CS 171 - Programming Assignment 1

Mark Boady - Drexel University

January 4, 2018

1 Overview

This project has two programs. Make sure to complete both.

Contents

2 Program 1 (Loan Calculator)

The goal of this program is to compare three different types of student loans. Develop a program that asks the user for the amount they want to borrow. Show information about each loan to help the user decide which is best.

2.1 Loan Calculations

2.1.1 Subsidized Federal Direct Loans

Federal Subsidized Loans do not start accruing interest until after graduation from college. There are a few values that are needed to compute information about the loan.

Name	Explanation
P	**P**rinciple: The amount of money loaned.
y	The number of **y**ears the loan is for.
t	The **t**imes per year interest is compounded. For this assignment, t=12.
i	The **i**nterest rate as a decimal number.
f	The **f**ee rate for the loan.

The monthly payment is computed using the following formula.

$$M = \frac{P * i}{t * \left(1 - \left(1 + \frac{i}{t}\right)^{-y*t}\right)} \tag{1}$$

For example, someone borrows $4,000.00$ at 3.4% interest for 10 years. Their monthly payment is be computed as

$$P = 4000 \tag{2}$$
$$i = 0.034 \tag{3}$$
$$y = 10 \tag{4}$$
$$t = 12 \tag{5}$$
$$M = \frac{4000 * 0.034}{12\left(1 - \left(1 + \frac{0.034}{12}\right)^{-10*12}\right)} \tag{6}$$
$$= \frac{136}{3.454648520} \tag{7}$$
$$= 39.36724 \tag{8}$$

The monthly payment is $39.37.

To compute the total amount paid over the course of the loan, multiply this amount by the number of payments. Do not round numbers while doing the calculations, let Python handle decimal digits. Only round numbers when displaying them.

$$\begin{align}
\text{Balance} &= M * t * y \tag{9}\\
&= 39.36724 * 12 * 10 \tag{10}\\
&= 4724.06880 \tag{11}
\end{align}$$

The total amount paid on the loan is $\$4,724.07$.
The amount of interest paid is the total paid minus the principle.

$$\begin{align}
\text{Interest Paid} &= \text{Balance} - P \tag{12}\\
&= 4724.06880 - 4000 \tag{13}\\
&= 724.06880 \tag{14}
\end{align}$$

The interest paid on this loan is $\$724.07$.
When a loan is taken out, there is also a fee charged. The fee is based only on the principle. On this loan, the fee is 1.051%.

$$\begin{align}
\text{Fee} &= P * f \tag{15}\\
&= 4000 * 0.01051 \tag{16}\\
&= 42.04 \tag{17}
\end{align}$$

The total extra cost of the loan is the fee plus the interest paid. A summary of the loan information is provided below for a Subsidized Federal Loan.

Principle	$\$4,000.00$
Interest Rate	3.4%
Years	10
Monthly Payment	$\$39.37$
Total Paid on Loan	$\$4,724.07$
Total Interest Paid	$\$724.07$
Additional Fees Paid	$\$42.04$
Total Costs Over Principle	$\$766.11$

2.1.2 Unsubsidized Federal Direct Loans

Unsubsidized Federal Loans and PLUS loans work in a similar way. The main difference is that interest accumulates while in school. This means, the starting principle balance will be higher then the amount taken out. The current interest rate for an unsubsidized loan is 6.8%. If someone borrowed $\$4,000$ on a ten year loan, they are adding interest to their principle throughout college.

The amount of principle the student will be paying after 4 years is computed using the following formula.

$$\text{New Principle} = P * (1 + i * 4.25) \tag{18}$$
$$= 4000 * (1 + 0.068 * 4.25) \tag{19}$$
$$= 5156.00 \tag{20}$$

To compute the monthly payments for the loan, we need to start with $5,156.00 as the principle instead of $4,000. This accounts for all the extra interest the student gained during their education. Notice the number 4.25 is used. Loan repayments don't start the day of graduation. This means interest is gained for a little over 4 years.

Once we know the balance when payment starts, the remaining calculations are the same as in the previous part. A summary chart is provided below.

