

# Homework 4

## Solution Key

### Problem 4.1

*...By running it and by reading the man page, determine what the command*

```
ls -ailtu
```

*does and how to interpret its output. As part of the explanation, show one or more lines of its output so that you can indicate what each piece means.*

The argument to `ls` in this case represents five distinct command-line options, one per letter. Since there are no further arguments, the command is executed with respect to the current directory. The letters modify the base command as follows:

- a** Prints all directory entries, including those beginning with a period (normally omitted).
- i** Includes each entry's inode number, roughly, a pointer to the file's location on disk.
- l** Includes "long-form" info on a file, including its owner, date, and file permissions. The date/time printed is by default the moment it was most recently modified, but see below.
- t** Sorts the files by date, most recent first. The date used is by default the moment it was most recently modified, but see below.
- u** Causes a different 'date' used for the previous two options: instead of time of modification, the date/time of most recent *access* will be used.

So the command will give a detailed and complete listing of the current directory, including inode info as well as owner, size, and date/time of most recent access. The listing will be sorted with the most recently accessed items first.

A typical line of output is as follows:

```
11703605 -rw-r--r-- 1 dblaheta staff 1773 Apr 11 15:29 hwk4.tex
```

The first number is the inode, not directly interpretable except as a unique identifier. The second piece is a representation of the permissions: in this case, the owner may read and write the file, while other members of the group (and anyone else) can only read it. Next comes the number of “hard links”, usually 1 for a regular file (but see below). Next we see that it is owned by user ‘dblaheta’ and group ‘staff’ (which may or may not be a group that ‘dblaheta’ is a member of). Then the file size in bytes (1773), the time of most recent access, and finally the filename.

A line showing a directory looks slightly different:

```
11685065 drwxr-xr-x 7 dblaheta staff 238 Apr 11 03:26 figs
```

The second element here begins with ‘d’ to show that it is a directory, and the ‘x’ elements that the user, group, and indeed anyone can ‘execute’ the directory—meaning that they can access its elements. The other difference is that the following item, here 7, shows the number of “hard links” to the directory, which for directories is often 2 plus the number of subdirectories, although there can be other factors that bring it up higher.

### Problem 4.2

Solution in course directory.

### Problem 4.3

Solution in course directory.