

Lab 0: Getting Started

lab00.zip (lab00.zip)

Due by 11:59pm on Friday, June 25.

Starter Files

Download lab00.zip (lab00.zip). Inside the archive, you will find starter files for the questions in this lab, along with a copy of the Ok (ok) autograder.

Introduction

This lab explains how to use your own computer to complete assignments for CS 61A and introduces some of the basics of Python.

If you need any help at any time through the lab, please feel free to come to office hours (/~cs61a/su21/office-hours) or post on piazza.

This lab looks really long, but it's mostly setup and learning how to use the essential tools for this class; these may seem a bit difficult now, but will quickly become second nature as we move further into the course.

Here's a video that the Summer 2020 course staff made to guide you.

Setup

Install a terminal

The terminal is a program that allows you to interact with your computer by entering commands. No matter what operating system you use (Windows, macOS, Linux), the terminal will be an essential tool for CS 61A.

macOS/Linux

If you're on a Mac or are using a form of Linux (such as Ubuntu), you already have a program called `Terminal` or something similar on your computer. Open that up and you should be good to go.

Windows

You can just skip this step and use Windows PowerShell instead of Bash for the purposes of 61A. PowerShell comes pre-installed on Windows and requires no extra setup. You can simply launch it from the Start menu. Simple commands like `cd` and `ls` will work (python will work after the setup), which encompass most of the Bash commands you need for this course.

Later courses will use Bash and use more sophisticated commands, though, so if you'd like to get familiar with that instead, you can install Git-Bash via either method below:

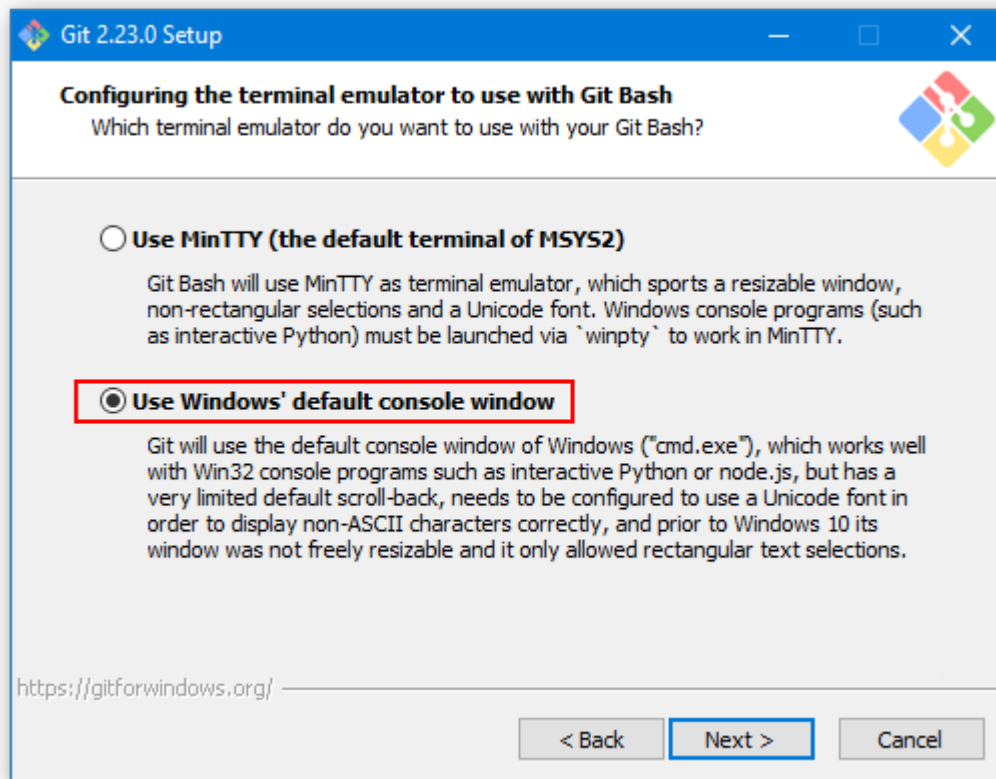
- **Easy (automatic) method:** Right-click here, click *Save link as...* (assets/Install-Python-on-Windows.jse), then save and run our automated installer, following the displayed instructions. **Note:** If nothing happens when you run the installer, follow the anti-virus note below. (*Advanced users:* If double-clicking doesn't work, you can also try `cscript "Install-Python-on-Windows.jse"` from PowerShell or the Command Prompt.) If this method **succeeds**, you can move on and install a text editor; you now run Python inside Git-Bash. (In fact, *only* inside Git-Bash. So this *won't* let you run `.py` files by double-clicking them. But you shouldn't need to do that for this course.) If this method **fails**, try the alternate method below.

