

UNIX AND X

by

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**An Introduction to Unix
and X Windows using Linux**

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An Introduction to Unix and X — Part I

At first mention, any technical term in this document is written in italics. The term *Public Workstation Facility* (PWF) is used in Cambridge to refer loosely to a Personal Computer (PC) together with its connection to a *network*. This document explains how to use a variant of Unix called *Linux* which may be implemented on a PC and which has, in particular, been implemented on PWFs in Cambridge. These PWFs also support Windows 2000.

1.1 Assumption

- It is assumed that you have a PWF account.

1.2 The Public Workstation Facility

- Sit down at a PC-based workstation. The main components are a *screen* (or *monitor*), a *computer*, a *keyboard* and a *mouse*. These are the most visible manifestations of a PWF. Note that any PWF can gain access to numerous other computers via the network and, by the same means, can make use of a variety of printers.
- Certain keys on the keyboard are engraved with cryptic symbols. Note particularly:
 1. The SHIFT-keys, each of which is engraved with an open up-arrow, `⇧`.
 2. The TAB-key which is engraved with a pair of arrows, `⇧⇧`.
 3. The RETURN-key is engraved with a bent left-arrow, `↵`.
 4. The BACKSPACE-key which is engraved with a straight left-arrow, `←`.
- The RETURN-key is normally pressed at the end of each line. It must not be confused with the **Enter**-key which is at the extreme right-hand end of the keyboard. This latter key *will never be used in this course*.
- The BACKSPACE-key is used for correcting mistakes; it cancels the character most recently keyed in.

1.3 Power

- It is local policy that the computers are *kept permanently switched on*. This saves time when you first sit down and also means that the state of the machines can be monitored remotely. An automatic power-save feature ensures that very little electricity is used when the computer is left unattended.

1.4 Installing PWF Linux

- Every user of the PWF has a different personal identifier and you need to be sure you know yours, as well as your password, before continuing.
- When you first sit at a free workstation the power-save feature may mean the screen is completely blank or just displays a small rectangular *window* dominated by the words Windows 2000 Professional. In either case move the mouse slightly. This should result the PWF Login window in which there is an invitation to press:

Ctrl+Alt+Delete to Login or Shutdown

- By default, the PWFs use a Microsoft Windows *operating system* (Windows 2000 currently). To use PWF Linux it is necessary to shut the PC down and start it afresh via the **Shutdown** facility. Begin with **Ctrl+Alt+Delete**...
- Press *and hold down* the **Ctrl**-key.
- Keeping the **Ctrl**-key held down, press *and hold down* the **Alt**-key.
- Keeping the **Ctrl**-key and **Alt**-key held down, momentarily press the **Delete**-key.
- The result on the screen should be a *message window* which refers to the Computer Misuse Act 1990 and other more recent legislation. It is important to read this notice.
- Now move the mouse. An arrow, called the *mouse pointer*, will move on the screen. Steer this pointer to the *button* marked **OK** and press the left-hand mouse button.
- This last action is called *clicking* and the instruction would normally be written simply as ‘click **OK**’. Always use the *left*-hand mouse button to click.
- The screen should soon display a new window with the *title* **Novell Login** in its *title bar* (the strip at the top). You must not login! Instead, click **Shutdown**, one of three buttons at the bottom of the window.
- A new window offers a choice of two options, **Shutdown** or **Shutdown and Restart**. Click **Shutdown and Restart** and then click **OK**.
- Be patient! It takes about a minute for the system to shut down and you are then invited to ‘select the operating system’ you wish to use. Press the **↓** key to *highlight* the second choice, **PWF Linux**, and press **RETURN**.
- Be even more patient! It takes over a minute to install PWF Linux after which you are presented with a window headed **Regulation of Investigatory Powers Act**.

1.5 Logging into PWF Linux

- The **Regulation of Investigatory Powers Act** window has three buttons at the bottom. Click **Login to PWF-Linux**
- You should now see the login window in which there are two obvious rectangular boxes into which your user identifier and password must be keyed.
- In the upper box, labelled **Login**, there should be an I-bar, a *text cursor*, indicating that any text keyed in will go into that box.
- Key your user identifier into this upper box and press **RETURN**. This should result in the text cursor moving to the lower box labelled **Password**.
- Key in your password. Nothing will appear in the box, so other people cannot see what you have typed. Press **RETURN** again.
- Eventually, the screen settles down to showing two windows in an otherwise featureless *root window*. (This is the Unix equivalent of the *desktop* in Microsoft terminology.)
- You have successfully logged into PWF Linux and have started an *X-session*. You are looking at two *X-windows*.
- One of the windows, probably at the top of the screen, has **PWF Message of the Day** in its title bar. You normally don’t need to take too much notice of the messages.

- The other window, probably at the bottom of the screen, is the Window Manager window. In particular, this incorporates a list of all the other windows in the root window, only one at the moment, the PWF Message of the Day window.
- Move the mouse around and notice how the mouse pointer takes on a variety of different appearances.
- When the mouse pointer is in the root window it has the form of a bold 'X'). When it is in the main part of the PWF Message of the Day window it takes the form of an I-bar. It can also take on the form of an arrow or a pointing hand and many other forms besides.

1.6 The Main Menu

- Click anywhere in the root window.
- This brings up the Main Menu. Notice that the first entry is Unix shell and the last entry is Logout.
- Click the Unix shell entry and a new window appears which has xterm in its title bar. Notice that xterm also appears as a new entry in the Window Manager window. This is the first example of an xterm window. Such windows are used for giving Unix *commands*.
- The writing is rather small. Bear with this for a few pages. Ways of changing the size of the writing will be discussed later.
- The window incorporates a Unix *prompt* which probably consists of the identifier of your PC, a colon, and your user identifier, and the whole has a dollar-sign appended.

1.7 Focusing

- Move the mouse pointer into the Message of the Day window and then into the xterm window and back again. Notice how the title bars and window edges change colour. The colour highlights a window to indicate that it is *in focus* or *selected*. Moreover, the entry in the Window Manager window which relates to a selected window is also highlighted.
- When the xterm window is in focus the text cursor after the prompt is in the form of a solid black box. When the window is out of focus, the text cursor is in the form of a hollow rectangle.
- Notice that when the mouse pointer is moved from the xterm window directly into the root window the xterm window does not lose focus. It loses focus only when the pointer is moved into the Message of the Day window.

1.8 Two Unix commands

- After making sure that the xterm window is in focus (the text cursor a solid block), key in the following *Unix command* and press RETURN:

date

- Unix is case sensitive, so it is important to type `date` and not `DATE` or `Date`.

- Any typing mistake which is noticed immediately can be corrected using `BACKSPACE`. It is almost always necessary to press `RETURN` after keying in a command. In the present case, the date and time are given.

- Try another command:

`who`

- The result is a list of people who are using your PC at the moment. You are likely to be the only user!

1.9 The `passwd` command

- To change your PWF password, begin by giving the `passwd` command:

`passwd`

- The system invites you to take part in three lines of dialogue, quoting your existing password, your new password and your new password again.

1.10 Finishing

- The approved way of finishing is to use the Main Menu. Click anywhere in the root window to bring up the Main Menu and click Logout.
- You will be asked Do you really want to logout? Click Logout.
- The screen goes blank briefly and then reverts to the Regulation of Investigatory Powers Act window. It is now in order to walk away from the PC if you feel like taking a break.
- You, or any other user, wishing to use this PC later can then click Login to PWF-Linux or Reboot for Microsoft Windows as appropriate.

An Introduction to Unix and X — Part II

Only three Unix commands were described in Part I. Here in Part II more of the numerous facilities available in PWF Linux will be introduced.




2.1 Logging in

- If you are continuing immediately from Part I your PC should still be showing the Regulation of Investigatory Powers Act window and you should click Login to PWF-Linux. Then log in as before.
- If you have been away some time, or have decided to use a different PC, you may be presented with the Ctrl+Alt+Delete invitation. You will have to install PWF Linux as described in Part I and then log in as before.



