -20      0     0 -      I<   ?          0:00 [watchdogd]
1     0   683     2  20   0      0     0 -      S    ?          0:00 [kauditd]
1     0   689     2  20   0      0     0 -      S    ?          0:00 [kswapd0]
1     0   821     2   0 -20      0     0 -      I<   ?          0:00 [kthrotld]
1     0   871     2   0 -20      0     0 -      I<   ?          0:00 [kstrp]
1     0   899     2   0 -20      0     0 -      I<   ?          0:00 [ipv6_addrconf]
1     0  1736     2   0 -20      0     0 -      I<   ?          0:00 [ata_sff]
1     0  1751     2  20   0      0     0 -      S    ?          0:00 [scsi_eh_0]
1     0  1752     2   0 -20      0     0 -      I<   ?          0:00 [scsi_tmf_0]
1     0  1756     2  20   0      0     0 -      S    ?          0:00 [scsi_eh_1]
1     0  1758     2   0 -20      0     0 -      I<   ?          0:00 [scsi_tmf_1]
1     0  1854     2   0 -20      0     0 -      I<   ?          0:00 [xfsalloc]
1     0  1855     2   0 -20      0     0 -      I<   ?          0:00 [xfs_mru_cache]
1     0  1857     2   0 -20      0     0 -      I<   ?          0:00 [xfs-buf/xvda1]
1     0  1858     2   0 -20      0     0 -      I<   ?          0:00 [xfs-data/xvda1]
1     0  1859     2   0 -20      0     0 -      I<   ?          0:00 [xfs-conv/xvda1]
1     0  1860     2   0 -20      0     0 -      I<   ?          0:00 [xfs-cil/xvda1]
1     0  1861     2   0 -20      0     0 -      I<   ?          0:00 [xfs-reclaim/xvd]
1     0  1862     2   0 -20      0     0 -      I<   ?          0:00 [xfs-log/xvda1]
1     0  1863     2   0 -20      0     0 -      I<   ?          0:00 [xfs-eofblocks/x]
1     0  1864     2  20   0      0     0 kthrea S    ?          0:00 [xfsaild/xvda1]
1     0  1865     2   0 -20      0     0 -      I<   ?          0:00 [kworker/0:1H]
4     0  1931     1  20   0  49308 10964 SyS_ep Ss   ?          0:00 /usr/lib/systemd/systemd-journald
1     0  1943     2   0 -20      0     0 -      I<   ?          0:00 [ena]
4     0  1956     1  20   0 116824  2132 core_s Ss   ?          0:00 /usr/sbin/lvmetad -f
4     0  2084     1  20   0  46036  4080 SyS_ep Ss   ?          0:00 /usr/lib/systemd/systemd-udevd
1     0  2637     2   0 -20      0     0 -      I<   ?          0:00 [rpciod]
```

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-219-197-165.us-east-2.compute.amazonaws.com — 202×56

```
[root@ip-172-31-45-240 ~]# ps alxf
F   UID   PID  PPID PRI  NI    VSZ   RSS WCHAN  STAT TTY        TIME COMMAND
1     0     2     0  20   0      0     0 -      S    ?          0:00 [kthreadd]
1     0     4     2   0 -20      0     0 -      I<   ?          0:00  \_ [kworker/0:0H]
1     0     5     2  20   0      0     0 -      I    ?          0:00  \_ [kworker/u30:0]
1     0     6     2   0 -20      0     0 -      I<   ?          0:00  \_ [mm_percpu_wq]
1     0     7     2  20   0      0     0 -      S    ?          0:00  \_ [ksoftirqd/0]
1     0     8     2  20   0      0     0 rcu_gp I    ?          0:00  \_ [rcu_sched]
1     0     9     2  20   0      0     0 -      I    ?          0:00  \_ [rcu_bh]
1     0    10     2 -100  -      0     0 -      S    ?          0:00  \_ [migration/0]
5     0    11     2 -100  -      0     0 -      S    ?          0:00  \_ [watchdog/0]
1     0    12     2  20   0      0     0 -      S    ?          0:00  \_ [cpuhp/0]
5     0    13     2  20   0      0     0 -      S    ?          0:00  \_ [kdevtmpfs]
1     0    14     2   0 -20      0     0 -      I<   ?          0:00  \_ [netns]
1     0    15     2  20   0      0     0 -      I    ?          0:00  \_ [kworker/u30:1]
1     0    20     2  20   0      0     0 -      S    ?          0:00  \_ [xenbus]
1     0    21     2  20   0      0     0 -      S    ?          0:00  \_ [xenwatch]
1     0   171     2  20   0      0     0 watchd S    ?          0:00  \_ [khungtaskd]
1     0   172     2  20   0      0     0 -      S    ?          0:00  \_ [oom_reaper]
1     0   173     2   0 -20      0     0 -      I<   ?          0:00  \_ [writeback]
1     0   175     2  20   0      0     0 -      S    ?          0:00  \_ [kcompactd0]
1     0   176     2  25   5      0     0 -      SN   ?          0:00  \_ [ksmd]
1     0   177     2  39  19      0     0 -      SN   ?          0:00  \_ [khugepaged]
1     0   178     2   0 -20      0     0 -      I<   ?          0:00  \_ [crypto]
1     0   179     2   0 -20      0     0 -      I<   ?          0:00  \_ [kintegrityd]
1     0   181     2   0 -20      0     0 -      I<   ?          0:00  \_ [kblockd]
1     0   534     2   0 -20      0     0 -      I<   ?          0:00  \_ [md]
1     0   537     2   0 -20      0     0 -      I<   ?          0:00  \_ [edac-poller]
1     0   542     2   0 -20      0     0 -      I<   ?          0:00  \_ [watchdogd]
1     0   683     2  20   0      0     0 -      S    ?          0:00  \_ [kauditd]
1     0   689     2  20   0      0     0 -      S    ?          0:00  \_ [kswapd0]
1     0   821     2   0 -20      0     0 -      I<   ?          0:00  \_ [kthrotld]
1     0   871     2   0 -20      0     0 -      I<   ?          0:00  \_ [kstrp]
1     0   899     2   0 -20      0     0 -      I<   ?          0:00  \_ [ipv6_addrconf]
1     0  1736     2   0 -20      0     0 -      I<   ?          0:00  \_ [ata_sff]
1     0  1751     2  20   0      0     0 -      S    ?          0:00  \_ [scsi_eh_0]
1     0  1752     2   0 -20      0     0 -      I<   ?          0:00  \_ [scsi_tmf_0]
1     0  1756     2  20   0      0     0 -      S    ?          0:00  \_ [scsi_eh_1]
1     0  1758     2   0 -20      0     0 -      I<   ?          0:00  \_ [scsi_tmf_1]
1     0  1854     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfsalloc]
1     0  1855     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs_mru_cache]
1     0  1857     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-buf/xvda1]
1     0  1858     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-data/xvda1]
1     0  1859     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-conv/xvda1]
1     0  1860     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-cil/xvda1]
1     0  1861     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-reclaim/xvd]
1     0  1862     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-log/xvda1]
1     0  1863     2   0 -20      0     0 -      I<   ?          0:00  \_ [xfs-eofblocks/x]
1     0  1864     2  20   0      0     0 kthrea S    ?          0:00  \_ [xfsaild/xvda1]
1     0  1865     2   0 -20      0     0 -      I<   ?          0:00  \_ [kworker/0:1H]
1     0  1943     2   0 -20      0     0 -      I<   ?          0:00  \_ [ena]
1     0  2637     2   0 -20      0     0 -      I<   ?          0:00  \_ [rpciod]
1     0  2639     2   0 -20      0     0 -      I<   ?          0:00  \_ [xprtiod]
1     0  3402     2  20   0      0     0 -      I    ?          0:00  \_ [kworker/0:0]
1     0 29484     2  20   0      0     0 -      I    ?          0:00  \_ [kworker/0:2]
1     0 29587     2  20   0      0     0 -      I    ?          0:00  \_ [kworker/0:1]
```

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-219-197-165.us-east-2.compute.amazonaws.com — 202×56

```
1     0   899     2   0 -20       0     0 -       I<   ?          0:00  \_ [ipv6_addrconf]
1     0  1736     2   0 -20       0     0 -       I<   ?          0:00  \_ [ata_sff]
1     0  1751     2  20   0       0     0 -       S    ?          0:00  \_ [scsi_eh_0]
1     0  1752     2   0 -20       0     0 -       I<   ?          0:00  \_ [scsi_tmf_0]
1     0  1756     2  20   0       0     0 -       S    ?          0:00  \_ [scsi_eh_1]
1     0  1758     2   0 -20       0     0 -       I<   ?          0:00  \_ [scsi_tmf_1]
1     0  1854     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfsalloc]
1     0  1855     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs_mru_cache]
1     0  1857     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-buf/xvda1]
1     0  1858     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-data/xvda1]
1     0  1859     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-conv/xvda1]
1     0  1860     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-cil/xvda1]
1     0  1861     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-reclaim/xvd]
1     0  1862     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-log/xvda1]
1     0  1863     2   0 -20       0     0 -       I<   ?          0:00  \_ [xfs-eofblocks/x]
1     0  1864     2  20   0       0     0 kthrea S    ?          0:00  \_ [xfsaild/xvda1]
1     0  1865     2   0 -20       0     0 -       I<   ?          0:00  \_ [kworker/0:1H]
1     0  1943     2   0 -20       0     0 -       I<   ?          0:00  \_ [ena]
1     0  2637     2   0 -20       0     0 -       I<   ?          0:00  \_ [rpciod]
1     0  2639     2   0 -20       0     0 -       I<   ?          0:00  \_ [xprtiod]
1     0  3402     2  20   0       0     0 -       I    ?          0:00  \_ [kworker/0:0]
1     0 29484     2  20   0       0     0 -       I    ?          0:00  \_ [kworker/0:2]
1     0 29587     2  20   0       0     0 -       I    ?          0:00  \_ [kworker/0:1]
4     0     1     0  20   0  43524  5220 SyS_ep Ss   ?          0:01 /usr/lib/systemd/systemd --switched-root --system --deserialize 22
4     0  1931     1  20   0  49308 10964 SyS_ep Ss   ?          0:00 /usr/lib/systemd/systemd-journald
4     0  1956     1  20   0 116824  2132 core_s Ss   ?          0:00 /usr/sbin/lvmetad -f
4     0  2084     1  20   0  46036  4080 SyS_ep Ss   ?          0:00 /usr/lib/systemd/systemd-udevd
5     0  2642     1  16  -4  64328  2328 SyS_ep S<sl ?          0:00 /sbin/auditd
4    81  2666     1  20   0  60420  4012 SyS_ep Ss   ?          0:00 /usr/bin/dbus-daemon --system --address=systemd: --nofork --nopidfile --systemd-activation
5    32  2667     1  20   0  73828  3564 SyS_po Ss   ?          0:00 /sbin/rpcbind -w
4     0  2668     1  20   0  28512  2968 SyS_ep Ss   ?          0:00 /usr/lib/systemd/systemd-logind
4   999  2671     1  20   0  12656  1756 core_s Ss   ?          0:00 /usr/bin/lsmd -d
4     0  2678     1  20   0  13144   880 SyS_po Ss   ?          0:00 /sbin/rngd -f
5   997  2690     1  20   0 122644  4072 core_s S    ?          0:00 /usr/sbin/chronyd
1     0  2702     1  20   0 208356  3628 SyS_ep Ssl  ?          0:00 /usr/sbin/gssproxy -D
5     0  2893     1  20   0 105448  4096 core_s Ss   ?          0:00 /sbin/dhclient -q -lf /var/lib/dhclient/dhclient--eth0.lease -pf /var/run/dhclient-eth0.pid -H ip-172-31-45-240 eth0
1     0  2994     1  20   0 105448  3856 core_s Ss   ?          0:00 /sbin/dhclient -6 -nw -lf /var/lib/dhclient/dhclient6--eth0.lease -pf /var/run/dhclient6-eth0.pid eth0 -H ip-172-31-45-240
5     0  3128     1  20   0  90416  4740 SyS_ep Ss   ?          0:00 /usr/libexec/postfix/master -w
4    89  3129  3128  20   0  90504  6828 SyS_ep S    ?          0:00  \_ pickup -l -t unix -u
4    89  3130  3128  20   0  90580  6652 SyS_ep S    ?          0:00  \_ qmgr -l -t unix -u
4     0  3167     1  20   0 224824  5896 core_s Ssl  ?          0:00 /usr/sbin/rsyslogd -n
4     0  3170     1  20   0 542424 12992 SyS_ep Ssl  ?          0:00 /usr/bin/amazon-ssm-agent
4     0  3173     1  20   0 112924  7192 core_s Ss   ?          0:00 /usr/sbin/sshd -D
4     0 29487  3173  20   0 150608  8876 SyS_po Ss   ?          0:00  \_ sshd: ec2-user [priv]
5  1000 29501 29487  20   0 150608  4660 core_s S    ?          0:00      \_ sshd: ec2-user@pts/0
0  1000 29502 29501  20   0 124792  3780 -       Ss   pts/0      0:00          \_ -bash
4     0 29525 29502  20   0 216936  6344 SyS_po S    pts/0      0:00              \_ sudo -i
4     0 29526 29525  20   0 124792  4064 -       S    pts/0      0:00                  \_ -bash
0     0 29594 29526  20   0 160376  3896 -       R+   pts/0      0:00                      \_ ps alxf
4     0  3181     1  20   0  27916  2236 hrtime Ss   ?          0:00 /usr/sbin/atd -f
4     0  3183     1  20   0 135116  3128 hrtime Ss   ?          0:00 /usr/sbin/crond -n
4     0  3204     1  20   0 121336  1760 core_s Ss+  tty1       0:00 /sbin/agetty --noclear tty1 linux
4     0  3205     1  20   0 120984  2128 core_s Ss+  ttyS0      0:00 /sbin/agetty --keep-baud 115200,38400,9600 ttyS0 vt220
1     0  3228     1  20   0   4308   108 core_s Ss   ?          0:00 /usr/sbin/acpid
1     0  3324     1  20   0 134212  2724 -       Ss   ?          0:00 /usr/sbin/anacron -s
[root@ip-172-31-45-240 ~]#
```

Tools for baseline

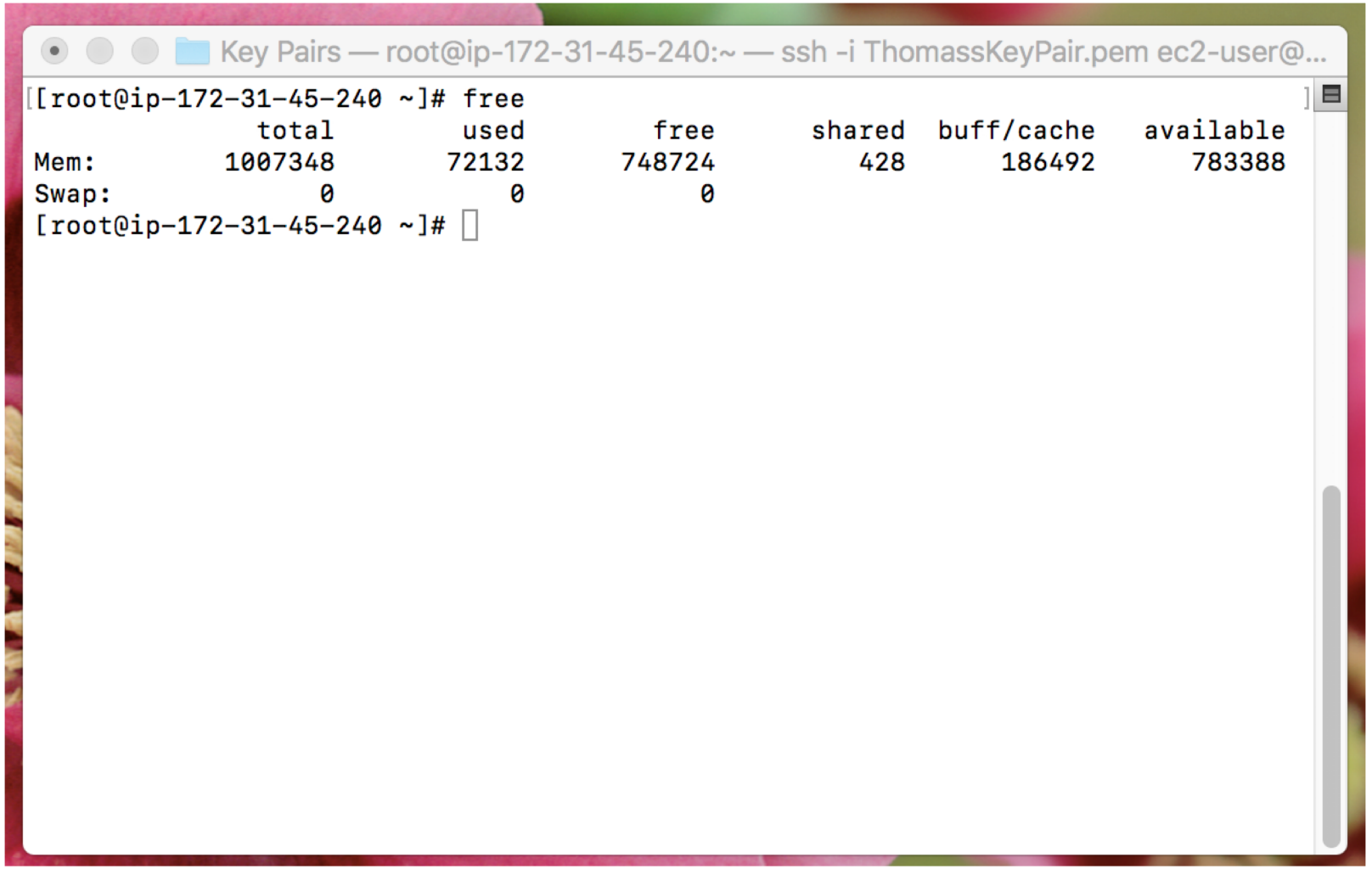
- Check out what's running, how much memory, cpu, etc.

Tools for baseline

- Check out what's running, how much memory, cpu, etc.
- Record this info so you can compare later

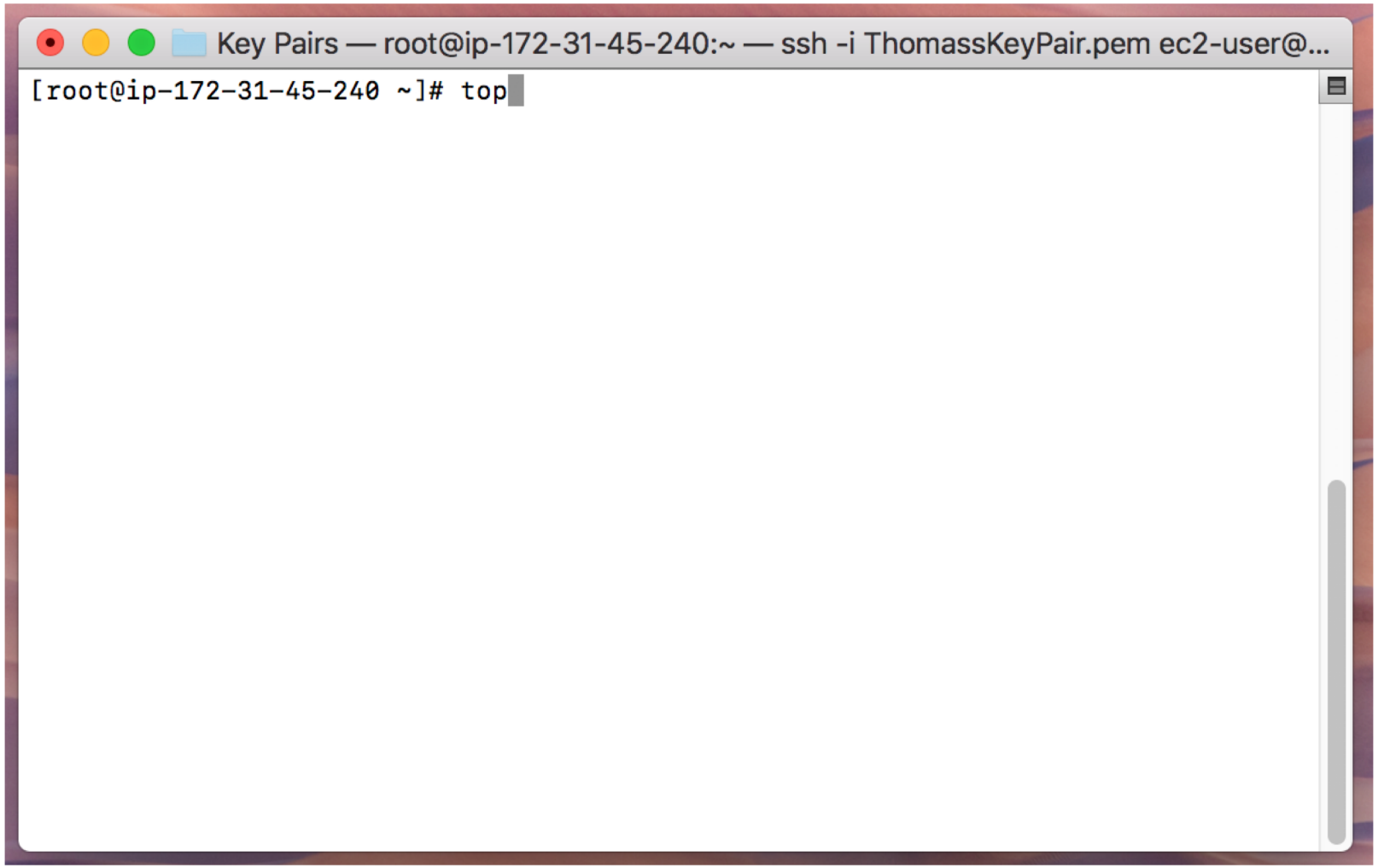
Tools for baseline

- free


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# free
total used free shared buff/cache available
Mem: 1007348 72132 748724 428 186492 783388
Swap: 0 0 0
[root@ip-172-31-45-240 ~]#

Tools for baseline

- top


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# top

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...

