systemd: the new init system for Linux

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History

init, the father of processes

- ✔ BIOS loads bootloader from hard drive
- ✔ bootloader loads GRUB
- ✔ GRUB loads kernel
- ✔ kernel mounts filesystems and loads drivers
- ✔ kernel starts first process (init)

sysvinit startup

✔ init looks for default runlevel and runs its scripts to start the appropriate services

✔ each runlevel has a directory **`/etc/rcN.d/`** with start and stop symlinks to scripts in **`/etc/init.d`**

init systems

traditional: sysvinit (Linux)
alternate: OpenRC (Gentoo), upstart (Ubuntu)
other OS: BSD, SMF (Solaris), launchd (Mac)

systemd development

started by Lennart Poettering, Kay Sievers

What's wrong with sysvinit?

synchronous
everything started at boot time
can't control double-forked child processes

What's better about systemd?

asynchronous
services started only when needed (via socket)
services run in cgroups

Why is systemd controversial?

“do one thing and do it well” (feature creep)
depends on dbus/kdbus
Linux-specific (because of cgroups)
binary log file (the journal)

http://0pointer.de/blog/projects/the-biggest-myths.html

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personality conflicts...

I hate Lennart Poettering and his systemd, journ-
JUST RTFM, WILL YOU?
quickmeme.com

systemd adoption

Ubuntu:	upstart 2006 (native init 2009)
Fedora:	upstart 2008, systemd 2011
RHEL:	RHEL 7 (just released) uses systemd
SUSE:	upstart option 2010, systemd 2011
SLES:	SLES 12 (Q3) will use systemd
Debian:	systemd 2014, Ubuntu will follow

Mechanics

Why is sysvinit synchronous?

services wait for their dependencies
(which open a socket when ready)

Why not open the socket on startup?

services with dependencies can start at once
socket buffer holds messages until ready

Why is sysvinit slow?

shell scripts! (shell loaded over and over)
multiple invocations of grep, awk, sed...

Why not use configuration files?

in **`/usr/lib/systemd/system`**
locals, overrides in **`/etc/systemd/system`**

```
[Unit]
Description=PostgreSQL database server
After=network.target

[Service]
Type=forking
User=postgres
Group=postgres
Environment=PGPORT=5432
Environment=PGDATA=/var/lib/pgsql/data
OOMScoreAdjust=-1000
ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA}
ExecStart=/usr/bin/pg_ctl start -D ${PGDATA} -s -o
  "-p ${PGPORT}" -w -t 300
ExecStop=/usr/bin/pg_ctl stop -D ${PGDATA} -s -m fast
ExecReload=/usr/bin/pg_ctl reload -D ${PGDATA} -s
TimeoutSec=300

[Install]
WantedBy=multi-user.target
```

some systemd unit types:

service: traditional daemon (ssh, http, kdm...)
socket: listener socket for service activation
target: like a runlevel, but not exclusive

no /etc/inittab:

`/etc/systemd/system/default.target`

is a symlink to e.g.

`/lib/systemd/system/graphical.target`

some distros use symlinks:

```
runlevel0.target -> poweroff.target
runlevel1.target -> rescue.target
runlevel2.target -> multi-user.target
runlevel3.target -> multi-user.target
runlevel4.target -> multi-user.target
runlevel5.target -> graphical.target
runlevel6.target -> reboot.target
```

more unit types:

slice: resource control via cgroups (can control CPU share, memory usage, IO bandwidth, device access)

snapshot: saves current runtime state, can return to it with **`isolate`** (lost on reboot)

more unit types:

device: when device is ready (udev)
mount: (`/etc/fstab` still preferred)
automount: (requires matching mount unit)
swap: swap space
path: unit activation on path change
timer: event based on boot time,
time since a unit's activation,
calendar time

sysvinit compatibility

“virtual” service units created in-memory

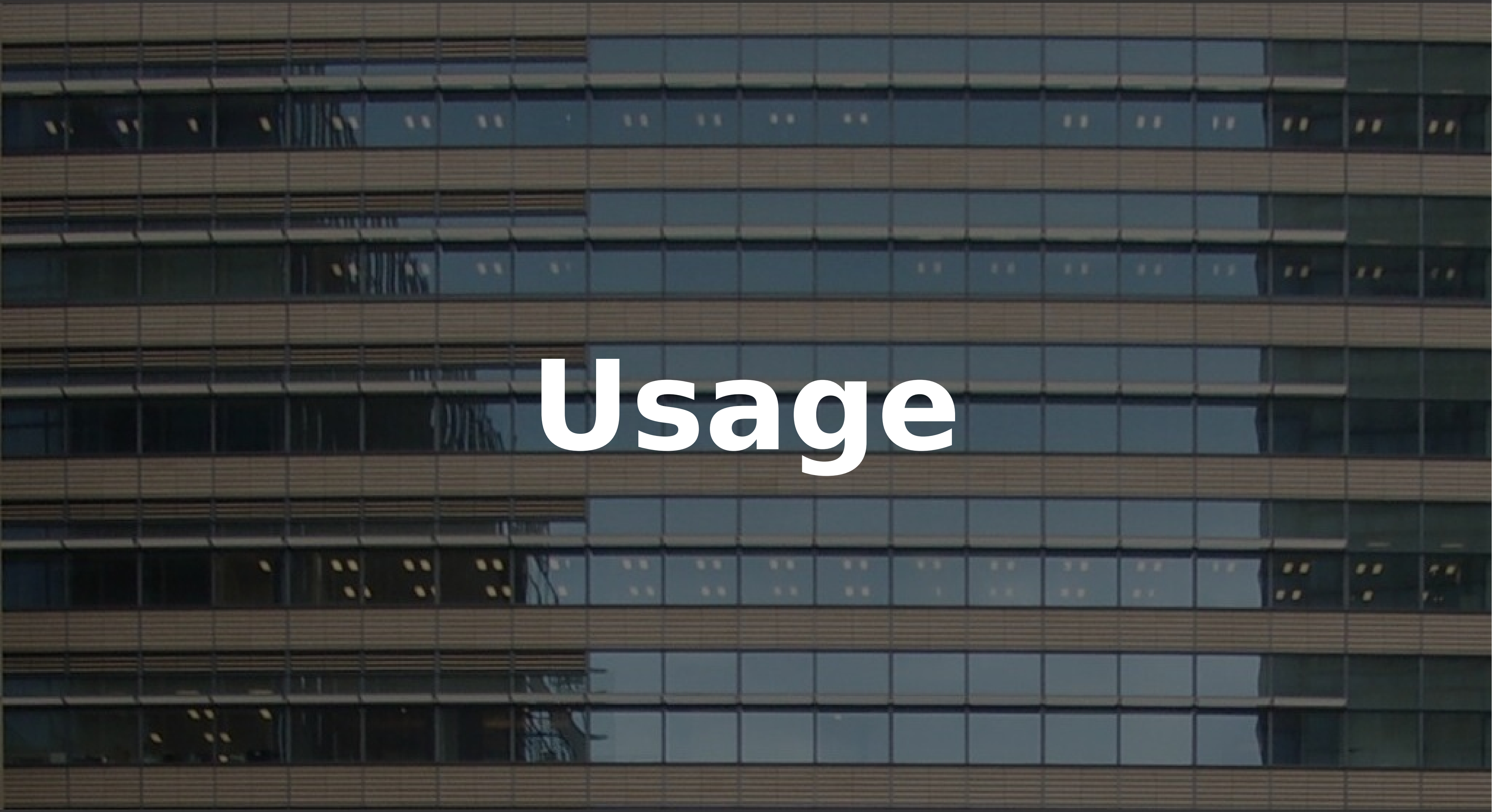
look for **`LSB:`** or **`SYSV:`** in the output of

```
  systemctl list-units
```

