Outline

- Popular Linux Distributions
- RedHat and RedHat clones
- Environment Modules
- Compilers
- Essential Linux commands
- A note on “randomness”
- Lightweight Kernels
Popular Linux Distributions

This list is by no means complete

- RedHat
- Fedora
- Scientific Linux
- CentOS
- SuSE/SLES
- OpenSuSE
- Debian
- Ubuntu
- Gentoo
RedHat and RedHat clones:
You can never have too much of a good thing!

<table>
<thead>
<tr>
<th>Package Manager:</th>
<th>RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package Format:</td>
<td>RPM</td>
</tr>
</tbody>
</table>

What *ARE* CentOS, Scientific Linux, and Fedora?
When to pick RedHat over one of its clones:

Pick RedHat when you have:

▶ Plenty of budget for the licenses
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- Pick Fedora if you want the latest in the RedHat world
- Pick CentOS if you want a (free!) rebuild of RHEL
- Pick Scientific Linux if you want a (free!) rebuild of RHEL with a bit of a "scientific computing" bent to it.
- Pick any to be simpler to maintain than official RedHat IMHO :P
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When to pick SuSE Enterprise Server:

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Other Popular Linux Distributions

- Debian Gnu/Linux – A very conservative stability oriented distribution. Installing and upgrading packages is simple, but graphical tools are lacking.
- Ubuntu Linux – Based on Debian. Timely releases. Focus on a nice user desktop. “Meant to compliment Debian”.
- Gentoo Linux – Portage system inspired by FreeBSD Ports Tree. Pretty much the entire system is compiled (on your system) to be optimized for your hardware.
Environment Modules

*Environment Modules* provide a convenient, consistent way to modify a user’s environment to enable the usage of a library, application, or piece of documentation. Modules can:

- Set/Unset environment variables
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- Add-to/Remove from PATHs & MANPATHs, etc.
- be loaded and *unloaded* dynamically
- be used to manage different versions of software
- be bundled into “meta-modules” to load complex sets of software
- be used by all popular shells: bash, ksh, zsh, sh, csh, tcsh, as well as some scripting languages such as perl
Using Environment Modules

First, we’ll load the module for GCC 3.4.6:

```
$ module load gcc/3.4.6
$ which gcc
/opt/gcc-3.4.6/bin/gcc
```

Now, we’ll switch to the module for GCC 4.1.2:

```
$ module load gcc/4.1.2
$ which gcc
/usr/bin/gcc
```

Now, we’ll unload the module:

```
$ module unload gcc
$ which gcc
gcc not found
```
## Popular Compilers & Languages

<table>
<thead>
<tr>
<th>Compiler Vendor</th>
<th>Language(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCC</td>
<td>C, C++, Objective-C, Fortran, Java, Ada</td>
</tr>
<tr>
<td>INTEL</td>
<td>C, C++, Fortran</td>
</tr>
<tr>
<td>Portland Group (PGI)</td>
<td>C, C++, Fortran</td>
</tr>
<tr>
<td>PathScale</td>
<td>C, C++, Fortran</td>
</tr>
<tr>
<td>IBM XLC</td>
<td>C, C++, Fortran</td>
</tr>
<tr>
<td>IBM XLF</td>
<td>Fortran</td>
</tr>
<tr>
<td>NAG</td>
<td>Fortran</td>
</tr>
</tbody>
</table>
### Popular Compilers & Supported Processors

<table>
<thead>
<tr>
<th>Compiler Vendor</th>
<th>Processor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCC</td>
<td>... A lot ...</td>
</tr>
<tr>
<td>INTEL</td>
<td>INTEL</td>
</tr>
<tr>
<td>Portland Group (PGI)</td>
<td>x86, x86-64</td>
</tr>
<tr>
<td>PathScale</td>
<td>x86, x86-64, AMD64, EM64T</td>
</tr>
<tr>
<td>IBM XLC</td>
<td>Power Series, (Incl. PPC)</td>
</tr>
<tr>
<td>IBM XLF</td>
<td>Power Series, (Incl. PPC)</td>
</tr>
<tr>
<td>NAG</td>
<td>Several</td>
</tr>
</tbody>
</table>
## Popular Compilers Advantages

