Homework 2 - Distances to Planets and Stars

Due: Mon Feb 7

Points: 200 total. Turn in your code and the answers to the 6 questions.

The Solar system and Exoplanets

Lots of you have seen models in school of the solar system.

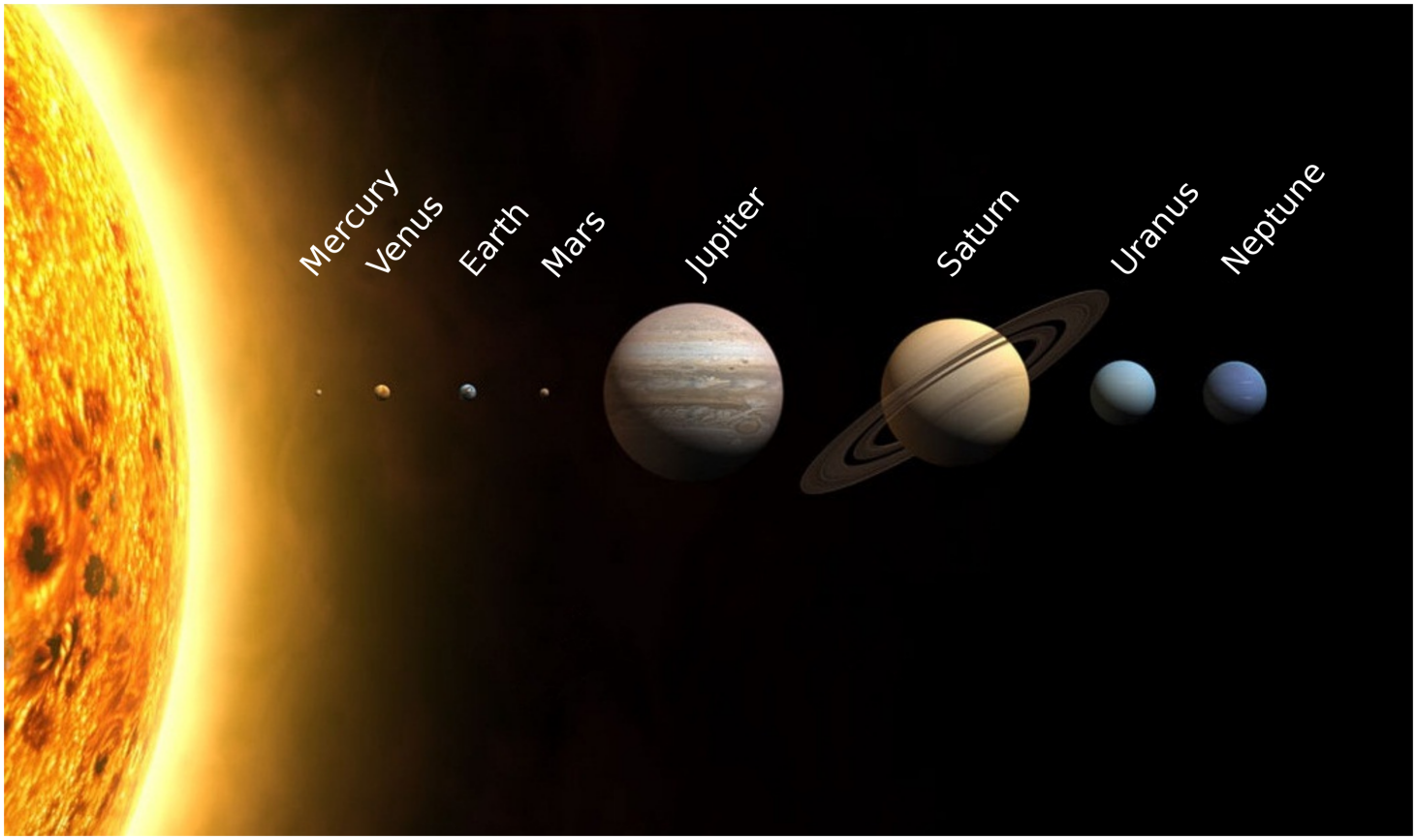

Image From Wikipedia! That is fun!!!

But very inaccurate. Whenever you have a model you have inaccuracies. That is not to say that it is not useful. This is useful in showing the relative size and the order of the planets in our solar system.

It is way, way, way off in giving you a sense of the scale of the solar system. In our model we will use the size of a tennis ball as our model Sun and then calculate the sizes of the planets and distances to other stars.

For our calculations a tennis ball is 2.75 inches in diameter. Note that some of our data is diameter and some is radius. Diameter is radius times 2.

All of our calculations need to be carefully checked. Read: https://www.simscale.com/blog/2017/12/nasa-mars-climate-orbiter-metric/ Unit conversion errors are a serious thing. $125 million probe lost because of a conversion error between metric and English units.