2.2 Moving a window

- Any window can be manipulated in various ways. For example it is easy to use the mouse to *move* a window. Move the mouse pointer to the middle of the title bar of the Message of the Day window (the pointer turns into an arrow) and press *and hold down* the left-hand mouse button (the pointer turns into a blob).
- *Keeping the button held down*, move the mouse a little to the right. Moving the mouse with the button held down is known as *dragging the mouse*. The appearance of the pointer changes again and, in this case, an outline of the window moves too. Move the outline so that it is central in the root window and release the button.
- The window jumps to the position the outline was dragged to just before the button was released.

2.3 Changing a window's size — I



- The title bar of the Message of the Day window is flanked by buttons, one on the left and three on the right. The middle button on the right  is used to make the window taller. Click the  button now.
- The window becomes much taller. Click the  button again and the window reverts to its previous size.

2.4 Iconifying and deiconifying


- If a window isn't needed for a while but you don't actually want to destroy it, you can *iconify* it. The leftmost of the three buttons on the right  is used to iconify the window. Click the  button now.
- Two things happen. The window disappears and a little blob appears against the relevant entry (at the moment the *only* entry) in the list of windows in the Window Manager window.
- To *deiconify* the window, click the entry in the Window Manager window (which then loses its blob) and the window reappears.

- A second way to iconify a window is to click the entry in the Window Manager window. Click this now. The window iconifies. Click the entry again and the window deiconifies.



2.5 The menu button

- The button  at the left-hand end of the title bar brings up a menu. Click  now. A drop-down menu appears. There are various entries including (De)Iconify. Click this entry and the window iconifies again.
- Try some experiments but leave the new window *deiconified*.

2.6 Changing a window's size — II

- There is a less coarse way of changing a window's size than clicking the  button. Move the mouse pointer into the root window below the Message of the Day Window. Check that the mouse pointer has the form of a bold 'X'.
- Next move the mouse pointer *very slowly* upwards into the window. The pointer takes on *two* intermediate appearances between being a bold 'X' and an I-bar. In the first of these appearances the mouse pointer takes the form of an underlined downward-pointing arrow. This draws attention to the bottom edge of the window.
- When the mouse pointer has this underlined downward-pointing arrow appearance, press and hold down the left-hand mouse button and drag the bottom edge downwards. When you release the button, the bottom edge of the window will have been dragged downwards thereby enlarging the window.
- The edge could equally have been dragged upwards to make the window smaller. Moreover, any of the four edges of the window may be dragged inwards or outwards in this way. Finally, all four corners may be dragged inwards or outwards too. Try some experiments.

2.7 Destroying a window

- The Message of the Day window is not going to be of any further use so it can be destroyed. Click the menu button and *notice but don't use* the Destroy entry. Clicking this entry would be one way to destroy the window but there is an alternative way...
- The rightmost button of the three buttons on the right  is used to destroy the window. Click  now. The window vanishes and cannot be brought back again. The reference in the Window Manager window disappears too.

2.8 The Main Menu — an xterm window

- The only obvious window now is the Window Manager window but don't forget that the rest of the screen is called the root window. Click, now, anywhere in the root window.
- This brings up the Main Menu whose first entry is Unix shell. Click this entry to create a new xterm window. As expected, this has xterm in its title bar and there is a corresponding entry in the Window Manager window.

- To check that all is well, select the new window and give the `date` command:

`date`

2.9 A second xterm window

- You can have several windows open at once. It is easy to create a second xterm window via the Main Menu but it is instructive to use an alternative approach. . .
- Being very careful to note the `&` give the following command:

`xterm &`

- A new window appears which is clearly another xterm window. Like the first, it has xterm in the title bar, and there is a second xterm entry in the Window Manager window. Ensure that the second window is clear of the first. Move the new window if necessary.
- You should notice in the first window that, following the `xterm &` command, there are two numbers. The second (which probably has four or five digits) is a Unix *process number*. It is usually unnecessary to take much notice of it but it is important to check that such a number has been quoted.
- Focus on the two xterm windows in turn and note how the highlighting of the title bars and edges changes and how the highlighting of the entries in the Window Manager window changes too. When the mouse pointer is in neither window, whichever was in focus most recently stays in focus.
- The new xterm window can, of course, be used for giving Unix commands. After making sure that the new window is in focus, give the `date` command again:

`date`

2.10 Raising and lowering windows

- It doesn't take long for there to be so many windows that there isn't enough space for all of them. Move the newer window (by dragging its title bar) so that it overlaps about half the older window.
- Focus on the two windows in turn. The effects are largely as before. Any command that is keyed in will appear in whichever window is in focus. It is perfectly possible to give a command from a window which is partially obscured. Try giving the `date` command from the partially obscured window:

`date`

- If nothing happens you probably forgot to include the `&` when you gave the `xterm &` command to create the new xterm window. Ignore this problem for the moment.
- Next, click the title bar of the partially obscured window. This action *raises* the window; it is now the turn of the other window to be partially obscured.
- Next, *double-click* the title bar of the window which is now on top (by clicking twice in quick succession without moving the mouse between the two clicks).
- This action *lowers* the window; it goes behind the other xterm window. Alternately clicking and double-clicking the title bar of a window alternately raises and lowers that window.

- Try some experiments but conclude with the new xterm window on top.

2.11 Removing the new xterm window

- Two ways of destroying a window have already been noted. You can click and choose the Destroy command or you can click . It is instructive to see a third approach. . .
- Focus on the new xterm window and key in Ctrl-d. The xterm window disappears and the relevant entry is removed from the Window Manager window.
- Focus on the original xterm window and press RETURN. A somewhat cryptic message including the word Done appears. This is simply to note that you have abandoned the new xterm window.

2.12 More about the & — background and foreground tasks

- It is instructive to see what happens if you forget the & when giving the command `xterm &` to create an xterm window. Focus on the original xterm window and, this time, deliberately omit the & when giving the command:

```
xterm
```

- A new xterm window is created but no Unix process number or prompt appears in the original xterm window. Move the new window clear if necessary.
- Focus on the new xterm window and give the `date` command:

```
date
```

- There should be no problems. Now focus on the original xterm window and give the `date` command again:

```
date
```

- This time nothing happens. When & is used to create a new xterm window, the system arranges for this new window to be run as a *background task*. This means one can focus on the old window and give Unix commands *even though the new xterm window continues in being*. Without the &, the new xterm window is a *foreground task* and no useful work can be carried out in the old window.
- Now remove the *new* xterm window by focusing on it and keying in Ctrl-d. When the window goes, the results of the `date` command at last appear in the old window.

2.13 Bigger writing in xterm windows

- The writing in the new xterm windows has been the same size as that in the original window. To make the writing bigger, first focus on the original window and then incorporate the items `-fn 9x15bold` between the `xterm` and the & when giving the `xterm` command (there is a space after `-fn` and *don't forget the &*):

```
xterm -fn 9x15bold &
```

- Unix keywords are usually introduced with a '-'. Here `-fn` stands for *fount* (English spelling!) and `9x15bold` is the name of one of many founts which are available. The writing in the new xterm window is somewhat easier to read.

- Give the `date` command in the new window:

```
date
```

2.14 Getting going — iconifying the original xterm window

- Different users have different ideas about how best to set up windows at the beginning of a session. After some experience everyone develops an individual style. For the moment, let's assume that you prefer the larger font in the new window and wish to work from that.
- The original xterm window is unlikely to be used again. You could remove it but it is better practice to iconify it. Iconify the original xterm window now.
- Move the new xterm window to the top left-hand corner of the root window.

2.15 The `ls` command

- The `ls` command is used to List and Sort one's *files*. After making sure that the xterm window is in focus, give this command:

```
ls
```

- At present, you have probably not set up any files explicitly but one or two files concerned with configuration might be listed. There may be a file with the name `Xrootenv.0` and this, and other configuration files, should be firmly left alone.