Anti-virus troubleshooting: Your anti-malware scanner may mistakenly block this file. In the case of Windows SmartScreen, you can bypass it as follows: manually open the download folder, right-click the installer, select Properties, **check the "Unblock" box**, click OK (<https://winaero.com/blog/wp-content/uploads/2015/10/Windows-10-unblock-a-file.png>), and run the installer again. For Windows Defender, students have sometimes reported success by clicking "See Details", letting it scan the file, and then rebooting. If your antivirus otherwise allows you, you can also try whitelisting the file. In any case, if you don't find a workaround that works for you, you can just use the manual installation method below.

- **Alternate (manual) method:** First, if you already tried the automatic installer above, make sure it's fully cleaned up:
 1. Look for *Git* as an installed program in "Add/Remove Programs", and, if it exists, uninstall it.
 2. Once Git is no longer installed, if a `C:\Program Files\Git` folder still exists, delete that too.

Now download and install Git Bash (<https://git-scm.com/download/win>). You can use the default options, **with one exception:** Select ***Use Windows' default console window*** in the *Configuring the terminal emulator to use with Git Bash* step. **This is very**

important! If you do not select this option, your terminal won't work with Python!



If you're already using Git-Bash from outside this course and reinstalling it isn't an option: Depending on whether you selected the MinTTY option when installing Git, it's possible that typing a command like `python` won't display anything on the screen. You can fix this by typing `wintpy python` instead (or `wintpy python3`, `wintpy py -3`, etc. as described below), but it will be painful, as you will have to remember to do this *every time* for the rest of the course! Hence, we recommend that you go back and reinstall Git-Bash with the recommended options if possible.

If everything succeeded, you are now able to launch a terminal on Windows by running Git-Bash.

SSL/TLS errors: If you ran into connection security errors, you may need to update your system and/or enable TLS 1.2 (e.g. see here (<https://support.microsoft.com/en-us/help/3140245>) for Windows 7). You can check your TLS version by installing Python first, and running the following in `python3`:

```
from json import loads; from urllib.request import urlopen;
loads(urlopen('https://www.howsmyssl.com/a/check').read().decode('UTF-8'))['tls_ver'
```

If you don't see TLS 1.2 or later, that may be why you are encountering problems. If you're on Windows 10, though, the problem may be something else, and you may need to search/ask for help.

Install Python 3

Python 3 is the primary programming language used in this course. Use the instructions below to install the Python 3 interpreter. (The instructions may feature older versions of Python 3, but the steps are similar.)

Important: If you already have an older version of Python installed, please make sure to download and install Python 3.9. You can check your Python version with `python --version`.

Linux

Run `sudo apt install python3` (Ubuntu), `sudo pacman -S python3` (Arch), or the command for your distro.

macOS

Download and install Python 3 (64-bit) (<https://www.python.org/ftp/python/3.9.5/python-3.9.5-macosx10.9.pkg>).

You may need to right-click the download icon and select "Open". After installing, please close and open your Terminal.