`service,chkconfig,telinit...` still work

for more information:

`freedesktop.org/wiki/Software/systemd/Incompatibilities/`



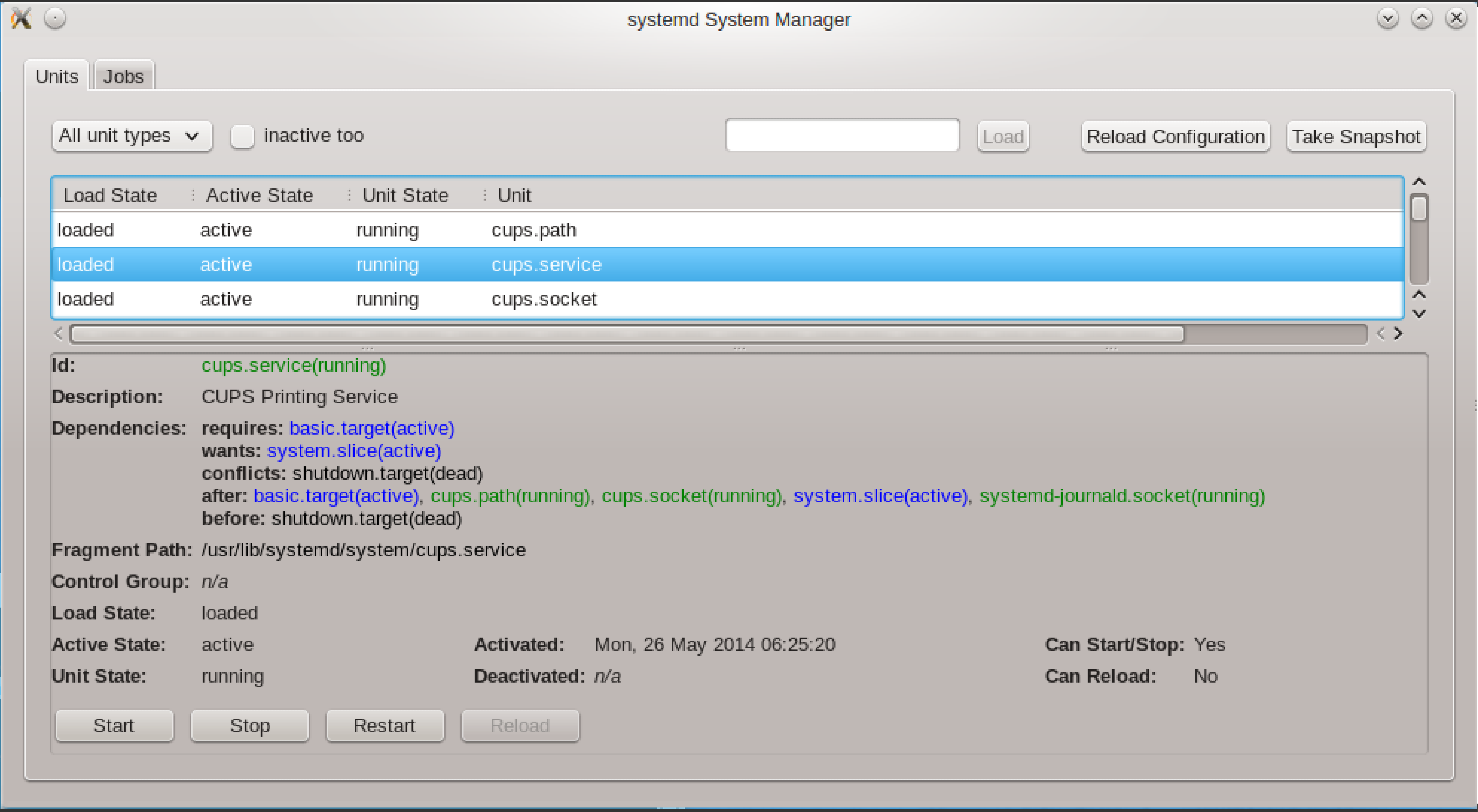
Usage

GUI front-end for systemd:

`systemadm`

On Fedora 20 and OpenSUSE 13.1, install **`systemd-ui`** package.

Good for exploring and learning systemd.



☐ inactive too

Load State	Active State	Unit State	Unit
loaded	active	running	cups.path
loaded	active	running	cups.service
loaded	active	running	cups.socket

Id: cups.service(running)

Description: CUPS Printing Service

Dependencies: **requires:** basic.target(active)
wants: system.slice(active)
conflicts: shutdown.target(dead)
after: basic.target(active), cups.path(running), cups.socket(running), system.slice(active), systemd-journald.socket(running)
before: shutdown.target(dead)

Fragment Path: /usr/lib/systemd/system/cups.service

Control Group: *n/a*

Load State: loaded

Active State: active **Activated:** Mon, 26 May 2014 06:25:20 **Can Start/Stop:** Yes

Unit State: running **Deactivated:** *n/a* **Can Reload:** No

Most frequently-used commands:

```
systemctl
journalctl
```

Completion prompting and color coding!

```
systemctl [list-units]
systemctl list-unit-files
systemctl -t service
systemctl --state failed
systemctl enable <servicename>
systemctl start <servicename>
systemctl status <servicename>
systemctl daemon-reload
systemctl halt
```