```
top - 12:33:46 up  1:03,  1 user,  load average: 0.00, 0.00, 0.00
Tasks:  86 total,   1 running,  49 sleeping,   0 stopped,   0 zombie
%Cpu(s):  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem :  1007348 total,   724448 free,    61588 used,   221312 buff/cache
KiB Swap:        0 total,        0 free,        0 used.   787852 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
    1 root      20   0   43524   5220   3916 S   0.0  0.5   0:01.52 systemd
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kthreadd
    4 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kworker/0:0H
    5 root      20   0       0      0      0 I   0.0  0.0   0:00.01 kworker/u30+
    6 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 mm_percpu_wq
    7 root      20   0       0      0      0 S   0.0  0.0   0:00.10 ksoftirqd/0
    8 root      20   0       0      0      0 I   0.0  0.0   0:00.13 rcu_sched
    9 root      20   0       0      0      0 I   0.0  0.0   0:00.00 rcu_bh
   10 root      rt   0       0      0      0 S   0.0  0.0   0:00.00 migration/0
   11 root      rt   0       0      0      0 S   0.0  0.0   0:00.00 watchdog/0
   12 root      20   0       0      0      0 S   0.0  0.0   0:00.00 cpuhp/0
   13 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kdevtmpfs
   14 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 netns
   15 root      20   0       0      0      0 I   0.0  0.0   0:00.02 kworker/u30+
   20 root      20   0       0      0      0 S   0.0  0.0   0:00.00 xenbus
   21 root      20   0       0      0      0 S   0.0  0.0   0:00.01 xenwatch
  171 root      20   0       0      0      0 S   0.0  0.0   0:00.00 khungtaskd
```

Tools for baseline

- top
  - t to change summary info
  - m to change memory summary
  - r to renice
  - k to kill

Tools for baseline

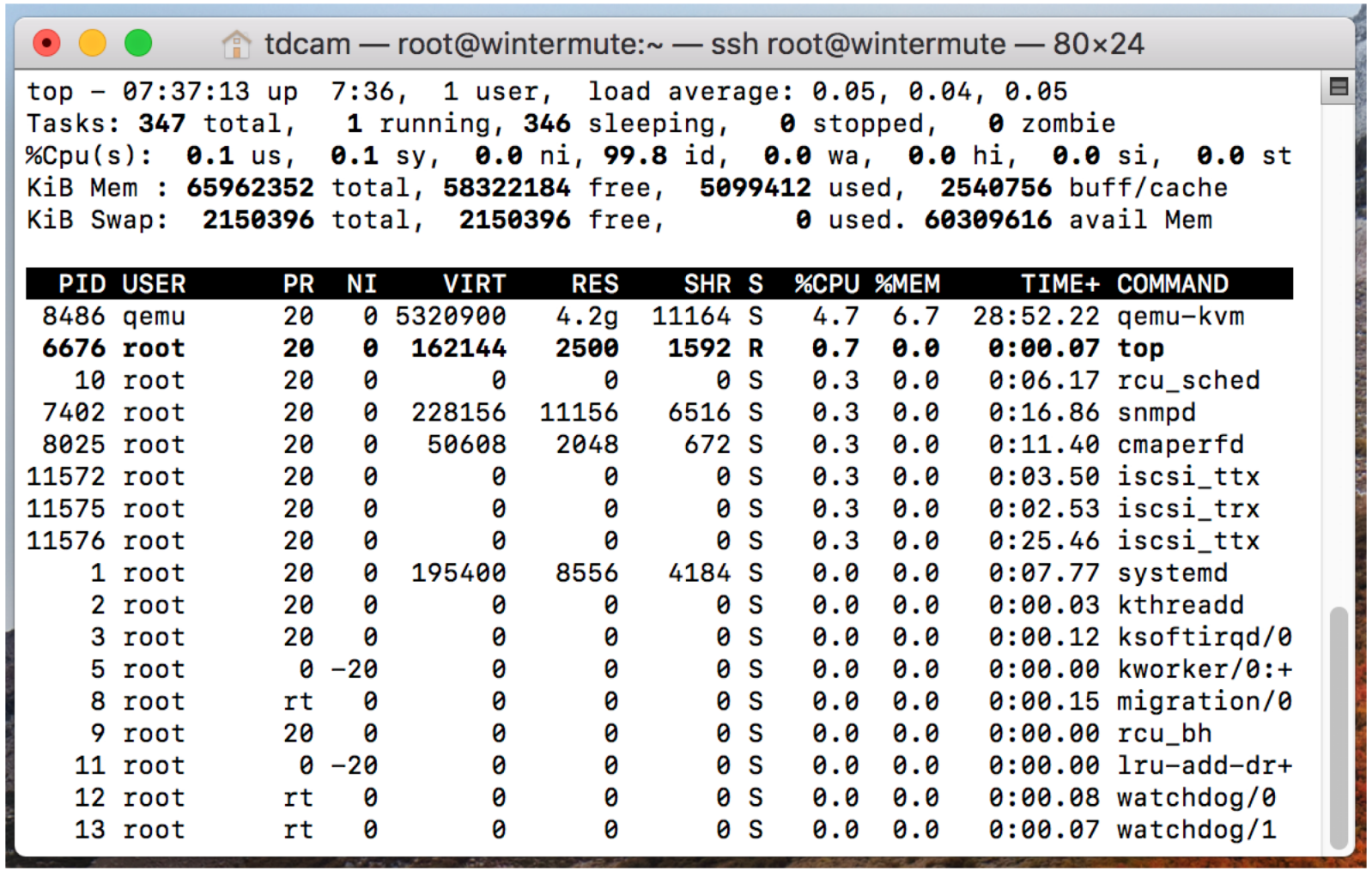
- top
  - Sometimes your system will seem fine but the app is really slow

Tools for baseline

- top
  - Sometimes your system will seem fine but the app is really slow
  - Looking at a per-cpu view can explain why

Tools for baseline

- top
  - Sometimes your system will seem fine but the app is really slow
  - Looking at a per-cpu view can explain why
  - Press 1


tdcam — root@wintermute:~ — ssh root@wintermute — 80×24
top - 07:37:13 up 7:36, 1 user, load average: 0.05, 0.04, 0.05
Tasks: 347 total, 1 running, 346 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.1 us, 0.1 sy, 0.0 ni, 99.8 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 65962352 total, 58322184 free, 5099412 used, 2540756 buff/cache
KiB Swap: 2150396 total, 2150396 free, 0 used. 60309616 avail Mem
PID USER PR NI VIRT RES SHR S %CPU %MEM TIME+ COMMAND
8486 qemu 20 0 5320900 4.2g 11164 S 4.7 6.7 28:52.22 qemu-kvm
6676 root 20 0 162144 2500 1592 R 0.7 0.0 0:00.07 top
10 root 20 0 0 0 0 S 0.3 0.0 0:06.17 rcu_sched
7402 root 20 0 228156 11156 6516 S 0.3 0.0 0:16.86 snmpd
8025 root 20 0 50608 2048 672 S 0.3 0.0 0:11.40 cmaperfd
11572 root 20 0 0 0 0 S 0.3 0.0 0:03.50 iscsi_ttx
11575 root 20 0 0 0 0 S 0.3 0.0 0:02.53 iscsi_trx
11576 root 20 0 0 0 0 S 0.3 0.0 0:25.46 iscsi_ttx
1 root 20 0 195400 8556 4184 S 0.0 0.0 0:07.77 systemd
2 root 20 0 0 0 0 S 0.0 0.0 0:00.03 kthreadd
3 root 20 0 0 0 0 S 0.0 0.0 0:00.12 ksoftirqd/0
5 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 kworker/0:+
8 root rt 0 0 0 0 S 0.0 0.0 0:00.15 migration/0
9 root 20 0 0 0 0 S 0.0 0.0 0:00.00 rcu_bh
11 root 0 -20 0 0 0 S 0.0 0.0 0:00.00 lru-add-dr+
12 root rt 0 0 0 0 S 0.0 0.0 0:00.08 watchdog/0
13 root rt 0 0 0 0 S 0.0 0.0 0:00.07 watchdog/1

tdcam — root@wintermute:~ — ssh root@wintermute — 97×39