2.16 Setting up a text file — Emacs

- The next task is to set up a Unix file whose file name is `jobletter798` and whose contents are to be a rather silly letter!
- A standard way of setting up a file is to use the Emacs text editor. The easiest way to invoke this editor is to click the root window to bring up the Main Menu and point at the Editors entry. This invokes a sub-menu in which you will see `emacs (text editor)`. Click this entry.
- A new window appears which has `emacs` in its title bar and there is an appropriate new entry in the Window Manager window though this may be obscured.
- Move the `emacs` window to the top right-hand corner of the root window.
- The main part of the `emacs` window contains a welcome message. This contains useful information which you can read now or another time.
- Near the bottom of the `emacs` window is a highlighted *mode line* which indicates that the editor is in `Lisp Interaction` mode. This may one day be of significance but ignore it for the moment.
- The mode line begins `--:-- *scratch*` which implies that you haven't yet specified a file name. Temporary arrangements have been made in consequence.
- The word `All` simply indicates that the entire text fits in the window. The welcome message isn't very long.
- Click anywhere in the main part of the window and the welcome message is replaced by some instructions for creating a new file. In all Emacs documentation the abbreviation

C- is used for Ctrl- and so it is easy to see that the cryptic C-x C-f stands for Ctrl-x followed by Ctrl-f. When Emacs is under consideration, the abbreviation C- will be used for Ctrl- from now on.

- Emacs is a command driven editor and the keystrokes C-x C-f refer to the Emacs `find-file` command. The `x` refers to an extended list of Emacs commands and the `f` stands for `find-file`. The idea now is to *attempt* to find a file called `jobletter798` and hope to fail! [If you succeed in finding the file it would be an *old* file but you want to create a *new* file. You would therefore want to choose a different name.]
- With the emacs window still in focus, key in C-x (remember this means Ctrl-x) and notice that after a couple of seconds C-x- appears in the *echo line*, the line below the mode line. This is a reminder of what you have just keyed in.
- It is useful to know what to do if you key in C-x (or any other Emacs command) accidentally. Simply key in C-g. Try that now. The C-x- disappears. Now key in:

C-x C-f

- A message which begins `Find file` appears in the echo line. The cursor jumps to the end of that line where you should key in:
jobletter798
- Press RETURN. The `*scratch*` in the mode line changes to `jobletter798` and the echo line confirms that this is a `New file` so the file name has not already been used. The main part of the window clears and the cursor jumps to the top left-hand corner ready for you to key in the contents of this new file.
- Key in the following, *including the two spelling mistakes*, and *press RETURN at the end of every line*:

Dear sir,

I am sorry I did not turn up for the job interview last week, but there was a good horror film on the television and I did not want to miss it.

I am willing to come for a new interview on Wednesday afternoon next week, though I must leave by 4:30 to go to the football game.

I am an expurt in UNIX, particularly the game playing programs, so I would be a grate asset to your company.

yours sincerely,

- Immediately you begin typing, the `--:--` at the beginning of the mode line changes to `--:**` where the asterisks indicate that the text has changed.

- One imagines that this is a job application letter written by someone who wants to work as a Unix programmer. There are two deliberate mistakes and you may have made some yourself!
- As usual, any typing mistake which is noticed immediately can be corrected by using BACKSPACE. To correct a typing mistake made on a previous line, use the *text cursor keys* (those marked with ↑, ←, ↓ and →) to move the text cursor to just *after* the position of the error and delete from there before retyping.
- Try some experiments with the text cursor keys. See what happens when the ← or → key is used to move the text cursor off the left- or right-hand end of a line. Notice that if one of these keys (or indeed *any* key) is held down for more than a fraction of a second its effect is repeated, a feature known as *auto-repeat*. Double-check the text after finishing the experiments. *Leave in the two deliberate mistakes.*
- The next step is to save this letter as the contents of the file `jobletter798` (this applicant has had numerous previous unsuccessful attempts).
- Saving requires another extended Emacs command, the `save-buffer` command. The associated keystrokes are `C-x C-s` so key in:

```
C-x C-s
```

- The echo line displays a message which begins `Wrote` and which ends with the file name `jobletter798` to indicate that the file has been saved.
- The `--:**` in the mode line changes back to `--:--` to signify that the displayed text is the same as that in the file.

2.17 The `ls` command again

- Lower the emacs window (by double-clicking the title bar) and focus on the xterm window. List and Sort your files again:

```
ls
```

- This time the file name `jobletter798` should be listed.

2.18 Aside — bigger writing in Emacs

- The default font in the emacs window suits most users but, if you prefer larger writing, you can always set up an emacs window from an xterm window and supply the font information explicitly. From the xterm window, and noting the *essential &*, give the command:

```
emacs -fn 9x15bold &
```

- A new emacs window appears with the larger font.

2.19 Leaving Emacs — I

- There are several ways of leaving Emacs. One way is to click but this is *not* generally a good idea because the exit from Emacs is precipitous and you are not given a chance to save any files that have inadvertently been left open.
- The new emacs window has not yet been used so there is no harm in clicking this time. Do that now. The new emacs window disappears.

2.20 Leaving Emacs — II

- The approved way of leaving Emacs is to use an appropriate Emacs command. First raise the (original) emacs window (by single-clicking its title bar).
- The appropriate Emacs command is `save-buffers-kill-emacs` and the associated keystrokes are `C-x C-c` and it is probably easiest just to think of the `c` as meaning cancel Emacs. Key in:

```
C-x C-c
```

- A message (`No files need saving`) appears momentarily in the echo line and the window disappears.

2.21 The more command

- From the xterm window, give the command:

```
more jobletter798
```

- The `more` command is used for inspecting the contents of a file. Here, the contents of the `jobletter798` file should appear.

2.22 The spell command

- Focus on the xterm window and, carefully noting the `<` character, give the command:

```
spell <jobletter798
```

- The `spell` command gives a list of spelling mistakes in the file heralded by `<` which may be pronounced ‘from’. The list should include `expurt` but not `grate`.

2.23 Correcting the mistakes


- The obvious way to correct mistakes is to use Emacs. Enter Emacs again via the emacs entry in the Editors sub-menu of the Main Menu.
- Move the emacs window to the top right-hand corner of the root window.
- To open an existing file, use the Emacs `find-file` command exactly as it was used previously. The difference is that you are not proposing to set up a new file this time so you *want* to find the file.
- Key in `C-x C-f` again.
- The message which begins `Find file` appears in the echo line and the cursor jumps to the end of that line where you should again key in:

```
jobletter798
```

- Press RETURN. The letter reappears in the main part of the emacs window and the `*scratch*` again changes to `jobletter798` but there is no mention of `New file` in the echo line.
- Other things to notice are that the cursor jumps to the beginning of the letter and there are no asterisks in the mode line. Also `Lisp Interaction` changes to `Fundamental`; Emacs has decided that the file contains ordinary text.

- Correct the spelling mistakes. The asterisks reappear. You should next save the revised version in exactly the way you saved the earlier version by using the Emacs `save-buffer` command, so key in:

`C-x C-s`

- The echo line confirms that Emacs duly `Wrote` the text to the file.
- Leaving Emacs before giving the `spell` command and then immediately re-entering Emacs was fairly pointless! The reason for doing so here is to show how to open an existing file when using Emacs.
- It is much more common to set up an emacs window at the beginning of a session and keep it until the end. If you think you are unlikely to be doing any editing for a while, you should follow normal practice and simply iconify the emacs window. It will then be instantly available should you wish to use it later.
- Iconify Emacs now. Click the  button.

2.24 Some Emacs commands

- The following summary lists the Emacs commands that have been mentioned so far:

<code>C-g</code>	<code>keyboard-quit</code>	Go away, I didn't mean it
<code>C-x C-f</code>	<code>find-file</code>	Find (open) an existing file
<code>C-x C-s</code>	<code>save-buffer</code>	Save (update) an existing file
<code>C-x C-c</code>	<code>save-buffers-kill-emacs</code>	Cancel (leave) Emacs

[Remember that in Emacs documentation the abbreviation `C-` is used for `Ctrl-`]

- When used in a simple way, Emacs can be menu driven. With the exception of `C-g`, the commands listed in the summary can be found as entries in the `Files` menu. Against each entry, the associated keystrokes are shown.
- Whether to use menus or keystrokes is largely a matter of taste but note that by no means all Emacs commands can be found as entries in menus.