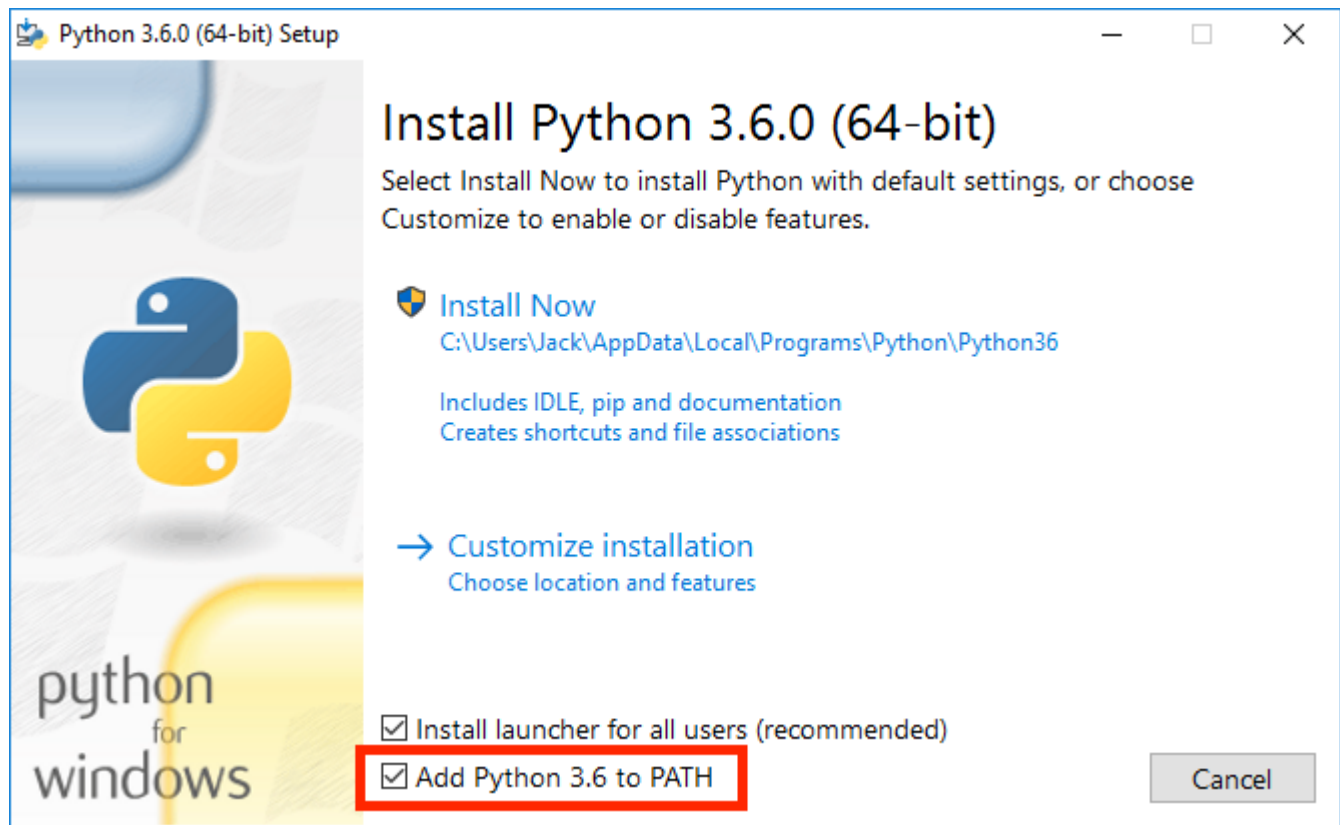
Windows

If you used our automated installer successfully, skip to the next section—you should already have Python.

If you'll be using PowerShell, open the Microsoft Store and search for "python". Install Python 3.9 by the Python Software Foundation (this should be the first result). You can then skip the rest of this section. (Important: If you later decide to reinstall Python differently, **uninstall it from the Microsoft Store first.**)

Otherwise, if you're installing manually, download & run Python 3 (the Windows x86-64 executable installer) (<https://www.python.org/ftp/python/3.9.5/python-3.9.5-amd64.exe>) and **make sure to check the "Add Python 3.x to PATH" box**, which will allow you to execute the `python` command from your terminal.

After installing, please close and open your terminal. Try running the `python` command. If this doesn't work, try `python3` or `py`. Windows may use any of these to refer to Python, so you should use the one that works on your machine.



Other

Download Python from the download page (<https://www.python.org/downloads/>).

Install a text editor

The **Python interpreter** that you just installed allows you to *run* Python code. You will also need a **text editor**, where you will *write* Python code.

There are many editors out there, each with its own set of features. Visual Studio Code (<https://code.visualstudio.com/>) and Atom (<https://atom.io/>) are the most popular choices among the course staff for writing Python. **We highly recommend for this class you use VS Code.**

Warning: Please, please, *please* do not use word processors such as Microsoft Word to edit programs. Word processors can add extra content to documents that will confuse the interpreter.

For your reference, we've also written some guides on using popular text editors. After you're done with lab, you can take a look if you're interested:

- Visual Studio Code (</~cs61a/su21/articles/vscode>): A full-featured desktop editor with many extensions available to support different languages.

- Atom ([/~cs61a/su21/articles/atom](#)): A more lightweight desktop editor.
- Emacs ([/~cs61a/su21/articles/emacs](#)): A command-line editor.
- Vim ([/~cs61a/su21/articles/vim](#)): A command-line editor.

