Software Installation and using Command Line Interfaces

COMP1048: Databases and Interfaces (2024-2025)

Matthew Pike & Yuan Yao

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Lab Overview

This lab will introduce you to command line interfaces (CLIs) and the software you will need to complete the labs and assignments for this module. The lab is divided into two parts.

In Part 1 we will install the software you will need to complete the labs and assignments for this module. This part is very important, so please follow the instructions carefully and ask for help if you need it.

Part 2 focuses on interacting with various tools through the CLI. A solid grasp of CLI usage is a key-skill for this and other computer science modules, so ensure you understand this lab's content thoroughly.

1 Software Installation

This section covers the installation of software for completing the module's labs and assignments. These are recommendations, and you may use alternative software if you prefer. For those unfamiliar with this type of software, we suggest following our recommendations.

1.1 Code Editor

You cannot use Microsoft Word to write code. You will need to install a suitable code editor for writing code. Many code editors are available, but we recommend two options for this module. You only need to install one of these:

- Sublime Text - https://www.sublimetext.com/
- Visual Studio Code - https://code.visualstudio.com/

1.2 Web Browser

For the "Interfaces" section of this module, you'll need a web browser to view the web pages and applications you create. While many web browsers are available, we suggest using one of the following. These browsers are recommended for their useful developer tools, which you'll need later in the module.

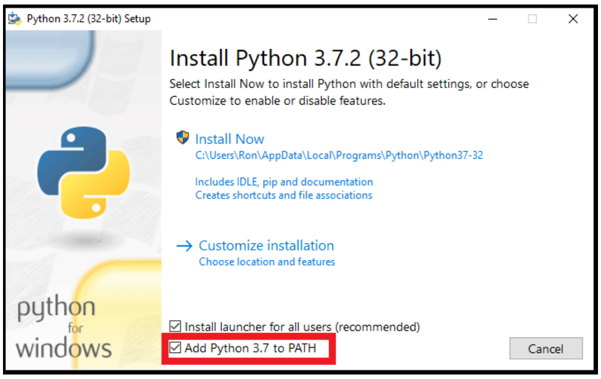
- Google Chrome - https://www.google.com/chrome/
- Mozilla Firefox - https://www.mozilla.org/en-GB/firefox/new/

1.3 Python

Python is a versatile programming language that we'll use to create web applications. You'll need to install Python version 3.8 or higher. You can download Python from the official website: https://www.python.org/downloads/.

! A common issue for Windows Users - Please pay attention!

When installing Python, select the option to add Python to your PATH, as shown in Figure 1. This allows you to run Python from the command line. Your Python version may differ from the one in Figure 1. This is acceptable, provided it's version 3.8 or later.



Python 3.7.2 (32-bit) Setup

Install Python 3.7.2 (32-bit)

Select Install Now to install Python with default settings, or choose Customize to enable or disable features.

C:\Users\Ron\AppData\Local\Programs\Python\Python37-32

Includes IDLE, pip and documentation
Creates shortcuts and file associations

Choose location and features

☑ Install launcher for all users (recommended)
☑ Add Python 3.7 to PATH

Figure 1: Remember to select "Add Python X.X to PATH".

