Lab 0: Workflow and Python Basics

lab00.zip (lab00.zip)

Due at 11:59pm on Friday, 06/22/2018.

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.

Submission

By the end of this lab, you should have submitted the lab with `python3 ok --submit`. You may submit more than once before the deadline; only the final submission will be graded. Check that you have successfully submitted your code on okpy.org (https://okpy.org/).

Introduction

This lab explains how to use your own computer to complete assignments for CS 61A, as well as introduce some of the basics of Python. If you are using a lab computer, most of the instructions are the same, except you won't have to install anything.

If you need any help at any time through the lab, please feel free to come to office hours (https://cs61a.org/office-hours.html)! You can also ask any questions at the homework party (https://cs61a.org/office-hours.html) at the end of the week or in lab.

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

Setup

Register for an account

> These accounts allow you to use instructional machines in the CS department, which can be useful if you do not have regular access to a computer. They are **not required if you do not plan on using the lab computers or printers**.

Go to the EECS account site (https://acropolis.cs.berkeley.edu/~account/webacct/) to register for an instructional account. Login using your Berkeley CalNet ID and click the `Get a new account` button in the row for CS 61A. Your username will be of the form cs61a-xxx. Write down or download your account form so you don't forget it!

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

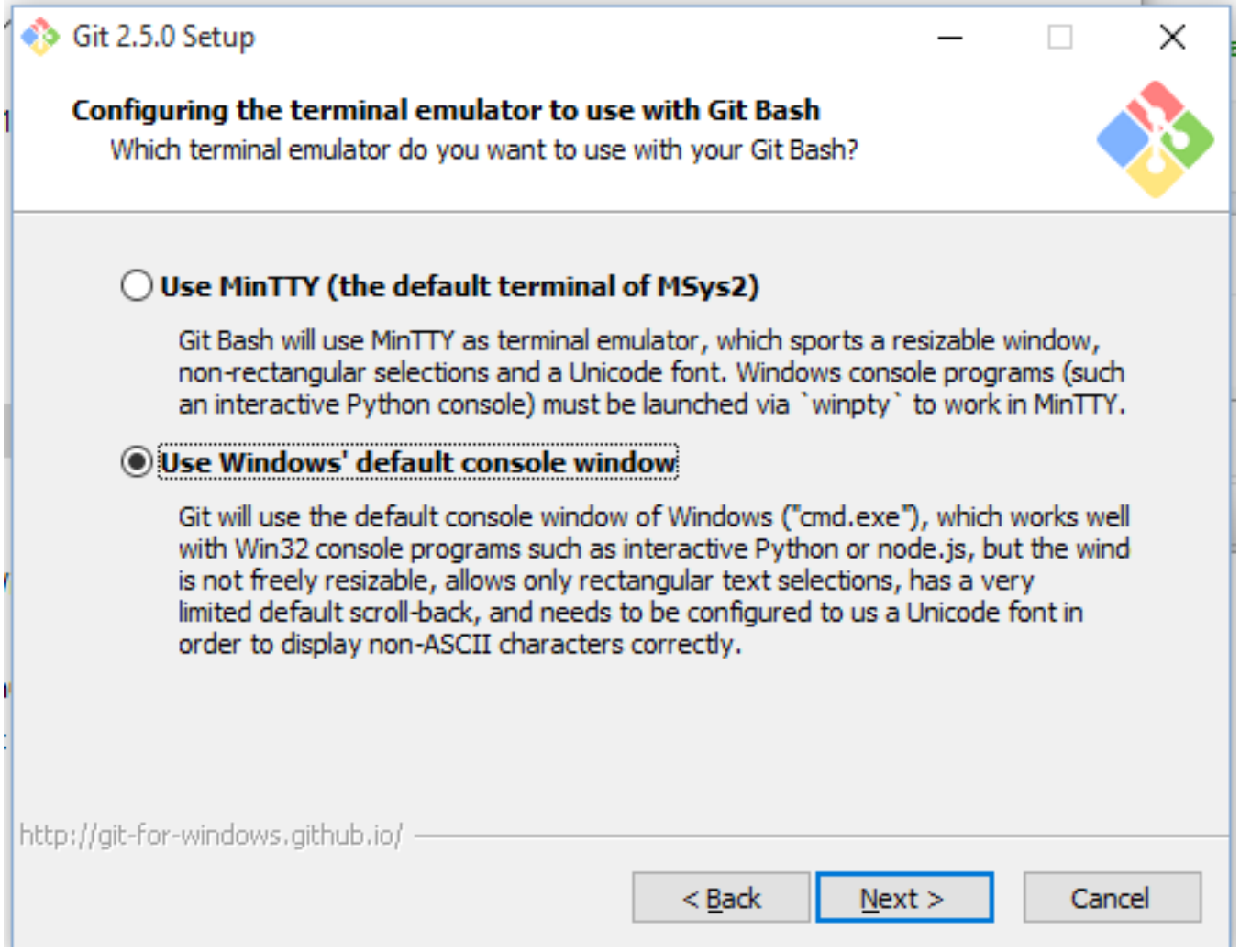
If you're on a Mac or are using a form of Linux (such as Ubuntu), you already have a program called `Terminal` or something similar on your computer. Open that up and you should be good to go.