<table>
<thead>
<tr>
<th>Compiler Vendor</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCC</td>
<td>Many platforms, No cost</td>
</tr>
<tr>
<td>INTEL</td>
<td>Heavily Optimized for INTEL Hardware</td>
</tr>
<tr>
<td>Portland Group (PGI)</td>
<td>Good x86, x86-64 performance</td>
</tr>
<tr>
<td>PathScale</td>
<td>Good 64 bit performance</td>
</tr>
<tr>
<td>IBM XLC</td>
<td>Heavily Optimized on Power processors</td>
</tr>
<tr>
<td>IBM XLF</td>
<td>Heavily Optimized on Power processors</td>
</tr>
<tr>
<td>NAG</td>
<td>Great for debugging!</td>
</tr>
</tbody>
</table>
Essential Linux commands

- top(1)
- ps(1)
- lsof(8)
- kill(1)
- df(1)
### top output

```
top - 11:28:13 up 15 days, 1:47, 1 user, load average: 4.01, 4.01, 4.00
Tasks: 85 total, 5 running, 80 sleeping, 0 stopped, 0 zombie
Cpu(s): 100.0%us, 0.0%sy, 0.0%ni, 0.0%id, 0.0%wa, 0.0%hi, 0.0%si, 0.0%st
Mem: 8308224k total, 6491856k used, 1816368k free, 48616k buffers
Swap: 2104472k total, 0k used, 2104472k free, 6225268k cached

<table>
<thead>
<tr>
<th>PID</th>
<th>USER</th>
<th>PR</th>
<th>NI</th>
<th>VIRT</th>
<th>RES</th>
<th>SHR</th>
<th>S</th>
<th>%CPU</th>
<th>%MEM</th>
<th>TIME+</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>20375</td>
<td>dgxu</td>
<td>25</td>
<td>0</td>
<td>469m</td>
<td>21m</td>
<td>2036</td>
<td>R</td>
<td>100</td>
<td>0.3</td>
<td>837:48.90</td>
<td>c32a2.exe</td>
</tr>
<tr>
<td>20376</td>
<td>dgxu</td>
<td>25</td>
<td>0</td>
<td>469m</td>
<td>21m</td>
<td>2036</td>
<td>R</td>
<td>100</td>
<td>0.3</td>
<td>837:48.95</td>
<td>c32a2.exe</td>
</tr>
<tr>
<td>20377</td>
<td>dgxu</td>
<td>25</td>
<td>0</td>
<td>469m</td>
<td>21m</td>
<td>2036</td>
<td>R</td>
<td>100</td>
<td>0.3</td>
<td>837:37.18</td>
<td>c32a2.exe</td>
</tr>
<tr>
<td>20378</td>
<td>dgxu</td>
<td>25</td>
<td>0</td>
<td>469m</td>
<td>21m</td>
<td>2036</td>
<td>R</td>
<td>100</td>
<td>0.3</td>
<td>837:48.37</td>
<td>c32a2.exe</td>
</tr>
<tr>
<td>1</td>
<td>root</td>
<td>16</td>
<td>0</td>
<td>720</td>
<td>280</td>
<td>244</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:02.45</td>
<td>init</td>
</tr>
<tr>
<td>2</td>
<td>root</td>
<td>RT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.04</td>
<td>migration/0</td>
</tr>
<tr>
<td>3</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>ksoftirqd/0</td>
</tr>
<tr>
<td>4</td>
<td>root</td>
<td>RT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>migration/1</td>
</tr>
<tr>
<td>5</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>ksoftirqd/1</td>
</tr>
<tr>
<td>6</td>
<td>root</td>
<td>RT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>migration/2</td>
</tr>
<tr>
<td>7</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>ksoftirqd/2</td>
</tr>
<tr>
<td>8</td>
<td>root</td>
<td>RT</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>migration/3</td>
</tr>
<tr>
<td>9</td>
<td>root</td>
<td>34</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>ksoftirqd/3</td>
</tr>
<tr>
<td>10</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.12</td>
<td>events/0</td>
</tr>
<tr>
<td>11</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>events/1</td>
</tr>
<tr>
<td>12</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.00</td>
<td>events/2</td>
</tr>
<tr>
<td>13</td>
<td>root</td>
<td>10</td>
<td>-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>S</td>
<td>0</td>
<td>0.0</td>
<td>0:00.08</td>
<td>events/3</td>
</tr>
</tbody>
</table>
```
download@nano31:~$ ps auxwww | grep -v root | grep -v download