```
top - 07:38:50 up  7:38,  1 user,  load average: 0.11, 0.06, 0.05
Tasks: 348 total,   1 running, 347 sleeping,   0 stopped,   0 zombie
%Cpu0  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu1  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu2  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu3  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu4  :  0.0 us,  0.3 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu5  :  0.0 us,  0.3 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu6  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu7  :  0.0 us,  0.3 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu8  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu9  :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu10 :  0.3 us,  0.0 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu11 :  1.0 us,  0.0 sy,  0.0 ni, 99.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu12 :  0.0 us,  0.3 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu13 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu14 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu15 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu16 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu17 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu18 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu19 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu20 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu21 :  1.0 us,  0.0 sy,  0.0 ni, 99.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu22 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
%Cpu23 :  0.0 us,  0.0 sy,  0.0 ni,100.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem : 65962352 total, 58320960 free,  5099960 used,  2541432 buff/cache
KiB Swap:  2150396 total,  2150396 free,        0 used. 60308464 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 8486 qemu      20   0 5304508   4.2g  11164 S   4.0  6.7  28:57.00 qemu-kvm
 7933 root      20   0   55392   3164   1952 S   0.7  0.0   0:19.72 cmahostd
 7280 root      20   0  162152   2520   1592 R   0.3  0.0   0:00.07 top
11571 root      20   0       0      0      0 S   0.3  0.0   0:01.34 iscsi_trx
    1 root      20   0  195400   8556   4184 S   0.0  0.0   0:07.79 systemd
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.03 kthreadd
    3 root      20   0       0      0      0 S   0.0  0.0   0:00.12 ksoftirqd/0
    5 root       0 -20       0      0      0 S   0.0  0.0   0:00.00 kworker/0:0H
    8 root      rt   0       0      0      0 S   0.0  0.0   0:00.15 migration/0
```

Tools for baseline

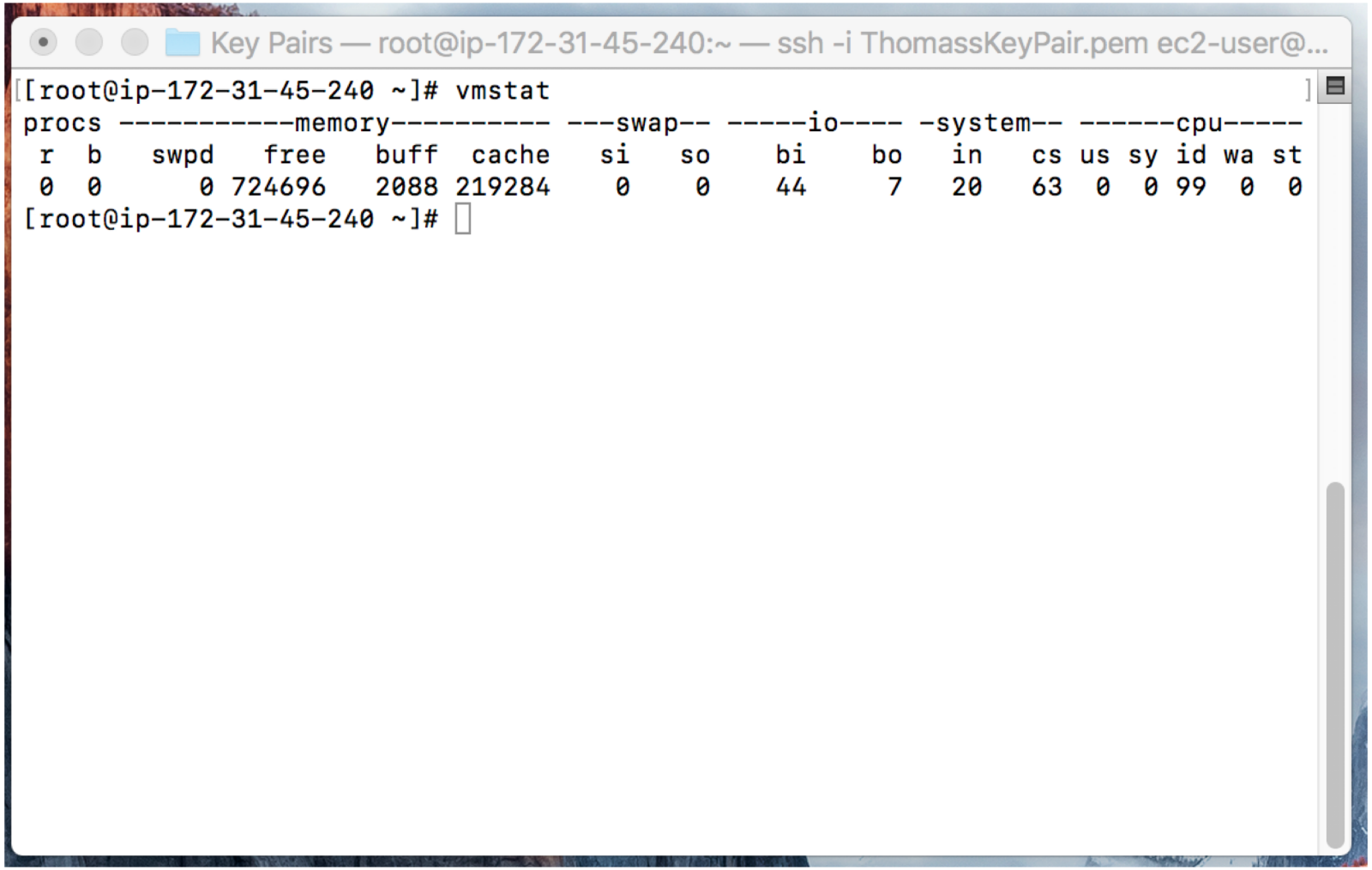
- vmstat
  - Part of the procps-ng package

Tools for baseline

- vmstat
  - Part of the procps-ng package
  - vmstat [number]

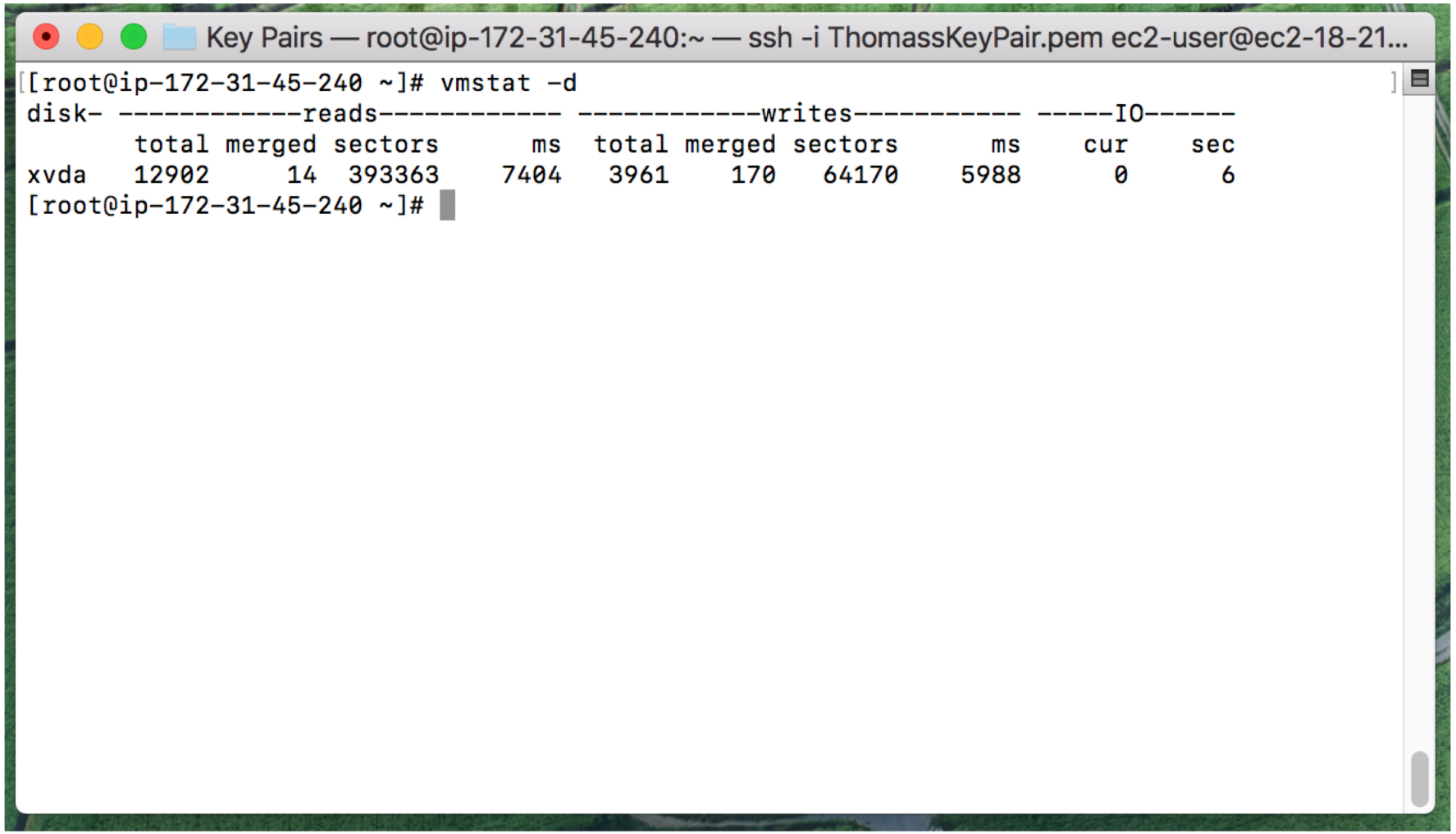
Tools for baseline

- vmstat
  - Part of the procps-ng package
  - vmstat [number]
  - Great for seeing what's going on with memory/cpu


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# vmstat
procs -----------memory---------- ---swap-- -----io---- -system-- ------cpu-----
r b swpd free buff cache si so bi bo in cs us sy id wa st
0 0 0 724696 2088 219284 0 0 44 7 20 63 0 0 99 0 0
[root@ip-172-31-45-240 ~]#

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-21...

```
[root@ip-172-31-45-240 ~]# vmstat 3
procs -----------memory---------- ---swap-- -----io---- -system-- ------cpu-----
 r  b   swpd   free   buff  cache   si   so    bi    bo   in   cs us sy id wa st
 0  0      0 724704   2088 219284    0    0    43     7   20   62  0  0 99  0  0
 0  0      0 724696   2088 219284    0    0     0     0   10   15  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0     0    5    8  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0     0    6    8  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0     1    7   12  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0     0    5    8  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0    44   13   11  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0     0    7   11  0  0 100  0  0
 0  0      0 724696   2088 219284    0    0     0     0    5    8  0  0 100  0  0
 0  0      0 722944   2088 219328    0    0     0     0   13   27  0  0 100  0  0
 1  0      0 724200   2088 219360    0    0     5     0   20   47  0  0 100  0  0
 0  0      0 724200   2088 219360    0    0     0     0    6   10  0  0 100  0  0
 0  0      0 724200   2088 219360    0    0     0     0    8   13  0  0 100  0  0
 0  0      0 724136   2088 219424    0    0     0    55   20   35  0  0 100  0  0
```


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-21...
[root@ip-172-31-45-240 ~]# vmstat -d
disk- ------------reads------------ ------------writes----------- -----IO------
total merged sectors ms total merged sectors ms cur sec
xvda 12902 14 393363 7404 3961 170 64170 5988 0 6
[root@ip-172-31-45-240 ~]#

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-21...

```
[root@ip-172-31-45-240 ~]# vmstat -m
Cache                  Num  Total   Size  Pages
rpc_inode_cache         23     23    704     23
xfs_dqtrx                0      0    528     31
xfs_rui_item             0      0    672     24
xfs_rud_item             0      0    152     26
xfs_ili                264    264    168     24
xfs_inode            15096  15096    960     34
xfs_efd_item            78     78    416     39
xfs_buf_item            66     66    248     33
xfs_da_state            34     34    480     34
xfs_btree_cur           35     35    232     35
xfs_log_ticket          44     44    184     22
bio-2                  200    200    320     25
kcopyd_job               0      0   3312      9
dm_uevent                0      0   2632     12
dax_cache               21     21    768     21
RAWv6                   28     28   1152     28
UDPv6                   25     25   1280     25
tw_sock_TCPv6            0      0    248     33
request_sock_TCPv6       0      0    312     26
TCPv6                   15     15   2176     15
cfq_io_cq                0      0    120     34
Cache                  Num  Total   Size  Pages
```

Tools for baseline

- iostat

Tools for baseline

- iostat
  - Part of the sysstat package

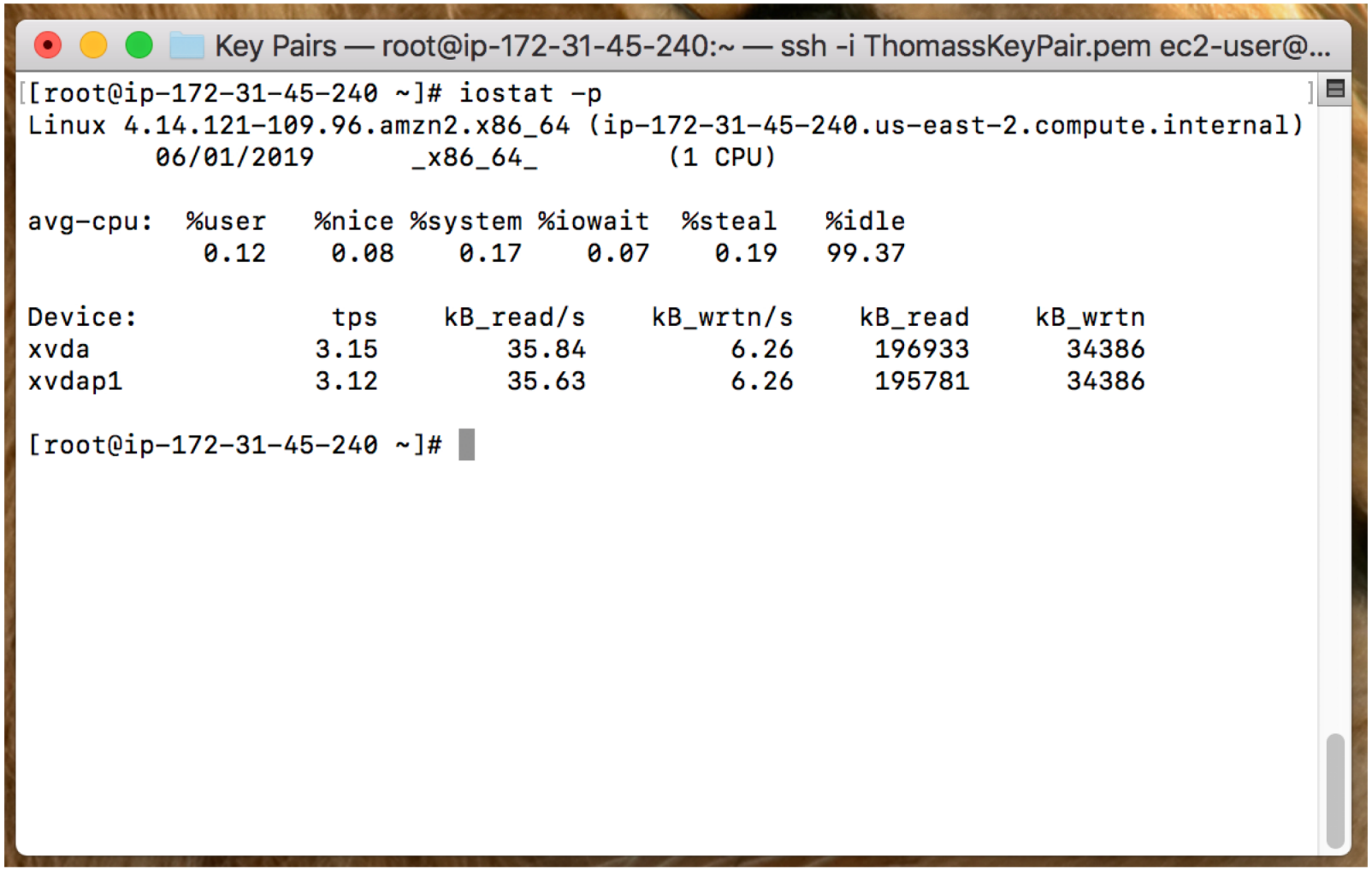
Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-21...

```
[root@ip-172-31-45-240 ~]# iostat
Linux 4.14.121-109.96.amzn2.x86_64 (ip-172-31-45-240.us-east-2.compute.internal)        0
6/01/2019       _x86_64_        (1 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           0.12    0.08    0.18    0.08    0.19   99.35

Device:            tps    kB_read/s    kB_wrtn/s    kB_read    kB_wrtn
xvda              3.22        37.27         6.22     196933      32841

[root@ip-172-31-45-240 ~]#
```


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# iostat -p
Linux 4.14.121-109.96.amzn2.x86_64 (ip-172-31-45-240.us-east-2.compute.internal)
06/01/2019 _x86_64_ (1 CPU)
avg-cpu: %user %nice %system %iowait %steal %idle
0.12 0.08 0.17 0.07 0.19 99.37
Device: tps kB_read/s kB_wrtn/s kB_read kB_wrtn
xvda 3.15 35.84 6.26 196933 34386
xvdap1 3.12 35.63 6.26 195781 34386
[root@ip-172-31-45-240 ~]#

Tools for baseline

- sar

Tools for baseline

- sar
  - Part of the sysstat package

Tools for baseline

- sar
  - Part of the sysstat package
  - Finer grained view over time

root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-219...

```
[root@ip-172-31-45-240 ~]# sar
Linux 4.14.114-105.126.amzn2.x86_64 (ip-172-31-45-240.us-east-2.compute.internal
)       06/01/2019      _x86_64_        (1 CPU)

05:11:49 AM       LINUX RESTART

05:18:06 AM       LINUX RESTART

05:20:01 AM     CPU     %user     %nice   %system   %iowait    %steal      %idle
05:30:01 AM     all      0.04      0.00      0.03      0.01      0.01      99.91
Average:        all      0.04      0.00      0.03      0.01      0.01      99.91

11:30:48 AM       LINUX RESTART

11:40:01 AM     CPU     %user     %nice   %system   %iowait    %steal      %idle
11:50:01 AM     all      0.00      0.00      0.00      0.00      0.00      99.99
12:00:01 PM     all      0.01      0.00      0.01      0.00      0.00      99.98
12:10:01 PM     all      0.10      0.00      0.03      0.01      0.01      99.85
12:20:01 PM     all      0.00      0.74      1.05      0.48      0.03      97.69
12:30:01 PM     all      0.02      0.00      0.02      0.00      0.01      99.94
12:40:01 PM     all      0.01      0.00      0.01      0.00      0.00      99.97
12:50:01 PM     all      0.01      0.00      0.01      0.00      0.00      99.97
01:00:01 PM     all      0.04      0.00      0.03      0.01      0.01      99.92
Average:        all      0.03      0.09      0.14      0.06      0.01      99.67
```

Tools for baseline

- ss

Tools for baseline

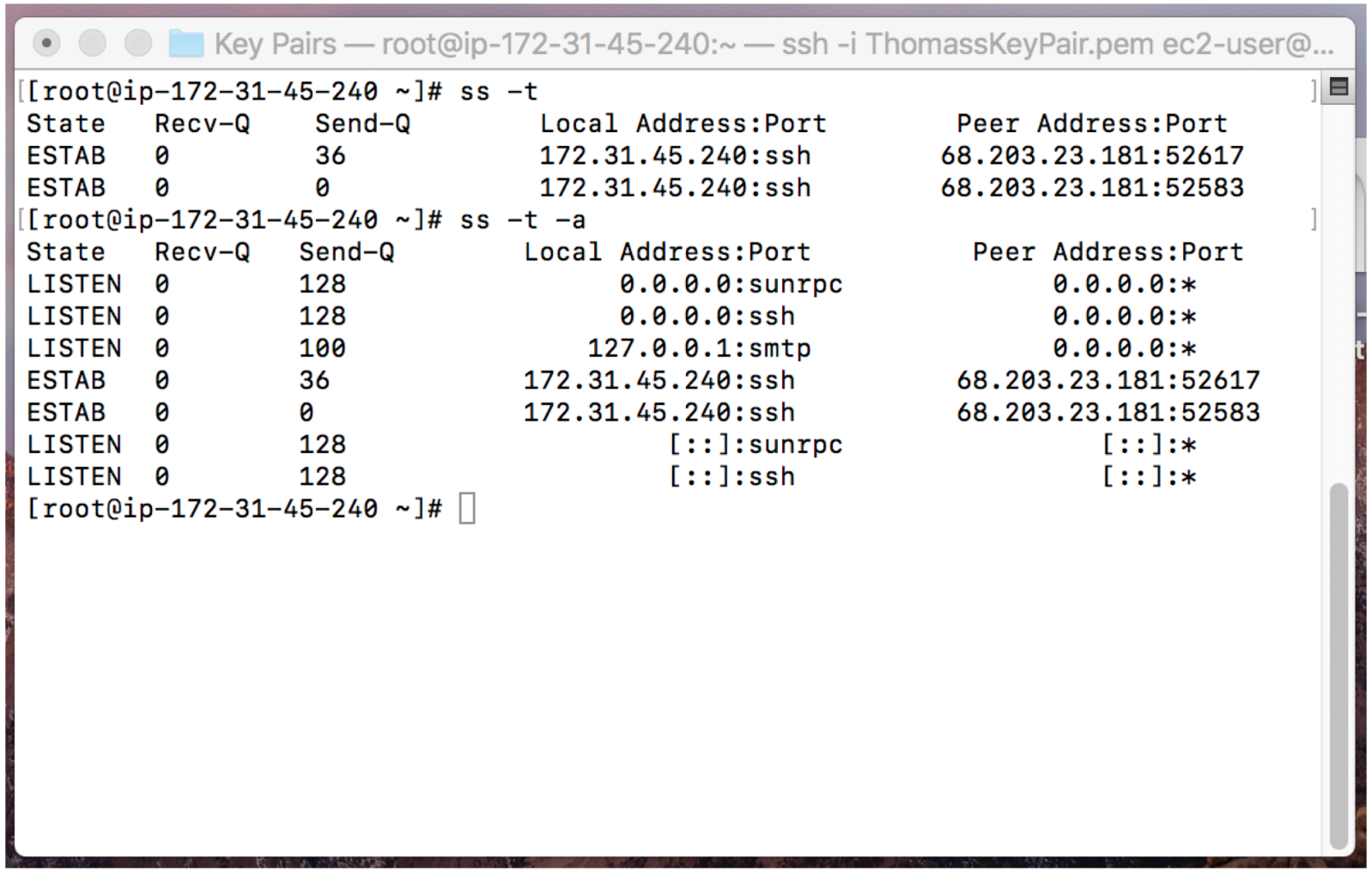
- ss
  - Network information

Tools for baseline

- ss
  - Network information
  - Replaces older utils like ~~netstat~~

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...