2.25 The `ls` command once more

- Focus on the xterm window and give the `ls` command again:

`ls`

- A new file name is listed. In addition to `jobletter798` there is `jobletter798~`. This new file contains a *back-up copy* of the previous version of the file. Emacs automatically backs up files in this way to protect you against possible accidents!

2.26 The `ls` command — dot files

- You might think that, at the moment, you have two files concerned with the job application plus one or two configuration files and no other files at all. Actually have a good many more configuration files which have been set up automatically. You may eventually learn how to modify these files but don't do this until you really understand what you are doing!

- For the moment it is of interest merely to see where these files are and to discover why the `ls` command hasn't revealed them. These files all begin with a dot and ordinarily the `ls` command doesn't list such files. If `ls` is followed by `-a` (`a` is for `all`) then the dot files *will* be listed. Give this modified command now:

```
ls -a
```

- A fair number of dot files are now listed in addition to the `jobletter` files you already know about. One dot file which doesn't exist just yet but which you may find a need to set up before long is `.emacs` which is a file for configuring Emacs to your own requirements.

2.27 The `cp` command

- It is unnecessary to know much about the dot files but there is just one of them which is missing at the moment but will eventually be needed if you are following this course. This is the file `.bash_profile` which should be copied into your file space now.
- It is safest to copy a definitive version from a special *file directory* `$CLTEACH/fhk1` (in which `$CLTEACH` is a Unix *environment variable* which provides a short-cut to the special directory) and you should use the following `cp` command (`cp` is for `copy`):

```
cp $CLTEACH/fhk1/.bash_profile .
```

- It is important to notice the dot and the *underscore* character in `.bash_profile` and that the command ends with a space followed by a lone dot. This lone dot refers to your file directory (in fact to your *home directory*) and the command as a whole is copying the `.bash_profile` file from the special directory to your home directory.
- If there is any sign of an error message, give the command again.

2.28 Finishing

- It is essential to finish in the approved manner...
- Choose `Logout` in the Main Menu. This will clear away all your windows including any which are iconified. When the `Regulation of Investigatory Powers Act` window appears it is safe to walk away from the PC. Do not switch off the PC or the monitor.

An Introduction to Unix and X — Part III

Here in Part III, further features of PWF Linux will be presented and a couple of very simple Java applications will be introduced.

3.1 Getting going

- Assuming a cold start, begin this and subsequent sessions by undertaking the following steps, which may be freely adapted as you develop your own style of working:
 1. Key in Ctrl+Alt+Delete.
 2. Click OK in the advisory message window.
 3. Click Shutdown in the Novell Login window.
 4. Select Shutdown and Restart and click OK in the Shutdown Computer window.
 5. Wait for the choice of operating systems, select PWF Linux, and press RETURN.
 6. Wait for the Regulation of Investigatory Powers Act window and click Login to PWF-Linux. Log in and destroy the PWF Message of the Day window.
 7. Bring up an xterm window and move it to the top left-hand corner of the root window.
 8. Bring up an emacs window and move it to the top right-hand corner of the root window.
- If there is no immediate intention to use Emacs, the emacs window should be iconified. This is the present case, so iconify the emacs window.
- The only window of consequence should be the xterm window. Check that this and the iconified emacs window are recorded as entries in the Window Manager window.

3.2 The cat command, standard input, standard output

- The cat command (short for ‘concatenate’) has many uses. In particular, there is a way of using it to copy the contents of one file to another file. Focus on the xterm window then, *carefully noting the < character and the > character*, give the command:

```
cat <jobletter798 >jobletter799
```
- Like many commands, the cat command requires *input* which comes *from* somewhere and produces *output* which goes *to* somewhere else. The characters < and > may be pronounced ‘from’ and ‘to’ respectively. In the present cat command:

```
input is taken from the file jobletter798 and
output is sent to the file jobletter799
```
- Both input and output have been specified explicitly. If no explicit output is specified for a command which produces output then results are sent to the *standard output* which simply means they appear in the xterm window immediately after the command. Give the command:

```
cat <jobletter799
```
- Here, input is from the file jobletter799 but output is to the standard output. The contents of the new file jobletter799 appear in the xterm window and are a direct copy of the contents of jobletter798.

- If no explicit input is specified for a command which requires input then input is taken from the *standard input*, meaning input from the keyboard. Give the command:

```
cat >jobletter800
```

- This time the system does not respond with a prompt; it is waiting for you to type the contents of the file. Key in:

```
Dear sir,  
Blah! Blah! Blah!
```

- Using the `cat` command in this way is an alternative to using Emacs for setting up a text file. It is normally better to use Emacs because mistakes can be corrected more easily. With the `cat` command, the cursor keys cannot be used.
- Key in `Ctrl-d` to terminate standard input. [You are not in Emacs so the abbreviation `C-d` is inappropriate but you may sometimes see `^d` used for `Ctrl-d`.] The `Ctrl-d` must be at the beginning of a line (just following `RETURN`). The system should reply with a prompt.
- It is here that a minor embarrassment could occur. If `Ctrl-d` is accidentally keyed in a second time, the window disappears. It can readily be recreated so no real harm is done but, on some versions of Unix, closing the principal `xterm` window precipitously logs you out. Accordingly, you should learn to take great care when keying in `Ctrl-d` and make sure that you key it in just once!
- Having noted that, by default, standard input is used for input and standard output is used for output, what happens if neither input nor output is specified? Give the `cat` command without any *arguments* (items following the command name):

```
cat
```

- The system is again expecting standard input (from the keyboard) so type some text:

```
The quick brown fox
```

- When `RETURN` is pressed, the system sends the line to the standard output (the window):

```
The quick brown fox
```

- The system doesn't give a prompt; it is waiting for more standard input. Type another line:

```
jumps over the lazy dog.
```

- The system sends the line to the standard output as before:

```
jumps over the lazy dog.
```

- Although it illustrates standard input and standard output, this exercise is not very useful! Key in `Ctrl-d` to quit from the `cat` command.
- So far, `<` has been used to indicate input *from* a file. This `<` can often be left out. Give the command:

```
cat jobletter799
```

- This works just as well as `cat <jobletter799` did earlier.

3.3 Local line editing

- If after a prompt in an xterm window you press the ↑ key then, instead of the text cursor moving up a line, the result is that the most recent command is reproduced. Try pressing the ↑ key now; the result is:

```
cat jobletter799
```

- The text cursor hovers at the end of the line. Use BACKSPACE to delete just the 799 and then key in 800 as a substitute. Now press RETURN, thereby giving the command:

```
cat jobletter800
```

- It is easy to make a more substantial change to the most recent command. First, press the ↑ key again, resulting in:

```
cat jobletter800
```

- Now use the ← key and BACKSPACE (these are two different keys) to delete cat and then key in spell and < to give the command:

```
spell <jobletter800
```

- Using the cursor keys and BACKSPACE to make changes to the line being typed is sometimes called *local line editing*.

3.4 History

- It is not just the most recent command which can be retrieved for editing. Try pressing the ↑ key six times *slowly*, pausing after each press to see the result. The six most recently given commands appear. Any of these could be edited if desired.
- Now press the ↓ key six times *slowly*. This brings you back to the present in stages. Using the ↑ and ↓ keys in this way is said to reveal *history*.

3.5 Geometry

- Give the following variant of the xterm command:

```
xterm -fn 9x15bold -geometry 80x28-0-0 &
```

- The -geometry item specifies four aspects of the new window:

80 is the width of the window measured in characters.

28 is the height of the window in lines.

-0 places the window on the right-hand side of the root window.

-0 places the window at the bottom of the root window.

- In summary, the 80x28 specifies the width and height of the window and the -0-0 causes the window to be placed in the bottom right-hand corner of the root window.
- Note that +0+0 would place the window in the top left-hand corner; -0+0 would place the window in the top right-hand corner and +0-0 would place the window in the bottom left-hand corner.
- There are other variations on the xterm command which are worth exploring so this first attempt will be abandoned. Ensure that the latest window is in focus and key in Ctrl-d to remove it.