Windows

For Windows users, we recommend downloading a terminal called Git Bash (http://git-scm.com/downloads).

You should be able to install Git Bash with most of the default configuration options, with one exception. In the *Configuring the terminal emulator to use with Git Bash* step, select the second option: *Use Windows' default console window*.

This is very important! If you do not select this option, your terminal will not work!



Install Python 3

Python 3 is the primary programming language used in this course. Use the appropriate download link and additional instructions below to install the Python 3 interpreter.

OS	Download
Windows	Installer (https://www.python.org/ftp/python/3.6.2/python-3.6.2-amd64.exe)
macOS	Installer (https://www.python.org/ftp/python/3.6.2/python-3.6.2-macosx10.6.pkg)
Ubuntu	`sudo apt-get install python3`
Other	Python3 Download (https://www.python.org/downloads/release/python-362/)

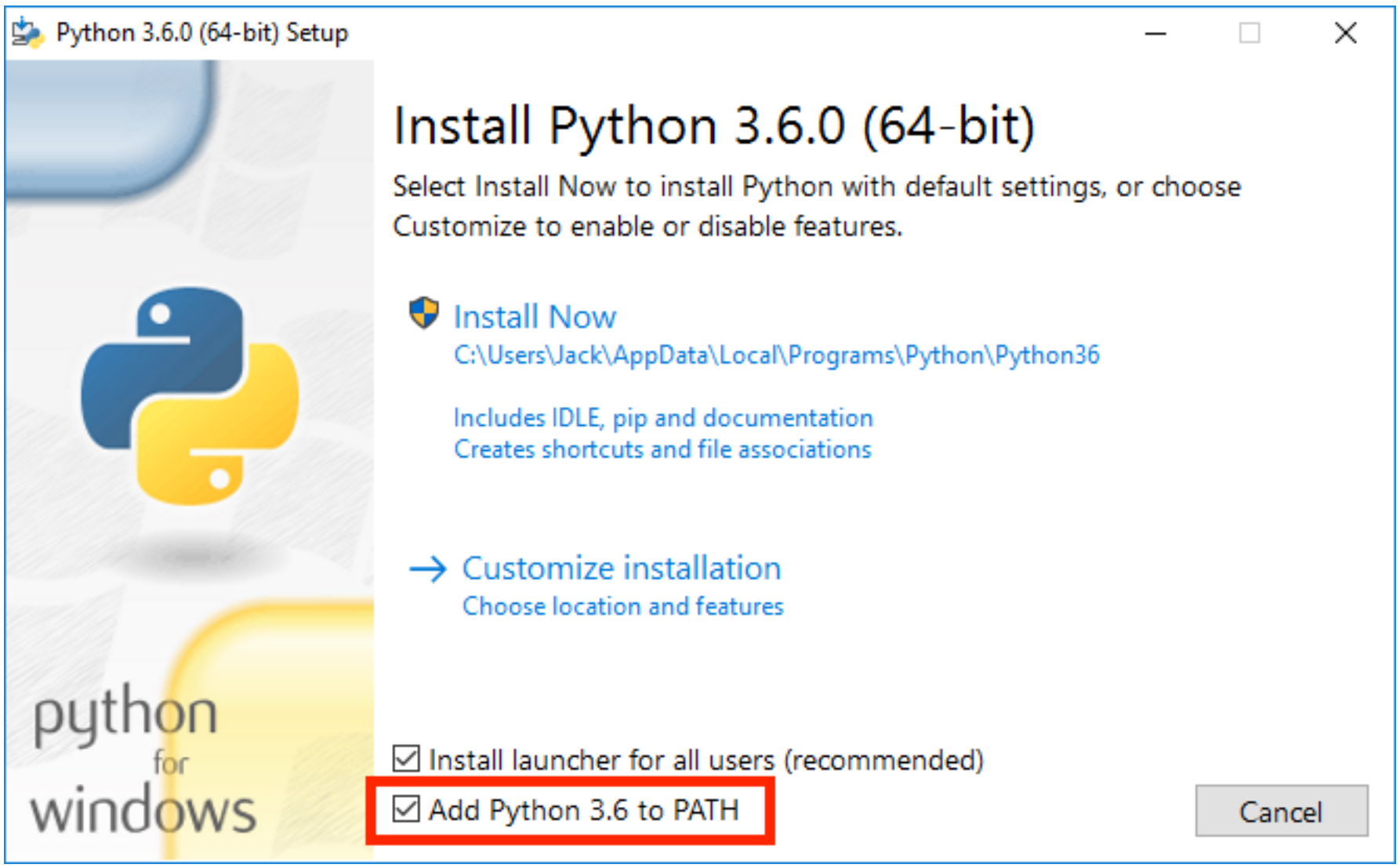
macOS

Refer to this video (https://www.youtube.com/watch?v=smHuBHxJdK8) for additional help on setting up Python (the video features a slightly older version of Python 3, but the steps are still the same).

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

Windows

When installing, make sure to check the "Add Python 3.6 to PATH" box, which will allow you to execute the `python` command from your terminal.



After installing please close and open your Terminal.

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. We find that Atom (https://atom.io/) and Sublime Text 3 (http://www.sublimetext.com/3) are popular choices among students, but you are free to use other text editors.

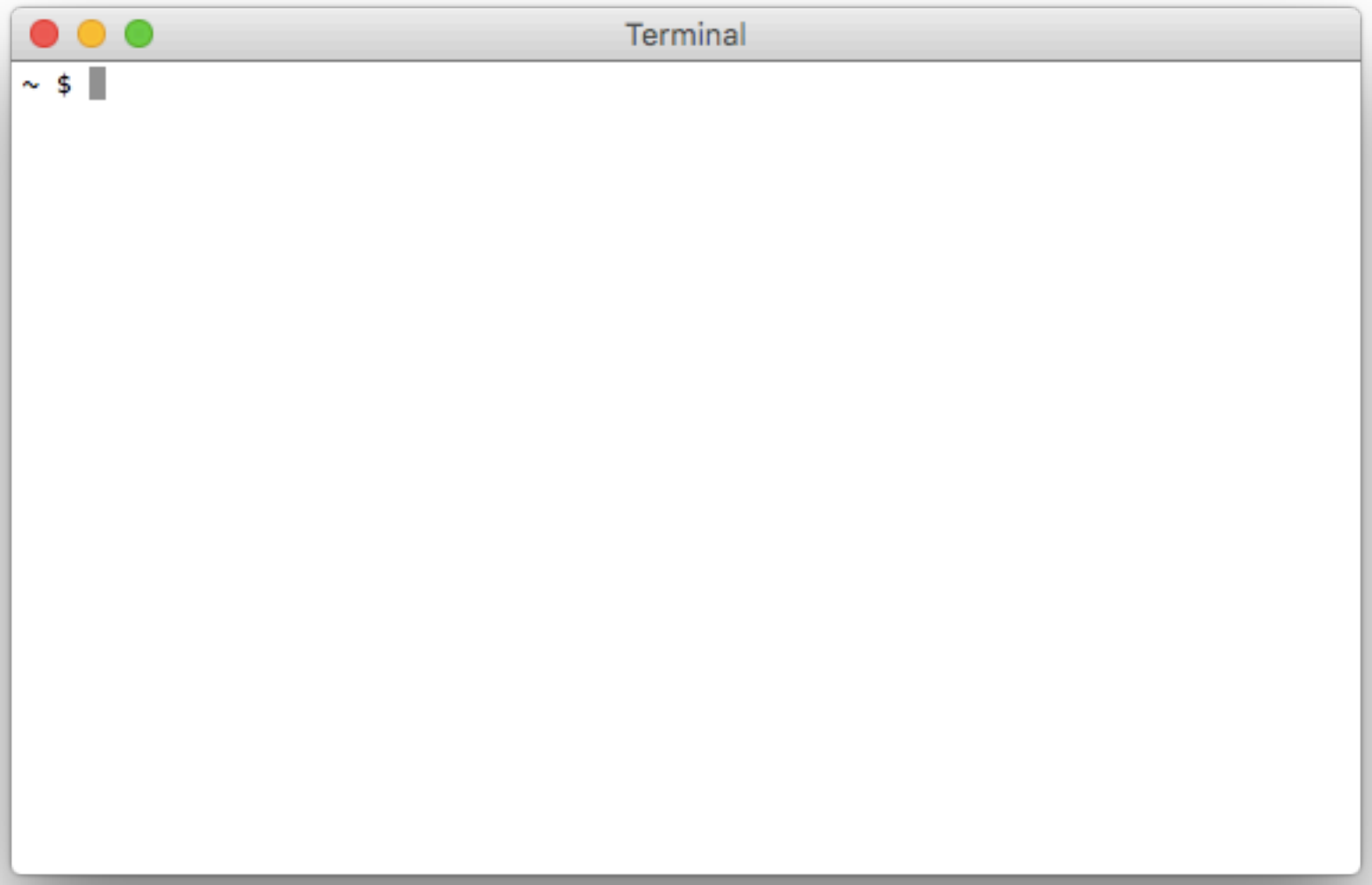
> **Note**: Please, please, *please* do not use word processors such as Microsoft Word to edit programs.