Pair Programming

Throughout this course, you will have many chances to collaboratively code with others in labs and projects. We recommend you download these pair programming extensions now to use in the future.

For sharing code, you can follow the instructions for your editor of choice:

- VS Code ([/~cs61a/su21/articles/vscode#pair-programming](#))
- Atom ([/~cs61a/su21/articles/atom#pair-programming](#))

Datahub as a backup

In case you had troubles installing a python interpreter, text editor, and terminal, or if you are using something that does not allow you to install software, like an iPad, you can as a temporary measure do the assignments in your browser while you acquire more appropriate hardware.

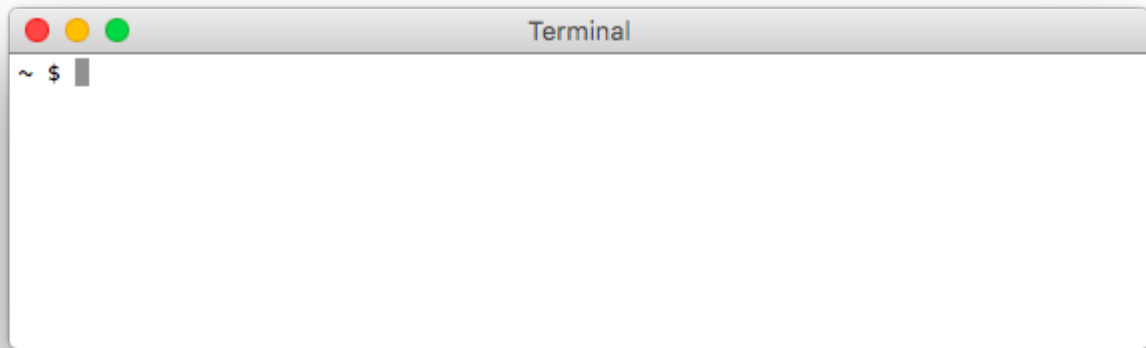
Steps to complete this assignment on datahub:

1. Visit Datahub (<https://datahub.berkeley.edu/>)
2. Upload the zip to datahub
3. Open a terminal by pressing New in the top left corner and selecting the terminal
4. Navigating to where the zip file is and running `unzip lab00.zip`
5. Opening up the code file, `lab00.py` and typing in it, then saving
6. Now you can submit the lab

Using the terminal

Let's check if everything was installed properly!

First, open a terminal window. If you're on Windows, launch *Git-Bash* from the Start menu. (Or if you're using PowerShell, run that instead.)



When you first open your terminal, you will start in the "home directory". The **home directory** is represented by the `~` symbol, which you might see at the prompt.

Don't worry if your terminal window doesn't look exactly the same. The important part is that the prompt shows `$` (indicating Bash), `%` (indicating zsh), or `PS` (PowerShell). If you see `C:\Users\0ski>` but no `PS` before it, you're in the Command Prompt! Do *not* use that! Close it, and launch Git-Bash or PowerShell instead. (Do *not* launch Git-CMD.)

Try running `echo "$HOME"`. Verify that it displays the path to your home directory.

Python Interpreter

We can use the terminal to check if your Python 3 interpreter was installed correctly. Try the following command:

```
python3
```

If the installation worked, you should see some text printed out about the interpreter followed by `>>>` on its own line. This is where you can type in Python code. Try typing some expressions you saw in lecture, or just play around to see what happens! You can type `exit()` or `Ctrl-D` to return to your command line.

Windows troubleshooting:

- If the `python3` command doesn't run *at all*: Try `python`, `py`, or `py -3` instead.
- If Python freezes (doesn't display anything at all): You probably didn't select the **"Use Windows' default console window"** option when installing Git-Bash manually. Try `wintpy python`, or just uninstall Git-Bash and reinstall it with the correct options.
- If you see `WindowsApps/python: Permission denied`: Open Settings (or right-click the Desktop & click Personalize), search for "App Execution Aliases" (or find it by clicking Home→Apps→App execution aliases), and disable the entries that say "python". (Screenshots here (<https://www.tenforums.com/tutorials/102096-manage-app-execution-aliases-windows-10-a.html>).) Alternatively, go to the `WindowsApps` folder whose path is shown and just rename `python.exe` and `python3.exe` to something else, or delete them entirely if you are able to. Then try again.
- If Python doesn't run *at all*, and you used our automated installer: Go back and try installing using the manual method.
- If Python doesn't run *at all*, and you installed manually: Make sure you set up your "PATH" correctly as shown above.
- If you mixed multiple versions of Python (e.g. 32-bit and 64-bit, or 3.6 and 3.8, etc.): They may conflict. Occasionally, this becomes extremely difficult to fix—even for instructors. Uninstall them one-by-one (the most recent one *first*), then reinstall only the latest 64-bit version.
- If Git Bash shows an empty black screen: You might have had Cygwin previously installed. You can try uninstalling Cygwin (recommended) and following this answer (<https://stackoverflow.com/a/30461913>), possibly uninstalling Git-Bash and/or Python as well, and re-running the installer.
- If you manually downloaded Python from its own home page and *don't see 64 in the file name*: You probably got the 32-bit version. It might work. But if it doesn't, uninstall it before trying another method. If you need to manually find the 64-bit version, look for a recent stable x86-64 executable installer (<https://www.python.org/downloads/windows/>).

Ask for help if you get stuck!

Organizing your files

In this section, you will learn how to manage files using terminal commands.

Make sure your prompt contains a `$` somewhere in it and does not begin with `>>>`. If it begins with `>>>` you are still in a Python shell, and you need to exit. See above for how.

Directories

The first command you'll use is `ls`. Try typing it in the terminal:

```
ls
```

The `ls` command **lists** all the files and folders in the current directory. A **directory** is another name for a folder (such as the `Documents` folder). Since you're in the home directory right now, you should see the contents of your home directory.

If `ls` doesn't work, but `dir` does: **stop!** You've mistakenly opened the Windows Command Prompt! Exit it, and run *Git-Bash* instead.

Changing directories

To move into another directory, use the `cd` command. Let's try moving into your Desktop directory. First, make sure you're in your home directory (check for the `~` on your command line) and use `ls` to see if the Desktop directory is present. Try typing the following command into your terminal, which should move you into that directory:

```
cd Desktop
```

Although, on some Windows accounts, your actual Desktop folder might actually be inside OneDrive:

```
cd OneDrive/Desktop
```

If you're *not* already in your home directory, try `cd ~/Desktop` instead (or `cd ~/OneDrive/Desktop`).

If you still can't find your Desktop directory, ask for help on Piazza or in office hours.

There are a few ways to return to the home directory:

- `cd ..` (two dots). The `..` means "the parent directory". In this case, the parent directory of `cs61a` is your home directory, so you can use `cd ..` to go up one directory.
- `cd ~` (the tilde). Remember that `~` means home directory, so this command will always change to your home directory.
- `cd` (`cd` on its own). Typing just `cd` is a shortcut for typing `cd ~`.

You do not have to keep your files on your Desktop if you prefer otherwise. Where you keep your files locally will not affect your grade. Do whatever is easiest and most convenient for you!

Windows PowerShell tip: If you're using PowerShell, you can start it directly by holding Shift, right-clicking inside any folder, and selecting "Open PowerShell Window here" (https://www.tenforums.com/attachments/tutorials/248020d1568908726-open-powershell-window-here-context-menu-add-windows-10-a-open_powershell_window_here_context_menu.png). It will automatically `cd` to that folder, so you'll have to run `cd ~` to change to your home directory.

Making new directories

The next command is called `mkdir`, which **makes** new **directories**. Let's make a directory called `cs61a` on your Desktop to store all of the assignments for this class:

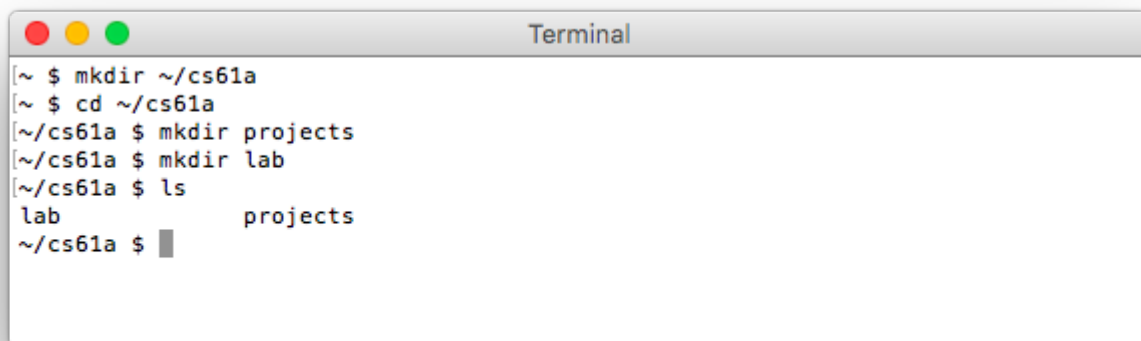
```
mkdir cs61a
```

A folder named `cs61a` will appear on your Desktop. You can verify this by using the `ls` command again or by simply checking your Desktop.