3.6 Colours

- Focus on the `xterm` window and, using local line editing, give the command:

```
xterm -fn 9x15bold -geometry 80x28-0-0 -fg white -bg blue &
```
- The `-fg` item specifies a foreground colour and the `-bg` item specifies a background colour. The result will soon be clear. Most of the common colours are available. Try some further experiments. Conclude by leaving one `xterm` window in the top left-hand corner.

3.7 Java Programs — Introduction

- Java is an important programming language which is commonly used in Computer Science projects. Java is designed to be used across the Internet and is also designed for industrial-scale software projects.
- Java programs come in two forms, *applications* and *applets*. The latter are accessed via Web browsers or the `appletviewer` command and will not be discussed here. The two programs introduced in this document are both simple examples of Java applications.

3.8 A Java application — the source code

- The file name for any Java *source code* must be in two parts separated by a dot. In the first illustration, the name `ComeIn.java` will be used. Unix and Java are both *case sensitive* so it will be important to key in `ComeIn.java` and not `comein.java` or `Comein.Java` and so on.
- The part of the file name before the dot can be fairly freely chosen by the programmer but the remainder must be `.java` which is known as a file name *extension*.
- Before going any further, deiconify the `emacs` window. Next, focus on the main part of the `emacs` window and embark on a new file by keying in:

```
C-x C-f
```

- The cursor jumps to the end of the echo line where (paying attention to the upper and lower cases of the letters) you should key in:

```
ComeIn.java
```

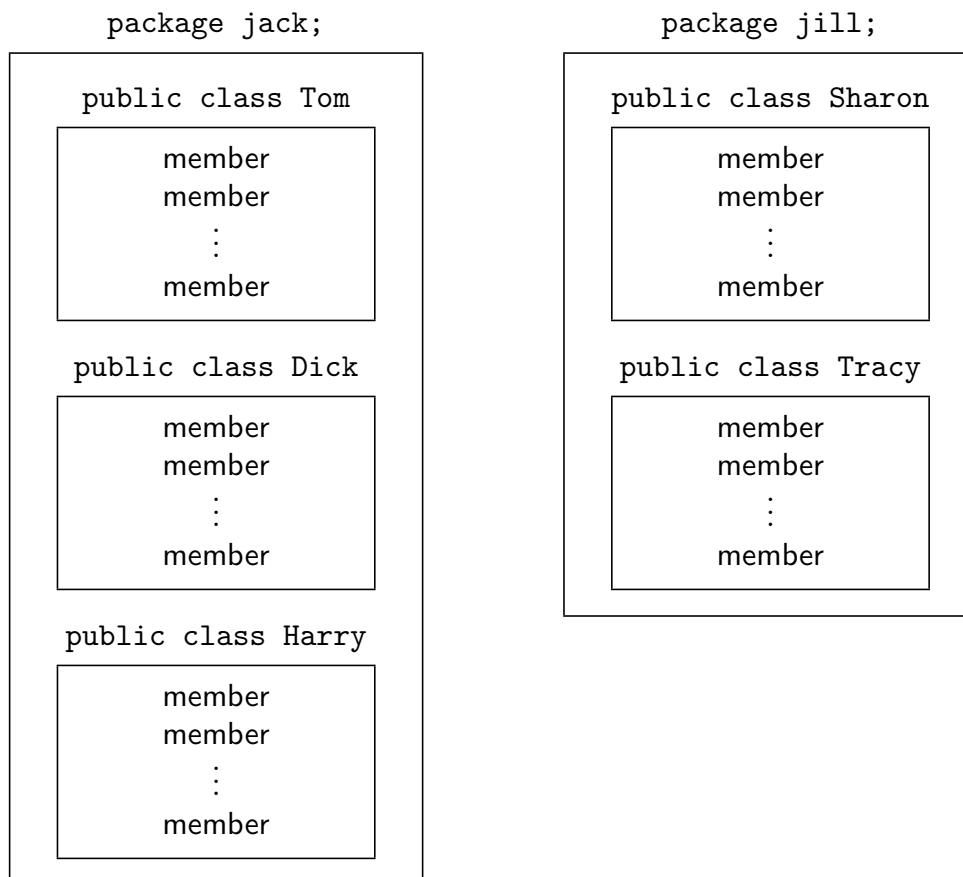
- Press RETURN. Check that the mode line confirms `ComeIn.java` and, also in the mode line, note that `Lisp Interaction` changes to `Java`.
- Now key in the following source code of a frivolous Java application:

```
public class ComeIn
{ public static void main(String[] args)
  { System.out.println("Come in number 57 please");
  }
}
```

- Be careful to write `public` and not `PUBLIC` or `Public` which won't work. Again, write `ComeIn` and not `comein` or `Comein` and, most important, write `String` and not `string`. Notice the semi-colon, the pair of square brackets, the two pairs of round brackets and the two pairs of vertically aligned curly brackets.

3.9 Java Programs — Outline syntax

- Java programs can be thought of as being arranged in various levels of wrapping. A big program will be divided into several *packages* and in each package there will be several *classes* and each class will consist of several *members*.
- To get some idea of the shape or *syntax* of a big Java program consider a diagrammatic representation of a program which is divided into two packages, one of which contains three classes and the other two classes:



- The diagram follows a Java convention that package names are normally written in lower-case letters but class names begin with an upper-case letter. The diagram loosely corresponds to the associated file structure. Every class is in a separate file and the class files in any particular package are in the same directory.
- A class may contain several different kinds of member and two of particular importance are *data fields* and *methods*. The introductory application is very short and consists of only a single class, `ComeIn`, which itself contains just one member, the method `main` which will be discussed shortly. The second application will include a data field.
- It is of minor note that the introductory application is *not* headed by a `package` statement. In consequence, the application will be regarded as belonging to some anonymous package. (In the present context, the anonymous package is, in effect, your home directory and the collection of class files that will accumulate in this directory.)

3.10 Java Programs — Syntax of a class definition

- A Java class definition consists of a *class heading* (conventionally written on a line by itself) followed by a *class body* which is enclosed in curly brackets.
- In a simple case the outline syntax of a class definition is:

```
public class class-name
{ member
  member
  :
}
```

- The keyword `class` in the class heading is preceded by the *public modifier* and this particular modifier ensures that the class is *visible* from other packages.

3.11 Java Programs — Syntax of a method definition

- A method in a Java class consists of a *method heading* (also conventionally written on a line by itself) followed by a *method body* which is enclosed in curly brackets:

```
modifiers method-type method-name(arguments)
{ statement
  statement
  :
}
```

- The word `method` stems from the terminology of *object-oriented* programming, Java being an object-oriented programming language. Close parallels of methods are found in almost all programming languages where equivalent entities may be referred to as functions, procedures or subroutines.
- There is a requirement that exactly one class in any Java application includes the method `main` and, moreover, the `main` method must always be heralded by the two modifiers `public` and `static`.
- A full understanding of these two modifiers will come with experience but, roughly speaking, the `public` modifier makes the method visible from outside the class (in particular by the *run-time system* which supervises the running of the program) and the `static` modifier ensures that the method is available for immediate execution.
- A typical method concludes execution by delivering some value as a *result*, perhaps an integer number. The *type* of the result determines the type of the method itself. Some methods do not deliver a result and in such cases the type of the method is deemed `void`. This is the case with the `main` method.
- The *arguments* of a method are enclosed in round brackets. The method `main` has a single argument whose type is a `String` array (written `String[]`). The name of the argument is `args`. When a Java application is run, the method `main` is handed any items such as file names which may appear on the command line. Each such item has type `String` (a sequence of characters) and each will be assigned to an element of the `args` array.

3.12 Printing a String

- In general, a method body incorporates a sequence of *statements* enclosed in curly brackets. In the introductory application, there is only one statement in the body and this prints out the `String` constant "Come in number 57 please".
- Printing is achieved via the somewhat ponderous syntax:

```
System.out.println(string-to-be-printed);
```

- Once again, a full understanding of this will come with experience and only a brief explanation is worthwhile now. There are numerous built-in packages in Java which contain facilities for standard operations like input-output. One such package is `java.lang` which includes the `System` class. This class has a data field `out` which, in turn, has access to the method `println`.
- The three items `System`, `out` and `println` are written as a continuous sequence with dots as separators. A `String` constant is enclosed between double-quotes and is handed to the `println` method as an argument (which is why it is in round brackets). The statement as a whole must be terminated with a semi-colon.
- When the application is run, `println` causes the `String` to be terminated with an end-of-line character. An alternative, `print` (without `ln`), is available if no end-of-line character is required.