`journalctl –f`	**(follow, like tail -f)**
`journalctl –x`	**(show extra)**
`journalctl –n99`	**(last 99 entries)**
`journalctl –b`	**(since boot)**
`journalctl –b –1`	**(since previous boot)**
`journalctl ––since`	**(since date/time)**
`journalctl –p err`	**(by priority)**
`journalctl –u`	**(by unit)**
`journalctl /usr/...`	**(by executable)**
`journalctl /dev/...`	**(by device)**

switch “runlevel”:

```
systemctl isolate <target-name>
```

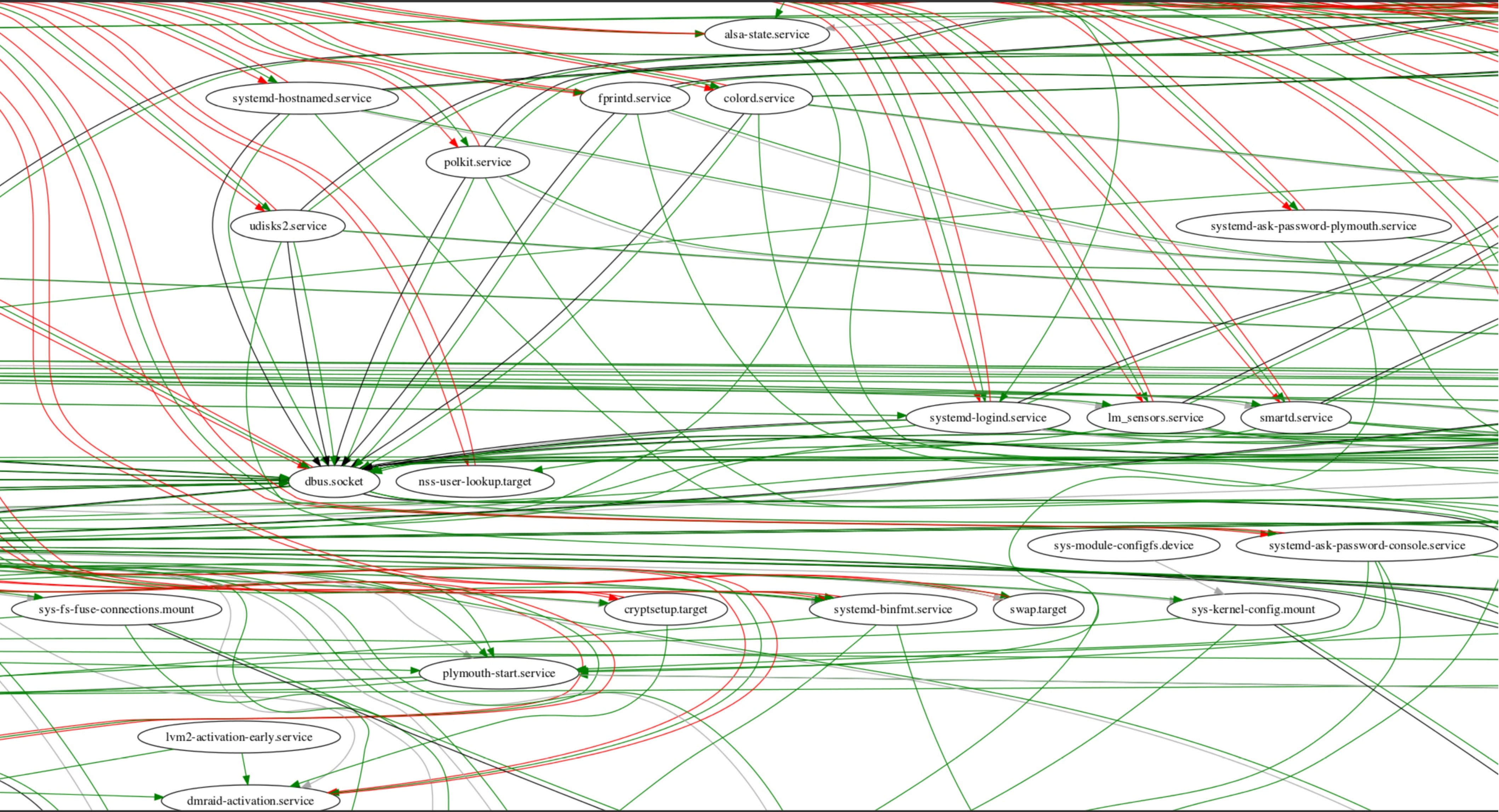
emergency boot: start kernel with

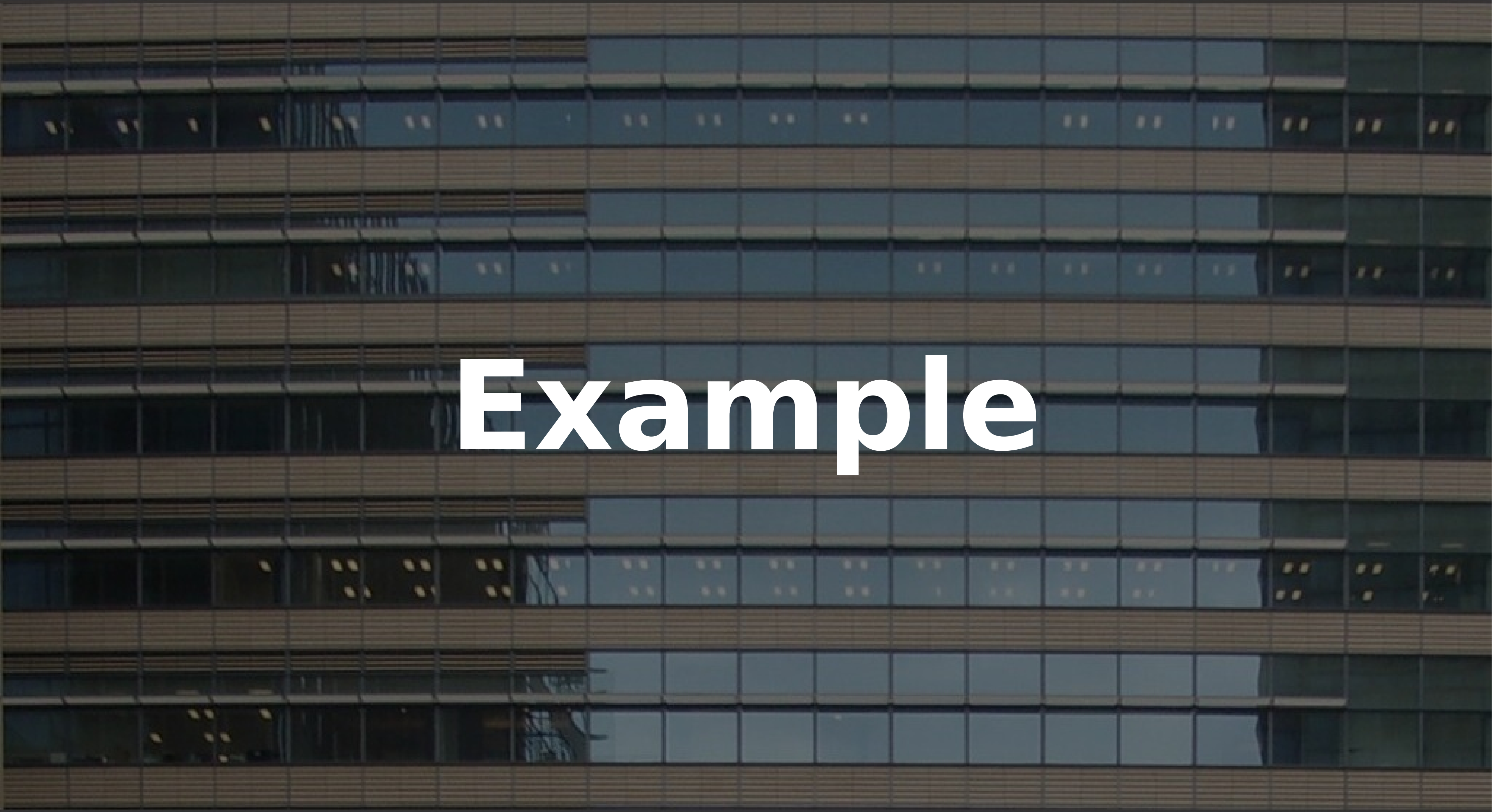
```
systemd.unit=<target-name>
```

systemd diagnostics:

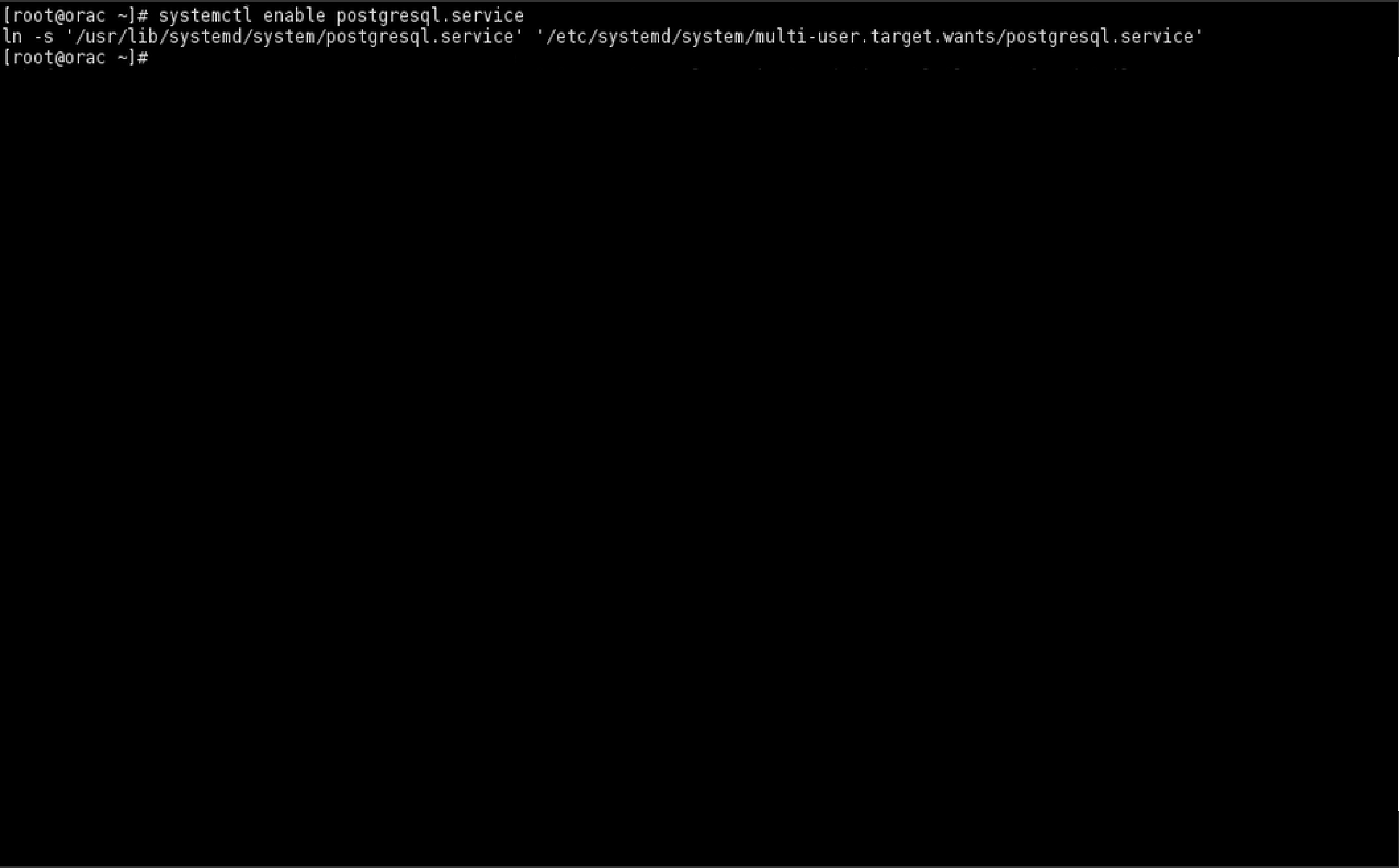
`systemd-cgls` **(“control group ls”)**
`systemd-cgtop` **(“control group top”)**

```
systemd-analyze
systemd-analyze blame
systemd-analyze plot > filename.svg
systemd-analyze dot | \
  dot -Tsvg > systemd.svg
```