At this point, let's create some more directories. First, make sure you are in the `~/Desktop/cs61a` directory. Then, create folders called `projects` and `lab` inside of your `cs61a` folder:

```
cd ~/Desktop/cs61a
mkdir projects
mkdir lab
```

Now if you list the contents of the directory (using `ls`), you'll see two folders, `projects` and `lab`.

A screenshot of a macOS Terminal window titled "Terminal". The window shows a series of commands and their outputs. The prompt is a tilde (~) indicating the home directory. The commands executed are: `mkdir ~/cs61a`, `cd ~/cs61a`, `mkdir projects`, `mkdir lab`, and `ls`. The output of `ls` shows two directories: `lab` and `projects`. The prompt then changes to `~/cs61a` after the `cd` command.

```
Terminal
[~ $ mkdir ~/cs61a
[~ $ cd ~/cs61a
[~/cs61a $ mkdir projects
[~/cs61a $ mkdir lab
[~/cs61a $ ls
lab          projects
~/cs61a $ ]
```

Downloading the assignment

If you haven't already, download the zip archive, `lab00.zip` (`lab00.zip`), which contains all the files that you'll need for this lab. Once you've done that, let's find the downloaded file. On most computers, `lab00.zip` is probably located in a directory called `Downloads` in your home directory. Use the `ls` command to check:

```
ls ~/Downloads
```

If you don't see `lab00.zip`, ask for help on Piazza or in office hours. On some versions of Safari the file may get unzipped for you, in which case you would just see a new directory named `lab00`.

Extracting starter files

You must expand the zip archive before you can work on the lab files. Different operating systems and different browsers have different ways of unzipping. If you don't know how, you can search online.

Using a terminal, you can unzip the zip file from the command line. First, `cd` into the directory that contains the zip file:

```
cd ~/Downloads
```

Now, run the `unzip` command (non-PowerShell) with the name of the zip file:

```
unzip lab00.zip
```

If you're using PowerShell 5 (already in Windows 10), you can instead run:

```
Expand-Archive -DestinationPath . -Force lab00.zip
```

You might also be able to extract files without using the terminal by double clicking (or right-clicking) them in your OS's file explorer.

Once you unzip `lab00.zip`, you'll have a new folder called `lab00` which contains the following files (check it out with `cd` and `ls`):

- `lab00.py` : The template file you'll be adding your code to
- `ok` : A program used to test and submit assignments
- `lab00.ok` : A configuration file for `ok`

Moving files

Move the lab files to the lab folder you created earlier:

```
mv ~/Downloads/lab00 ~/Desktop/cs61a/lab
```

The `mv` command will **move** the `~/Downloads/lab00` folder into the `~/Desktop/cs61a/lab` folder.

Now, go to the `lab00` folder that you just moved. Try using `cd` to navigate your own way! If you get stuck, you can use the following command:

```
cd ~/Desktop/cs61a/lab/lab00
```

Summary

Here is a summary of the commands we just went over for your reference:

- `ls` : **lists** all files in the current directory
- `cd <path to directory>` : **change** into the specified **directory**
- `mkdir <directory name>` : **make** a new **directory** with the given name
- `mv <source path> <destination path>` : **move** the file at the given source to the given destination

Finally, you're ready to start editing the lab files! Don't worry if this seems complicated—it will get much easier over time. Just keep practicing! You can also take a look at our UNIX tutorial ([/~cs61a/su21/articles/unix](https://inst.eecs.berkeley.edu/~cs61a/su21/articles/unix)) for a more detailed explanation of terminal commands.

Python Basics

Expressions and statements

Programs are made up of expressions and statements. An *expression* is a piece of code that evaluates to some value and a *statement* is one or more lines of code that make something happen in a program.