USER  PID  %CPU  %MEM  VSZ   RSS  TTY  STAT   START       TIME   COMMAND
100   2599  0.0   0.0   3416  988   ?   Ss   Sep17  0:01     /usr/bin/dbus-daemon --system
nobody 3157  0.0   0.0   1556  424   ?   Ss   Sep17  0:00     /sbin/portmap
daemon 3269  0.0   0.0   3252  916   ?   Ss   Sep17  0:00     /usr/sbin/slpd
ntp   3975  0.0   0.0   4164  4164   ?   SLs  Sep17  0:00     /usr/sbin/ntpd -p /var/lib/ntp/var/run/ntpd.pid -u ntp -i /var/lib/ntp
postfix 4118  0.0   0.0   5412  1672   ?   S    Sep17  0:00     qmgr -l -t fifo -u

dgxu 20279  0.0   0.0   4832  2004   ?   Ss   Oct01  0:00     -csh
dgxu 20331  0.0   0.0   1844  612   ?    S   Oct01  0:00     pbs_demux
dgxu 20370  0.0   0.0   4372  1664   ?    S   Oct01  0:00     /usr/bin/csh /var/spool/torque/mom_priv/jobs/31808.nano..SC

dgxu 20375  99.9  0.2  480564  21920   ?   R    Oct01  946:34     c32a2.exe
dgxu 20376  99.9  0.2  480576  21940   ?   R    Oct01  946:34     c32a2.exe
dgxu 20377  99.9  0.2  480576  21940   ?   R    Oct01  946:22     c32a2.exe
dgxu 20378  99.9  0.2  480568  21940   ?   R    Oct01  946:31     c32a2.exe
postfix 21805  0.0   0.0   5376  1644   ?   S    13:03  0:00     pickup -l -t fifo -u
ls/of lists open files

- Currently open files
**lsof lists open files**

- **Currently open files**
lsop lists open files

- Currently open files
- Open Network connections — -i
Is/of lists open files

- Currently open files
- Open Network connections — `-i`
- Open files in a given directory — `+d <directory>`
Isof lists open files

- Currently open files
- Open Network connections — `-i`
- Open files in a given directory — `+d <directory>`
- Open NFS files — `-N`
ls/of lists open files

- Currently open files
- Open Network connections — -i
- Open files in a given directory — +d <directory>
- Open NFS files — -N
- Unix Domain Sockets (used for IPC, etc.) — -U
Isoc lists open files

- Currently open files
- Open Network connections — -i
- Open files in a given directory — +d <directory>
- Open NFS files — -N
- Unix Domain Sockets (used for IPC, etc.) — -U
- a bunch of other options... RTFM!
Without any arguments, 
`lsof` lists all open files on the system

```
Command PID USER FD Type Device Size Node Name
init 1 root cwd DIR 8,2 696 2 /
init 1 root rtd DIR 8,2 696 2 /
init 1 root txt REG 8,2 517716 31071 /sbin/init
init 1 root mem REG 0,0 0 [heap] (stat: No such file or directory)
migration 2 root cwd DIR 8,2 696 2 /
migration 2 root rtd DIR 8,2 696 2 /
migration 2 root txt unknown /proc/2/exe
ksoftirqd 3 root cwd DIR 8,2 696 2 /
ksoftirqd 3 root rtd DIR 8,2 696 2 /
ksoftirqd 3 root txt unknown /proc/3/exe
migration 4 root cwd DIR 8,2 696 2 /
migration 4 root rtd DIR 8,2 696 2 /
migration 4 root txt unknown /proc/4/exe
ksoftirqd 5 root cwd DIR 8,2 696 2 /
ksoftirqd 5 root rtd DIR 8,2 696 2 /
ksoftirqd 5 root txt unknown /proc/5/exe
migration 6 root cwd DIR 8,2 696 2 /
migration 6 root rtd DIR 8,2 696 2 /
migration 6 root txt unknown /proc/6/exe
ksoftirqd 7 root cwd DIR 8,2 696 2 /
ksoftirqd 7 root rtd DIR 8,2 696 2 /
ksoftirqd 7 root txt unknown /proc/7/exe
migration 8 root cwd DIR 8,2 696 2 /
```

```
## lsof -i output

Have lsof list open Network “files”