```
[root@ip-172-31-45-240 ~]# ss
NetidState Recv-Q Send-Q                 Local Address:Port   Peer Address:Port
u_strESTAB 0      0                                  * 18653             * 18652
u_strESTAB 0      0                                  * 19312             * 19313
u_strESTAB 0      0       /run/systemd/journal/stdout 16262             * 16261
u_strESTAB 0      0                                  * 16061             * 16062
u_strESTAB 0      0                                  * 18643             * 18644
u_strESTAB 0      0                                  * 18646             * 18647
u_strESTAB 0      0       /run/systemd/journal/stdout 16807             * 16806
u_strESTAB 0      0                                  * 16331             * 16332
u_strESTAB 0      0                                  * 16261             * 16262
u_strESTAB 0      0                                  * 16806             * 16807
u_strESTAB 0      0                                  * 18644             * 18643
u_strESTAB 0      0       /run/dbus/system_bus_socket 16333             * 16211
u_strESTAB 0      0       /run/systemd/journal/stdout 14900             * 14899
u_strESTAB 0      0                                  * 14899             * 14900
u_strESTAB 0      0                                  * 16647             * 16648
u_strESTAB 0      0       /run/dbus/system_bus_socket 16654             * 16653
u_strESTAB 0      0                                  * 16332             * 16331
u_strESTAB 0      0                                  * 15027             * 15174
u_strESTAB 0      0                                  * 50412             * 50413
u_strESTAB 0      0                                  * 16211             * 16333
u_strESTAB 0      0                                  * 16062             * 16061
u_strESTAB 0      0       /run/systemd/journal/stdout 15174             * 15027
```

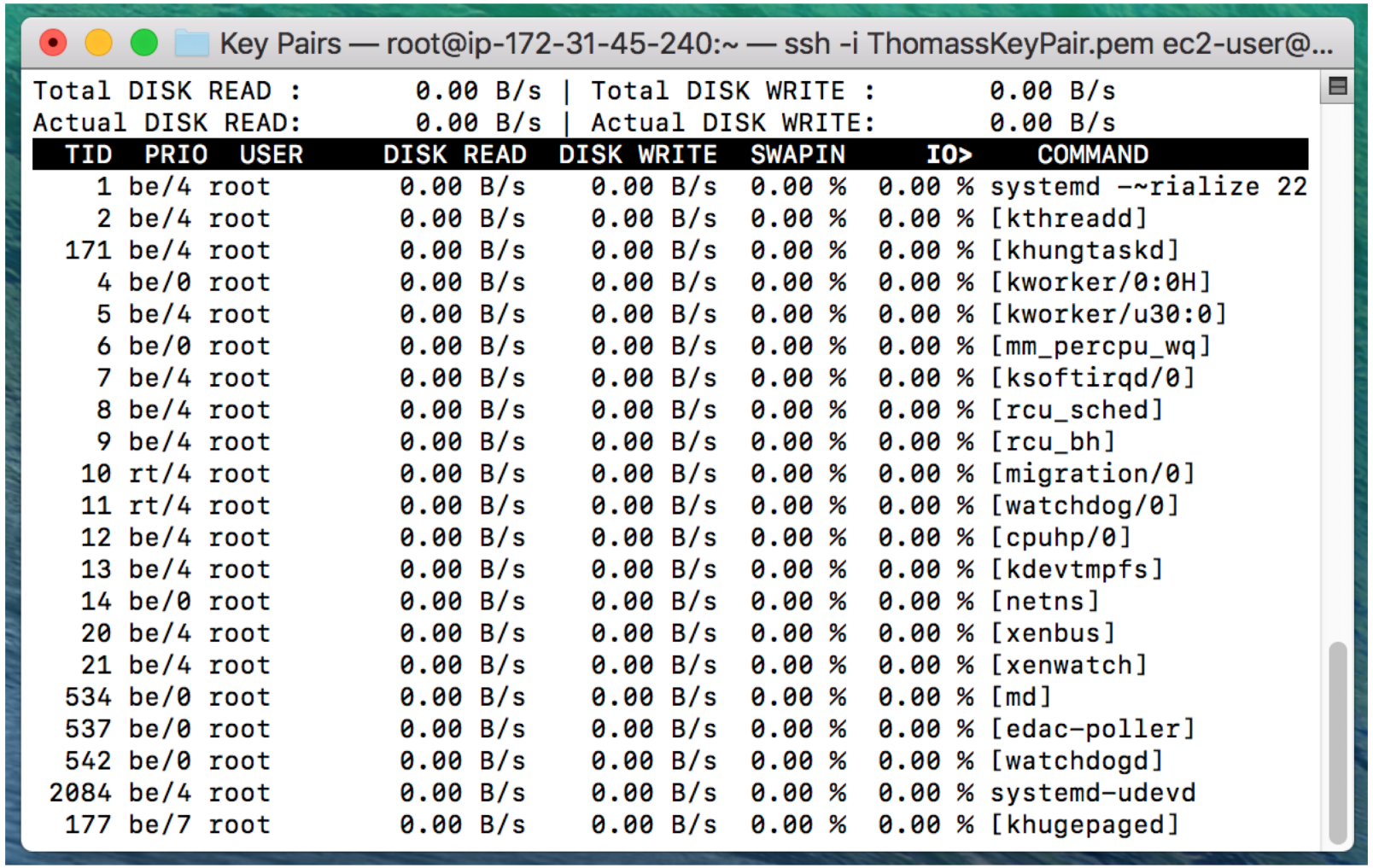

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# ss -t
State Recv-Q Send-Q Local Address:Port Peer Address:Port
ESTAB 0 36 172.31.45.240:ssh 68.203.23.181:52617
ESTAB 0 0 172.31.45.240:ssh 68.203.23.181:52583
[root@ip-172-31-45-240 ~]# ss -t -a
State Recv-Q Send-Q Local Address:Port Peer Address:Port
LISTEN 0 128 0.0.0.0:sunrpc 0.0.0.0:*
LISTEN 0 128 0.0.0.0:ssh 0.0.0.0:*
LISTEN 0 100 127.0.0.1:smtp 0.0.0.0:*
ESTAB 0 36 172.31.45.240:ssh 68.203.23.181:52617
ESTAB 0 0 172.31.45.240:ssh 68.203.23.181:52583
LISTEN 0 128 [::]:sunrpc [::]:*
LISTEN 0 128 [::]:ssh [::]:*
[root@ip-172-31-45-240 ~]#

Tools for baseline

- iotop

Tools for baseline

- iotop
  - Watch top i/o loads


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
Total DISK READ : 0.00 B/s | Total DISK WRITE : 0.00 B/s
Actual DISK READ: 0.00 B/s | Actual DISK WRITE: 0.00 B/s
TID PRIO USER DISK READ DISK WRITE SWAPIN IO> COMMAND
1 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % systemd -~rialize 22
2 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [kthreadd]
171 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [khungtaskd]
4 be/0 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [kworker/0:0H]
5 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [kworker/u30:0]
6 be/0 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [mm_percpu_wq]
7 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [ksoftirqd/0]
8 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [rcu_sched]
9 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [rcu_bh]