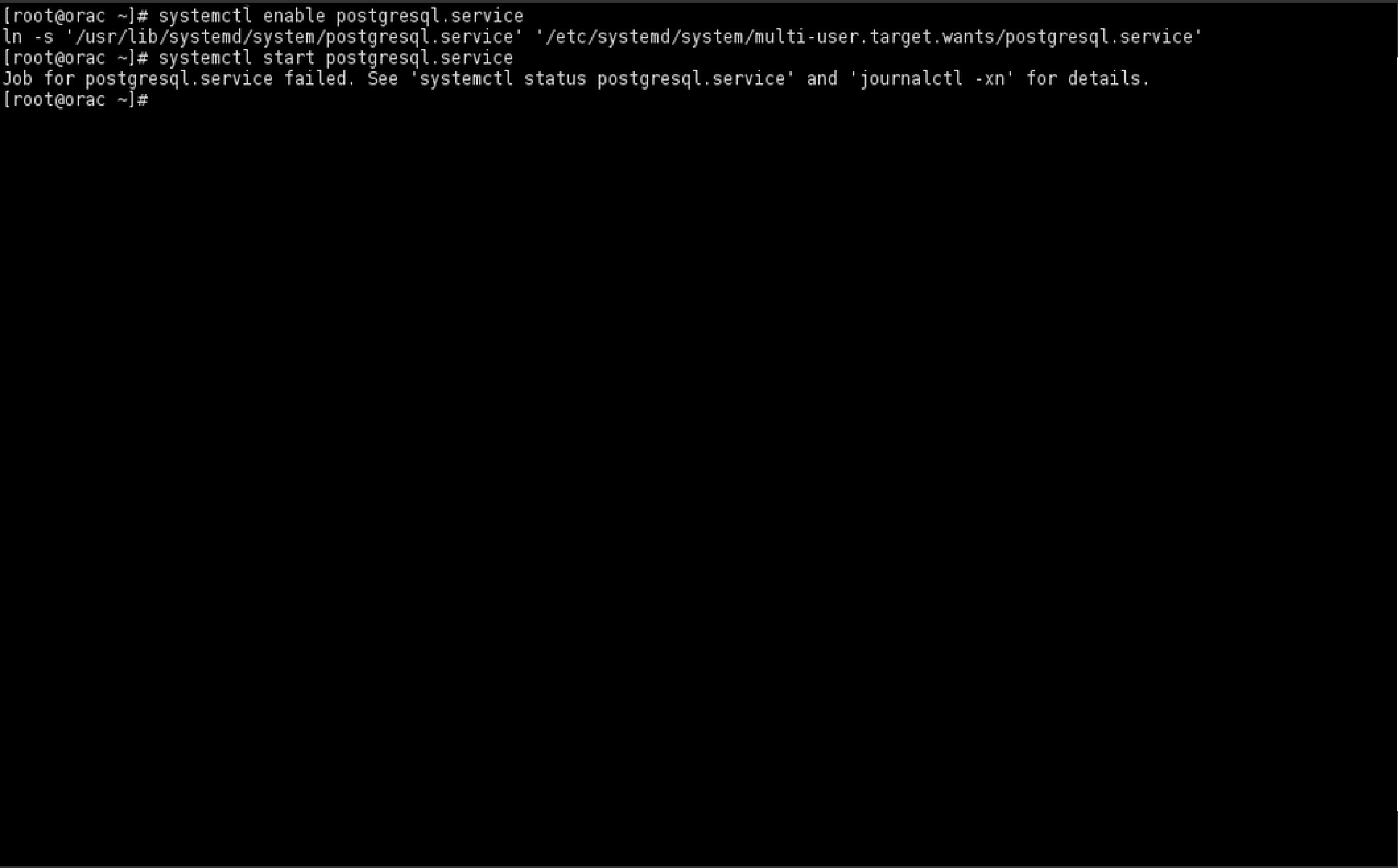

alsa-state.service
systemd-hostnamed.service
fprintd.service
colord.service
polkit.service
udisks2.service
systemd-ask-password-plymouth.service
systemd-logind.service
lm_sensors.service
smartd.service
dbus.socket
nss-user-lookup.target
sys-module-configfs.device
systemd-ask-password-console.service
sys-fs-fuse-connections.mount
cryptsetup.target
systemd-binfmt.service
swap.target
sys-kernel-config.mount
plymouth-start.service
lvm2-activation-early.service
dmraid-activation.service



Example



```
[root@orac ~]# systemctl enable postgresql.service
ln -s '/usr/lib/systemd/system/postgresql.service' '/etc/systemd/system/multi-user.target.wants/postgresql.service'
[root@orac ~]#
```



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Job for postgresql.service failed. See 'systemctl status postgresql.service' and 'journalctl -xn' for details.
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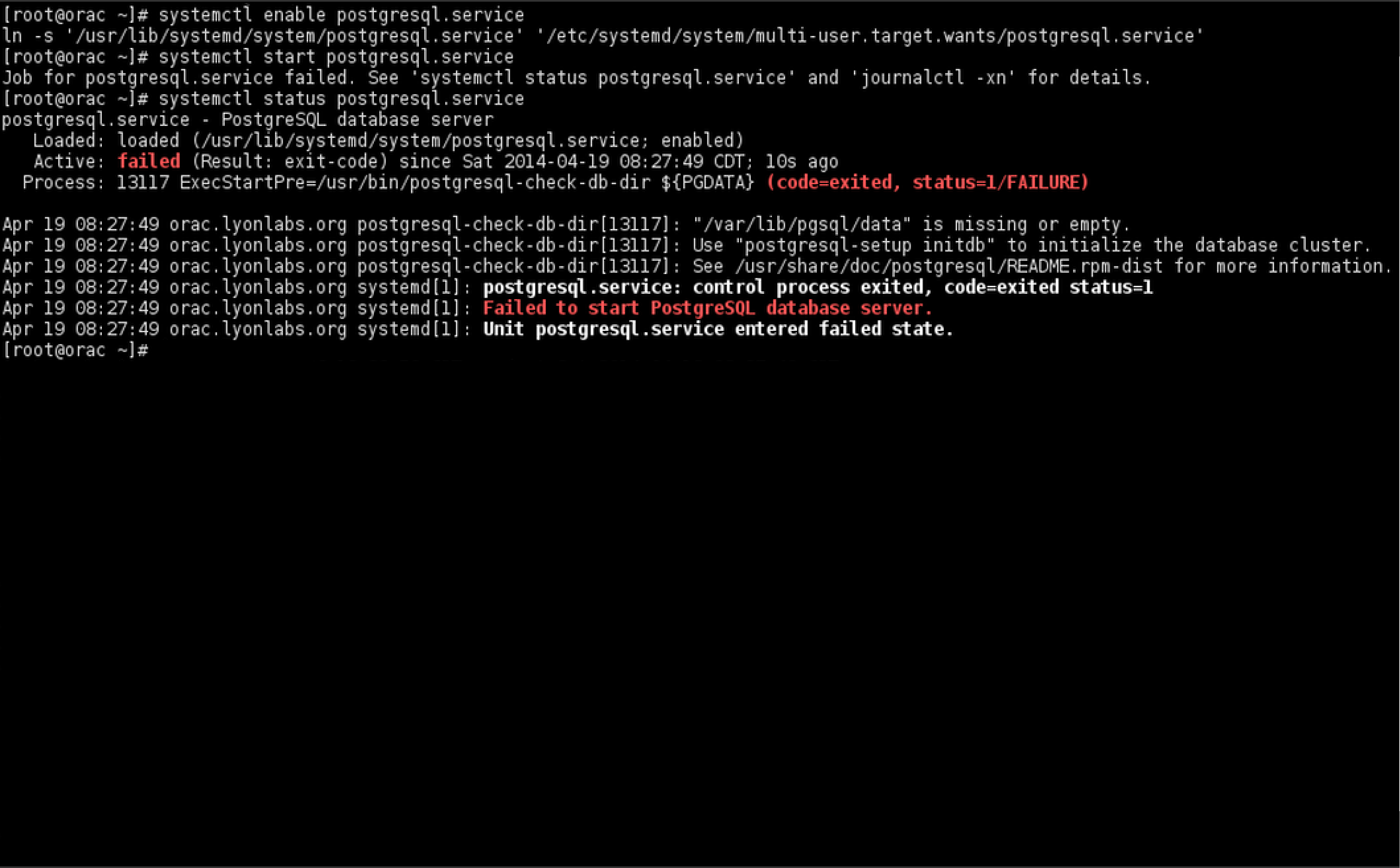