Principle	$4,000.00
Interest Rate	6.8%
Years	10
Monthly Payment	$59.34
Total Paid on Loan	$7,120.25
Total Interest Paid	$3,120.25
Additional Fees Paid	$42.04
Total Costs Over Principle	$3,162.29

2.1.3 Unsubsidized PLUS Loans

These work exactly the same as Unsubsidized Federal Direct Loans. They just have different Interest Rates and Fees.

2.2 Programming Project

Develop a Python program student_loans.py. The program should ask the user for two inputs. First, ask for the total amount of principle borrowed. Next, ask for the number of years on the loan. Assume all loans make 12 payments per year.

Your program will then compute all the following values for three different types of loans.

Principle
Interest Rate
Years
Monthly Payment
Total Paid on Loan
Total Interest Paid
Additional Fees Paid
Total Costs Over Principle

Compare the Following three types of loans.

Loan Type	Interest Rate	Fee Rate
Subsidized Federal Direct	3.4%	1.051%
Unsubsidized Federal Direct	6.8%	1.051%
Unsubsidized PLUS Loan	7.9%	4.204%

You can check your answers using the Student Loan Comparison Calculator linked below.

https://bigfuture.collegeboard.org/pay-for-college/loans

2.3 Example Execution Trace

You are not required to exactly match the below layout, but your content and results must be the same.

```
Welcome to the Student Loan Calculator
Enter the amount of the loan in dollars with (no commas):
4000
Enter the number of years the loan will be for:
10
_____
Subsidized Federal Direct Loan
Principle: 4000
Interest Rate: 3.4
Years: 10
Monthly Payment 39.37
Total Paid on Loan: 4724.07
Total Interest Paid: 724.07
Additional Fees Paid: 42.04
Total Costs Over Principle: 766.11
_____
Unsubsidized Federal Direct Loan
Principle: 4000
Interest Rate: 6.8
Years: 10
Monthly Payment 59.34
Total Paid on Loan: 7120.25
Total Interest Paid: 3120.25
Additional Fees Paid: 42.04
Total Costs Over Principle: 3162.29
_____
Federal Plus Loan
Principle: 4000
Interest Rate: 7.9
Years: 10
Monthly Payment 64.54
Total Paid on Loan: 7745.2
Total Interest Paid: 3745.2
```

Additional Fees Paid: 168.16
Total Costs Over Principle: 3913.36

3   Program 2 (Unit Conversions)

3.1   Overview

The goal of this program is to create a unit conversion program. The key programming feature explored in this assignment is dictionaries. You will use a dictionary to store reference information.

3.2   Unit Conversions

There are many different units of length. Converting between units is error prone. This can cause some major problems.

   `http://www.cnn.com/TECH/space/9909/30/mars.metric.02/`

In this assignment, you will write a program that converts between different units of length.

For consistency, we will always use the plural form of the units. For example, 1 feet instead of 1 foot. This will simplify your programming.

Your program must support the following U.S. Units. The below league measurement is for land leagues not nautical leagues.

Units	Relationship to other Units
1 inches	2.54 centimeters
1 feet	12 inches
1 yards	3 feet
1 miles	1760 yards
1 leagues	3 miles

Your program must support the following S.I. Units.

Units	Relationship to other Units
1 centimeters	0.01 meters
1 decimeter	10 centimeters
1 meters	10 decimeters
1 decameters	10 meters
1 hectometers	10 decameters
1 kilometers	10 hectometers

If asked to convert 2 feet into centimeters, we can compute

$$2 \text{ feet} * 12 \text{ inches/feet} = 24 \text{ inches} \qquad (21)$$
$$24 \text{ inches} * 2.54 \text{ centimeters/inches} = 60.96 \text{ centimeters} \qquad (22)$$

All of the relationships given above are relative. You cannot go directly from inches to miles without multiple steps.

For your programming project, you **must** create a dictionary of measurements. You should pick a single unit of measurement to be your **base**. Then make a dictionary where the key is the unit of measure and the value is the relationship to your base unit.

For example, if you selected miles as your base unit, then the dictionary position for "inches" should store how many miles are equal to 1 inch. (Note: miles would not be a good base unit to select. It is very big compared to most of the other units.)