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:

- Atom (/articles/atom.html)
- Sublime Text 3 (/articles/sublime.html)
- Emacs (/articles/emacs.html)
- Vim (/articles/vim.html)

Using the terminal

Let's check if everything was installed properly! First, open a new terminal window, if you haven't already.



When you first open your terminal, you will start in the home directory. The **home directory** is represented by the `~` symbol.

> Don't worry if your terminal window doesn't look exactly the same; the important part is that the text on the left-hand side of the `$` has a `~` (tilde). That text might also have the name of your computer.

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.

> If you are using Windows and the `python3` command doesn't work, try using just `python` or `py`. If neither of those work, make sure you set up your PATH correctly as shown above. Ask for help if you get stuck!

Organizing your files

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

Directories

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

```
ls
```

The `ls` command **l**i**s**ts 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.

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
```

If your desktop directory is not located within your home directory and you can't find it, ask a TA or a lab assistant for help.

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!

Making new directories

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

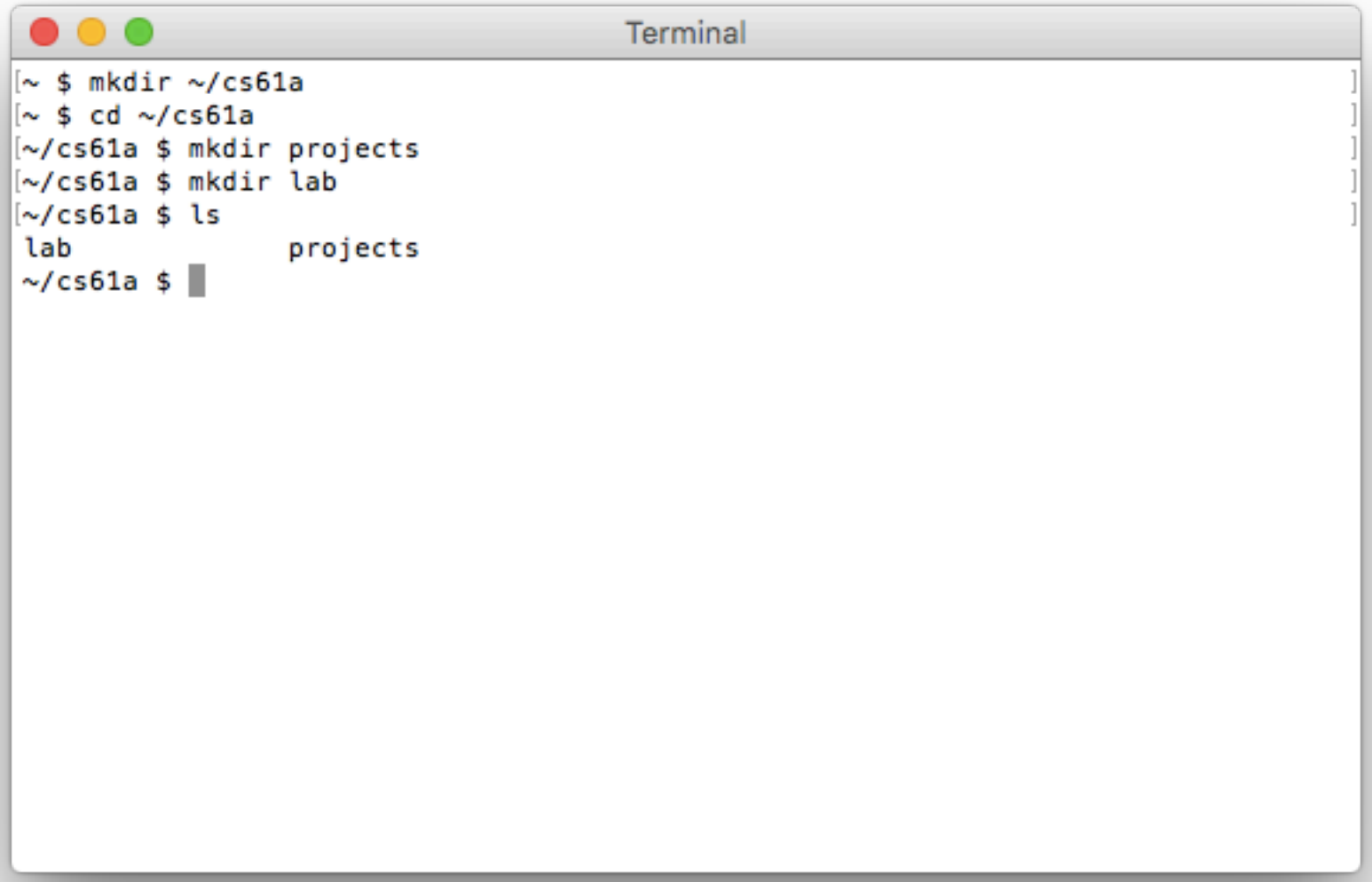
```
mkdir cs61a
```

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`.



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 a TA or lab assistant for help.

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 with the name of the zip file:

```
unzip lab00.zip
```

You might also be able to unzip files without using the terminal by double 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 **m**o**v**e 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`: **l**i**s**ts all files in the current directory