10 rt/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [migration/0]
11 rt/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [watchdog/0]
12 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [cpuhp/0]
13 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [kdevtmpfs]
14 be/0 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [netns]
20 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [xenbus]
21 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [xenwatch]
534 be/0 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [md]
537 be/0 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [edac-poller]
542 be/0 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [watchdogd]
2084 be/4 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % systemd-udevd
177 be/7 root 0.00 B/s 0.00 B/s 0.00 % 0.00 % [khugepaged]

Tools for baseline

- I/O scheduler

Tools for baseline

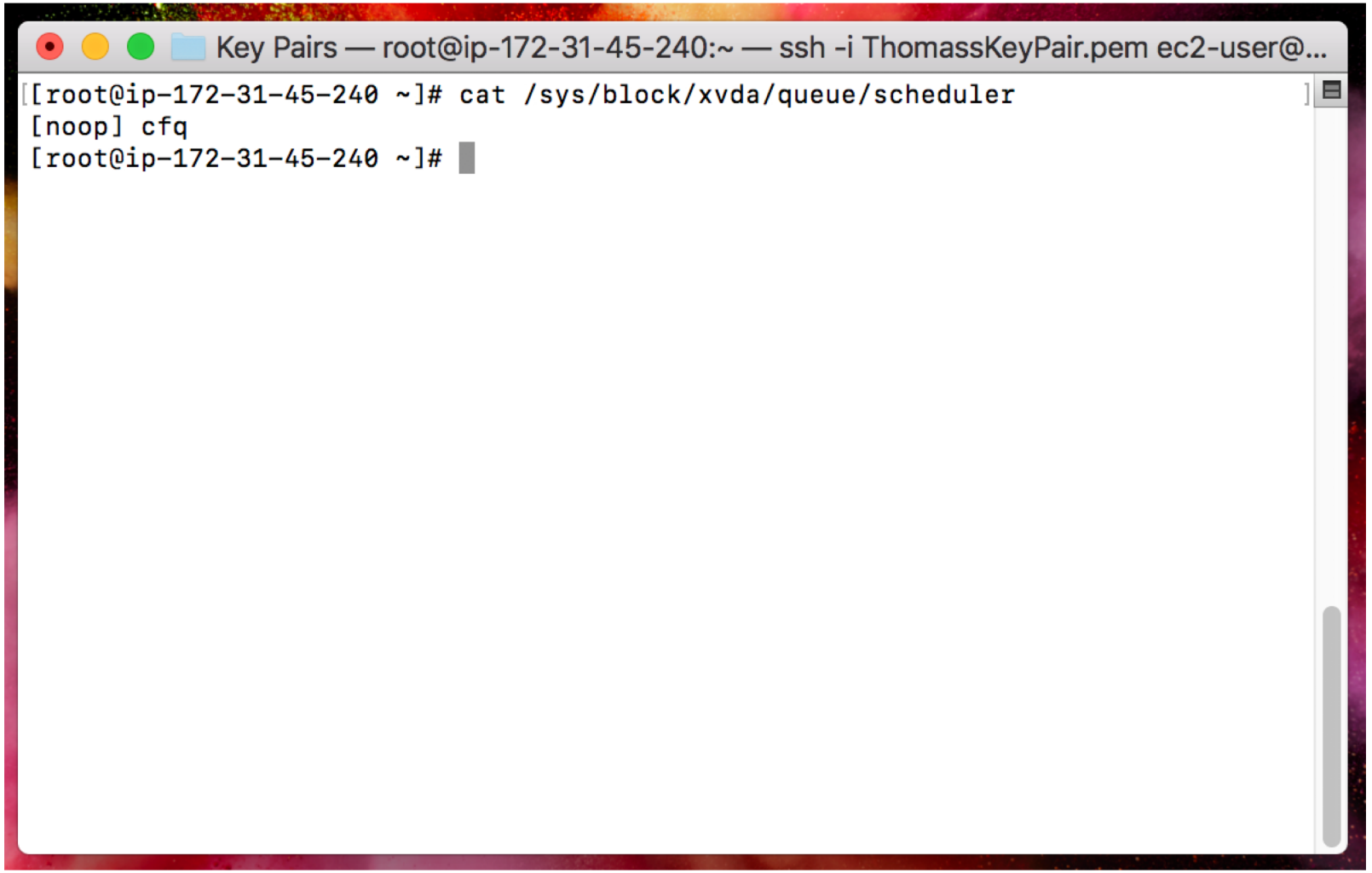
- I/O scheduler
  - CFQ (cfq): the default scheduler for many Linux distributions; it places synchronous requests, submitted by processes, into a number of per-process queues and then allocates timeslices for each of the queues to access the disk.

Tools for baseline

- I/O scheduler
  - Noop scheduler (noop): the simplest I/O scheduler for the Linux kernel based on the First In First Out (FIFO) queue concept. This scheduler is best suited for SSDs.

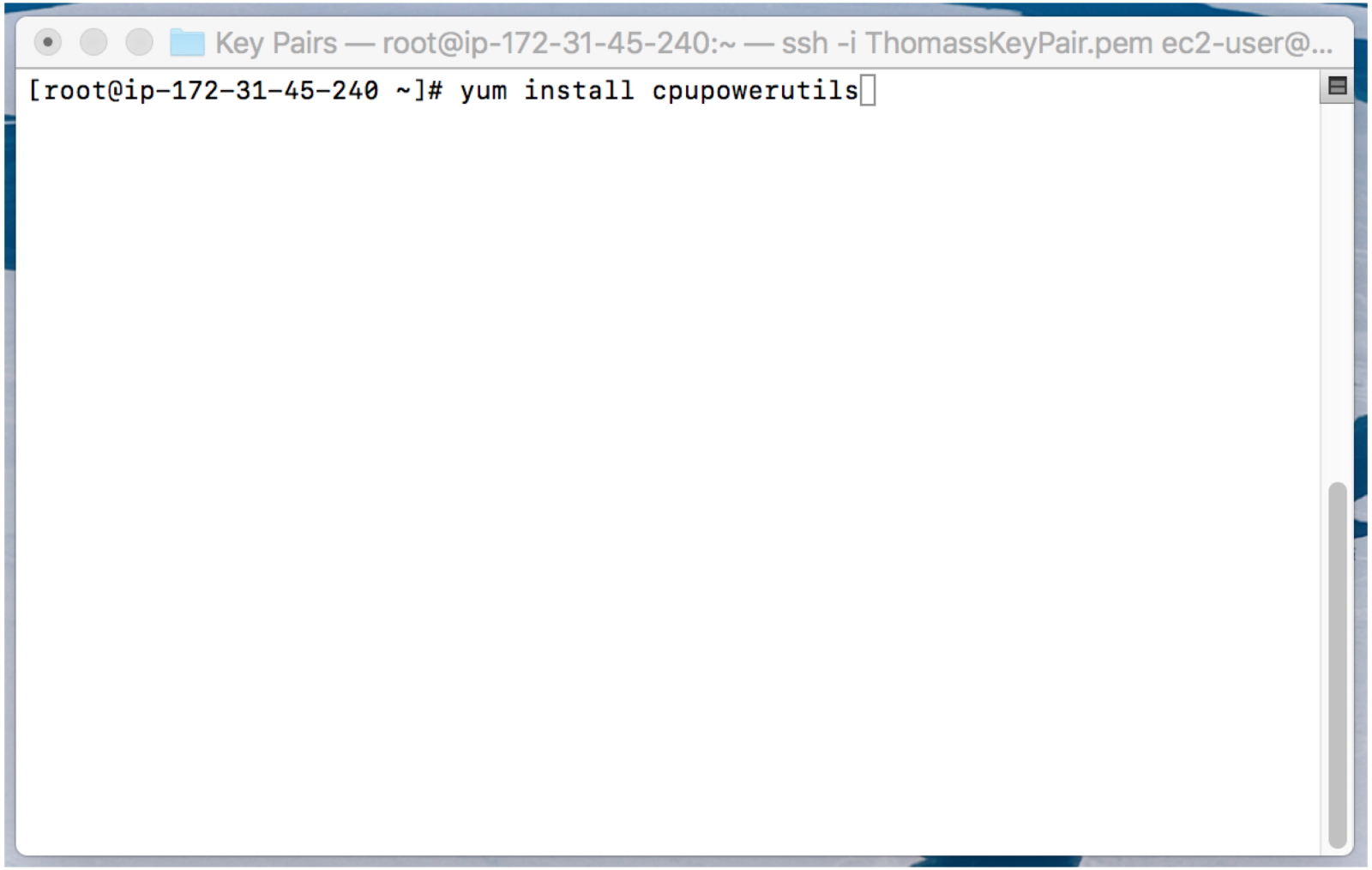
Tools for baseline

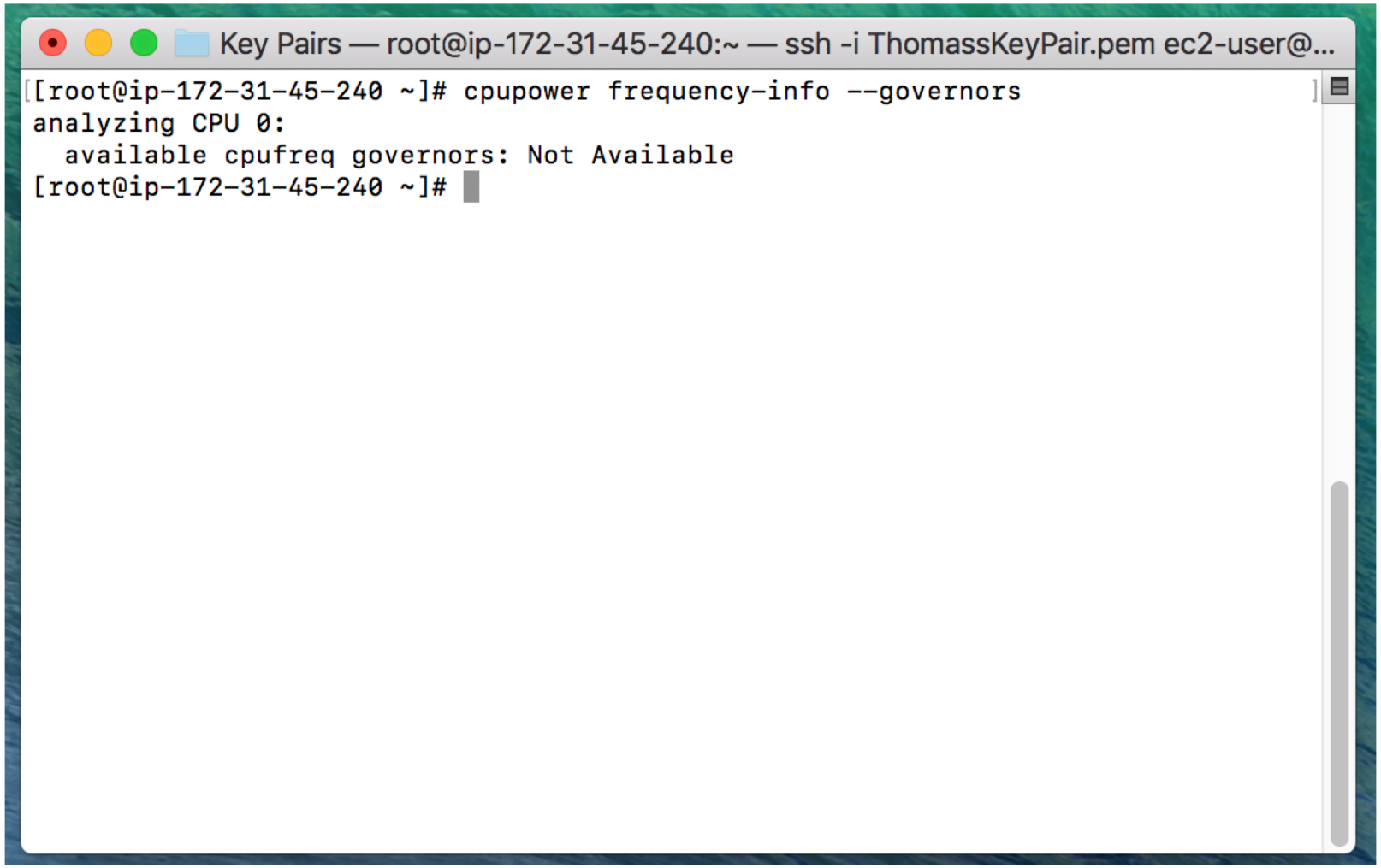
- I/O scheduler
  - Deadline scheduler (deadline): attempts to guarantee a start service time for a request.


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# cat /sys/block/xvda/queue/scheduler
[noop] cfq
[root@ip-172-31-45-240 ~]#

Tools for baseline

- CPU management


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# yum install cpupowerutils


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# cpupower frequency-info --governors
analyzing CPU 0:
available cpufreq governors: Not Available
[root@ip-172-31-45-240 ~]#

Tools for tuning

Tools for tuning

- I'm lazy

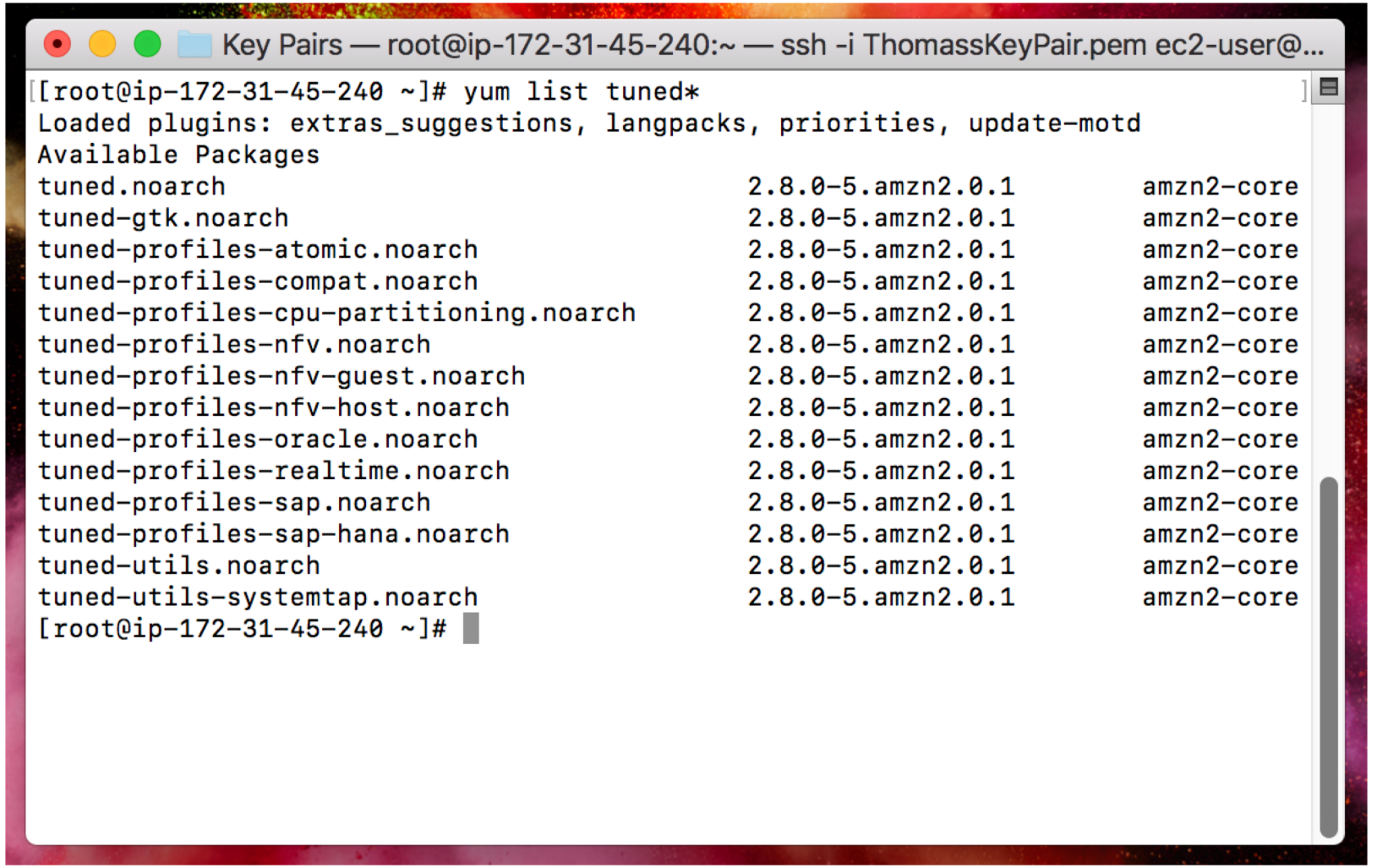
Tools for tuning

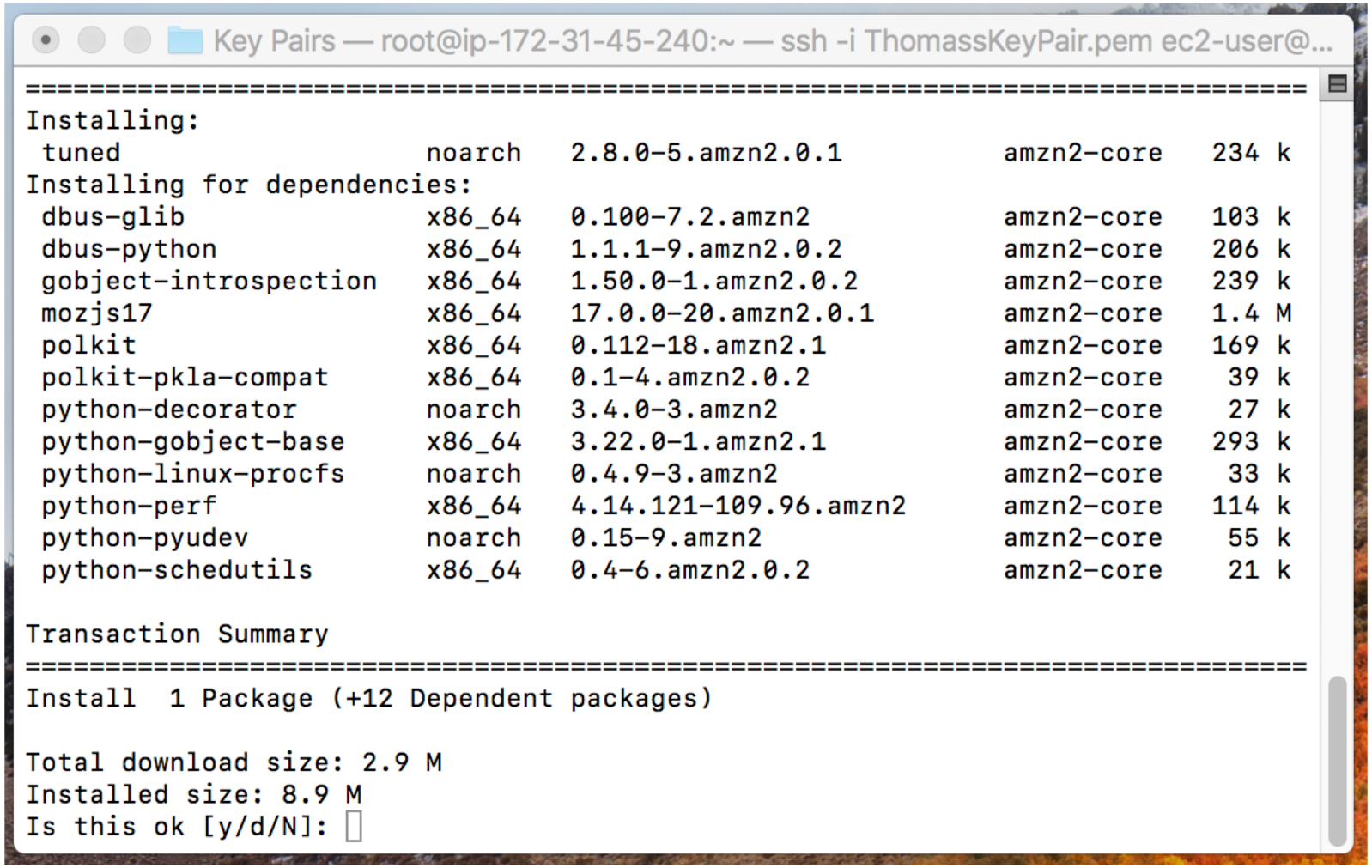
- I'm lazy
- I like tuned (pronounced "tune-dee")

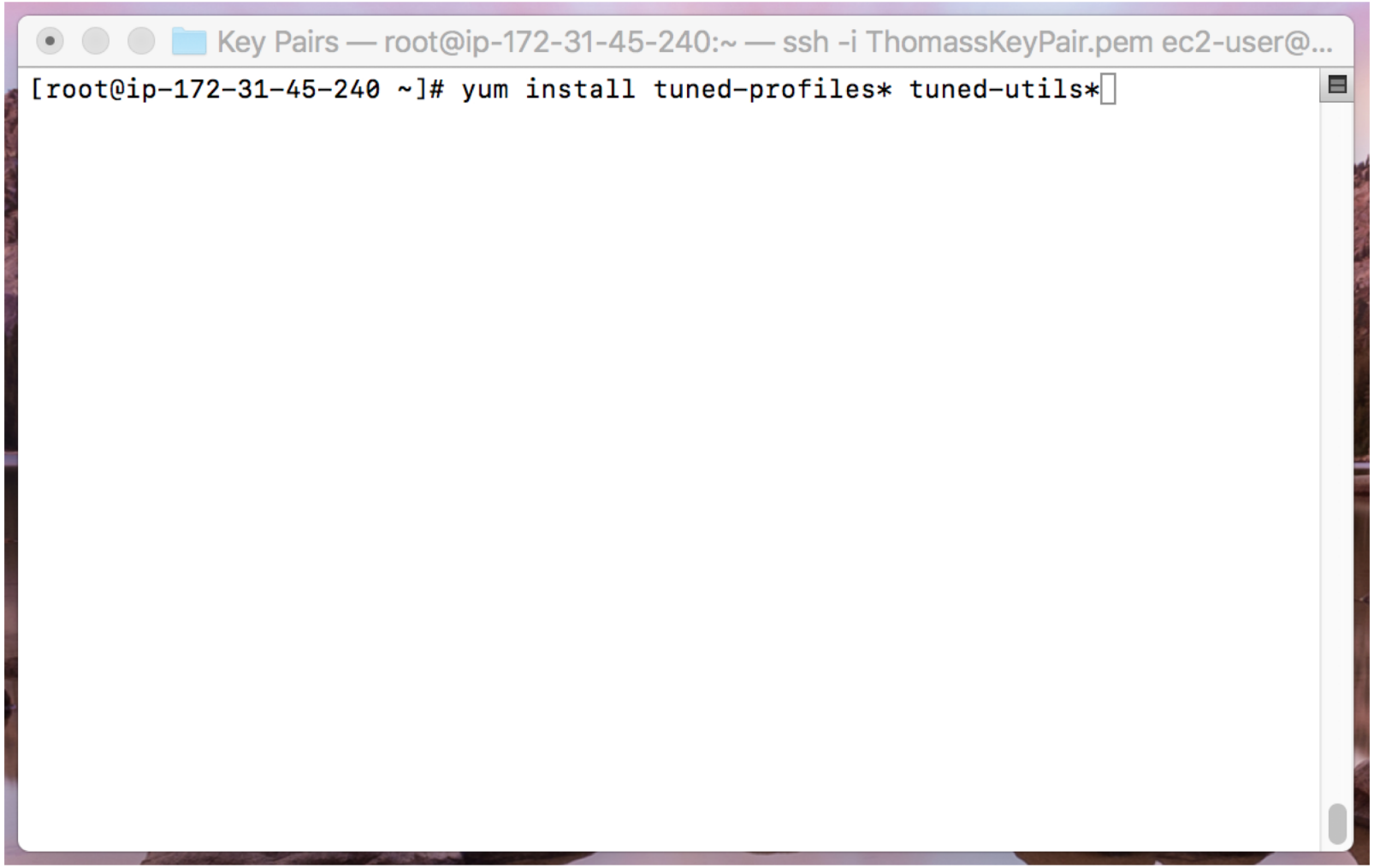
3.1. Tuned Overview

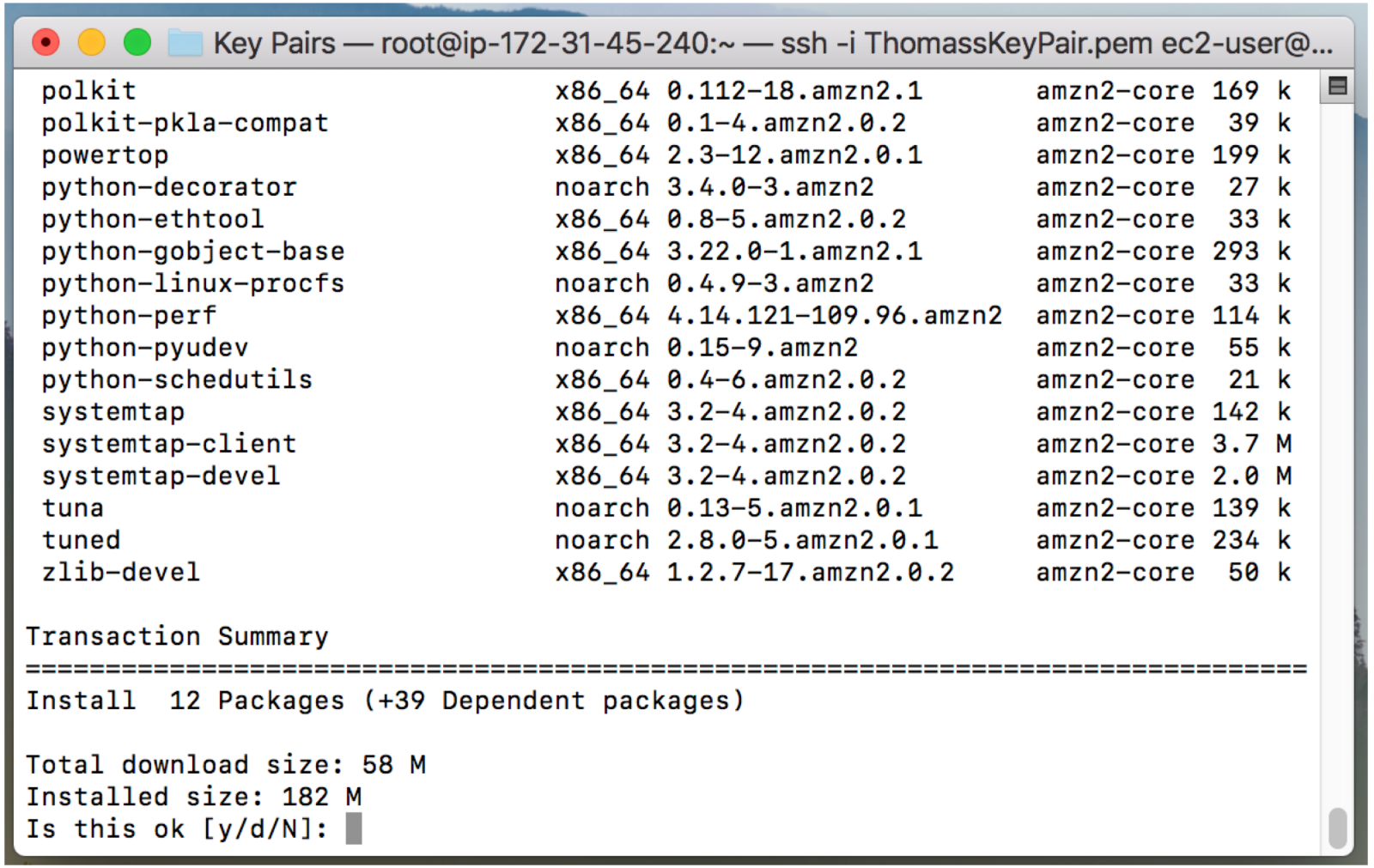
Tuned is a daemon that uses `udev` to monitor connected devices and statically and dynamically tunes system settings according to a selected profile. **Tuned** is distributed with a number of predefined profiles for common use cases like high throughput, low latency, or powersave. It is possible to modify the rules defined for each profile and customize how to tune a particular device. To revert all changes made to the system settings by a certain profile, you can either switch to another profile or deactivate the **tuned** service.

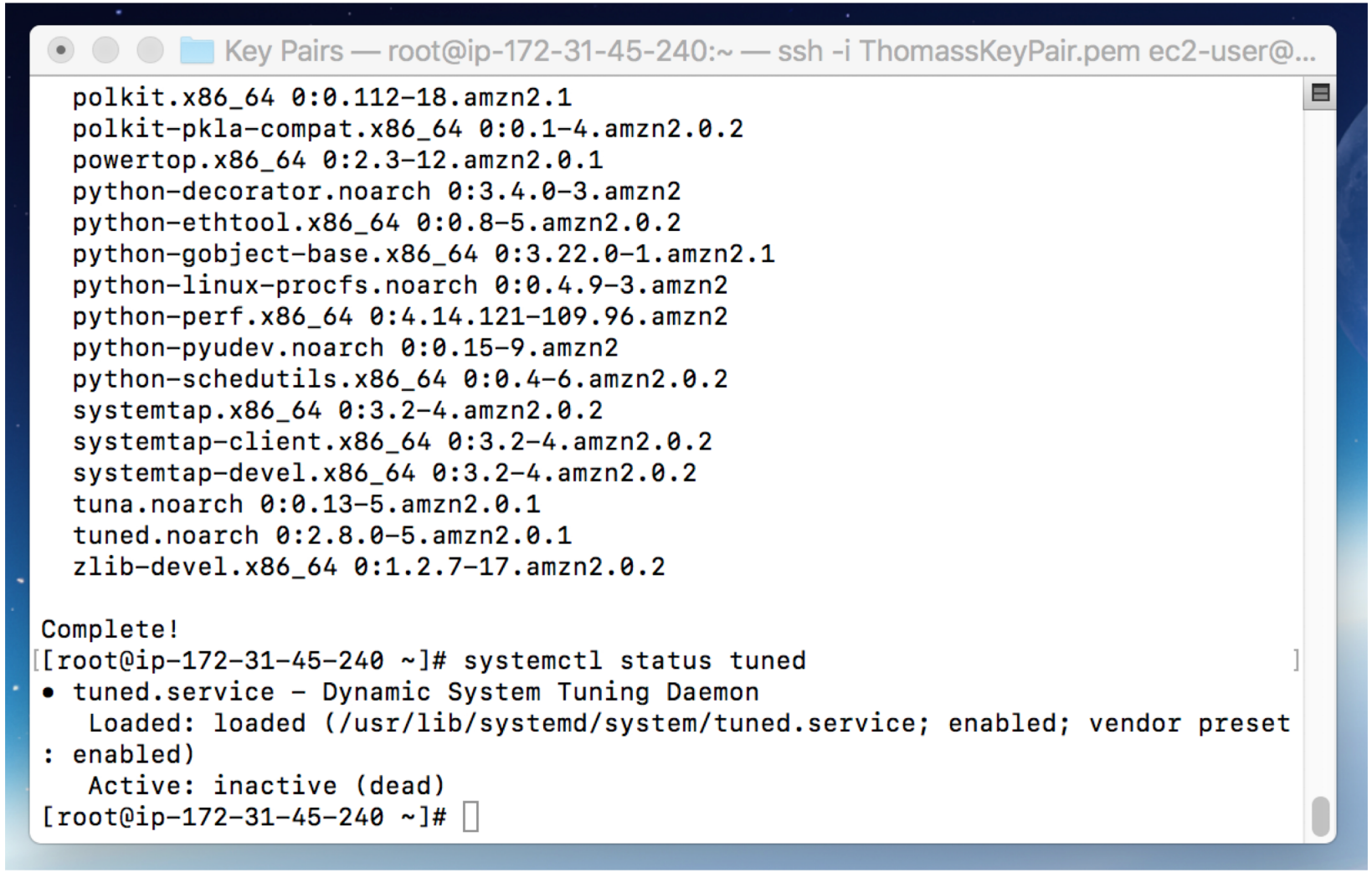
https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/performance_tuning_guide/chap-red_hat_enterprise_linux-performance_tuning_guide-tuned#ch-Tuned-overview


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# yum list tuned*
Loaded plugins: extras_suggestions, langpacks, priorities, update-motd
Available Packages
