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### Administrivia

- Reminder: Homework 2 due Wednesday.
- Homework 1 graded; sample solution on Web soon.

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### More Useful Commands, Continued

- `xargs` — “build and execute command lines from standard input”.
- Examples:
  - Find all processes for program `java` and kill them:  

```
ps aux | grep java | awk '{print $2}' | xargs kill
```
  - Minute essay from last time.

## Shell Input as a Programming Language

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- What `bash` understands is in a sense a programming language, with the shell as its interpreter:
  - Variables (untyped).
  - Expressions (arithmetic and logical).
  - Conditionals (if/then/else) and loops.
  - Functions.
- Can be used interactively, or collected into “scripts”.
- I will talk about `bash`, but most shells provide similar functionality, just sometimes with different syntax. If you want to write scripts portable to most UNIX systems, probably best to stick to `sh` subset of `bash`.

## Shell Scripts

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- A “shell script” is just a sequence of things you could type at the shell prompt, collected in a (text) file.
- Normally, first line of script is `#!` followed by path for shell (`/bin/bash`, e.g.), and the file is marked “executable” (with `chmod`). But you can also execute commands in file `anyfile` via `bash anyfile`.
- With the exception of the first line, lines starting with `#` are comments.

## Shell Variables

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- Define/assign variables with, e.g., `myvar="hello"`. (Notice absence of spaces.)
- Reference with, e.g., `$myvar`.
- What's the difference between these and "environment variables" already mentioned? Shell variables are local to the shell, not passed on to child processes. Distinction is somewhat blurred in Bourne shells. Convention is that environment variable names are all caps.

## Command Substitution

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- Can "inline" output of one command as parameters of another using backquotes. Example:  

```
vim `find . -name "*.c"`
```

or use newer bash syntax  

```
vim $(find . -name "*.c")
```
- The "inlined" command can even be a pipeline. Example:  

```
ls -ld `echo $PATH | sed 's:/:/g'`
```

## Shell Functions and Parameters

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- Define functions as described previously — `function` followed by name, parentheses, then function definition in curly brackets. Separate/end commands with `;` or newlines.
- Parameters for functions and shell scripts are positional — `$0` for function name, then `$1`, etc. `$*` is a list of all parameters; `$#` is the count of parameters, not including `$0`.
- Call functions or shell scripts by giving name and then parameters, separated by whitespace. (If a parameter should include whitespace, use quoting or escape characters.)

## Conditionals and Loops

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- Basic syntax for `if/then/else`:  

```
if command
then list-of-commands
else list-of-commands
fi
```

Which branch is taken depends on return code from command after `if` — 0 considered “true”, other values “false”.
- Basic syntax for while loops:  

```
while command
do list-of-commands
done
```

Continues until return code from command after `while` is non-zero.

## Conditionals and Loops, Continued

- Basic syntax for `for` loops:

```
for var in list-of-values
do list-of-commands
done
```

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- Other constructs include `case` (like C `switch`), `until`.

## Useful Commands for Conditions, Loops, Etc.

- Probably the most common for conditions is `test` (commonly abbreviated as square brackets). Many options. Example:

```
if [ -z "$1" ]
then echo Usage: `basename $0` someparameter; exit
fi
```

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- For lists/loops, `seq`, wildcards, and command substitution are good.

Examples:

```
for n in `seq -w 0 21`
do echo Xena$n
done
```

```
for f in `ls -A $HOME`
do du -sh $HOME/$f
done
```

### Other Features

- Evaluating (numeric) expressions — next time.
- Reading from standard input — next time.

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### Minute Essay

- The command `ping -c 1 Janus00` will test to see if Janus00 is network-reachable. Write a few lines of `bash` input that would let you “ping” all the Janus machines.

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### Minute Essay Answer

- One possible answer:

```
for n in `seq -w 0 21`  
do  
    ping -c 1 Janus$n  
done
```

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- Another answer (contributed by a student one year):

```
for n in `uptime | grep Janus | awk '{print $1}'`  
do  
    ping -c 1 Janus$n  
done
```