- `cd <path to directory>`: **c**hange into the specified **d**irectory
- `mkdir <directory name>`: **m**a**k**e a new **dir**ectory with the given name
- `mv <source path> <destination path>`: **m**o**v**e 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 (/articles/unix.html) for a more detailed explanation of terminal commands.

Python Basics

Expressions and statements

Programs are made up of expressions and statements. In very simple terms, 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 type a Python expression into the Python interpreter, its value will be printed out. As you read through the following examples, try out some similar expressions in your own Python shell, which you can start up by typing this in your terminal:

```
python3
```

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 today's 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
```

Names are also primitive expressions. Names evaluate to the value that they are bound to in the current environment. One way to bind a name to a value is with an assignment statement.

Assignment statements

An assignment statement consists of a name and an expression. It changes the state of the program by evaluating the expression and *binding* its value to the name in the current frame.

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

Note that the statement itself doesn't evaluate to anything, because it's a statement and not an expression. Now, if we ask for `a`'s value, the interpreter will look it up in the current environment and output its value.

```
>>> a
75
```

Note that the name `a` is bound to the *value* 75, *not* the expression `(100 + 50) // 2`. **Names are bound to values, not expressions.**

Doing the assignment

Unlocking tests

One component of lab assignments is *unlocking* tests. Their purpose is to test your understanding and make sure you have a good enough grasp on the topic to make progress on the assignment.