```
nano:~ # lsof -i | head -25

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PID</th>
<th>USER</th>
<th>FD</th>
<th>TYPE</th>
<th>DEVICE</th>
<th>SIZE</th>
<th>NODE</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>ipmitool</td>
<td>1092</td>
<td>root</td>
<td>4u</td>
<td>IPv4</td>
<td>936203</td>
<td>UDP</td>
<td>nano.nano.alliance.unm.edu:10422-&gt;nano16-admin.nano.alliance.unm.edu:asf-rmcp</td>
<td></td>
</tr>
<tr>
<td>ipmitool</td>
<td>1689</td>
<td>root</td>
<td>4u</td>
<td>IPv4</td>
<td>838800</td>
<td>UDP</td>
<td>nano.nano.alliance.unm.edu:4625-&gt;nano04-admin.nano.alliance.unm.edu:asf-rmcp</td>
<td></td>
</tr>
<tr>
<td>conserver</td>
<td>2786</td>
<td>root</td>
<td>3u</td>
<td>IPv4</td>
<td>7037</td>
<td>TCP</td>
<td>*:console (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>conserver</td>
<td>2790</td>
<td>root</td>
<td>3u</td>
<td>IPv4</td>
<td>6386</td>
<td>TCP</td>
<td>*:47546 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>maui</td>
<td>2825</td>
<td>root</td>
<td>5u</td>
<td>IPv4</td>
<td>6531</td>
<td>TCP</td>
<td>*:42559 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>maui</td>
<td>2825</td>
<td>root</td>
<td>6u</td>
<td>IPv4</td>
<td>6532</td>
<td>TCP</td>
<td>*:42560 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>maui</td>
<td>2825</td>
<td>root</td>
<td>7u</td>
<td>IPv4</td>
<td>22318441</td>
<td>TCP</td>
<td>nano.nano.alliance.unm.edu:28955-&gt;nano.nano.alliance.unm.edu:pbs</td>
<td></td>
</tr>
<tr>
<td>maui</td>
<td>2825</td>
<td>root</td>
<td>8u</td>
<td>IPv4</td>
<td>22318455</td>
<td>TCP</td>
<td>*:pbs_sched (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>conserver</td>
<td>2833</td>
<td>root</td>
<td>3u</td>
<td>IPv4</td>
<td>6530</td>
<td>TCP</td>
<td>*:47591 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>ipmitool</td>
<td>3425</td>
<td>root</td>
<td>4u</td>
<td>IPv4</td>
<td>943140</td>
<td>TCP</td>
<td>nano.nano.alliance.unm.edu:11023-&gt;nano17-admin.nano.alliance.unm.edu:asf-rmcp</td>
<td></td>
</tr>
<tr>
<td>sshd</td>
<td>4231</td>
<td>root</td>
<td>3u</td>
<td>IPv6</td>
<td>594518</td>
<td>TCP</td>
<td>nano.alliance.unm.edu:ssh-&gt;ycg34884vig.dl.ac.uk:51452 (ESTABLISHED)</td>
<td></td>
</tr>
<tr>
<td>sshd</td>
<td>4233</td>
<td>gbassi</td>
<td>3u</td>
<td>IPv6</td>
<td>594518</td>
<td>TCP</td>
<td>nano.alliance.unm.edu:ssh-&gt;ycg34884vig.dl.ac.uk:51452 (ESTABLISHED)</td>
<td></td>
</tr>
<tr>
<td>lmgrd</td>
<td>4358</td>
<td>root</td>
<td>0u</td>
<td>IPv4</td>
<td>1250597</td>
<td>TCP</td>
<td>*:27000 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>lmgrd</td>
<td>4358</td>
<td>root</td>
<td>3u</td>
<td>IPv4</td>
<td>1250621</td>
<td>TCP</td>
<td>localhost:27000-&gt;localhost:12969 (ESTABLISHED)</td>
<td></td>
</tr>
<tr>
<td>atomist</td>
<td>4359</td>
<td>root</td>
<td>0u</td>
<td>IPv4</td>
<td>1250597</td>
