PHYS 410: Computational Physics   Fall 2001   Homework 1
Due: Tuesday, September 18, 10:00

Problem 1a: Send me (`choptuik@physics.ubc.ca`) an e-mail message from your account on the Physics & Astronomy Department Sun server, `physics.ubc.ca`. Use the short form of the system's "hostname"—i.e. `physics`—for the subject of the message. Include *your* name in the body of the message. Incidentally, note that there is a Unix command `hostname`.

Problem 1b: Send me an e-mail message from your account on the `lnx` machines. Again, use the hostname for the subject of the message, and include your name in the text of the message.

Problem 1c: Using the `ssh-keygen` command as discussed in class, and described in the *Unix* notes, create (or add to) the files `~/.ssh/authorized_keys` on *both* your `physics` and `lnx` accounts so that you can `ssh` and `scp` from `physics` to `lnx1, lnx2, lnx3` and vice versa, without being prompted for a password.

Do the remaining problems using your account on the `lnx` *machines (it doesn't matter which one or ones you use). In particular, note that "~" in the following refers to your* `lnx` *home directory, and all file and directory references are to files on those machines. As always, send me mail immediately if you encounter problems using any of the machines.*

IMPORTANT!! Be sure to read and follow all instructions *carefully*, as your grade will depend on certain files being in the right places with the right names. *Note that you will be copying files owned by user* `phys410` *several times.*

Problem 2: I have created directories for each of you which you may use to "publish" Web pages (related to this course) via my research group's web server (`http://laplace.physics.ubc.ca`). Your personal directory (which I'll refer to as your Web directory) is `~/public_html`. I have created a "template" homepage named `~phys410/public_html/index.html`. Copy this HTML file into your Web directory (use the same name—`index.html`) and modify the HTML file to reflect your name, address, phone-number etc. Use your text editor of choice (presumably `vi` or `emacs`) to perform the modifications. If you don't feel like publishing any specific piece of information, specify it as "unlisted". Below the horizontal rule (line) in the template file, add suitably labelled links to (a) the course home page (b) the instructor's home page and (c) at least 5 Web pages that have something to do with "blue stragglers". Check your work by verifying that you can get to your home page by going to our Course page, selecting "Student Pages" and then your name. Also, please send me e-mail should the way I have listed your name in the "Student Pages" list need changing.

Problem 3a: I have created a subdirectory named `hw1` (for Homework 1) in your home directory. I have also changed the permissions on this directory so that your work remains private; please do not alter the permissions until after the homework has been graded. In this new directory, create another subdirectory named `a3`. In that directory (`~/hw1/a3`), and using `vi` or `emacs`, create a file named `apple` which contains the following text from *Gravitation*, by Misner, Thorne and Wheeler. Try to duplicate the spacing, line breaks, punctuation etc. as closely as possible.

```
Once upon a time a student lay in a garden under an apple tree reflecting
on the difference between Einstein's and Newton's views about
gravity.  He was startled by the fall of an apple nearby.  As he
looked at the apple, he noticed ants beginning to run along its
surface. His curiousity aroused, he thought to investigate the
principles of navigation followed by an ant.  With his magnifying glass,
he noted one track carefully, and, taking his knife, made a cut in the apple
skin one mm above the track and another cut one mm below it.  He peeled
off the resulting little highway of skin and laid it out on the face
of his book.  The track ran as straight as a laser beam along this
highway.  No more economical path could the ant have found to cover
the ten cm from start to end of that strip of skin.  Any zigs and
zags or even any smooth bend in the path on its way along the apple
peel from starting point to end point would have increased its length.

   ``What a beautiful geodesic'', the student commented.
```

Problem 3b: Create a file in the same directory (`~/hw1/a3`) called `kumquat` which is identical to `apple` except that all occurences of the word "apple" are replaced with "kumquat". Leave a brief note in a file called `README` (again in the same directory) which describes how you created `kumquat` and made the changes.

Problem 4: In a directory `~/hw1/a4`, create a file called `stripped` whose contents are identical to `~phys410/hw1/q4/input` except that all lines which have a '`#`' (hash mark) in the first column, but no '`!`' (exclamation mark) in the second column, have been removed. Leave a brief note in `~/hw1/a4/README` which describes how you solved the problem.