tuned.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-gtk.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-atomic.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-compat.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-cpu-partitioning.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-nfv.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-nfv-guest.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-nfv-host.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-oracle.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-realtime.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-sap.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-profiles-sap-hana.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-utils.noarch 2.8.0-5.amzn2.0.1 amzn2-core
tuned-utils-systemtap.noarch 2.8.0-5.amzn2.0.1 amzn2-core
[root@ip-172-31-45-240 ~]#


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
Installing:
tuned noarch 2.8.0-5.amzn2.0.1 amzn2-core 234 k
Installing for dependencies:
dbus-glib x86_64 0.100-7.2.amzn2 amzn2-core 103 k
dbus-python x86_64 1.1.1-9.amzn2.0.2 amzn2-core 206 k
gobject-introspection x86_64 1.50.0-1.amzn2.0.2 amzn2-core 239 k
mozjs17 x86_64 17.0.0-20.amzn2.0.1 amzn2-core 1.4 M
polkit x86_64 0.112-18.amzn2.1 amzn2-core 169 k
polkit-pkla-compat x86_64 0.1-4.amzn2.0.2 amzn2-core 39 k
python-decorator noarch 3.4.0-3.amzn2 amzn2-core 27 k
python-gobject-base x86_64 3.22.0-1.amzn2.1 amzn2-core 293 k
python-linux-procfs noarch 0.4.9-3.amzn2 amzn2-core 33 k
python-perf x86_64 4.14.121-109.96.amzn2 amzn2-core 114 k
python-pyudev noarch 0.15-9.amzn2 amzn2-core 55 k
python-schedutils x86_64 0.4-6.amzn2.0.2 amzn2-core 21 k
Transaction Summary
Install 1 Package (+12 Dependent packages)
Total download size: 2.9 M
Installed size: 8.9 M
Is this ok [y/d/N]:


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# yum install tuned-profiles* tuned-utils*


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
polkit x86_64 0.112-18.amzn2.1 amzn2-core 169 k
polkit-pkla-compat x86_64 0.1-4.amzn2.0.2 amzn2-core 39 k
powertop x86_64 2.3-12.amzn2.0.1 amzn2-core 199 k
python-decorator noarch 3.4.0-3.amzn2 amzn2-core 27 k
python-ethtool x86_64 0.8-5.amzn2.0.2 amzn2-core 33 k
python-gobject-base x86_64 3.22.0-1.amzn2.1 amzn2-core 293 k
python-linux-procfs noarch 0.4.9-3.amzn2 amzn2-core 33 k
python-perf x86_64 4.14.121-109.96.amzn2 amzn2-core 114 k
python-pyudev noarch 0.15-9.amzn2 amzn2-core 55 k
python-schedutils x86_64 0.4-6.amzn2.0.2 amzn2-core 21 k
systemtap x86_64 3.2-4.amzn2.0.2 amzn2-core 142 k
systemtap-client x86_64 3.2-4.amzn2.0.2 amzn2-core 3.7 M
systemtap-devel x86_64 3.2-4.amzn2.0.2 amzn2-core 2.0 M
tuna noarch 0.13-5.amzn2.0.1 amzn2-core 139 k
tuned noarch 2.8.0-5.amzn2.0.1 amzn2-core 234 k
zlib-devel x86_64 1.2.7-17.amzn2.0.2 amzn2-core 50 k
Transaction Summary
Install 12 Packages (+39 Dependent packages)
Total download size: 58 M
Installed size: 182 M
Is this ok [y/d/N]:


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
polkit.x86_64 0:0.112-18.amzn2.1
polkit-pkla-compat.x86_64 0:0.1-4.amzn2.0.2
powertop.x86_64 0:2.3-12.amzn2.0.1
python-decorator.noarch 0:3.4.0-3.amzn2
python-ethtool.x86_64 0:0.8-5.amzn2.0.2
python-gobject-base.x86_64 0:3.22.0-1.amzn2.1
python-linux-procfs.noarch 0:0.4.9-3.amzn2
python-perf.x86_64 0:4.14.121-109.96.amzn2
python-pyudev.noarch 0:0.15-9.amzn2
python-schedutils.x86_64 0:0.4-6.amzn2.0.2
systemtap.x86_64 0:3.2-4.amzn2.0.2
systemtap-client.x86_64 0:3.2-4.amzn2.0.2
systemtap-devel.x86_64 0:3.2-4.amzn2.0.2
tuna.noarch 0:0.13-5.amzn2.0.1
tuned.noarch 0:2.8.0-5.amzn2.0.1
zlib-devel.x86_64 0:1.2.7-17.amzn2.0.2
Complete!
[root@ip-172-31-45-240 ~]# systemctl status tuned
• tuned.service - Dynamic System Tuning Daemon
Loaded: loaded (/usr/lib/systemd/system/tuned.service; enabled; vendor preset