<td>TCP</td>
<td>*:27000 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>atomist</td>
<td>4359</td>
<td>root</td>
<td>3u</td>
<td>IPv4</td>
<td>1250600</td>
<td>TCP</td>
<td>*:18965 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>atomist</td>
<td>4359</td>
<td>root</td>
<td>5u</td>
<td>IPv4</td>
<td>1250620</td>
<td>TCP</td>
<td>localhost:12969-&gt;localhost:27000 (ESTABLISHED)</td>
<td></td>
</tr>
<tr>
<td>atomist</td>
<td>4359</td>
<td>root</td>
<td>16u</td>
<td>IPv4</td>
<td>2561344</td>
<td>TCP</td>
<td>nano.nano.alliance.unm.edu:18965-&gt;nano.nano.alliance.unm.edu:pbs_sched (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>ipmitool</td>
<td>4985</td>
<td>root</td>
<td>4u</td>
<td>IPv4</td>
<td>848505</td>
<td>UDP</td>
<td>nano.nano.alliance.unm.edu:5366-&gt;nano05-admin.nano.alliance.unm.edu:asf-rmcp</td>
<td></td>
</tr>
<tr>
<td>sshd</td>
<td>5331</td>
<td>root</td>
<td>3u</td>
<td>IPv6</td>
<td>1276944</td>
<td>TCP</td>
<td>nano.alliance.unm.edu:ssh-&gt;augerdata1.phys.unm.edu:7000 (ESTABLISHED)</td>
<td></td>
</tr>
<tr>
<td>sshd</td>
<td>5333</td>
<td>bbecker</td>
<td>3u</td>
<td>IPv6</td>
<td>1276944</td>
<td>TCP</td>
<td>nano.alliance.unm.edu:ssh-&gt;augerdata1.phys.unm.edu:7000 (ESTABLISHED)</td>
<td></td>
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<tr>
<td>sshd</td>
<td>5333</td>
<td>bbecker</td>
<td>7u</td>
<td>IPv4</td>
<td>1277133</td>
<td>TCP</td>
<td>localhost:6013 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>sshd</td>
<td>5333</td>
<td>bbecker</td>
<td>8u</td>
<td>IPv6</td>
<td>1277134</td>
<td>TCP</td>
<td>localhost:6013 (LISTEN)</td>
<td></td>
</tr>
<tr>
<td>ipmitool</td>
<td>5345</td>
<td>root</td>
<td>4u</td>
<td>IPv4</td>
<td>948946</td>
<td>UDP</td>
<td>nano.nano.alliance.unm.edu:11175-&gt;nano18-admin.nano.alliance.unm.edu:asf-rmcp</td>
<td></td>
</tr>
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</table>
```
### lsOf +d /tmp output

Have lsOf list open files in a directory

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<thead>
<tr>
<th>COMMAND</th>
<th>PID</th>
<th>USER</th>
<th>FD</th>
<th>TYPE</th>
<th>DEVICE</th>
<th>SIZE</th>
<th>NODE</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>gdm</td>
<td>12029</td>
<td>root</td>
<td>6u</td>
<td>unix</td>
<td>0xf4c8be40</td>
<td>48458</td>
<td>/tmp/.gdm_socket</td>
<td></td>
</tr>
<tr>
<td>bash</td>
<td>13447</td>
<td>download</td>
<td>cwd</td>
<td>DIR</td>
<td>8,2</td>
<td>72</td>
<td>942748</td>
<td>/tmp/foo</td>
</tr>
<tr>
<td>emacs</td>
<td>18184</td>
<td>download</td>
<td>cwd</td>
<td>DIR</td>
<td>8,2</td>
<td>72</td>
<td>942748</td>
<td>/tmp/foo</td>
</tr>
<tr>
<td>sbcl</td>
<td>18193</td>
<td>download</td>
<td>cwd</td>
<td>DIR</td>
<td>8,2</td>
<td>72</td>
<td>942748</td>
<td>/tmp/foo</td>
</tr>
</tbody>
</table>
### lsof -N output

Have lsof list open NFS files