1.4 Flask

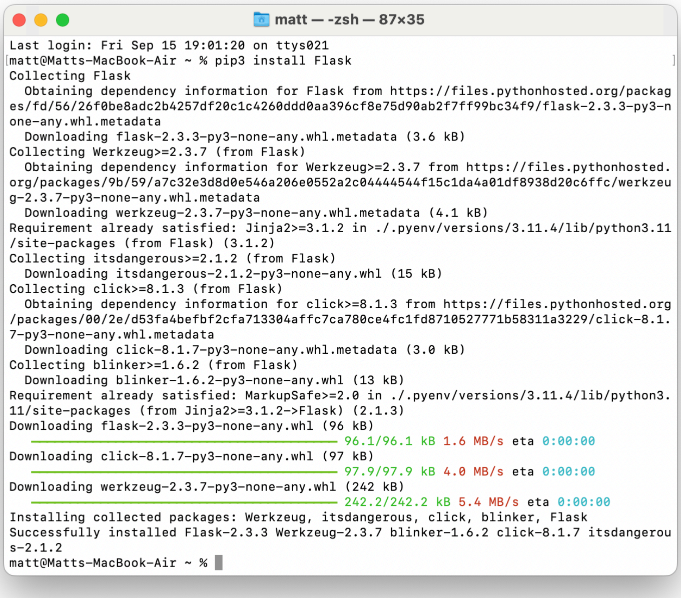
! Python must be installed first

Install Python before Flask. Flask is a Python library and requires Python to be installed first.

Flask is a Python library we'll use to build web applications. Install Flask using the `pip3 install` command in your CLI (see Section 2.1 for CLI access instructions for your operating system). Note that Flask is written with a capital "F".

```
pip3 install Flask
```

This command installs Flask and its dependencies. Your output should be similar to Figure 2. Some differences in the output are normal, as long as there are no errors.



```
Last login: Fri Sep 15 19:01:20 on ttys021
matt@Matts-MacBook-Air ~ % pip3 install Flask
Collecting Flask
  Obtaining dependency information for Flask from https://files.pythonhosted.org/packag
es/fd/56/26f0be8adc2b4257df20c1c4260ddd0aa396cf8e75d90ab2f7ff99bc34f9/flask-2.3.3-py3-n
one-any.whl.metadata
  Downloading flask-2.3.3-py3-none-any.whl.metadata (3.6 kB)
Collecting Werkzeug>=2.3.7 (from Flask)
  Obtaining dependency information for Werkzeug>=2.3.7 from https://files.pythonhosted.
org/packages/9b/59/a7c32e3d8d0e546a206e0552a2c04444544f15c1da4a01df8938d20c6ffc/werkzeu
g-2.3.7-py3-none-any.whl.metadata
  Downloading werkzeug-2.3.7-py3-none-any.whl.metadata (4.1 kB)
Requirement already satisfied: Jinja2>=3.1.2 in ./.pyenv/versions/3.11.4/lib/python3.11
/site-packages (from Flask) (3.1.2)
Collecting itsdangerous>=2.1.2 (from Flask)
  Downloading itsdangerous-2.1.2-py3-none-any.whl (15 kB)
Collecting click>=8.1.3 (from Flask)
  Obtaining dependency information for click>=8.1.3 from https://files.pythonhosted.org
/packages/00/2e/d53fa4befbf2cfa713304affc7ca780ce4fc1fd8710527771b58311a3229/click-8.1.
7-py3-none-any.whl.metadata
  Downloading click-8.1.7-py3-none-any.whl.metadata (3.0 kB)
Collecting blinker>=1.6.2 (from Flask)
  Downloading blinker-1.6.2-py3-none-any.whl (13 kB)
Requirement already satisfied: MarkupSafe>=2.0 in ./.pyenv/versions/3.11.4/lib/python3.
11/site-packages (from Jinja2>=3.1.2->Flask) (2.1.3)
Downloading flask-2.3.3-py3-none-any.whl (96 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 96.1/96.1 kB 1.6 MB/s eta 0:00:00
Downloading click-8.1.7-py3-none-any.whl (97 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 97.9/97.9 kB 4.0 MB/s eta 0:00:00
Downloading werkzeug-2.3.7-py3-none-any.whl (242 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 242.2/242.2 kB 5.4 MB/s eta 0:00:00
Installing collected packages: Werkzeug, itsdangerous, click, blinker, Flask
Successfully installed Flask-2.3.3 Werkzeug-2.3.7 blinker-1.6.2 click-8.1.7 itsdangerou
s-2.1.2
matt@Matts-MacBook-Air ~ % 
```

Figure 2: Example output from installing Flask.