: enabled)
Active: inactive (dead)
[root@ip-172-31-45-240 ~]#

Tools for tuning

- Let's see what the system looks like before any changes

Tools for tuning

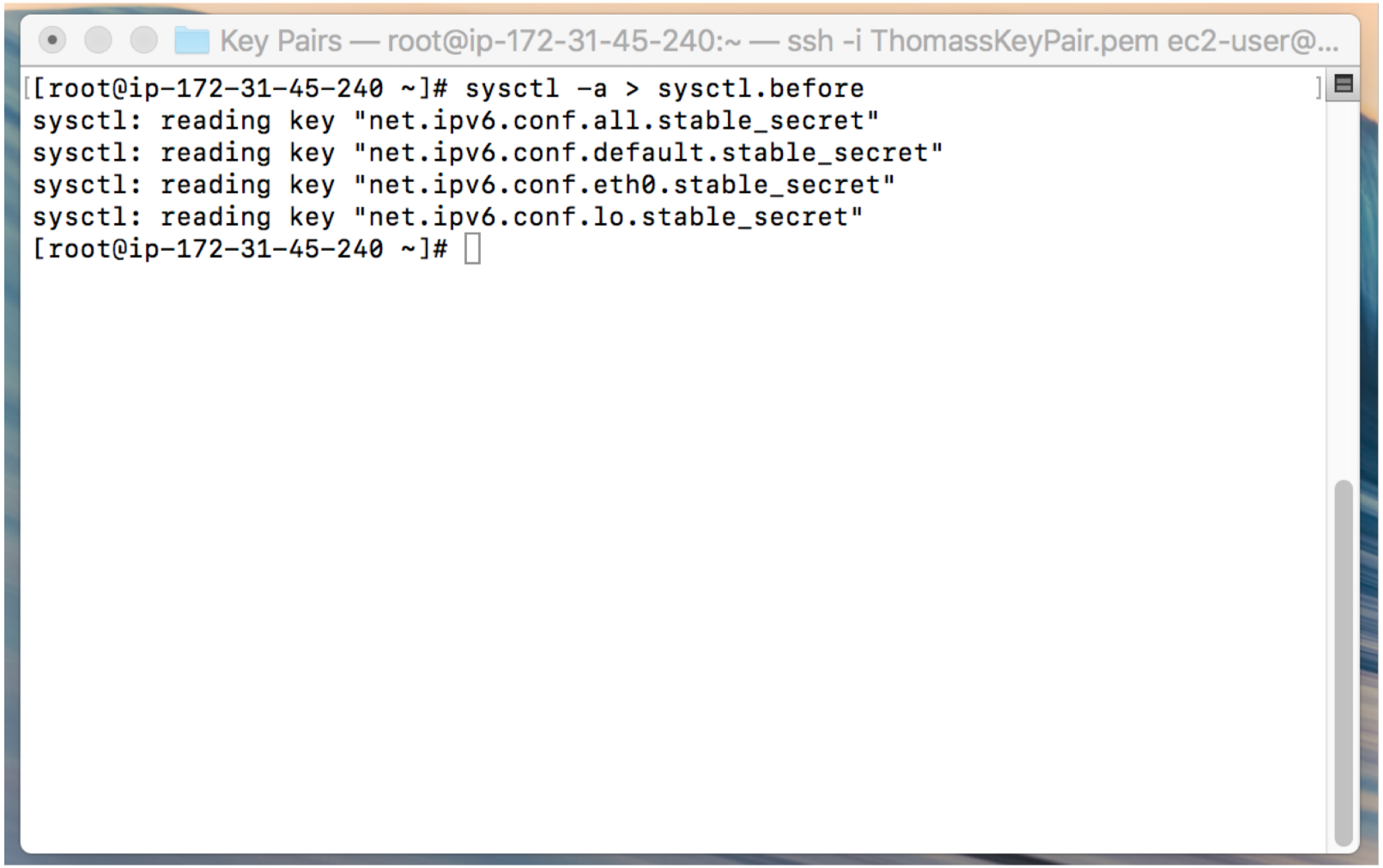
- Let's see what the system looks like before any changes
- We're going to see what the kernel runtime parameters are without tuned

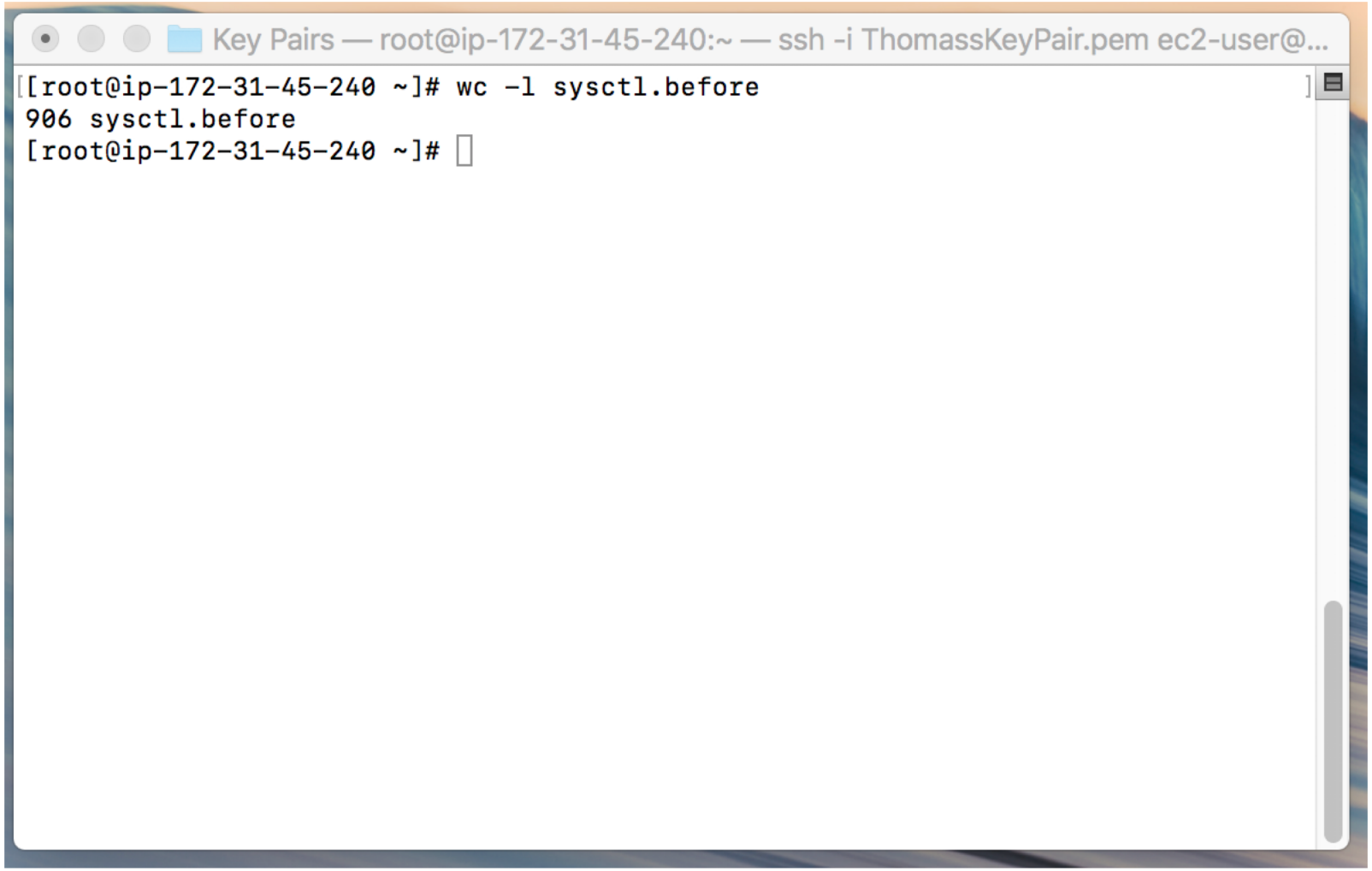
Tools for tuning

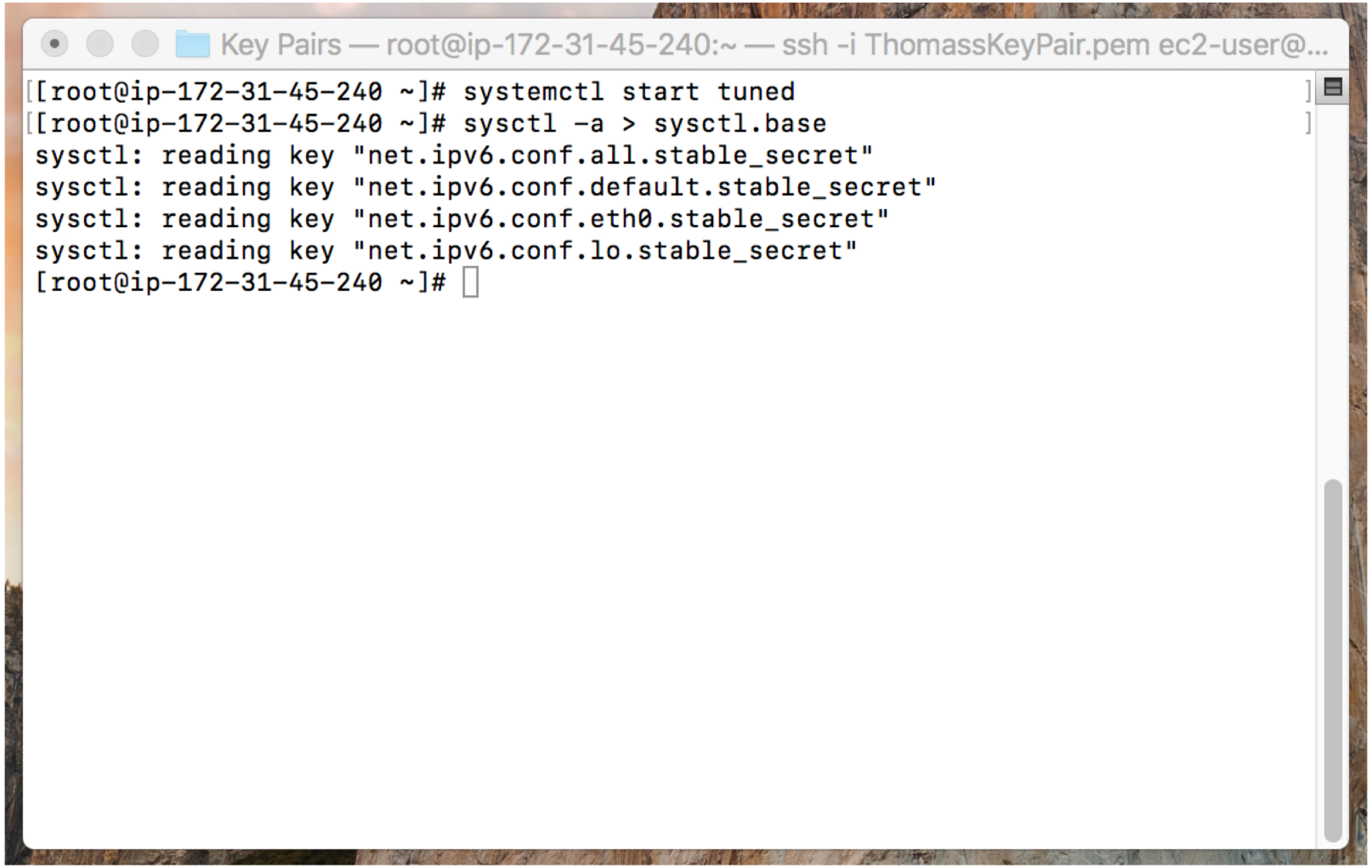
- Let's see what the system looks like before any changes
- We're going to see what the kernel runtime parameters are without tuned
- Then we'll see the base configuration

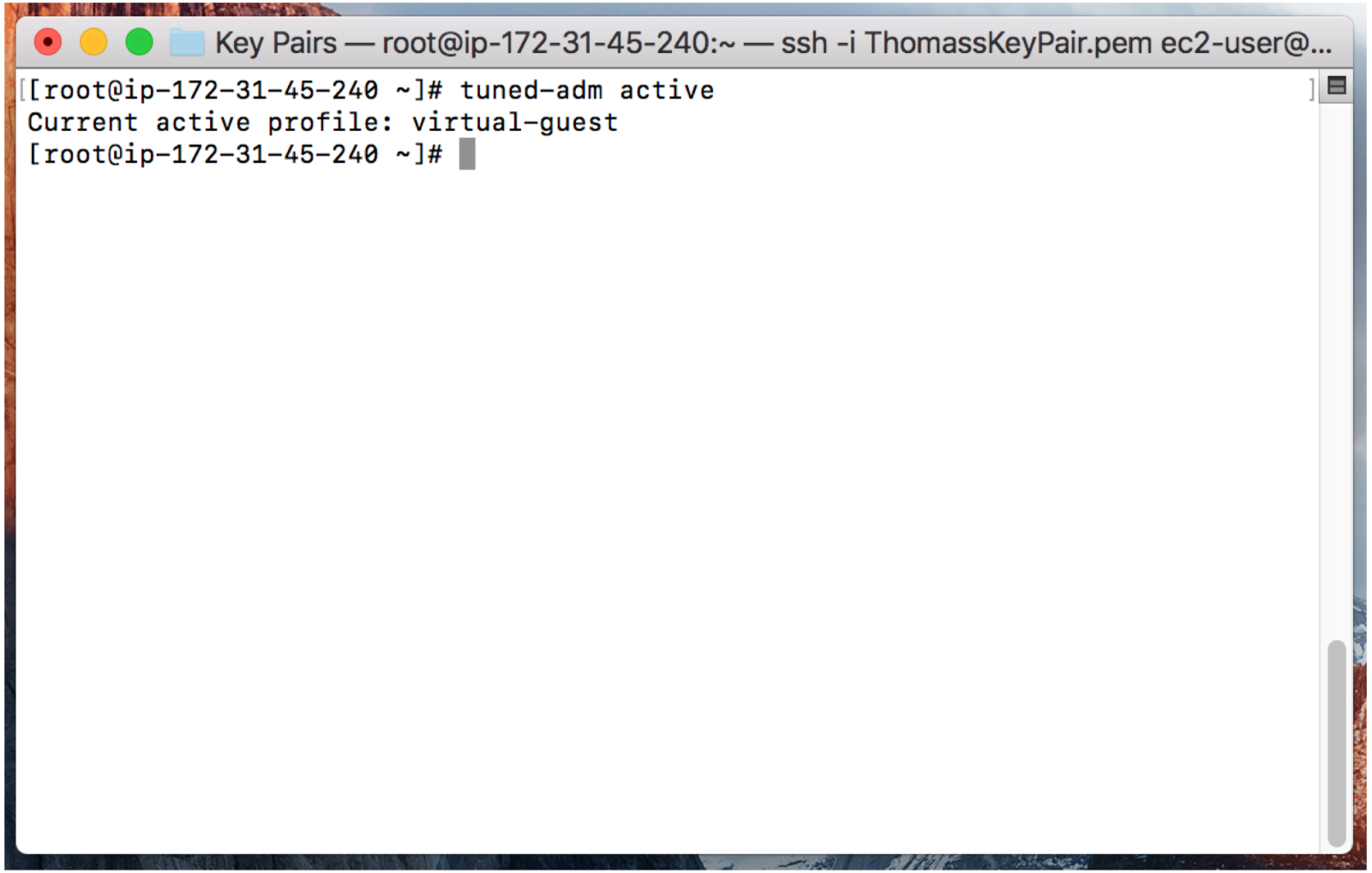
Tools for tuning

- Let's see what the system looks like before any changes
- We're going to see what the kernel runtime parameters are without tuned
- Then we'll see the base configuration
- Then we'll try different profiles


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# sysctl -a > sysctl.before
sysctl: reading key "net.ipv6.conf.all.stable_secret"
sysctl: reading key "net.ipv6.conf.default.stable_secret"
sysctl: reading key "net.ipv6.conf.eth0.stable_secret"
sysctl: reading key "net.ipv6.conf.lo.stable_secret"
[root@ip-172-31-45-240 ~]#

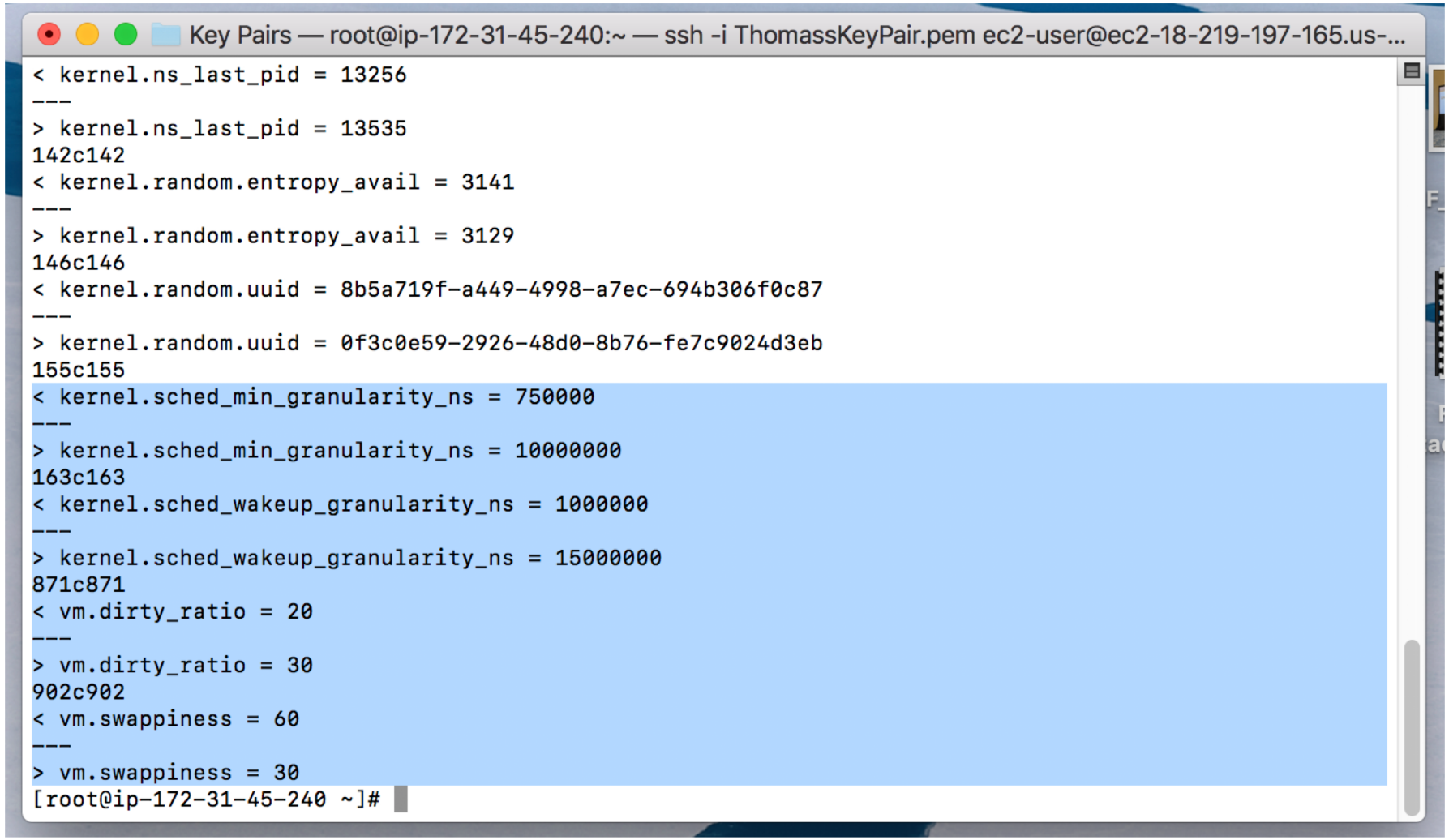

Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# wc -l sysctl.before
906 sysctl.before
[root@ip-172-31-45-240 ~]#


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# systemctl start tuned
[root@ip-172-31-45-240 ~]# sysctl -a > sysctl.base
sysctl: reading key "net.ipv6.conf.all.stable_secret"
sysctl: reading key "net.ipv6.conf.default.stable_secret"
sysctl: reading key "net.ipv6.conf.eth0.stable_secret"
sysctl: reading key "net.ipv6.conf.lo.stable_secret"
[root@ip-172-31-45-240 ~]#


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# tuned-adm active
Current active profile: virtual-guest
[root@ip-172-31-45-240 ~]#

Tools for tuning

- Diff the before and base


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@ec2-18-219-197-165.us-...
< kernel.ns_last_pid = 13256

> kernel.ns_last_pid = 13535
142c142
< kernel.random.entropy_avail = 3141

> kernel.random.entropy_avail = 3129
146c146
< kernel.random.uuid = 8b5a719f-a449-4998-a7ec-694b306f0c87

> kernel.random.uuid = 0f3c0e59-2926-48d0-8b76-fe7c9024d3eb
155c155
< kernel.sched_min_granularity_ns = 750000

> kernel.sched_min_granularity_ns = 10000000
163c163
< kernel.sched_wakeup_granularity_ns = 1000000

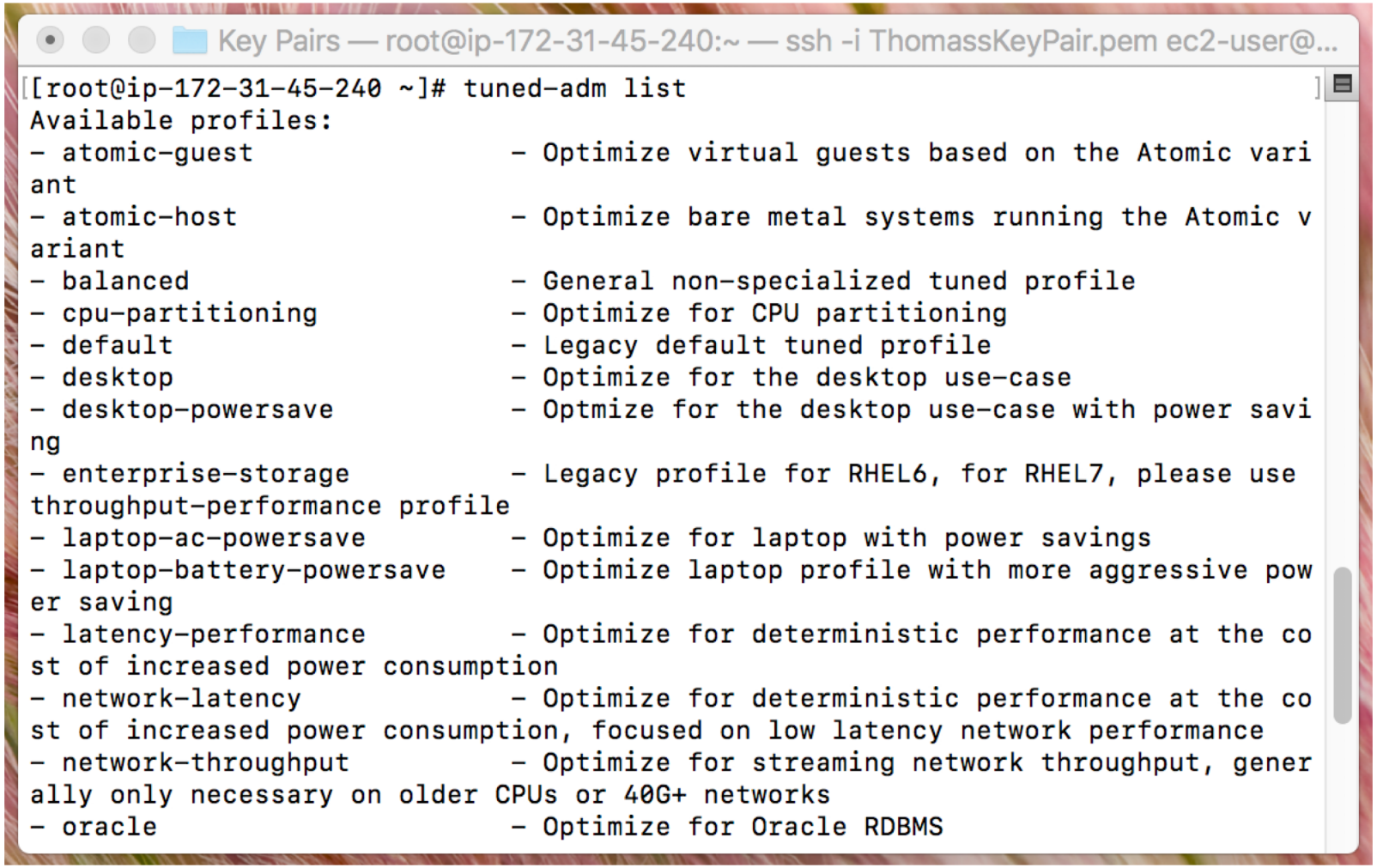
> kernel.sched_wakeup_granularity_ns = 15000000
871c871
< vm.dirty_ratio = 20

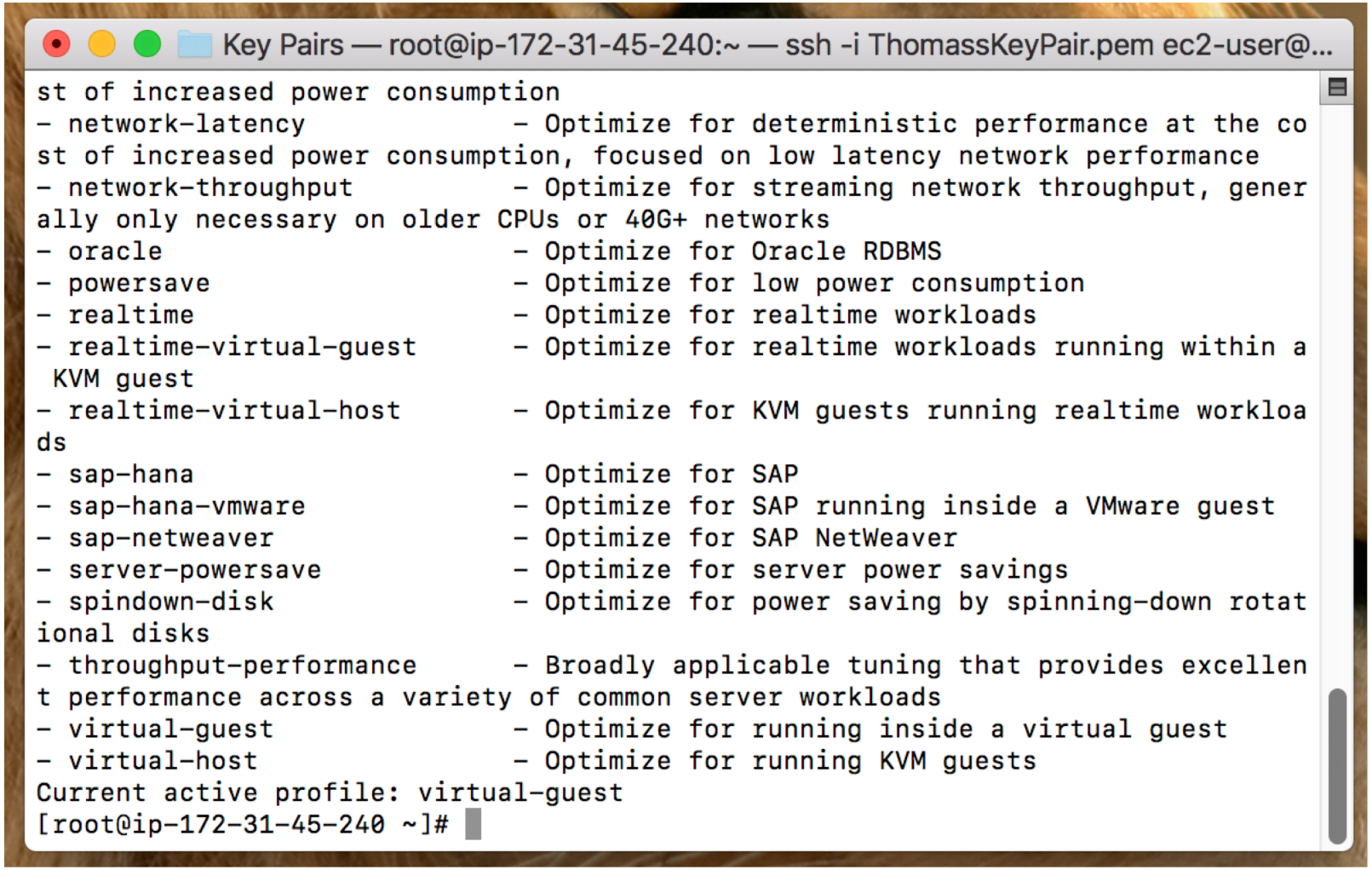
> vm.dirty_ratio = 30
902c902
< vm.swappiness = 60

> vm.swappiness = 30
[root@ip-172-31-45-240 ~]#

Tools for tuning

- What options do we have?


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# tuned-adm list
Available profiles:
- atomic-guest - Optimize virtual guests based on the Atomic variant
- atomic-host - Optimize bare metal systems running the Atomic variant
- balanced - General non-specialized tuned profile
- cpu-partitioning - Optimize for CPU partitioning
- default - Legacy default tuned profile
- desktop - Optimize for the desktop use-case
- desktop-powersave - Optmize for the desktop use-case with power saving
- enterprise-storage - Legacy profile for RHEL6, for RHEL7, please use throughput-performance profile
- laptop-ac-powersave - Optimize for laptop with power savings
- laptop-battery-powersave - Optimize laptop profile with more aggressive power saving