```
nano:~ # lsof -N | head -25
```

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PID</th>
<th>USER</th>
<th>FD</th>
<th>TYPE</th>
<th>DEVICE</th>
<th>SIZE</th>
<th>NODE</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>tcsh</td>
<td>4235</td>
<td>gbassi</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td></td>
<td>/users/gbassi/CSR_NANO/300lambda (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>5335</td>
<td>bbecker</td>
<td>cwd</td>
<td>DIR</td>
<td>0,22</td>
<td>21408</td>
<td></td>
<td>/nano/scratch/bbecker/anisop/DATA_Box (nanoserv.nano.alliance.unm.edu:/raid)</td>
</tr>
<tr>
<td>tcsh</td>
<td>6028</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>tcsh</td>
<td>6129</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>sftp-serv</td>
<td>6151</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>tcsh</td>
<td>9405</td>
<td>gsmith</td>
<td>cwd</td>
<td>DIR</td>
<td>0,21</td>
<td>4096</td>
<td>89833556</td>
<td>/nfs/scratch/gsmith/blact/L3/dyn (serrano.alliance.unm.edu:/nfs)</td>
</tr>
<tr>
<td>tcsh</td>
<td>10241</td>
<td>erbb123</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>886392</td>
<td>/users/erbb123/SNL/R2LT/Run10 (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>15753</td>
<td>bbecker</td>
<td>cwd</td>
<td>DIR</td>
<td>0,22</td>
<td>21408</td>
<td>312134</td>
<td>/nano/scratch/bbecker/anisop/DATA_Box (nanoserv.nano.alliance.unm.edu:/raid)</td>
</tr>
<tr>
<td>vi</td>
<td>18238</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>vi</td>
<td>18238</td>
<td>dianah</td>
<td>4u</td>
<td>REG</td>
<td>0,19</td>
<td>16384</td>
<td>122110610</td>
<td>/users/dianah/.opt.out.swp (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>18501</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>bash</td>
<td>18665</td>
<td>download</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>8192</td>
<td>66322440</td>
<td>/users/download (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>18811</td>
<td>jsegroup</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>45105785</td>
<td>/users/jsegroup/tomas/compile (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>vnl</td>
<td>20496</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>vnl_exec</td>
<td>20498</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>vnl_exec</td>
<td>20498</td>
<td>dianah</td>
<td>5w</td>
<td>REG</td>
<td>0,19</td>
<td>121913498</td>
<td>/users/dianah/.vnl/vnl.log (serrano.alliance.unm.edu:/export)</td>
<td></td>
</tr>
<tr>
<td>vnl_exec</td>
<td>20498</td>
<td>dianah</td>
<td>9r</td>
<td>REG</td>
<td>0,19</td>
<td>79515</td>
<td>35423375</td>
<td>/users/dianah/.vnl/saves/2_0_1/1220647684.vnl (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>vnl_exec</td>
<td>20498</td>
<td>dianah</td>
<td>11r</td>
<td>REG</td>
<td>0,19</td>
<td>11026</td>
<td>122110623</td>
<td>/users/dianah/adal.vnl (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>27220</td>
<td>gsmith</td>
<td>cwd</td>
<td>DIR</td>
<td>0,21</td>
<td>4096</td>
<td>2113589</td>
<td>/nfs/scratch/gsmith/ospf/spvc_mml (serrano.alliance.unm.edu:/nfs)</td>
</tr>
<tr>
<td>tcsh</td>
<td>30608</td>
<td>dianah</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>35405932</td>
<td>/users/dianah (serrano.alliance.unm.edu:/export/home/alliance)</td>
</tr>
<tr>
<td>tcsh</td>
<td>30961</td>
<td>gsmith</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>50698</td>
<td>/users/gsmith (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>sftp-serv</td>
<td>30983</td>
<td>gsmith</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>50698</td>
<td>/users/gsmith (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>31521</td>
<td>bbecker</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>33210</td>
<td>/users/bbecker (serrano.alliance.unm.edu:/export)</td>
</tr>
<tr>
<td>tcsh</td>
<td>31685</td>
<td>bbecker</td>
<td>cwd</td>
<td>DIR</td>
<td>0,19</td>
<td>4096</td>
<td>33210</td>
<td>/users/bbecker (serrano.alliance.unm.edu:/export)</td>
</tr>
</tbody>
</table>
### lsof -U output

Have lsof list open UNIX domain sockets (used for IPC, etc.)