To verify Flask's installation, run this command from the CLI:

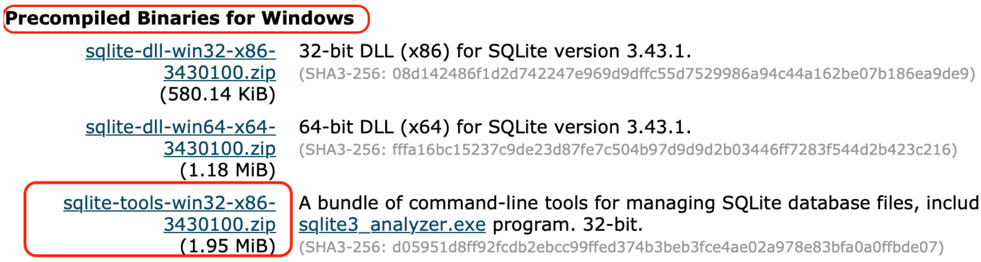
```
pip3 list
```

If Flask is installed correctly, you'll see the version number in the CLI output.

1.5 SQLite

SQLite is a lightweight but extremely powerful database management system (DBMS) that we will use in this module. You can download SQLite from https://www.sqlite.org/download.html. Follow the instructions below for your operating system.

1.5.1 Windows

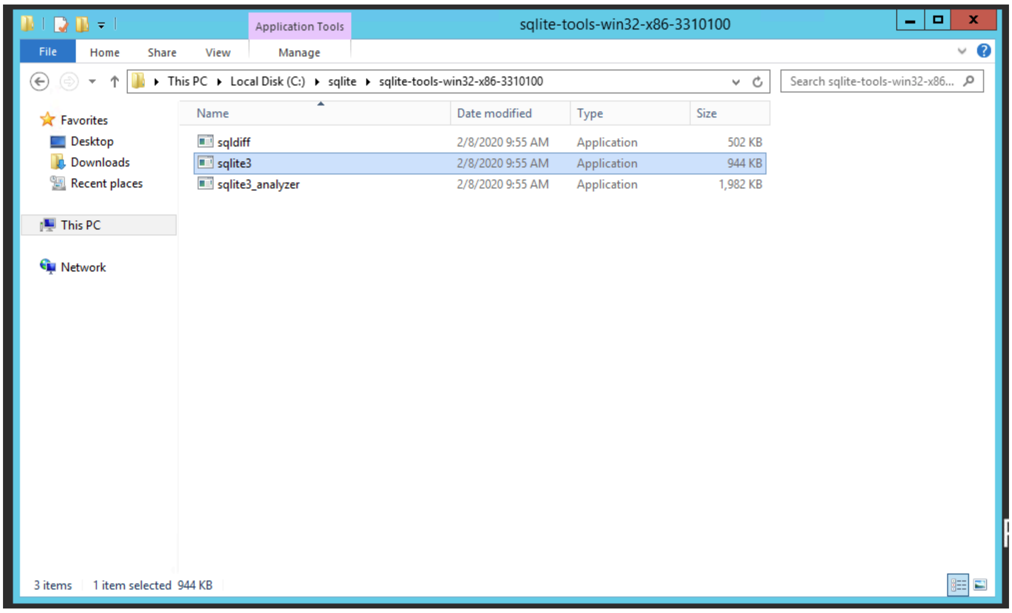


Precompiled Binaries for Windows

sqlite-dll-win32-x86-3430100.zip (580.14 KiB)	32-bit DLL (x86) for SQLite version 3.43.1. (SHA3-256: 08d142486f1d2d742247e969d9dffc55d7529986a94c44a162be07b186ea9de9)
sqlite-dll-win64-x64-3430100.zip (1.18 MiB)	64-bit DLL (x64) for SQLite version 3.43.1. (SHA3-256: fffa16bc15237c9de23d87fe7c504b97d9d9d2b03446ff7283f544d2b423c216)
sqlite-tools-win32-x86-3430100.zip (1.95 MiB)	A bundle of command-line tools for managing SQLite database files, including sqlite3_analyzer.exe program. 32-bit. (SHA3-256: d05951d8ff92fcdb2ebcc99ffed374b3beb3fce4ae02a978e83bfa0a0ffbde07)

Figure 3: Download the precompiled binaries for Windows. The version number may be different to the one shown here.

