

Slide 1

### Administrivia

- Reminder: Homework 1 due today (5pm).
- Note about reading assignments: Yes, they're long! Meant to be skimmed — read carefully only parts that we talked about in class, or that interest you.
- Homework 2 on Web, due next Wednesday.

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### Shell Built-Ins, Recap/Correction

- Last time: First token on each input line is “command”, which can be an external command or a shell built-in.
- One key difference — external command executes as a separate (“child”) process, so cannot change shell’s “execution environment”, including environment variables and current directory.

## Shell Customizations

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- At startup, shell reads in various configuration files (see man page for details). At least one will be in your home directory (`.bashrc` for `bash` — also `.bash_profile`, read when shell is a “login shell”).
- In these files, you can
  - Define/redefine environment variables (e.g., `PATH`, `PS1`). For `bash`, be sure to `export` them. Can define new ones (I find this useful).
  - Define aliases/functions (more on next slide).
- Caution: The default setup on our lab machines is somewhat elaborate. Goal is to have things work right on all environments — Linux (currently F7), but also Mac OS X. Look at `~/defaults/system/SYSTEM.bashrc` for details.

## Shell Customizations — Aliases and Functions (`bash`)

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- Aliases are simple substitution, no parameters. E.g.

```
alias lt='ls -ltF'
alias google='lynx http://www.google.com'
```
- Functions can have positional parameters. E.g.,

```
function cd-and-show() { cd $1 ; pwd ; ls; }
```

### Processes and "Job Control"

- Normally, command you type is a "foreground process". Append `&`, though, and you get a "background process".
- Can make a foreground process a background process, and vice versa (`fg` and `bg` commands; `jobs` command).
- Can even run commands in "batch" mode (`batch` command).

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### I/O Redirection

- In programming classes I talk about "reading from standard input" (`stdin`) rather than "reading from the keyboard", and "writing to standard output" rather than "writing to the screen". Why?

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## I/O Redirection, Continued

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- `stdin` (standard input) can come from keyboard, file, or inline in shell script.
- `stdout` and `stderr` (standard input, output) can go to terminal or file (overwrite or append), separately or together. (Syntax depends in part on which shell you're using.)
- How is this useful? (e.g., in program development? testing?)
- *OR* — remember quotation from first class?  
“Write programs that do one thing and do it well. Write programs to work together. Write programs to handle text streams, because that is a universal interface.”

## Pipes

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- “Pipes” provide one-way communication between programs — output of program A becomes input of program B.
- Key component of “the UNIX philosophy” — emphasis on providing a toolkit of small programs, mechanisms for combining them.
- “Filters” are programs designed to work this way, and there are lots of them (some in next slides and next time). `less` and `more` also useful.

## Filters

- `head`, `tail`.
- `sort`, `uniq`.
- `grep` — search for text (or regular expression — more later).
- `wc` — count characters, words, lines.
- `tr` — “translate”. Good for converting, e.g., upper-case to lower-case.
- `tee` — duplicates input. Good for capturing output to a file while also displaying it onscreen.

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## Filters, Continued

- `sed` — “stream editor”. Example — convert DOS/Windows-style text file (each line ends with `\r\n`) to UNIX-style (each line ends with `\n`).
- `awk` — “pattern scanning and processing language” — many interesting possibilities; simplest is just to break up input into whitespace-delimited fields.

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## Examples

- Find all processes that belong to your username:

```
ps aux | grep $USER
```

- Generate a list of machines that are "up":

```
uptime | grep up | awk '{print $1}'
```

- Show how much space each subdirectory of your home directory is using, sorted by size.

```
du -sk $HOME/* | sort -n
```

(Unfortunately this omits directories starting with a dot.)

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## Minute Essay

- What command could you use to count the number of aliases in your `.bashrc` file?
- Was Homework 1 too hard, too easy, or about right?

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### Minute Essay Answer

- One possible answer (to the first question):  
`grep alias .bashrc | wc -l`

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