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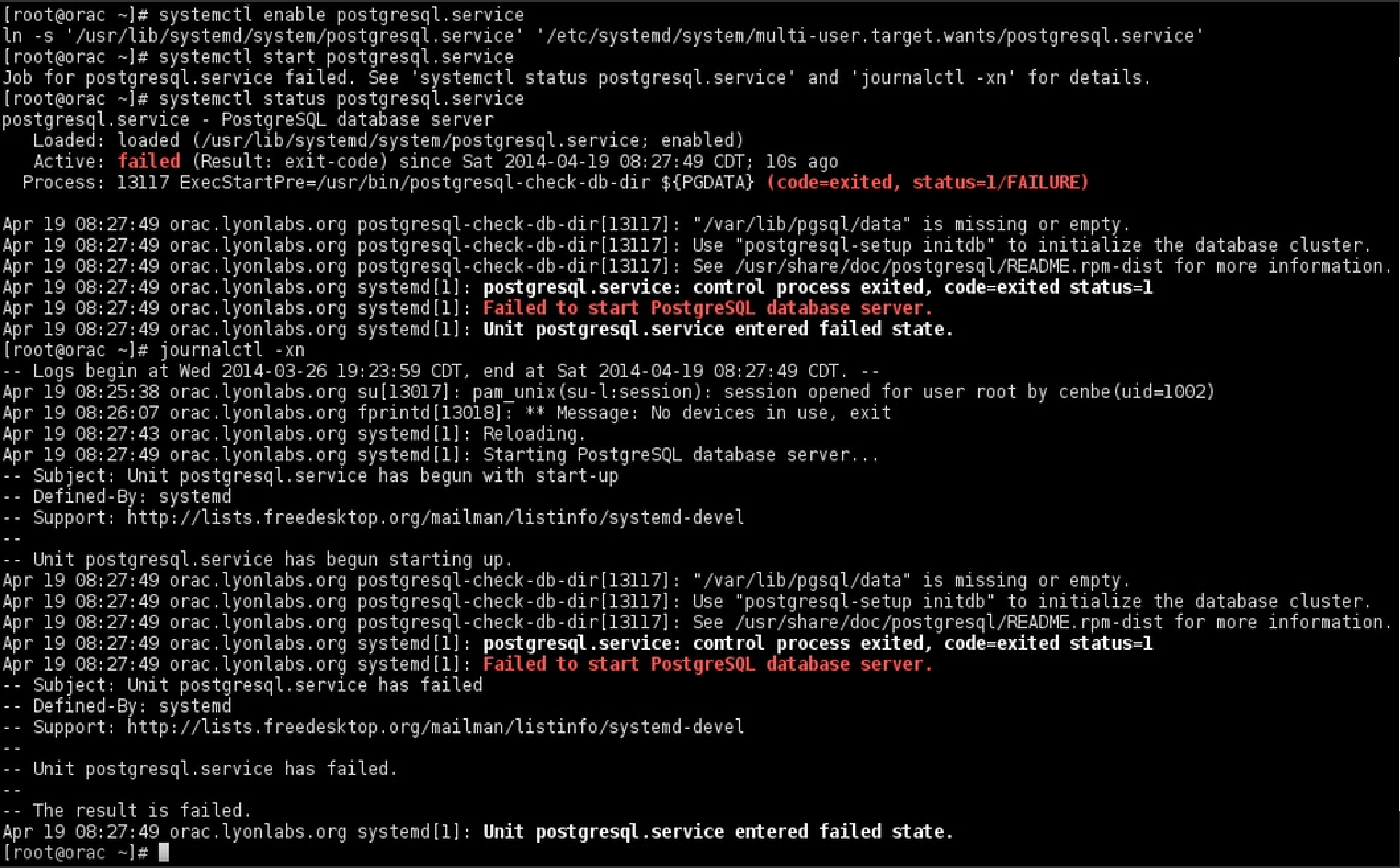
[root@orac ~]# systemctl status postgresql.service
postgresql.service - PostgreSQL database server
   Loaded: loaded (/usr/lib/systemd/system/postgresql.service; enabled)
   Active: failed (Result: exit-code) since Sat 2014-04-19 08:27:49 CDT; 10s ago
  Process: 13117 ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA} (code=exited, status=1/FAILURE)

Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: "/var/lib/pgsql/data" is missing or empty.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: Use "postgresql-setup initdb" to initialize the database cluster.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: See /usr/share/doc/postgresql/README.rpm-dist for more information.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: postgresql.service: control process exited, code=exited status=1
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Failed to start PostgreSQL database server.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Unit postgresql.service entered failed state.
[root@orac ~]#
```



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[root@orac ~]# journalctl -xn
-- Logs begin at Wed 2014-03-26 19:23:59 CDT, end at Sat 2014-04-19 08:27:49 CDT. --
Apr 19 08:25:38 orac.lyonlabs.org su[13017]: pam_unix(su-l:session): session opened for user root by cenbe(uid=1002)
Apr 19 08:26:07 orac.lyonlabs.org fprintd[13018]: ** Message: No devices in use, exit
Apr 19 08:27:43 orac.lyonlabs.org systemd[1]: Reloading.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Starting PostgreSQL database server...
-- Subject: Unit postgresql.service has begun with start-up
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit postgresql.service has begun starting up.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: "/var/lib/pgsql/data" is missing or empty.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: Use "postgresql-setup initdb" to initialize the database cluster.
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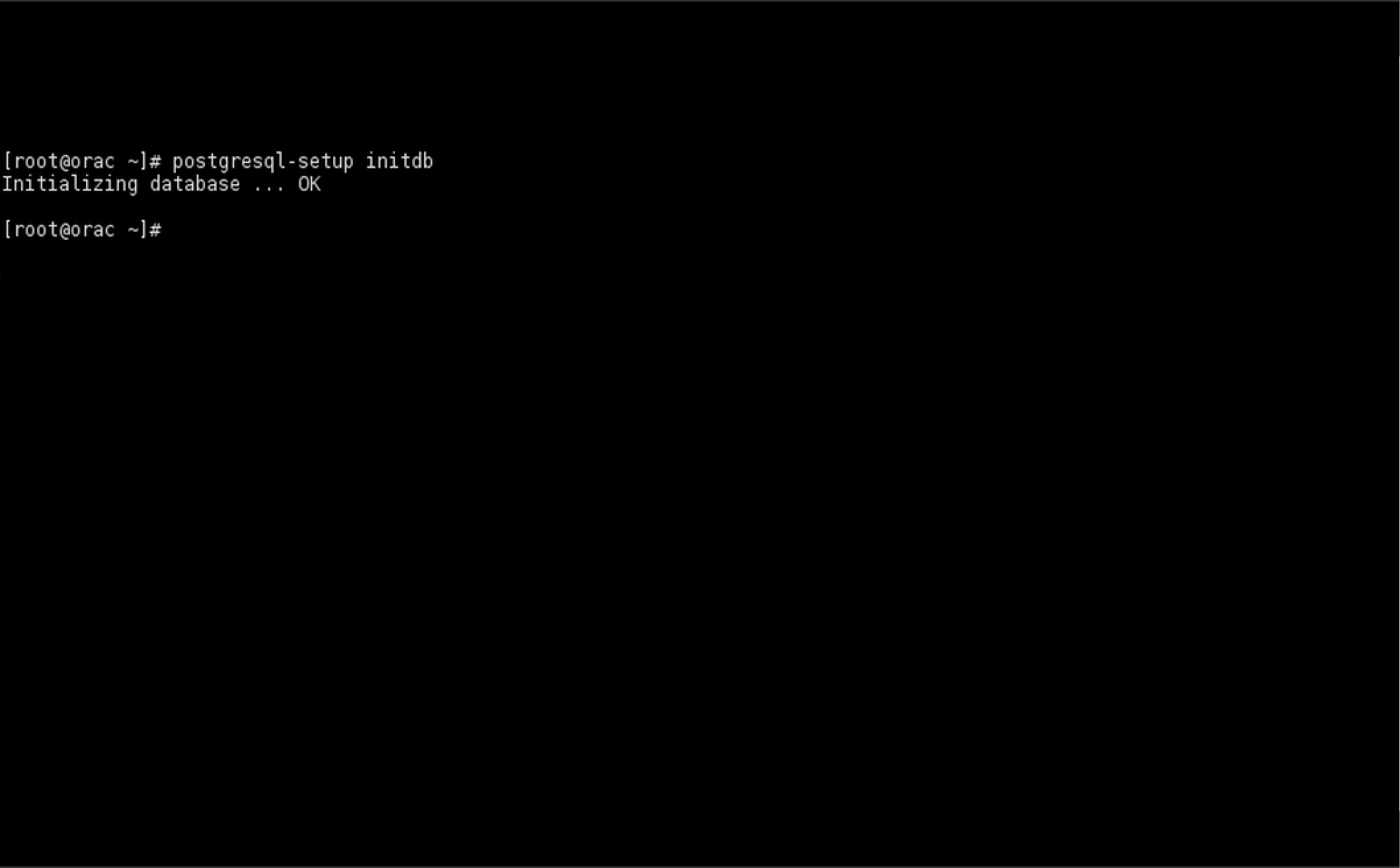
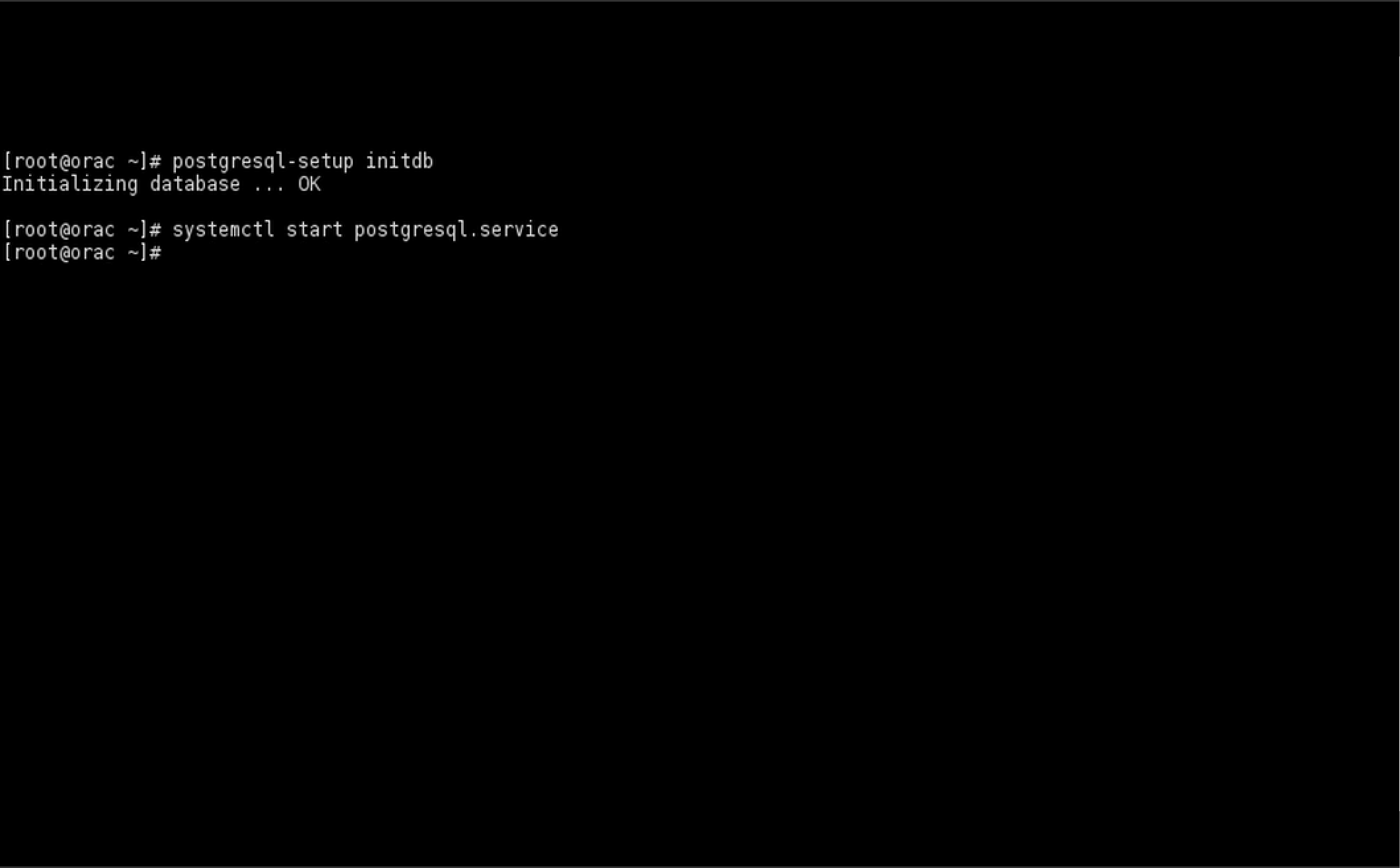
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Failed to start PostgreSQL database server.
-- Subject: Unit postgresql.service has failed
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit postgresql.service has failed.
--
-- The result is failed.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Unit postgresql.service entered failed state.
[root@orac ~]#
```



```
[root@orac ~]# postgresql-setup initdb
Initializing database ... OK

[root@orac ~]#
```