1. Navigate to https://www.sqlite.org/download.html in your web browser.
2. Under "Precompiled Binaries for Windows" click on the link for "sqlite-tools-win32-x86-xxxxxx.zip", where xxxxxx is the version number. This is shown in Figure 3 .
3. Extract the contents of the zip file to a folder on your computer. You can do this by right clicking on the zip file and selecting "Extract All". Make sure you extract the files and not just open the zip file and run the executable from there, as this will cause problems later.
4. In the extracted folder, you should see a file called `sqlite3.exe`, as highlighted in Figure 4. This is the SQLite command line utility. You can run this by double clicking on it which will open the command line tool. We won't be using the other files in the folder, so you can delete them if you like.
5. That's it! You have installed SQLite. You can now use the SQLite command line tool to interact with SQLite databases, something we will be doing future labs.



Application Tools
sqlite-tools-win32-x86-3310100
File
Home
Share
View
Manage
This PC ▸ Local Disk (C:) ▸ sqlite ▸ sqlite-tools-win32-x86-3310100
Search sqlite-tools-win32-x86...
Favorites
Desktop
Downloads
Recent places
This PC
Network
3 items
1 item selected 944 KB

Name	Date modified	Type	Size
sqldiff	2/8/2020 9:55 AM	Application	502 KB
sqlite3	2/8/2020 9:55 AM	Application	944 KB
sqlite3_analyzer	2/8/2020 9:55 AM	Application	1,982 KB

Figure 4: The sqlite3.exe file.

1.5.2 Linux and Mac

Mac users and most Linux users have SQLite pre-installed. To check, open the Terminal and run:

```
sqlite3 --version
```

This should display the SQLite version number.

For Linux users who see an error, you'll need to install SQLite. The method varies by distribution, so refer to your distribution's documentation for specific instructions.

1.6 Software Installation Summary

You should now have installed:

- A suitable code editor
- A web browser with development tools
- Python 3.8 or higher
- Flask and its dependencies
- SQLite

It's important to have all the software installed and working. If you face any issues, ask a member of the teaching team during the lab. We can't easily diagnose problems after the lab ends, so please seek help if needed. From Lab 003 onwards, we'll assume you have all the software installed and working properly. We won't be able to help with software installation issues after Lab 002.

2 Using the Command Line

This part of the lab introduces you to the command line interface (CLI). You'll learn how to navigate the file system, create files and directories, and run programs. Developers and system administrators often use CLIs for tasks that are challenging to do with a graphical user interface (GUI) - the type of interface you likely know best. As a computer scientist, it's important to become familiar and comfortable with a CLI. You'll use one throughout this module, in future modules, and in your career.

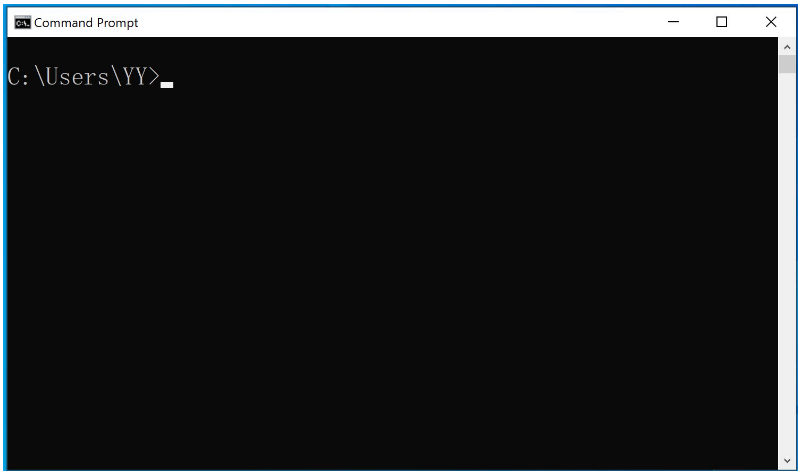
> ! Safety on the CLI
>
> CLIs are powerful tools, but they can harm your computer if used carelessly. When using the command line:
>
> - Always double-check commands before pressing enter.
> - Don't copy and paste commands from the internet unless you understand them fully.
> - Don't let others run commands on your computer.
> - Don't run commands you don't understand.