With this dictionary, you will be able to convert between any of the units above using only two steps.

1. Convert value in **from units** to **base units**

2. Convert value in **base units** to **to units**

3.3   Programming Project

Develop a Python program unit_conversion.py. The program should ask the user for three inputs. First, ask for the value to be converted as a float. Next, ask for the type of units the value is currently in. Finally, ask to the target units to convert to.

Your program will then print out the unit conversion.

You **must** store all your unit conversions in a dictionary. (See Section 3.2)

You are not required to do any error checking. If the user enters invalid units, it is acceptable that your program crashes. You may assume all inputs given will be valid.

You program must print out all the units it supports so the user knows exactly what to type. If the output does not make it clear what the correct spelling/capitalization is for each unit then points will be deducted. We can only assume the user will give valid input if they understand what input is expected.

You must show at least 4 decimal digits if they are significant. Rounding errors will be accepted as long as they are reasonably small.

You can check your answers using the google. For example, search for "200 centimeters in yards" in google to see a conversion. Google will assume nautical leagues which is not what we are using.

3.4   Example Execution Trace

You are not required to exactly match the below layout, but your content and results must be the same.

The below execution traces do not test all possible types of units. Only a few examples are shown. You are expected to do additional testing on your own.

3.4.1   Example 1

```
Welcome to the length conversion wizard.
This program can convert between any of the following lengths.
inches
```

```
feet
yards
miles
leagues
centimeters
decimeters
meters
decameters
hectometers
kilometers
Note: You must use the units exactly as spelled above.

Enter value:
25
Enter from units:
inches
Enter to units:
feet
25.0 inches is 2.0833333333333335 feet
```

3.4.2 Example 2

```
Welcome to the length conversion wizard.
This program can convert between any of the following lengths.
inches
feet
yards
miles
leagues
centimeters
decimeters
meters
decameters
hectometers
kilometers
Note: You must use the units exactly as spelled above.

Enter value:
91
Enter from units:
leagues
Enter to units:
kilometers
91.0 leagues is 439.35091199999994 kilometers
```

3.4.3 Example 3

```
Welcome to the length conversion wizard.
This program can convert between any of the following lengths.
inches
feet
yards
miles
leagues
centimeters
decimeters
meters
decameters
hectometers
kilometers
Note: You must use the units exactly as spelled above.

Enter value:
2.45
Enter from units:
feet
Enter to units:
hectometers
2.45 feet is 0.0074676000000000005 hectometers
```

4 Grading

You will be graded on the quality of your design and execution of your program.

- Program 1 (Loan Calculator) 60 points

    - Program's Output is clear and easy to understand: 10 points
    - Program takes two inputs from user: 10 points
    - Calculations Correct for Subsidized Loan: 10 points
    - Calculations Correct for Unsubsidized Loan: 10 points
    - Calculations Correct for PLUS Loan: 10 points
    - Calculations Correct for Fees: 5 points
    - Correct File Name: 1 point
    - Name in Comments: 1 point
    - Section Number in Comments: 1 point
    - Code is well Commented: 2 points

- Program 2 (Unit Conversion) 40 points

    - Correct File Name: 1 point
    - Name in Comments: 1 point
    - Section Number in Comments: 1 point
    - Code is well Commented: 2 points
    - Unit Conversions stored in a Dictionary: 8 points
    - Correct Unit Conversions: (22 points, 2 points per unit)
    - Program inputs correct: 3 points
        * Reads float: 1 point
        * Reads from units: 1 point
        * Reads to units: 1 point
    - Output is well formatted and easy to read: 2 points

If you code has any errors, a 50 point deduction will be taken. Only portions of the code that execute without errors will be graded. It is better to hand in unfinished but working code. Test your code as you develop it.

5 Resources

You can learn more about the calculations at these websites.
http://mathforum.org/dr.math/faq/faq.interest.html
https://www.calculatorsoup.com/calculators/financial
https://www.calculateme.com/Length/Leagues(Land)/ToKilometers.htm
https://en.wikipedia.org/wiki/League_(unit)
https://en.wikipedia.org/wiki/Unit_of_length