```
nano:~ # lsof -U | head -25

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>PID</th>
<th>USER</th>
<th>FD</th>
<th>TYPE</th>
<th>DEVICE</th>
<th>SIZE</th>
<th>NODE</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>udevd</td>
<td>1115</td>
<td>root</td>
<td>3u</td>
<td>unix</td>
<td>0xdff57c80</td>
<td>2704</td>
<td>socket</td>
<td></td>
</tr>
<tr>
<td>resmgrd</td>
<td>2766</td>
<td>root</td>
<td>3u</td>
<td>unix</td>
<td>0xdff57580</td>
<td>6309</td>
<td>/var/run/.resmgr_socket</td>
<td></td>
</tr>
<tr>
<td>dbus-daem</td>
<td>2787</td>
<td>messagebus</td>
<td>3u</td>
<td>unix</td>
<td>0xdff573c0</td>
<td>6357</td>
<td>/var/run/dbus/system_bus_socket</td>
<td></td>
</tr>
<tr>
<td>dbus-daem</td>
<td>2787</td>
<td>messagebus</td>
<td>6u</td>
<td>unix</td>
<td>0xdff57740</td>
<td>6381</td>
<td>socket</td>
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</tr>
<tr>
<td>dbus-daem</td>
<td>2787</td>
<td>messagebus</td>
<td>7u</td>
<td>unix</td>
<td>0xdff57900</td>
<td>6382</td>
<td>socket</td>
<td></td>
</tr>
<tr>
<td>dbus-daem</td>
<td>2787</td>
<td>messagebus</td>
<td>8u</td>
<td>unix</td>
<td>0xf596b580</td>
<td>19971</td>
<td>/var/run/dbus/system_bus_socket</td>
<td></td>
</tr>
<tr>
<td>acpid</td>
<td>2792</td>
<td>root</td>
<td>4u</td>
<td>unix</td>
<td>0xdff57200</td>
<td>6403</td>
<td>/var/run/acpid.socket</td>
<td></td>
</tr>
<tr>
<td>acpid</td>
<td>2792</td>
<td>root</td>
<td>5u</td>
<td>unix</td>
<td>0xf6d33200</td>
<td>15147</td>
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<td></td>
</tr>
<tr>
<td>acpid</td>
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<td>root</td>
<td>7u</td>
<td>unix</td>
<td>0xf52fb580</td>
<td>48677</td>
<td>/var/run/acpid.socket</td>
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</tr>
<tr>
<td>acpid</td>
<td>2792</td>
<td>root</td>
<td>8u</td>
<td>unix</td>
<td>0xf4c8bc80</td>
<td>48678</td>
<td>socket</td>
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</tr>
<tr>
<td>hald</td>
<td>3108</td>
<td>root</td>
<td>7u</td>
<td>unix</td>
<td>0xdff57ac0</td>
<td>7493</td>
<td>socket</td>
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</tr>
<tr>
<td>hald</td>
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<td>8u</td>
<td>unix</td>
<td>0xdff57040</td>
<td>7494</td>
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<td>0xf7de1040</td>
<td>7495</td>
<td>socket</td>
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<td>root</td>
<td>11u</td>
<td>unix</td>
<td>0xdff57e40</td>
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<td>socket</td>
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<td>unix</td>
<td>0xf596b740</td>
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<td>root</td>
<td>13u</td>
<td>unix</td>
<td>0xf596bac0</td>
<td>19621</td>
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<td>root</td>
<td>5u</td>
<td>unix</td>
<td>0xf7a18200</td>
<td>594625</td>
<td>socket</td>
<td></td>
</tr>
<tr>
<td>sshd</td>
<td>4233</td>
<td>gbassi</td>
<td>4u</td>
<td>unix</td>
<td>0xf6d333c0</td>
<td>594624</td>
<td>socket</td>
<td></td>
</tr>
<tr>
<td>hald-addo</td>
<td>4830</td>
<td>root</td>
<td>3u</td>
<td>unix</td>
<td>0xf7de1c80</td>
<td>15144</td>
<td>socket</td>
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<tr>
<td>hald-addo</td>
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<td>root</td>
<td>4u</td>
<td>unix</td>
<td>0xf6d33040</td>
<td>15146</td>
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<td>sshd</td>
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<td>root</td>
<td>5u</td>
<td>unix</td>
<td>0xf4c8b200</td>
<td>1277100</td>
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<td></td>
</tr>
<tr>
<td>sshd</td>
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<td>bbecker</td>
<td>4u</td>
<td>unix</td>
<td>0x37b53c0</td>
<td>1277099</td>
<td>socket</td>
<td></td>
</tr>
<tr>
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<td>root</td>
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<td>unix</td>
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<td>2069874</td>
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<td>6026</td>
<td>dianah</td>
<td>4u</td>
<td>unix</td>
<td>0xc7422580</td>
<td>2069873</td>
<td>socket</td>
<td></td>
</tr>
</tbody>
</table>
```
kill(1)

kill -9 kills processes dead

Use kill for, well, what it says.. to kill processes!
kill can also be used to send an arbitrary signal, such as SIGHUP or SIGUSR to a process.
## df output