2.1 How to open and use the CLI

This section shows you how to open the CLI on your operating system.

2.1.1 Windows

> ℹ Windows CMD CLI
>
> The Windows CLI is called the *command prompt*. It's also known as `cmd` or `cmd.exe`.



```
C:\Users\YY>_
```

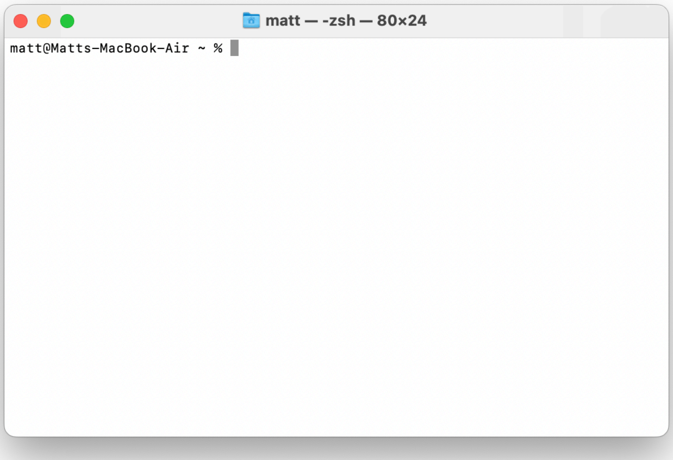
Figure 5: The command line/CMD CLI on Windows.

1. Open the Start menu, type 'cmd' and press Enter. This opens the command prompt.
2. You can now type commands. For example, type `dir` and press Enter to list files in the current working directory (CWD).

2.1.2 Linux and Mac

Mac Command Line

The command line on Mac and Linux is called the 'terminal'.



```
matt@Matts-MacBook-Air ~ %
```

Figure 6: The terminal CLI on Mac.

1. On Mac: Open Spotlight (press `command + space`), type `terminal` and press Enter. On Linux: The method varies across distributions. Check your distribution's documentation.
2. You can now type commands. For example, type `ls` and press Enter to list files in the current working directory (CWD).

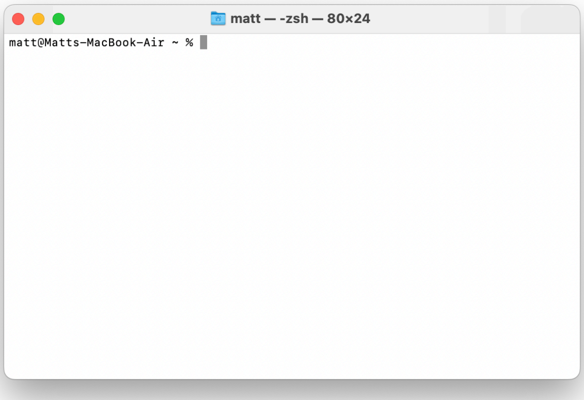
2.2 Navigating the File System

This section shows you how to navigate the file system using a CLI. The file system is the way in which files and directories are organised on your computer.

Current Working Directory (CWD)

The Current Working Directory (CWD) is the directory in which you're currently operating within the file system. It's important to note that commands entered in the CLI will work relative to the CWD. When you change your CWD, subsequent commands will be executed in the context of this new directory.

First, open the CLI by following the instructions in Section 2.1 . You should see an interface similar to Figure 7 .



```
matt@Matts-MacBook-Air ~ %
```

Figure 7: Your CLI usually begins in your home directory. We'll check our exact location shortly.