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.

```
>>> 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 += 3                      # Equivalent to y = y + 3
>>> y * 2
______

>>> y /= 4                      # Equivalent to 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_eighteen():
    """Come up with the most creative expression that evaluates to 2018,
    using only numbers and the +, *, and - operators.

    >>> twenty_eighteen()
    2018
    """
    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: "if we input this Python code, what should the expected output be?"

In `twenty_eighteen`,

- The docstring tells you to "come up with the most creative expression that evaluates to 2018," but that you can only use numbers and arithmetic operators `+` (add), `*`

(multiply), and `-` (subtract).
- The doctest checks that the function call `twenty_eighteen()` should return the number 2018.

> You generally will not need to 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.

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 2018. What's the most creative expression you can come up with?

> Don't forget to save your assignment after you edit it! 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.

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
```

The first time you run Ok, you will be prompted for your bCourses email. Please follow these directions (/articles/using-ok.html#signing-in-with-ok). We use this information to associate your code with you when grading.

> 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, you should see a successful test:

```
=====================================================================
Assignment: Lab 0
Ok, version v1.11.1
=====================================================================

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Running tests

---------------------------------------------------------------------
Test summary
    1 test cases passed! No cases failed.
```

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

```
---------------------------------------------------------------------
Doctests for twenty_eighteen

>>> from lab00 import *
>>> twenty_eighteen()
2013

# Error: expected
#     2018
# 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. Note that it is **not** 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 (/articles/using-ok.html#signing-in-with-ok). After that, Ok will print out a message like the following:

```
Submitting... 100% complete
Backup 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 (/articles/using-ok.html). You can also use the `--help` flag:
>
> ```
> python3 ok --help
> ```
>
> This flag works just like it does for UNIX commands we used earlier.

Appendix: Using your class account

The following is optional. Please only read if you plan on using an instructional account.

Logging into your class account

From your laptop

Most of the work in this class can be done without logging into your account. However, there may be times when you'll find working from an instructional account to be easier.

Let's log in now. Open up your terminal and type in the following command:

```
ssh cs61a-?@ashby.cs.berkeley.edu
```

where `?` is replaced with the rest of your username.

> If you're interested, here's an explanation of what the command does:
>
> 1. `ssh` is a **s**ecure **sh**ell (i.e. terminal) that connects to other computers over a network.
> 2. `cs61a-?` is the username on the remote computer.
> 3. `ashby.cs.berkeley.edu` is the domain name of the remote computer. For our purposes it can be any of the servers (http://inst.eecs.berkeley.edu/cgi-bin/clients.cgi?choice=13&string=) that belong to Berkeley's CS department.

You can also watch this video (http://www.youtube.com/watch?v=irwlU7esODA) for help.

The first time you attempt to `ssh` to a new server, the following message will appear:

```
The authenticity of host 'ashby.cs.berkeley.edu' can't be established.
RSA key fingerprint is ...
Are you sure you want to continue connecting (yes/no)?
```

Say yes. Your computer will remember the remote server, and won't ask you again.

Once you confirm, you will be prompted for your password. If you haven't changed your password yet, use the password you were assigned when you registered for your account.

> When you type your password, nothing will show up! This is a security feature, not a bug. Continue typing and press enter to log in.

From an instructional machine

Most of our instructional computers use Ubuntu, a version of the Linux operating system. To log in, just find a lab computer and enter your username and password.

Once you log in, you'll want to open a terminal. On Ubuntu, you can open a terminal with `Ctrl-Alt-T`.

Changing your password

The temporary password is not the easiest thing to remember. While still logged in, you can change your password by running this command and following the directions on the screen.

```
ssh update
```

Registering your account

The first time you log in to your class account, your terminal may ask you some registration questions about the following:

- Last name
- First name
- Student ID
- Email (please use the same email as above!)
- Code name (we don't use this information, you can enter anything you want)

> If your terminal doesn't prompt you for this information the first time you log in, you can type `register` to begin the process. You don't need to do this again if you've already registered before.

If you find errors (e.g. you misspelled your name), fix them immediately by running the command:

```
re-register
```

Logging out

Once you've registered your account and changed your password, you can log out by pressing `Ctrl-D`, or with the command `exit`.

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/3.4/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 lab00.py
```

- **`-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 lab00.py
```

- **`-m doctest`** : Runs doctests in a particular file. Doctests are surrounded by triple quotes (`"""`) within functions. Each test consists of `>>>` followed by some Python code and the expected output.

```
 python3 -m doctest lab00.py
```

Assignments (/articles/about.html#assignments)

Exams (/articles/about.html#exams)

Grading (/articles/about.html#grading)