When you enter a Python expression into the interactive Python interpreter, its value will be displayed. As you read through the following examples, try out some similar expressions on your own Python interpreter, which you can start up by typing this in your terminal:

```
python3
```

Remember, if you are using Windows and the `python3` command doesn't work, try using `python` or `py`. See the install Python 3 section for more info and ask for help if you get stuck!

You'll be learning various types of expressions and statements in this course. For now, let's take a look at the ones you'll need to complete this lab.

Primitive expressions

Primitive expressions only take one step to evaluate. These include numbers and booleans, which just evaluate to themselves.

```
>>> 3
3
>>> 12.5
12.5
>>> True
True
```

Arithmetic expressions

Numbers may be combined with mathematical operators to form compound expressions. In addition to the `+` operator (addition), the `-` operator (subtraction), the `*` operator (multiplication) and the `**` operator (exponentiation), there are three division-like operators to remember:

- Floating point division (`/`): divides the first number number by the second, evaluating to a number with a decimal point *even if the numbers divide evenly*.
- Floor division (`//`): divides the first number by the second and then rounds down, evaluating to an integer.
- Modulo (`%`): evaluates to the positive remainder left over from division.

Parentheses may be used to group subexpressions together; the entire expression is evaluated in PEMDAS order.

```
>>> 7 / 4
1.75
>>> (2 + 6) / 4
2.0
>>> 7 // 4          # Floor division (rounding down)
1
>>> 7 % 4           # Modulus (remainder of 7 // 4)
3
```

Assignment statements

An assignment statement consists of a name and an expression. It changes the state of the program by evaluating the expression to the right of the `=` sign and *binding* its value to the name on the left.

```
>>> a = (100 + 50) // 2
```

Now, if we evaluate `a`, the interpreter will display the value 75.

```
>>> a
75
```

Doing the assignment

Unlocking tests

One component of lab assignments is to predict how the Python interpreter will behave.

Enter the following in your terminal to begin this section:

```
python3 ok -q python-basics -u
```

You will be prompted to enter the output of various statements/expressions. You must enter them correctly to move on, but there is no penalty for incorrect answers.

The first time you run Ok, you will be prompted for your bCourses email. Please follow these directions ([/~cs61a/su21/articles/using-ok/#signing-in-with-ok](https://inst.eecs.berkeley.edu/~cs61a/su21/articles/using-ok/#signing-in-with-ok)). We use this information to associate your code with you when grading.

```
>>> 10 + 2
-----

>>> 7 / 2
-----

>>> 7 // 2
-----

>>> 7 % 2          # 7 modulo 2, equivalent to the remainder of 7 // 2
-----
```

```
>>> x = 20
>>> x + 2
-----

>>> x
-----

>>> y = 5
>>> y = y + 3
>>> y * 2
-----

>>> y = y // 4
>>> y + x
-----
```

Understanding problems

Labs will also consist of function writing problems. Open up `lab00.py` in your text editor. You can type `open .` on MacOS or `start .` on Windows to open the current directory in your Finder/File Explorer. Then double click or right click to open the file in your text editor. You should see something like this:

```
def twenty_twenty_one():  
    """Come up with the most creative expression that evaluates to 2021,  
    using only numbers and the +, *, and - operators.  
  
    >>> twenty_twenty_one()  
    2021  
    """  
    return _____
```

The lines in the triple-quotes `"""` are called a **docstring**, which is a description of what the function is supposed to do. When writing code in 61A, you should always read the docstring!

The lines that begin with `>>>` are called **doctests**. Recall that when using the Python interpreter, you write Python expressions next to `>>>` and the output is printed below that line. Doctests explain what the function does by showing actual Python code. It answers the question: "If we input this Python code, what should the expected output be?"

In `twenty_twenty_one`,

- The docstring tells you to "come up with the most creative expression that evaluates to 2021," but that you can only use numbers and arithmetic operators `+` (add), `*` (multiply), and `-` (subtract).
- The doctest checks that the function call `twenty_twenty_one()` should return the number 2021.

You should not modify the docstring, unless you want to add your own tests! The only part of your assignments that you'll need to edit is the code unless otherwise specified.

Writing code

Once you understand what the question is asking, you're ready to start writing code! You should replace the underscores in `return _____` with an expression that evaluates to 2021. What's the most creative expression you can come up with?

Don't forget to save your assignment after you edit it! In most text editors, you can save by navigating to `File > Save` or by pressing `Command-S` on MacOS or `Ctrl-S` on Windows.