3.13 Saving the Java application

- The rules for the file name the source code can now be clarified. The first part of the file name must exactly match the class-name and `.java` must be used as the file name extension. Clearly `ComeIn.java` is the appropriate file name here.
- The quickest way to give the Emacs `save-buffer` command is to use the keystrokes `C-x C-s` but it is instructive to give an Emacs command the slow way...
- In Emacs documentation `C-something` stands for `Ctrl-something`. Additionally there is `M-something` which stands for `Meta-something`. Few keyboards have a key which is actually marked `Meta` and on a PWF you should use `Esc`. [On some other workstations `Alt` may be the appropriate key.]
- Where `Esc` is used to key in `M-x`, you must press *and release* `Esc` before pressing `x`; thus `Esc` and `x` are pressed in turn and not together. [At terminals where `Alt` is appropriate, use `Alt` rather like `Ctrl`: hold the key down and then tap `x`.]
- Key in `M-x` by whichever means is appropriate. Note that `M-x` appears in the echo line. Strictly, this is the Emacs `execute-extended-command` command. It means that you can now key in the full name of *any* Emacs command. Key in:

```
save-buffer
```

- Emacs is another system which is case sensitive so be careful what you key in.
- Focus on the `xterm` window and give the command:

```
ls
```

- You should see the file `ComeIn.java` listed alongside the `jobletter` files.

3.14 Compiling the Java application

- To be useful, a Java application must be *compiled* and then *run*.
- Focus on the xterm window, and give the command:

```
javac ComeIn.java
```

- Notice that the `.java` file name extension must be quoted.
- The `javac` command invokes the Java *compiler*.
- If you made any mistakes when keying in the application the compiler will complain! With luck any complaint will be helpful. If there are any complaints the source code must be corrected, saved again, and the `javac` command repeated. Keep going until there are no complaints!
- The compiled code of any Java class goes to a file whose name consists of the class name followed by a `.class` extension. Give the command:

```
ls
```

- Check that the file `ComeIn.class` is listed.

3.15 Running the Java application

- The Java compiler does not generate code which is ready for immediate linking, loading and running. Instead, the compiler generates *bytecode* for the Java Virtual Machine (JVM). The JVM can be regarded as an *interpreter* with a *run-time system*.
- It is the `java` command which invokes the Java interpreter. Key in:

```
java ComeIn
```

- Notice that the `.class` file name extension must *not* be quoted.
- The bytecode is duly interpreted and this will involve, at run-time, the dynamic loading of input–output facilities (and, in general, other facilities besides). Ordinary linking does not occur in Java.
- The output should be `Come in number 57 please` and this should be followed by a Unix prompt.

3.16 A second application

- The second illustration will be sufficiently like the first that the easiest way to proceed is to edit the source code of `ComeIn.java` in Emacs.
- Focus on the emacs window and modify the source code to the following:

```
public class ComeAgain
{ private static int n;

    public static void main(String[] args)
    { n = 57;
      System.out.println("Come in number " + n + " please");
    }
}
```


- The application again consists of a single class, this time called `ComeAgain` so the first line will need changing. The new class incorporates a data field as well as a method.
- The `private static int n;` *declares* a data field whose name is `n` and whose type is `int` (a whole number). The `private` modifier is at the other extreme from `public` and restricts the visibility of the data field to within the class only. This is fine given that the only reference to `n` is from the method `main`. The `static` modifier is essential and ensures that the data field is accessible. The semi-colon terminator is mandatory.
- The `main` method includes the assignment statement `n = 57;` which gives a value to the data field. An assignment statement must also be terminated with a semi-colon.
- The argument of the `println` statement has been split into three separate strings which are joined into a single string by the use of `+`, the Java string concatenation operator. The middle item of the three, `n`, is of course of type `int` but when an `int` is seen in a `String` context it is automatically converted to `String` type. Thus the value of the `int n`, `57`, is changed to the `String "57"`.
- Notice that the first of the three strings ends with a space (after `number`) and the last of the three begins with a space (before `please`). These spaces ensure that there is a space either side of the `"57"` in the output.
- You should *not* use the Emacs `save-buffer` command to save this source code because that will overwrite the `ComeIn.java` file. You should use the Emacs `write-file` command instead. Its associated keystrokes are `C-x C-w` so key in:

```
C-x C-w
```

- The message in the echo line begins `Write file` and, at the end of this line, key in:

```
ComeAgain.java
```

- Focus on the xterm window and compile the new application:

```
javac ComeAgain.java
```

- Assuming there are no complaints, run the compiled code:

```
java ComeAgain
```

- The output should be `Come in number 57 please` as before.
- This second application is somewhat contrived. Its principal purpose is to present a class which contains a data field and a method, the two most important kinds of class member. Typically, classes contain several data fields and several methods.

3.17 Layout

- Readers who have studied Java before, however cursorily, will have noticed that the layout used in the two examples is somewhat idiosyncratic.
- The layout employed in most text books follows a style adopted in the early days of C when only primitive editors were available, a poor precedent! Source code is much easier to understand if matching curly brackets are vertically aligned.
- In the illustrations above, each level of indentation involves shifting the code an extra three spaces to the right. Every curly bracket is centred with respect to a three-space gap. Whatever style you choose, note that good layout greatly improves readability.

3.18 Emacs buffers

- Focus again on the emacs window.
- At the moment Emacs is displaying the new source code. The source code of the first application has not been lost because it was saved in a different file. To retrieve the earlier code, key in:

```
C-x C-f
```

- Then key in the file name `ComeIn.java` and press RETURN.
- The previous source code should appear.
- Although Emacs is now displaying just the old version, both files are open. The two lots of source code are in separate Emacs *buffers*. To see what buffers exist, give the `list-buffers` command. Key in:

```
C-x C-b
```

- The emacs window splits into two half-size windows. The old source code is in the upper and a list of buffers is in the lower. The list includes `ComeIn.java` and `ComeAgain.java` as well as `*Buffer List*` which is the buffer containing the list.
- Note that the text cursor is in the upper of the two windows. To get rid of the lower window, give the `delete-other-windows` command. This uses the digit-1 key *without* Ctrl. Key in:

```
C-x 1
```

- To bring the `ComeAgain.java` buffer back as the displayed buffer, give the `switch-to-buffer` command. This uses the `b` key, again *without* Ctrl. Key in:

```
C-x b
```

- The message in the echo line should indicate that Emacs will, by default, switch to the `ComeAgain.java` buffer. If this *isn't* the default, you can key in `ComeAgain.java` explicitly. Press RETURN.
- The new source code should reappear in the emacs window and `ComeAgain.java` should appear in the mode line.

3.19 The cal command

- No use will be made of Emacs for a while so iconify the emacs window.
- Almost all commands that have appeared so far have produced results which have been sent to the standard output. The `java` command is no exception. Here is another example. From the xterm window give the command:

```
cal 1900
```

- The calendar for all 12 months of 1900 is displayed but there is a snag. The xterm window is probably too small to accommodate the whole of the standard output and the first part of the calendar runs off the top of the window. There are various ways of dealing with this problem ...

3.20 The scroll bar

- Along the left-hand edge of the xterm window, there is a narrow column, the lower part of which is highlighted by a vertical stripe. This stripe is called the *scroll bar* and the height of the scroll bar relative to the height of the column indicates the proportion of the text which is in the window compared with the amount which has run off the top but is still accessible.
- Move the mouse pointer to somewhere a little below the top of the scroll bar and press *and hold down* the middle mouse button. *Keeping the middle button held down*, move the mouse pointer slowly upwards. Notice that the text in the window moves downwards; this is called *scrolling* the window. All the earlier months of 1900 can be brought back. Release the middle button.
- Pressing RETURN results in an abrupt jump to the end of the text. Try this.
- Each of the mouse buttons has a different effect on the scroll bar. Experimentation is advised.