- latency-performance - Optimize for deterministic performance at the cost of increased power consumption
- network-latency - Optimize for deterministic performance at the cost of increased power consumption, focused on low latency network performance
- network-throughput - Optimize for streaming network throughput, generally only necessary on older CPUs or 40G+ networks
- oracle - Optimize for Oracle RDBMS


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
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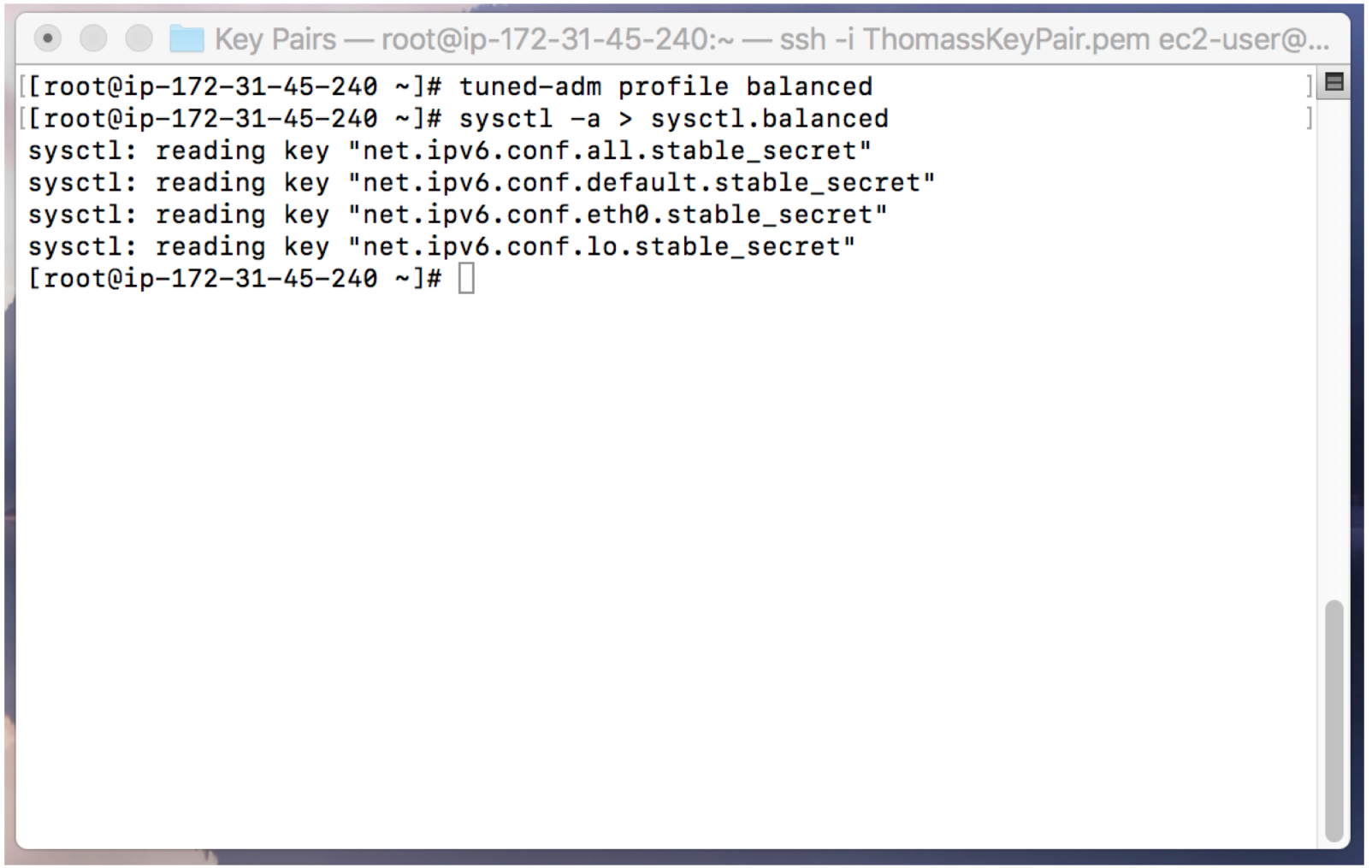
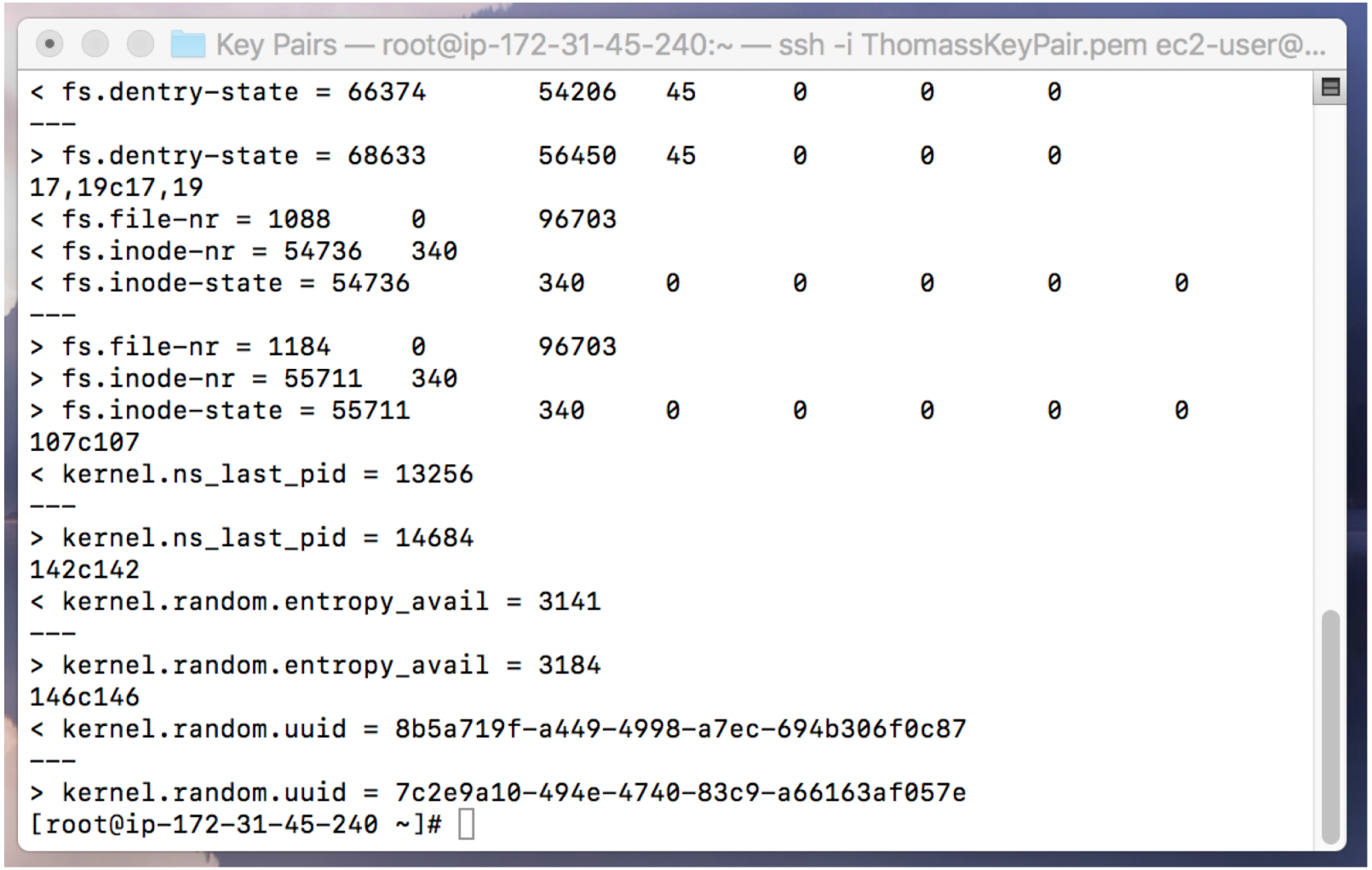
- network-throughput - Optimize for streaming network throughput, gener
ally only necessary on older CPUs or 40G+ networks
- oracle - Optimize for Oracle RDBMS
- powersave - Optimize for low power consumption
- realtime - Optimize for realtime workloads
- realtime-virtual-guest - Optimize for realtime workloads running within a
KVM guest
- realtime-virtual-host - Optimize for KVM guests running realtime workloa
ds
- sap-hana - Optimize for SAP
- sap-hana-vmware - Optimize for SAP running inside a VMware guest
- sap-netweaver - Optimize for SAP NetWeaver
- server-powersave - Optimize for server power savings
- spindown-disk - Optimize for power saving by spinning-down rotat
ional disks
- throughput-performance - Broadly applicable tuning that provides excellen
t performance across a variety of common server workloads
- virtual-guest - Optimize for running inside a virtual guest
- virtual-host - Optimize for running KVM guests
Current active profile: virtual-guest
[root@ip-172-31-45-240 ~]#

Tools for tuning

- Let's play around a bit!


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
[root@ip-172-31-45-240 ~]# tuned-adm profile balanced
[root@ip-172-31-45-240 ~]# sysctl -a > sysctl.balanced
sysctl: reading key "net.ipv6.conf.all.stable_secret"
sysctl: reading key "net.ipv6.conf.default.stable_secret"
sysctl: reading key "net.ipv6.conf.eth0.stable_secret"
sysctl: reading key "net.ipv6.conf.lo.stable_secret"
[root@ip-172-31-45-240 ~]#


Key Pairs — root@ip-172-31-45-240:~ — ssh -i ThomassKeyPair.pem ec2-user@...
< fs.dentry-state = 66374 54206 45 0 0 0

> fs.dentry-state = 68633 56450 45 0 0 0
17,19c17,19
< fs.file-nr = 1088 0 96703
< fs.inode-nr = 54736 340
< fs.inode-state = 54736 340 0 0 0 0 0

> fs.file-nr = 1184 0 96703
> fs.inode-nr = 55711 340
> fs.inode-state = 55711 340 0 0 0 0 0
107c107
< kernel.ns_last_pid = 13256

> kernel.ns_last_pid = 14684
142c142
< kernel.random.entropy_avail = 3141

> kernel.random.entropy_avail = 3184
146c146
< kernel.random.uuid = 8b5a719f-a449-4998-a7ec-694b306f0c87

> kernel.random.uuid = 7c2e9a10-494e-4740-83c9-a66163af057e
[root@ip-172-31-45-240 ~]#

Tools for tuning

- Why do you suppose nothing changed in sysctl?

Tools for tuning

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- It may have changed the I/O scheduler, CPU frequency, etc.

Tools for tuning

- Why do you suppose nothing changed in sysctl?
- It may have changed the I/O scheduler, CPU frequency, etc.
- Since this is a cloud instance, some of the changes are not available

Conclusion

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- We've really only scratched the surface of tuning
- We can tune networking, file services, and so on
- But you should have a basic understanding of what and how you can inspect and change things on Linux

THANK YOU!

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Questions?

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