Our first task is to find out which directory we are currently in.

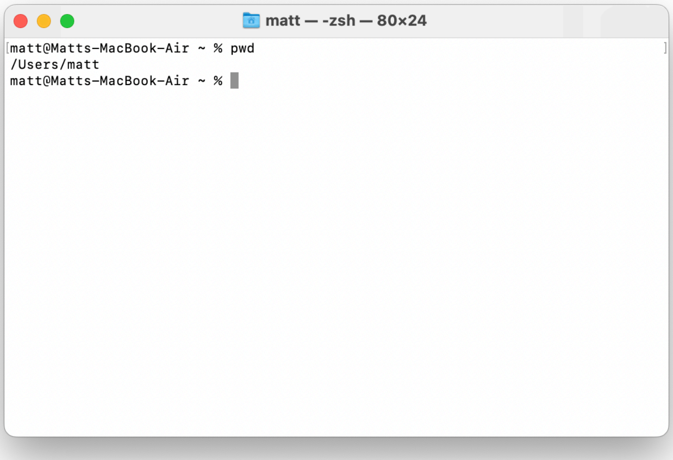
To do this on a Unix-based system (Mac or Linux), type the following command and press Enter:

```
pwd
```

Or on Windows:

```
chdir
```

The output should be the path to the current directory. On Mac and Linux this will be something like `/Users/username`. On Windows it will be something like `C:\Users\username`, but this depends on your version of Windows. The output of the **pwd** command on a Mac is shown in Figure 8.



```
matt@Matts-MacBook-Air ~ % pwd
/Users/matt
matt@Matts-MacBook-Air ~ %
```

Figure 8: The output of the **pwd** command on a Mac.

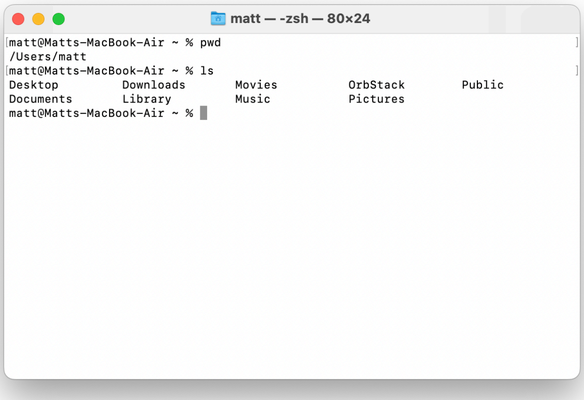
Now that we know our CWD, we can list the files in it. To do this on a Unix-based system, type the following command:

```
ls
```

Or on Windows:

```
dir
```

The output should be a list of files and directories in the CWD. The output of the `ls` command on a Mac is shown in Figure 9 . Of course, the output will depend on which directory you are in and what files and directories are in the CWD.



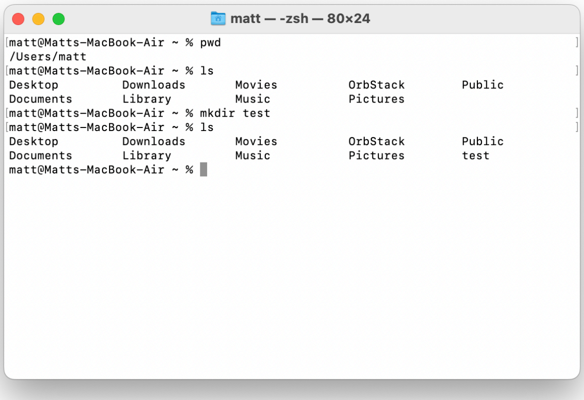
```
matt@Matts-MacBook-Air ~ % pwd
/Users/matt
matt@Matts-MacBook-Air ~ % ls
Desktop         Downloads       Movies          OrbStack        Public
Documents       Library         Music           Pictures
matt@Matts-MacBook-Air ~ % 
```

Figure 9: The output of the `ls` command on a Mac.

