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Scheduling Execution

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Periodic Execution

⌘ system backups, security checking, network operations, etc. all require an unattended and/or periodic operation facility

☒ must remember that Unix is primarily an interactive system

☒ *scheduling is almost entirely according to time, not load, resources, etc.*

- so IBM shouldn't worry!

⌘ Unix has three such facilities:

☒ cron

☒ at

☒ *both offer essentially the same facility*

☒ *cron comes from BSD world, at from SysV*

☒ batch

☒ *not really periodic, but unattended*

☒ there are others

☒ *e.g. NQS from NASA Ames Labs., etc.*

- NASA is a big Linux supporter

Cron

⌘ periodic execution handled by the cron daemon, crond

☒ started at boot time

☒ *via a script in /etc/rc.d/init.d and the normal symlink mechanism*

☒ does logging to /var/log/cron

⌘ configured on a system basis via /etc/crontab

☒ created & installed via the crontab -e command

```
# use /bin/sh to run commands, no matter what /etc/passwd says
SHELL=/bin/sh
# mail any output to `root, no matter whose crontab this is
MAILTO=root
#
# run five minutes after midnight, every day
5 0 * * *      $HOME/bin/daily.job >> $HOME/tmp/out 2>&1
# run at 2:15pm on the first of every month -- output mailed to paul
15 14 1 * *    $HOME/bin/monthly
# run at 10 pm on weekdays, annoy Joe
# things bracketed by % are presented via standard input; % is translated to \n
0 22 * * 1-5   mail -s "It's 10pm" joe%Joe,%%Where are your kids?%
23 0-23/2 * * *echo "run 23 minutes after midn, 2am, 4am ..., everyday"
5 4 * * sun    echo "run at 5 after 4 every sunday"
```

☒ use crontab -l to list the current cron tasks

Personal Cron Tasks

⌘ configured via personal crontab files

⚠ not in BSD Unix

⚠ *so cron is restricted to root on these systems*

⚠ stored as /var/spool/cron/username

⚠ who can use cron can be configured

⚠ via /etc/cron.allow and /etc/cron.deny

- simply a list of user names

```
# cat /etc/cron.deny
bob
# crontab -e
You (bob) are not allowed to use this program (crontab)
See crontab(1) for more information
```

⚠ *if neither file exists cron is either a completely open facility, or restricted to root, depending on compile-time options*

- RedHat allows unrestricted use in this case

At

⌘ executes commands at a specified time

- ☒ not really intended for repetitive tasks like cron
- ☒ allows fairly complex time specifications

```
% at 4:27pm + 3 days
...
% at 10am Jul 31
...
% at 1am tomorrow
...
```

- ☒ calls the atd daemon to do the scheduling
 - ☒ *maintains a queue*
 - /var/spool/at
 - /var/spool/at/spool (stores the output from the jobs)
 - ☒ *either respawns itself every 5 mins or is run by cron every 5 mins*
- ☒ associated commands
 - ☒ *atq*
 - lists the user's pending jobs (everyone's if the user is root)
 - ☒ *atrm*
 - deletes jobs from the queue
- ☒ similar security to cron
 - ☒ */etc/at.allow and /etc/at.deny*
 - ☒ *if neither exists, facility is limited to root*

At Example

```
# at now + 5 minutes
at> cat <<!
at> this is a test
at> how are you?
at> !
at> <EOT>
warning: commands will be executed using /bin/sh
job 2 at 1998-12-07 20:38
# atq
2          1998-12-07 20:38 a
# pg /var/spool/at/a0000200e831de
#!/bin/sh
# atrun uid=500 gid=500
# mail      bob 0
umask 2
HOME=/home/bob; export HOME
PATH=/usr/sbin:/sbin:/usr/local/bin:/bin:/usr/bin:/usr/X11R6/bin; export PATH
MAIL=/var/spool/mail/bob; export MAIL
LOGNAME=bob; export LOGNAME
HOSTTYPE=i386-linux; export HOSTTYPE
VENDOR=intel; export VENDOR
OSTYPE=linux; export OSTYPE
MACHTYPE=i386; export MACHTYPE
SHLVL=1; export SHLVL
PWD=/home/bob; export PWD
USER=bob; export USER
GROUP=bob; export GROUP
HOST=redhat; export HOST
REMOTEHOST=aunty; export REMOTEHOST
HOSTNAME=redhat; export HOSTNAME
cd /home/bob || {
    echo 'Execution directory inaccessible' >&2
    exit 1
}
cat <<!
this is a test
how are you?
!
```

Batch

⌘ executes commands when system load levels permit

☒ when the load average drops below 0.8, or the value specified in the invocation of atrun

☒ *atrun is a shell script 'wrapping' atd -s*

- -s says only process queue once

☒ *can also run atd "by hand"*

- -l option specifies appropriate load level

☒ not in all Unix versions

⌘ *"At and batch as presently implemented are not suitable when users are competing for resources. If this is the case for your site, you might want to consider another batch system, such as nqs."*

Batch

- ⌘ **executes commands when system load levels permit**
 - ⏏ when the load average drops below 0.8, or the value specified in the invocation of atrun
 - ⏏ *atrun is a shell script 'wrapping' atd*
 - ⏏ not in all Unix implementations
 - ⏏ *is in RedHat*