Running tests

In CS 61A, we will use a program called `ok` to test our code. `ok` will be included in every assignment in this class.

For quickly generating `ok` commands, you can now use the `ok` command generator (<https://links.cs61a.org/ok-help>).

Back to the terminal! Make sure you are in the `lab00` directory we created earlier (remember, the `cd` command lets you change directories).

In that directory, you can type `ls` to verify that there are the following three files:

- `lab00.py` : the starter file you just edited
- `ok` : our testing program
- `lab00.ok` : a configuration file for `Ok`

Now, let's test our code to make sure it works. You can run `ok` with this command:

```
python3 ok
```

Remember, if you are using Windows and the `python3` command doesn't work, try using just `python` or `py`. See the the install Python 3 section for more info and ask for help if you get stuck!

If you wrote your code correctly and you finished unlocking your tests, you should see a successful test:

```
=====
Assignment: Lab 0
Ok, version v1.18.1
=====

~~~~~

Running tests

-----

Test summary
  3 test cases passed! No cases failed.
```

If you didn't pass the tests, `ok` will instead show you something like this:

```
-----  
Doctests for twenty_twenty_one  
  
>>> from lab00 import *  
>>> twenty_twenty_one()  
2013  
  
# Error: expected  
#      2021  
# but got  
#      2013  
  
-----  
Test summary  
  0 test cases passed before encountering first failed test case
```

Fix your code in your text editor until the test passes.

Every time you run Ok, Ok will try to back up your work. Don't worry if it says that the "Connection timed out." We won't use your backups for grading.

While `ok` is the primary assignment "autograder" in CS 61A, you may find it useful at times to write some of your own tests in the form of doctests. Then, you can try them out using the `-m doctest` option for Python).

Submitting the assignment

Now that you have completed your first CS 61A assignment, it's time to turn it in. It is **not** sufficient to receive credit for an assignment simply by running the autograder per the last section. You must follow these steps to submit and get points!

Step 1: Submit with `ok`

In your terminal, make sure you are in the directory that contains `ok`. If you aren't there yet, you can use this command:

```
cd ~/Desktop/cs61a/lab/lab00
```

Next, use `ok` with the `--submit` option:

```
python3 ok --submit
```

This will prompt you for an email address if you haven't run Ok before. Please follow these directions ([/~cs61a/su21/articles/using-ok/#signing-in-with-ok](https://cs61a.su21/articles/using-ok/#signing-in-with-ok)), and refer to the troubleshooting steps on that page if you encounter issues. After that, Ok will print out a message like the following:

```
Submitting... 100% complete
Submission successful for user: ...
URL: https://okpy.org/...
```

Step 2: Verify your submission

You can follow the link that Ok printed out to see your final submission, or you can go to okpy.org (<https://okpy.org>). You will be able to view your submission after you log in.

Make sure you log in with the same email you provided when running `ok` from your terminal!

You should see a successful submission for Lab 0.

Congratulations, you just submitted your first CS 61A assignment!

More information on Ok is available here ([/~cs61a/su21/articles/using-ok/](https://cs61a.su21/articles/using-ok/)). You can also use the `--help` flag:

```
python3 ok --help
```

This flag works just like it does for UNIX commands we used earlier.

Appendix: Useful Python command line options

When running a Python file, you can use options on the command line to inspect your code further. Here are a few that will come in handy. If you want to learn more about other Python command-line options, take a look at the documentation (<https://docs.python.org/3.8/using/cmdline.html>).

- Using no command-line options will run the code in the file you provide and return you to the command line.

```
python3
```

- **-i** : The `-i` option runs your Python script, then opens an interactive session. In an interactive session, you run Python code line by line and get immediate feedback instead of running an entire file all at once. To exit, type `exit()` into the interpreter prompt. You can also use the keyboard shortcut `Ctrl-D` on Linux/Mac machines or `Ctrl-Z Enter` on Windows.

If you edit the Python file while running it interactively, you will need to exit and restart the interpreter in order for those changes to take effect.

```
python3 -i
```

- **-m doctest** : Runs doctests in a particular file. Doctests are surrounded by triple quotes (`"""`) within functions.

Each test in the file consists of `>>>` followed by some Python code and the expected output (though the `>>>` are not seen in the output of the doctest command).

```
python3 -m doctest
```