3.21 Sending output to a file

- From the xterm window, press RETURN and then give the following version of the `cal` command:

```
cal 1900 >then
```

- The calendar for 1900 goes to the file `then`.
- This may not immediately seem to be helpful since if you inspect the contents of the file `then` using the `cat` command the calendar still won't fit:

```
cat then
```

- Resorting to the scroll bar is unnecessary because the `more` command (this was first used in section 2.21) can be exploited. Using the `more` command, a file can be looked at one windowful at a time. Try:

```
more then
```

- Only as many lines appear as will fit and there is a note of what percentage of the text this is. Press RETURN repeatedly to advance through the text one line at a time. To advance through the text one windowful at a time, repeatedly press the SPACE-BAR.

3.22 Pipes

- A *pipe* is a sequence of commands which are strung together so that the output of one command becomes the input of the next. The commands are separated by vertical bars (note that the vertical bar key is next to the Z key). An example of a pipe is:

```
cal 1900 | more
```

- The output from the command to the left of the `|` becomes the input of the command to the right of the `|`. This example of a pipe is quicker than typing `cal 1900 >then` followed by `more then` which not only involves keying in two lines but introduces the file `then` which isn't needed when a pipe is used.

- The `more` command again causes the display to pause after a windowful but notice that no percentage is quoted because `more` doesn't know how much more there is to come. As before, press the SPACE-BAR to see the rest of the text.

- A second example of a pipe is:

```
cal 1900 | cat >then
```

- The output of the `cal` command is piped to the input of the `cat` command. The output of the `cat` command goes a new file `then`. Note that this is a silly example because it would have been better to use `cal 1900 >then` alone!

3.23 Highlighting and copying text

- Suppose you wish to set up a file containing just the first three months of 1900. Clearly you could use Emacs to edit the file `then` but it is quicker to use the *highlighting* feature of X.

- Give the `more` command again:

```
more then
```

- Just the first part of the file appears in the window. Now quit from the `more` command without inspecting the whole file: simply press `q` (for quit).

- Next use the `cat` command to embark on keying in a new file `jfm` (for January, February and March):

```
cat >jfm
```

- Press RETURN. Notice that the text cursor is in position ready for you to key in the first line of the required text but don't do that. Instead proceed as follows...

- Move the mouse pointer to the beginning of the line on which `January` is written. Press the *left-hand* button. Then, move the mouse pointer to the beginning of the line on which `April` is written and press the *right-hand* button.

- The use of the left- and right-hand buttons in this way highlights a *region* of text. Highlighted regions of text can be copied to the place marked by the text cursor and just now the text cursor is at the bottom of the window.

- To copy the highlighted text, simply press the *middle* button. The copy appears at the bottom of the window as standard input for the `cat` command. Key in Ctrl-d to terminate the input.

- To turn the highlighting off, click the mouse anywhere in the `xterm` window.

- To check the effect of what you have just done, clear the window and inspect the contents of the new file:

```
clear
```

```
cat jfm
```

- Note that highlighted regions do not have to be large chunks of text. Single sentences or even single words can be highlighted and copied. Note, further, that text which is highlighted in one window can be copied to another window.

3.24 Highlighting rules

- To highlight a region of text:
Press the Left mouse button at the beginning of the region
Press the Right mouse button at the end of the region
- To copy a highlighted region of text to the position marked by the text cursor:
Press the Middle mouse button

3.25 Completion in Emacs

- Emacs has many hundreds of features and it is worth trying out just a few more in this introductory document.
- First, deiconify Emacs. The Java source code is still in the window. Bring back the `jobletter798` file instead. Begin with:
`C-x C-f`
- This invokes the `find-file` command. The cursor jumps to the end of the echo line where you could key in `jobletter798` but it is unnecessary to key this in in full. *Without pressing* RETURN just key in the first letter:
`j`
- Now press the SPACE-BAR. The window splits and all files which begin with `j` are listed in the bottom half; these are the possible *completions*. As well as `jfm` there are four file names which begin `jobletter`. Now just key in the single letter `o` and press the SPACE-BAR again:
`o SPACE-BAR`
- Emacs now knows enough to complete as far as `jobletter` but it still doesn't know exactly what you want. You have to key in:
`798`
- Press RETURN and the file's contents duly appear.

3.26 Clicking the mouse in Emacs

- Click the first `y` of `yours sincerely`. The text cursor jumps to the position of the mouse pointer. This is an alternative to using the cursor keys.
- If you press BACKSPACE you will, of course, delete the character to the left of the `y`, probably a space. To delete the `y` without first moving the cursor, key in:
`C-d`
- This is the `delete-char` command and deletes the character the cursor is on rather than the one to its left. Now key in an upper-case `Y` instead:
`Y`
- In a similar way change the `s` of `sir` to an upper-case `S` (or make it lower case if it already is upper case!).

3.27 The Emacs undo command

- A mistake can be undone using the Emacs `undo` command. Emacs documentation gives `C-_` for this but notice that as well as the usual use of `Ctrl` you will probably need to use `SHIFT` for the *underscore* character. That said, key in `C-_` *four* times very slowly to see the effect:

`C-_ C-_ C-_ C-_`

- Not only does this negate the earlier changes but, assuming those were the *only* changes, the two asterisks in the mode line disappear to indicate that the text has not been changed since the file was opened.

3.28 Emacs kill and yank

- Click the `D` of `Dear` and key in:

`C-k`

- This is the `kill-line` command. The `Dear sir`, goes blank. To get rid of this blank line, give another:

`C-k`

- Killed text goes to the *kill-buffer* and can be brought back. Try:

`C-y`

- This is the `yank` command. Anything in the kill-buffer is yanked back.
- Kill and yank can be used as *cut and paste* in a word processor. Click the `I` at the beginning of the final paragraph and then give the `kill-line` command *five* times:

`C-k C-k C-k C-k C-k`

- The first four kill the two lines of the paragraph and the last kills the blank line before `yours sincerely`. Next click the `I` at the beginning of what has just become the final paragraph and then yank back the killed text:

`C-y`

3.29 Filling

- Click the `c` of `company`. Then, *including the spelling mistakes and without pressing RETURN*, key in:

`spendid, manificent and most whizzo`

- [After `whizzo` there should be a space.] When a line gets to the edge of the window a backstroke character appears and the text carries onto the next line down. Clearly this is all a bit of a mess so, remembering that `M` means *Meta* (and on a PWF this means using `Esc`), key in:

`M-q`

- This is the `fill-paragraph` command. It tidies up the paragraph so that each line runs up as close to column 70 as possible without going beyond column 70.
- Click somewhere in each of the other two paragraphs in turn and key `M-q` in each. All three paragraphs should now be filled to 70 characters.

3.30 Key bindings in Emacs

- Most commonly-used Emacs commands can be given in a slow way and in a quick way. The slow way involves keying in the command name as was demonstrated for `save-buffer` in section 3.13. It is much quicker to key in `C-x C-s`. This short version is called a *key binding*.

3.31 Commands without key bindings

- A good way to check spelling is to give the Emacs `ispell-buffer` command. This is the first Emacs command for which there is *no* key binding. It *has* to be given the long way. To give a command by keying in its full name you always begin by:

`M-x`

- In principle you now key in `ispell-buffer` but fortunately the Emacs completion facility can again save you effort. Key in as far as the `p` of `ispell`:

`isp` SPACE-BAR

- On pressing the SPACE-BAR Emacs supplies `ell-` and you now continue:

`b` SPACE-BAR

- This time Emacs supplies `uffer`. Press RETURN and the Emacs spell-checker is invoked. Very likely the first word to be queried will be `spendid`. This word is highlighted and suggested correct versions appear at the top of the window. A message in the echo line explains how to get further information.