Problem 5: Make the directory ~/hw1/a5. The file /usr/share/dict/words contains a list of "words" (mostly genuine English words—for the purposes of this question, any entry in the file will be deemed a "word"), one per line. How many words does the file contain? Answer in ~/hw1/a5/README. In ~/hw1/a5 create files with the following names and contents (words should appear one per line):

- `3letter` which contains all the three-character (three-letter) words in `/usr/share/dict/words`, which begin with 'e' or 'E', in alphabetical order.
- `15letter` which contains an alphabetical list of all the fifteen-character words in `/usr/share/dict/words` which do *not* contain 'i', 'I', 'o' or 'O'.
- `r6letter` which contains all the six-letter words in `/usr/share/dict/words` in *reverse* alphabetical order (*Hint:* Use the Unix `sort` command).
- `3vowels` which contains an alphabetical list of all the words in `/usr/share/dict/words` which contain exactly 3 vowels. (Define the set of vowels to be 'a', 'A', 'e', 'E', 'i', 'I', 'o', 'O', 'u' and 'U', and note that individual vowels *can* be repeated).

Leave comments in ~/hw1/a5/README which describe how you solved each problem.

Problem 6: Make the directory ~/hw1/a6. Use the plotting program `gnuplot` to produce a plot of $\exp(-4x^2)\sin(12x)$ for $-1 \le x \le 1$. Save your plot as the postscript file `plot.ps` in the directory ~/hw1/a6. *Hint:* Use `gnuplot`'s extensive on-line help: you may find `help plot`, `help postscript` and `help output` useful.

Problem 7: Make the directory ~/hw1/a7. In that directory create a (Bourne)-shell script, `Rcp`, which has the following usage:

```
usage: Rcp file [file ...]
```

`Rcp` accepts an arbitrary number of arguments, which are to be the names of files and/or directories. For each argument which names an existing file or directory, `Rcp` echoes to standard output a complete `scp` command which can then be used to `scp` that file or directory to a remote host.

Note that `Rcp` does *not* actually do any `scp`-ing it merely "echoes" commands which can, for example, be cut-and-pasted into a shell running on the machine to which one wants to transfer the files.

Some usage examples should make the operation of `Rcp` clear:

```
% pwd; ls
a-dir/  a-file

% Rcp
usage: Rcp file [file ...]

% Rcp a-file
scp matt@lnx1.physics.ubc.ca:/tmp/Rcp-demo/a-file .

% Rcp a-dir
scp -r matt@lnx1.physics.ubc.ca:/tmp/Rcp-demo/a-dir .

% Rcp a-file a-dir
scp matt@lnx1.physics.ubc.ca:/tmp/Rcp-demo/a-file .
scp -r matt@lnx1.physics.ubc.ca:/tmp/Rcp-demo/a-dir .

% Rcp no-file
```

```
no-file: No such file or directory

% Rcp a-file no-dir
scp matt@lnx1.physics.ubc.ca:/tmp/Rcp-demo/a-file .
no-dir: No such file or directory

% Rcp no-file no-dir
no-file: No such file or directory
no-dir: No such file or directory
```

As much as possible, your script should behave exactly as above; note in particular the usage message which is printed when the script is invoked with no arguments, the error messages printed for arguments which do not name a file or directory, and the `-r` flag which appears in the output corresponding to a directory argument.

Hints: Consider the *Unix* commands: `hostname`, `test` and `pwd`, and note that the environment variable `USER` contains your userid. Remember to use the `-x` flag in the script header for debugging purposes:

```
#! /bin/sh -x
```

Once you have coded and debugged (if necessary!) `Rcp`, create the directory `~/bin` and copy `Rcp` there. Once this is done, execute the C-shell built-in command `rehash` to update the command hash tables, and ensure that `Rcp` works as a regular command for you; for example, verify that you get a usage message from `Rcp` when you invoke it from your home directory:

```
% cd; Rcp
usage: Rcp file [file ...]
```