Next, we will add a new directory to the CWD. To do this, run the following command:

```
mkdir test
```

Here we are telling the operating system to create a new directory called `test`. You can check that the directory has been created by running the `ls` or `dir` command again. You should see the new directory listed in the output. The new output should be different from the output shown in Figure 9 .



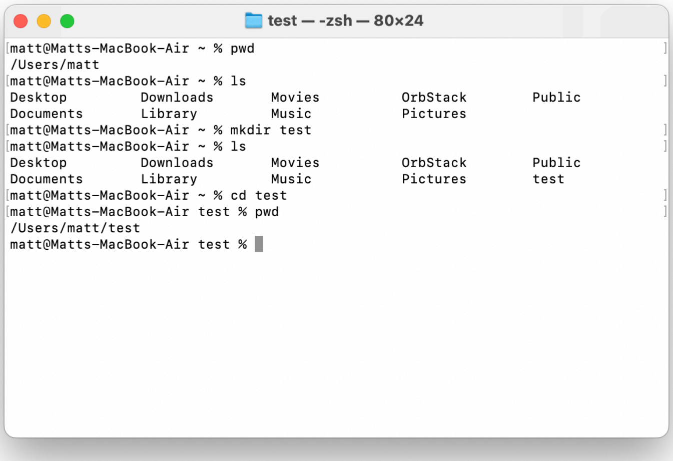
```
matt@Matts-MacBook-Air ~ % pwd
/Users/matt
matt@Matts-MacBook-Air ~ % ls
Desktop         Downloads       Movies          OrbStack        Public
Documents       Library         Music           Pictures
matt@Matts-MacBook-Air ~ % mkdir test
matt@Matts-MacBook-Air ~ % ls
Desktop         Downloads       Movies          OrbStack        Public
Documents       Library         Music           Pictures        test
matt@Matts-MacBook-Air ~ % 
```

Figure 10: The output of the `ls`/`dir` command after creating a new director using `mkdir`.

Now we want to change our CWD to the be the one we just created, `test`. To do this, run the following command:

```
cd test
```

You can check that this has worked by running the `pwd` or `chdir` command again. You should see that the output has changed to reflect the new directory. The new output should be different from the output shown in Figure 8.



```
matt@Matts-MacBook-Air ~ % pwd
/Users/matt
matt@Matts-MacBook-Air ~ % ls
Desktop         Downloads       Movies          OrbStack        Public
Documents       Library         Music           Pictures
matt@Matts-MacBook-Air ~ % mkdir test
matt@Matts-MacBook-Air ~ % ls
Desktop         Downloads       Movies          OrbStack        Public
Documents       Library         Music           Pictures        test
matt@Matts-MacBook-Air ~ % cd test
matt@Matts-MacBook-Air test % pwd
/Users/matt/test
matt@Matts-MacBook-Air test % 
```

Figure 11: The output of the `pwd`/`chdir` command after changing directory using `cd`.

Great! If we want to go back to the parent directory, we can use the `cd ..` command. The `..` part of the command means "parent directory". So `cd ..` means "change the CWD to be the parent of the CWD". You can check that this has worked by running the `pwd` or `chdir` command again.

i Why use such short commands?

You may wonder why these commands are so short. The reason is that the CLI is designed to be used by developers and system administrators who often need to type commands very quickly. Typing `cd` is much faster than typing `change_directory`. Similarly, typing `ls` is quicker than typing `list`, and so on.

2.3 Network Tools

In this section, we will show you how to use some tools that will help you understand how networks and the Internet work. These tools are available on all operating systems, but as we've already seen, the exact commands can be slightly different.

! Lab 001 Assignment

You will need to take some screenshots of the output of these commands for the Lab 001 assignment. Note that only the output for the commands in Section 2.3 is required. You do not need to capture the output of the commands in Section 2.

