

# Homework 2 - Distances to Planets and Stars

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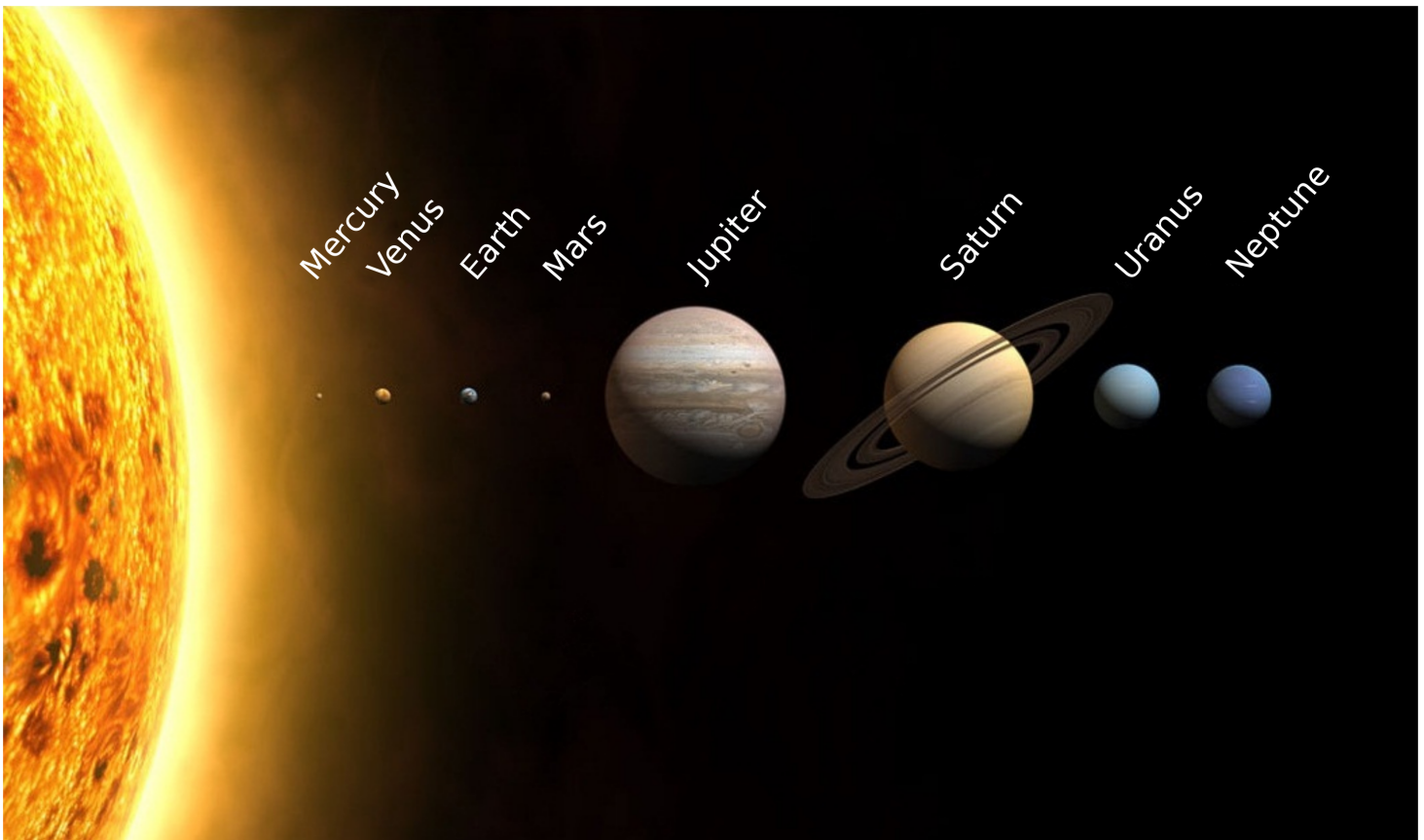
Due: Mon Sep 13

Points: 200 total. 100pts for Assignment, 100 in lab.

## The Solar system and Exoplanets

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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 sence 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

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The sizes of the planets in our solar system:

Planet	Radius	Description
Mercury	1,516mi (2,440km)	about $\frac{1}{3}$ 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 (1,391,400km) in diameter.