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[root@orac ~]# postgresql-setup initdb
Initializing database ... OK

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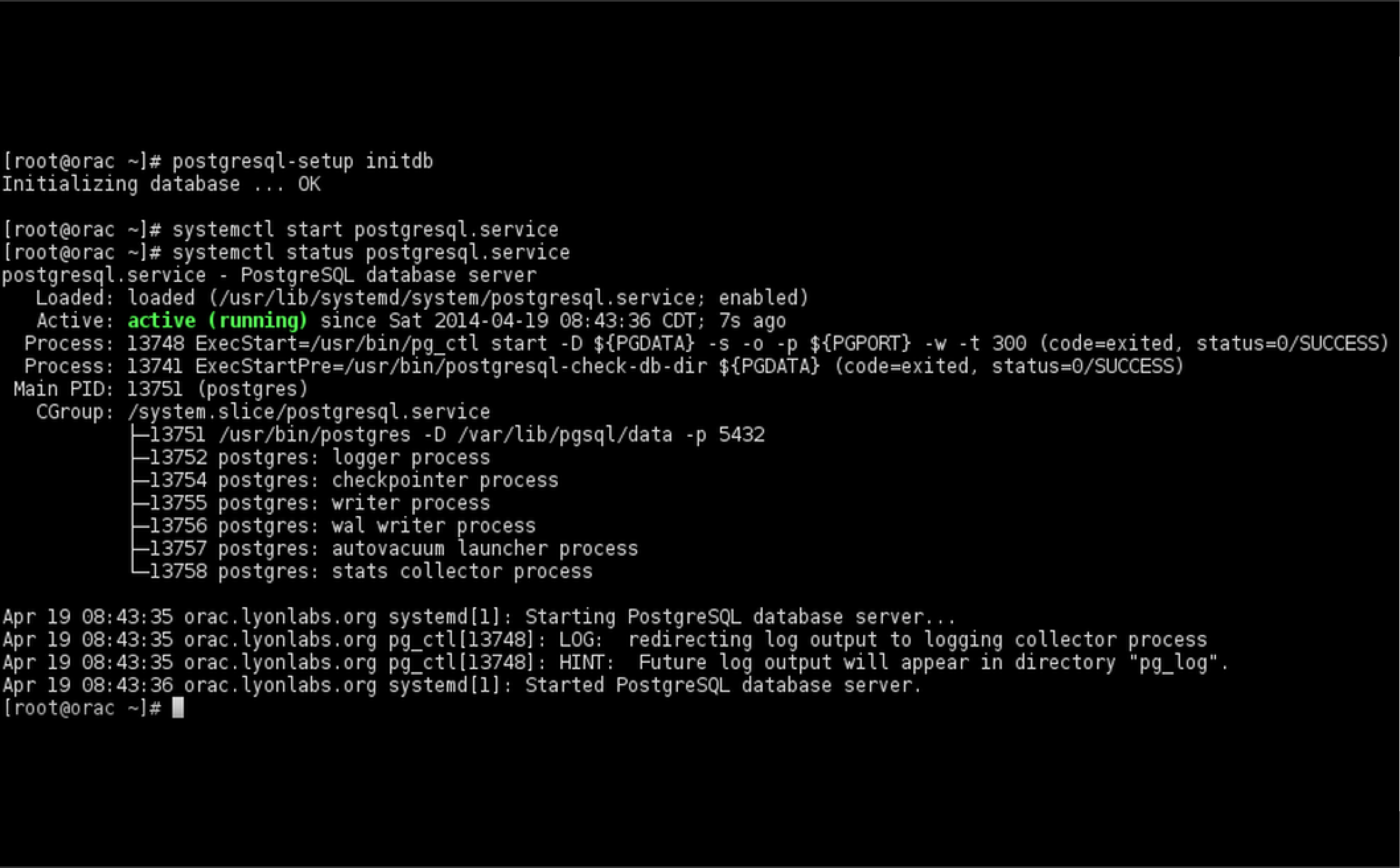
[root@orac ~]#
```



```
[root@orac ~]# postgresql-setup initdb
Initializing database ... OK

[root@orac ~]# systemctl start postgresql.service
[root@orac ~]# systemctl status postgresql.service
postgresql.service - PostgreSQL database server
   Loaded: loaded (/usr/lib/systemd/system/postgresql.service; enabled)
   Active: active (running) since Sat 2014-04-19 08:43:36 CDT; 7s ago
  Process: 13748 ExecStart=/usr/bin/pg_ctl start -D ${PGDATA} -s -o -p ${PGPORT} -w -t 300 (code=exited, status=0/SUCCESS)
  Process: 13741 ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA} (code=exited, status=0/SUCCESS)
 Main PID: 13751 (postgres)
   CGroup: /system.slice/postgresql.service
           ├─13751 /usr/bin/postgres -D /var/lib/pgsql/data -p 5432
           ├─13752 postgres: logger process
           ├─13754 postgres: checkpointer process
           ├─13755 postgres: writer process
           ├─13756 postgres: wal writer process
           ├─13757 postgres: autovacuum launcher process
           └─13758 postgres: stats collector process

Apr 19 08:43:35 orac.lyonlabs.org systemd[1]: Starting PostgreSQL database server...
Apr 19 08:43:35 orac.lyonlabs.org pg_ctl[13748]: LOG:  redirecting log output to logging collector process
Apr 19 08:43:35 orac.lyonlabs.org pg_ctl[13748]: HINT:  Future log output will appear in directory "pg_log".
Apr 19 08:43:36 orac.lyonlabs.org systemd[1]: Started PostgreSQL database server.
[root@orac ~]# 
```

resources:

overview:
http://www.freedesktop.org/wiki/Software/systemd/

“Demystifying systemd” slides:
http://bit.ly/1jm87CJ

“Getting Ready for Systemd” video:
https://access.redhat.com/site/videos/403833