- The suggestions at the top are numbered (0), (1), etc. and, assuming one of these suggestions is acceptable, you key in the appropriate number. Very likely you key in:

`2`

- The spell-checker then notes the next error, probably `manificent`, and again there are numbered suggestions. This time you probably need to key in:

`1`

- The spell-checker probably queries `whizzo` next and is again likely to suggest some alternatives. If you want to change the word but are not happy with any of the suggestions key in:

`r`

- Note that `r` stands for `replace`. The offending word appears in the echo line. Edit `whizzo` in the echo line (use the BACKSPACE-key) so that it is replaced by:

`wizard`

- Press RETURN and the replacement takes effect. If you *are* happy with the spelling of a word that has been queried simply press the SPACE-BAR to leave the word unchanged.

3.32 Automatic filling of paragraphs

- The Emacs `auto-fill-mode` command saves you from having to key `M-q` in every paragraph. There is no key binding for this command so, using completion, go:

`M-x au` SPACE-BAR `f` SPACE-BAR `m` SPACE-BAR

- Press RETURN and, from now on, paragraph filling will be automatic. Note `Fill` appears in the mode line. To see what this means, first:

Click the `.` at the end of `football game`.

- Move the cursor one place right and continue, *on the same line*, by keying in a new sentence:

`It's a needle match that day and I simply must watch it.`

- The line now splits at a sensible place and there is no backstroke character.

3.33 Emacs conclusion

- This is sufficient Emacs for one session. Follow usual practice: don't leave Emacs, simply save the latest version of the file and iconify the window. First save the file:

`C-x C-s`

- Now iconify Emacs. Note that there is a summary of the Emacs commands used in this document on page 32.

3.34 Checking the files

- Focus on the xterm window and check the entries in your home directory alone:

`ls`

- There should now be about a dozen entries, about half of which relate to your Java programs. These include the source files (which have the `.java` extension), possible back-up files (which end `.java~`) and also the class files (which have the `.class` extension).
- To delete a file, use the `rm` command (standing for `remove`). For example, to delete the file `jobletter798~` give the command:

`rm jobletter798~`

- Give the `ls` command to check that the file has been removed.

3.35 The `xlsfonts` and `xfd` commands

- To see what founts are available, give the `xlsfonts` command. (The absence of the letter 'u' is a consequence of American spelling!) Since there are several hundred founts, the output should be piped to the `more` command:

`xlsfonts | more`

- There really are hundreds! To see them all keep pressing the SPACE-BAR. If you get tired, you can quit from the `more` command by pressing `q`.
- To gain a quick impression of what a given fount looks like, use the `xfd` command. For example, to look at the `r24` fount give the command:

`xfd -fn r24 &`

- A table showing the characters in the `r24` fount appears. This is a *fixed-pitch* fount (all the characters are the same width) and fairly large. When finished, click `Quit` near the top-left hand corner of the `xfd` window.

- Two other fonts are worth a brief look, 5x8 (very small) and 9x15 (the unbold version of 9x15bold).

3.36 The Window Ops menu

- Suppose you want to move the Window Manager window. It has no title bar and so the usual approach is not available. To move this window you first have to invoke the Window Ops menu by clicking *with the middle mouse button* anywhere in the root window. Choose the Move entry from the Window Ops menu.
- Move the mouse pointer into the Window Manager window and then, using the usual left-hand button, drag the window to a new position.
- Focus on the xterm window and give the `xterm &` command to create a new xterm window:

```
xterm &
```

- Middle-click again anywhere in the root window to invoke the Window Ops menu. Choose the Destroy option and then click anywhere in the new xterm window.
- A somewhat incomprehensible note appears in the old xterm window. This is a cryptic explanation of what has just happened to the new window.
- Press RETURN in the surviving xterm window to produce a prompt.

3.37 Destroying windows

- The Destroy option can be used to destroy almost *any* window in an emergency. It won't often be necessary to use this facility but if a window appears to be stuck in some way or perhaps you have got into a mess in Emacs then this facility can be used as a last resort.

3.38 Driving Test

- On the last page of this document there is a driving test in which you have to exercise some of the facilities that have been introduced. If you have worked through this far the driving test should not be much of a challenge. Complete this test before finishing.

3.39 Finishing

- End the session in the approved manner. Chose Logout from the Main Menu and wait for the Regulation of Investigatory Powers Act window to appear before leaving the PC. Do not switch off the PC or the monitor.

3.40 Postscript A — HWM and Motif

- Throughout this document a standard Window Manager has been assumed. There are other window managers available, each with numerous facilities for configuring to suit individual taste. Popular alternative window managers include the Hummingbird Window Manager (HWM) and Motif.

3.41 Postscript B — Emacs commands

- In the following summary, the Emacs commands which have been mentioned in this document are shown in what is likely to be, very roughly, decreasing order of frequency of use. Since you are advised not to leave Emacs, **C-x C-c** is last in the list.
- The three columns show key bindings (where available), the full formal names of the commands and an informal description:

C-x C-f	<code>find-file</code>	Find (open) an existing file
C-x C-s	<code>save-buffer</code>	Save (update) an existing file
C-x C-w	<code>write-file</code>	Write a new file
C-_	<code>undo</code>	Undo a command
C-g	<code>keyboard-quit</code>	Go away, I didn't mean it
C-d	<code>delete-char</code>	Delete a character
C-k	<code>kill-line</code>	Delete from the cursor rightwards
C-y	<code>yank</code>	Bring back killed text
M-q	<code>fill-paragraph</code>	Tidy up a paragraph
M-x	<code>execute-extended-command</code>	For giving a command the long way
C-x C-b	<code>list-buffers</code>	List the buffers
C-x 1	<code>delete-other-windows</code>	Get rid of other Emacs windows
C-x b	<code>switch-to-buffer</code>	Change to another buffer
	<code>ispell-buffer</code>	Invoke the spell-checker
	<code>auto-fill-mode</code>	For automatic tidying of paragraphs
C-x C-c	<code>save-buffers-kill-emacs</code>	Cancel (leave) Emacs

3.42 Postscript C — Remote use of PWF Linux

- As most readers will know, a considerable amount of information relevant to teaching is available via the Computer Laboratory web site <http://www.cl.cam.ac.uk/>. Select the link `Taught courses` and scroll down to `Resource material` where you will find further links about PWF Linux.
- The link `Information about accessing the PWF remotely` advises that if you have access to a PWF Workstation running PWF Linux then use that, but...
- It is further explained that if you don't have access to a PWF Workstation running Linux then remote access to a shared facility is available. There are various ways of achieving this access and you should have no trouble understanding the explanation given.

An Introduction to Unix and X — Driving Test

To acquire a ‘tick’ for the above, work through the following steps to produce a printout whose appearance is like the lower half of this page:

- Edit your `ComeAgain.java` file so as to incorporate two Java comment lines at the beginning as in the version of `ComeAgain.java` shown below. Use your name and suitable times.
- Save the amended source code and check that it compiles by using the `javac` command.
- Give the three commands shown below after `pccl1520:C299$` prompts: these are the `more` command, the `javac` command and the `java` command.
- Next (and not shown on the lower half of this page) give the `cat` command to embark on a new file:

```
cat >tick
```

- Highlight and copy the mini-session (as described in section 3.23) so that it forms the contents of the file `tick`. Terminate `cat` with `Ctrl-d`. Use Emacs to edit the file `tick` so that there is one blank line before each line which begins with a prompt.
- Print the file by giving the following `lpr` command:

```
lpr -Pcl_co4_lj tick
```

- The output should appear on a printer in Cockcroft 4 whose name is `cs_co4_lj`. Apart from the prompts and your name and timings, the output should appear exactly as that below. Take it to Miss Northeast who may award a tick.

```
pccl1520:C299$ more ComeAgain.java
//  JAVA ASSESSED EXERCISES.  SUBMISSION 1 FROM F.H. KING.
//  Estimated time to complete: 30 mins.  Actual time: 1 hour.
```

```
public class ComeAgain
{ private static int n;

    public static void main(String[] args)
    { n = 57;
      System.out.println("Come in number " + n + " please");
    }
}
```

```
pccl1520:C299$ javac ComeAgain.java
```

```
pccl1520:C299$ java ComeAgain
Come in number 57 please
```