Sizes

The sizes of the planets in our solar system:

Planet	Radius	Description
Mercury	1,516mi (2,440km)	about $^1/_3$ the size of Earth
Venus	3,760mi (6,052km)	only slightly smaller than Earth
Earth	3,959mi (6,371km)	a nice place to live, about the size of Earth
Mars	2,106mi (3,390km)	about half the size of Earth
Jupiter	43,441mi (69,911km)	11x Earth's size
Saturn	36,184mi (58,232km)	9x larger than Earth
Uranus	15,759mi (25,362km)	4x Earth's size
Neptune	15,299mi (24,622km)	only slightly smaller than Uranus

The Sun is 865,370 miles in diameter.

Planet Distances from the Sun

Planet	Distance from Sun (km)	Distances from sun(miles)
Mercury	57,900,000	35,977,481
Venus	108,200,000	67,232,530
Earth	149,600,000	92,957,361
Mars	227,900,000	141,610,847
Jupiter	778,600,000	483,800,813
Saturn	1,433,500,000	890,737,818
Uranus	2,872,500,000	1,784,893,186
Neptune	4,495,100,000	2,793,132,589

Conversion Factor

To convert from the size in miles to tennis ball units (tb), divide the miles by 19,938,124,800.0 . This returns inches! So if you get a small value (like the size of earth) you will want to multiply by 1000 to get 1/1000th of an inch. If you get a large value (like the distance to a nearby star you will want to convert to miles)

Miles/Kilometers per Light Year

5,878,625,352,016,794 miles per light year.

Conversions

To convert kilometers to miles multiply the miles by 0.62137119 .

To convert from miles to kilometers multiply by 1.60934 .

A mile is 80 chains, a chain is 22 yards. A yard is 3 feet so a mile is 5280 feet. An acre is 10 square chains. All very convenient. 10 chains is 1 furlong. so an acre is 1 furlong by 1 furlong.

Learning Goals

1. Read in a value, calculate on it, print out results.
2. Testing of a program.
3. Printing out of results.
4. Debugging.
5. Use of a function in Python.
6. Editing text files.
7. What are files.
8. Organization of code.
9. Calculation with big numbers.
10. A model of how big the solar system is.

Program

Write a program that will:

1. Create a directory/folder for this code

2. Bring up Visual Studio Code in a new directory.

```
$ mkdir hw2
$ cd hw2
```

Or Windows/PowerShell

```
H:\> H:
H:\> mkdir hw2
H:\> cd hw2
```

3. Open visual studio code, open the folder/directory hw2. Edit the files.

4. use a “def” in `miles_to_tb.py` for the conversions

5. Have a test section at the bottom to test the function.

    - Write automated test code that will check that your conversion is correct.
    - Make it so that if you just run the conversion code it will run the test.

6. Run the test code - get this section to work.

7. Call the main program in the folder, `main.py` .

8. The main program will

    - `imort miles_to_tb`
    - Print out a prompt for the value, `print ( "Enter Miles" )`
    - read in the string, `input(miles_str)`
    - Convert to a number, `miles = float(miles_str)`
    - Apply a conversion from that unit to tennis ball model. (Call the function)
    - Output a value in miles, kilometers and feet plus inches (or fractions of an inch).

Example Code: from lecture...

main program (main.py)

```
# Read and call a function

import conv

print ( "Enter Miles" )

miles_str = input()
miles = int(miles_str)

km = conv.mi_to_km(miles)

print ( "km = {}".format(km) )
```

main program (conv.py)

```
# mi_to_km converts from miles as an integer or float to kilometers.
def mi_to_km ( mi ):
    conv = 1.60934
    km = mi * conv
    return (km)

# Automated Test
if __name__ == "__main__":
    n_err = 0
    x = mi_to_km ( 3 )
    if x !=  4.82802:
        n_err = n_err + 1
        print ( "Error: Test 1: conversion not working, expected {} got {}".
                format (  4.82802, x ) )
    x = mi_to_km ( 0 )
    if x != 0:
        n_err = n_err + 1
        print ( "Error: Test 2: conversion not working, expected {} got {}".
                format ( 0, x ) )

    if n_err == 0 :
        print ( "PASS" )
    else:
        print ( "FAILED" )
```

Part 2. Use your program a few times.

Questions: to be answer.

Questions are answered by doing a write up as a .md or .markdown (text) file in lab. The write-up should be written in Visual Studio Code (VS Code).

Use markdown https://www.markdownguide.org/cheat-sheet/ for the formatting of your text file answers.

This portion should be turned in as a part of your lab.

1. What is the closest star to planet Earth? Think! It shines on you every day.
2. How many feet is it from the sun to earh (remember that the program prints out in inches). Use your program to answer questions 2, 3, 4, 5, 6.
3. How far is it from Earth to moon in TB units?
4. How many feet from sun to Saturn in TB units?
5. How big is Saturn in tennis ball units?
6. If the Sun in our model is the size of a tennis ball, then how far is to Proxima Centauri 4.3 light years from us? Calculate for our tennis ball model the number of miles
   that 4.3 light years represents. Remember that the program returns inches, so you need to devide by 12, then by 5280 to get miles.

Write up your answers in a text file , `homework2.md` , using Visual Studio Code. (not Microsoft Word, or .pdf). In visual studio go and create a new file `homework2.md` and enter your answers. Save the file and turn it in.

Turn in your answers, and the code you developed and tested.

Copyright