1 — PHY 494: Homework assignment (45 points total)

Due Tuesday, Jan 24, 2017, 1:30pm.

Submit a PDF through Blackboard (name it *lastname*_*firstname*_hw1.pdf). Homeworks must be legible or may otherwise be returned ungraded with 0 points.

This assignment contains **bonus problems**. A bonus problem is optional. If you do it you get additional points that count towards this homework's total, although you can't get more than the maximum number of points. If you don't do it you can still get full points. Bonus problems and bonus points are indicated with an asterisk "*".

Note: In general, for full credit you need to (1) show the commands that you used and (2) answer the question. Sometimes you should also copy and paste output.

1.1 Commands and paths (8 points)

(The following questions do not require you to show code unless explicitly stated.)

(a) What is the function of the `cd` and the `pwd` command? [**2 points**]

(b) Show commands for two different ways to change to your home directory, assuming you are currently in the root directory. [**1.5 points**]

   BONUS: Show a third possibility. [**bonus +0.5***]

(c) Given the path `/home/dvader/Documents/../data/bases`:

   (i) Is this an absolute or relative path? [**0.5 points**]

   (ii) If you are located in the home directory of user dvader (`/home/dvader`) then what is the shortest path to `bases`? [**1 points**]

(d) If you were in a directory `/home/dvader/data` and you executed the command `cd ./../././../././.`, what would be the output of running the `pwd` command afterwards? [**1 points**]

(e) Describe two ways by which you could learn more about the function of a Unix command `frbzz` that you don't know anything about. [**2 points**]

(f) BONUS: (Skim)read Neal Stephenson's *In the Beginning was the command line* from 1999 (PDF[1])[2]. What are the advantages and disadvantages of using the command line instead of a graphical user interface? [**bonus +4***]

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[1] https://becksteinlab.physics.asu.edu/file_download/7/NealStephenson_Commandline.pdf?mimetype=pdf

[2] originally available from http://www.cryptonomicon.com/beginning.html

1.2 Copy, rename, delete (4 points)

Work through the Copy, rename, delete: Activity[3] (note that this exercise builds on previous parts of 01 The Unix Shell[4], which you should have also done). After you completed the activity (points 1 – 11) you should end up with a specific directory structure under ~/PHY494/01_shell. Show the output of the commands

```
cd ~
ls -R PHY494/01_shell
```

which will be compared against the expected directory structure and content. [**4 points**]

1.3 BONUS: Pipes and Filters (+5* points)

Work through the activities in the section Pipes and Filters[5]. Answer the following questions and show the commands that you used to arrive at the answer.

(a) How many lines does the file `planets_2.dat` contain? [**bonus +1***]

(b) What are the three biggest planets (by diameter) in the file `planets.dat`? [**bonus +1***]

(c) Which planets contain *ice* terrain? [**bonus +1***]

(d) What is the most frequent and the least frequent first letter amongst *all* the planets? [**bonus +2***]

1.4 Python Lists and Strings (20 points)

Lists and strings share some similarities but also have important differences. Let's look at them. (Type code in the Python interpreter e.g., `ipython`).

```
bag = ["guide", "towel", "tea", 42]
ga = "Four_score_and_seven_years_ago"
```

(Note that spaces are shown explicitly in the second string with the symbol "_"—just type a space.)

(a) How do you have to slice `bag` in order to get `['towel', 'tea']`? [**1 points**]

(b) What does `bag[::-1]` do?

How do you slice bag in order to get `['tea', 'towel']`? [**2 points**]

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[3]http://asu-compmethodsphysics-phy494.github.io/ASU-PHY494//2017/01/12/01_Unix_Shell/
   #copy-rename-delete

[4]http://asu-compmethodsphysics-phy494.github.io/ASU-PHY494//2017/01/12/01_Unix_Shell/

[5]http://asu-compmethodsphysics-phy494.github.io/ASU-PHY494//2017/01/12/01_Unix_Shell/
   #pipes-and-filters

(c) Strings can also be sliced. How do you have to slice `ga` to get

- "Four"
- "seven"

[2 points]

(d) You can access elements of a list in a variety of ways:

    (i) Explain what

```
bag[0] = 'book'
```

      does? (Hint: print `bag`!) **[1 points]**

   (ii) Create two new variables:

```
mybag = bag
yourbag = bag[:]
```

      and use them:

```
mybag[3] = "mice"
yourbag.append("money")
```

      What is the content of `bag`, `mybag`, `yourbag`? **[2 points]**

  (iii) From your observations, explain how the assignment `x = a` differs from `y = a[:]`? **[3 points]**

(e) Try

```
ga[:4] = "Three"
```

    (i) Describe what happens?[6] **[1 points]**

   (ii) How would you construct the string `"Three score and seven years ago"` from `ga` and the string `"Three"`? **[1 points]**

(f) What do the commands

```
ga.split()
a, b, c = ga.split()[:3]
list([1,2,3])
list(ga)
```

do? You can show the output but you need to explain in your own words what is happening. **[4 points]**

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[6]Note that strings are "immutable" objects in Python whereas lists are "mutable".

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(g) Nested lists: Given the list

```
bags = [['salt', 'pepper'], ['pen', 'eraser', 'ruler']]
```

how do you have to index **bags** to get

   (i) `['salt', 'pepper']` [**1 points**]
   (ii) `'pepper'` [**1 points**]
   (iii) `'ruler'` [**1 points**]

1.5 Very Simple Temperature Calculator (13 points)

Write a Python program `addtemperatures.py` that adds a temperature difference in Fahrenheit, $\Delta\theta$, to an absolute temperature, given in Kelvin, T. The program should

- ask the user for two floating point numbers T and θ as input

- print the sum $T + \theta$ in units of Kelvin

The conversion of an absolute temperature from Fahrenheit to Kelvin is (written with numbers T/K and $\theta/^\circ\mathrm{F}$)

$$T/\mathrm{K} = \frac{5}{9}(\theta/^\circ\mathrm{F} - 32) + 273.15 \tag{1}$$

(a) Derive an expression for $\Delta T = T_2 - T_1$ as a function of $\Delta\theta = \theta_2 - \theta_1$ (where T_2, T_1, θ_2, and θ_1 are arbitrary and only introduced to make the connection to Eq. 1). Show that the the difference in Kelvin is 5/9-th of the difference in Fahrenheit. [**2 points**]

(b) Write the `addtemperatures.py` program and copy and paste the code. [**7 points**]

(c) Show the complete input and output (copy and paste) for $\Delta\theta = 63^\circ\mathrm{F}$ and $T = 265\,\mathrm{K}$. [**4 points**]