Slide 1

Administrivia

- 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 in a week.

Slide 2

Shell Built-Ins Versus Commands, Recap

- 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. (So, `cd` is a built-in, as is any command that sets environment variables.)

Slide 3

Shell Customizations

- 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 F13), but also Mac OS X. Look at `~defaults/system/SYSTEM.bashrc` for details.

Slide 4

Shell Customizations — Aliases and Functions (`bash`)

- 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; }
```

Slide 5

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).

Slide 6

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?

Slide 7

I/O Redirection, Continued

- `stdin` (standard input) can come from keyboard, file, or inline in shell script.
- `stdout` and `stderr` (standard output, error) 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."

Slide 8

Pipes

- "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.

Slide 9

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.

Slide 10

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.

Slide 11

Examples

- Find all processes that belong to your username:

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

- Find all users who are running processes on the system:

```
ps aux | awk '{ print $1 }' | sort | uniq
```

- 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.)

Slide 12

Minute Essay

- What command could you use to count the number of aliases in your `.bashrc` file?

Slide 13

Minute Essay Answer

- One possible answer:

```
grep alias .bashrc | wc -l
```