```
nano:~ # df
Filesystem 1K-blocks Used Available Use% Mounted on
/dev/sda2 76017196 53164756 22852440 70% /
udev 4154112 116 4153996 1% /dev
serrano.alliance.unm.edu:/export/home/alliance 1007930816 956196432 534432 100% /users
serrano.alliance.unm.edu:/nfs/scratch 960412336 910471520 1154624 100% /nfs/scratch
nanoserv.nano.alliance.unm.edu:/raid 3165816480 2180893184 984923296 69% /nano/scratch
```
A note on “Randomness”

How is /dev/random populated (in Linux)? Where does it get its entropy from?

- Disk interrupts
- Keyboard interrupts
- Mouse interrupts
- Internal Hardware Random Number Generators
  *Lucky you!*
- **THATS IT**
How do I see how much randomness is available?
/dev/random is blocking on me!

▶ /proc/sys/kernel/random/entropy_avail — available entropy (more is good!)
How do I see how much randomness is available? 
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- /proc/sys/kernel/random/entropy_avail — available entropy (more is good!)
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- What if I NEVER get a larger number in entropy_avail? . . . and therefore /dev/random blocks forever?!!!
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What if I **NEVER** get a larger number in entropy_avail? ...and therefore /dev/random blocks forever?!!!

About all you can do (under Linux) is **rng-tools**
How do I see how much randomness is available?
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- `/proc/sys/kernel/random/entropy_avail` — available entropy (more is good!)
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- What if I **NEVER** get a larger number in entropy_avail? ...and therefore /dev/random blocks forever?!!!
- About all you can do (under Linux) is **rng-tools**
- rng-tools allows you to “seed” /dev/random using /dev/urandom
Lightweight Kernels

Lightweight Kernels were developed after observing that:

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- Most applications have no need for most UNIX processes
- General-purpose multiprocessing activity gets in the way of compute jobs
- Process scheduling gets in the way of compute jobs
- The above combined on *MANY* machines can *destroy* your performance!