2.3.1 The `ping` command

> **Stopping Running Processes**
>
> By default, on Unix systems (Linux and Mac), the `ping` command will run indefinitely. To stop the command (and any other command running in the CLI), press `Ctrl + C`.

The `ping` command sends a series of packets to a specified host and expects a response to each packet. When a return packet is received, `ping` reports the round trip time (the time between sending the packet and receiving the response).

You may find `ping` useful when debugging a web application. For example, if your web application is loading very slowly, you can use the `ping` command to investigate the network latency between your machine and the server you are interacting with. This will help determine if the problem is at the network level, rather than with the application itself.

Try running the following command from the CLI:

```
ping www.nottingham.edu.cn
ping www.nottingham.ac.uk
```

> Exercise 1: `ping`
>
> Capture the output of the 'ping' command for both hosts. A screenshot or copy and paste of the output is fine.
> In addition to capturing the output, answer the following questions
>
> - What is the latency (`time=x.xxx ms`) for the host `www.nottingham.edu.cn`?
> - What is the latency (`time=x.xxx ms`) for the host `www.nottingham.ac.uk`?
> - Why do you think the latency is different between the two hosts?

2.3.2 The `nslookup` command

The `nslookup` command performs a DNS lookup to determine the IP address for a domain name. To use `nslookup`, you need to specify the domain name you want to look up. Try running the following command from the CLI:

```
nslookup www.nottingham.edu.cn
nslookup www.nottingham.ac.uk
```

> Exercise 2: `nslookup`
>
> Record the output of the 'nslookup' command for both hosts. A screenshot or copy and paste of the output is fine. In addition to capturing the output, answer the following questions
>
> - What is the IP address of the nottingham.edu.cn host?
> - What is the IP address of the nottingham.ac.uk host?
> - Looking at the IP addresses returned by the 'nslookup' command, why do you think the IP addresses for the two hosts are different?

2.3.3 The `traceroute/tracert` command

The `traceroute/tracert` command shows you the route packets take from your computer to a specified host. This is useful for debugging network problems and can help you understand how the Internet works.

Try running the following command from the CLI:

On Unix-based systems:

```
traceroute www.nottingham.edu.cn
traceroute www.nottingham.ac.uk
```

On Windows:

```
tracert www.nottingham.edu.cn
tracert www.nottingham.ac.uk
```

Exercise 3: `traceroute/tracert`

Record the output of the `traceroute/tracert` command for both hosts. A screenshot or copy and paste of the output is fine, but in addition to the output, answer the following questions

- How many hops does it take to get from your computer to the host `www.nottingham.edu.cn`?
- How many hops does it take to get from your computer to the host `www.nottingham.ac.uk`?
- Why do you think the number of hops is different between the two hosts?
- Does the difference in the number of hops (or the time between hops) between the two hosts help explain the difference in latency between the two hosts?

3 Submitting your lab work

You should now have completed all the exercises in this lab. You should have captured the output of the commands and answered the questions in the following exercises: Section 2.3.1, Section 2.3.2, and Section 2.3.3. Compile your answers into a single PDF document and submit it to the Lab 001 assignment on Moodle. There is no standard template or format for lab submissions, but you should ensure that your submission is neat, easy to read, and includes a cover page with the following information:

- Your name
- Your student ID (e.g. z123456)
- The module code (COMP1048)
- The module title (Databases and Interfaces)
- The lab number (Lab 001) and title (Software Installation and using Command Line Interfaces)
- The date of submission

Your submission should be a single PDF file. You should name your PDF file using the following format: `DBI_lab001-<student_id>.pdf`, where `<student_id>` is your student ID. For example, if your student ID is `z123456`, you should name your PDF file `DBI_lab001-z123456.pdf`.

Please ensure that you submit your work before the deadline - 28 October 2024 at 15:00. Late submissions will not be accepted as stated on the coursework issue sheet. Failure to include the required cover page or submitting work in an unreadable format will be noted. No marks will be awarded for submissions to Lab 001, but future lab submissions will be assessed.