## Planet Distances from the Sun

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Planet	Distance from Sun (km)
Mercury	57,900,000
Venus	108,200,000
Earth	149,600,000

Planet	Distance from Sun (km)
Mars	227,900,000
Jupiter	778,600,000
Saturn	1,433,500,000
Uranus	2,872,500,000
Neptune	4,495,100,000

## Miles/Kilometers per Light Year

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

9,460,730,472,580,800 km per light year.

## Conversions

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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.

Let us do some calculation and fix this misconception.

Read about the TRAPPIST-1 star system. <https://exoplanets.nasa.gov/trappist1/>

There is a set of exoplanets that have been found around a star that is 35 light years from our local star (The Sun). Read the article: <https://earthsky.org/astronomy-essentials/how-far-is-a-light-year/>  
Find in the article where the author describes 35 light years as "close" to us.

## Learning Goals

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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. Differences between integer and float. Data Types. String data types.
11. A model of how big the solar system is.

## Program

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100pts total - Assignment 2. Turned in by upland your files as a .zip archive on the banner/wyoweb system.

Part 1: 75pts - Write a program that will:

1. Open PowerShell(windows) or Terminal(mac) or iTerm2(mac)
2. Create a directory/folder for this code

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

Or Windows/PowerShell

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

3. Create a file with the conversion code in it, `conv.py` .

```
$ vi conv.py
... edit file
```

Or Windows/PowerShell

```
H:\hw2\> vi conv.py
... edit file
```

4. use a "def" in `conv.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. Call the main program in the folder, `main.py` .

```
$ vi main.py  
... edit file
```

Or Windows/PowerShell

```
H:\hw2\> vi main.py  
... edit file
```

7. The main program will

- Print out a prompt for the value.
- Read in from the terminal a value in kilometers.
- 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)

```
# Step 5 - with function and a test.

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. 25pts - Write a program that will: Use the same technique as the above with different values for reading in light years and print out the output in miles and kilometers. This means creating a new directory for this 2nd set of code. Creating a set of files, one with the main program and a file for each of the conversions. The conversions are light-years-to-miles and miles-to-kilometers. Read in light years, print out miles and kilometers in the main program. Call the conversion from the main program. Implement test code in each of the conversion programs.

## Questions: to be answer in lab.

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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.

It is worth 100pts.

1. 5pts - What is the closest star to planet Earth? Think! It shines on you every day.
2. 10pts - Approximately how many exoplanets have been identified? (Use Google) Explain why you think this answer from Google and other sources is valid. Find a list of Kuiper belt objects. How many are there? How far is it to the Kuiper Belt in miles and kilometers? How far is it to the Oort Cloud in miles and kilometers?
3. 10pts - How far is it to the Trappist-1 system In Light Years? In miles and kilometers in our model, how far to this system?
4. 10pts - At the speed of light how far is it from Laramie to Tokyo Japan? Answer in fractions of a second.
5. 10pts - 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? In Miles and in kilometers? In Feet and meters?  
Calculate for our tennis ball model the number of miles that 4.3 light years represents. Using Google Maps - find a city that is approximately the same number of miles from Laramie to that city as our model calculates. How long will it take you to drive from Laramie to that city? Use approximate number of hours of driving time from Google Maps. Will you be able to see the tennis ball from that location? (Yes/No)
6. 5pts - Using the same calculation, L 95-59 is 35 light years from Earth. Use your program to calculate the number of miles and kilometers to L 95-59. For the tennis ball model calculate the number of miles in our model to L 95-59?
7. 15pts - If the Sun is a tennis ball, how big are each of the planets - in inches or thousandths of an inch?

8. 5pts - How big is the Moon in thousandths of inches in our model and how far from Earth in inches?
9. 5pts -How far is it to the Kupier Belt in miles and kilometers? How far in miles in the tennis ball model? If you are in Prixies Pasture at the "family" statue, put the Sun there - where will the Kupier Belt be?
10. 5pts - How far is it to the Oort Cloud in miles and kilometers? How far in miles in the tennis ball model? If you are in Prixies Pasture at the "family" statue, put the Sun there - where will the Oort Cloud be?
11. 10pts - Cygnus-x-1 is at the center of the Milky Way Galaxy, 29,000 light years from earth. How many miles is that?
12. 10pts - Ligo detected a black hole merger <https://www.ligo.caltech.edu/news/ligo20200902> of gw190521. How many light years is that away from earth? (See: <https://en.wikipedia.org/wiki/GW190521>. How far away is that in miles? Use 1,000,000,000 for a billion.

Write up your answers in a text file (not Microsoft Word, or .pdf).

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