Homework 1:
Drive My Car

Due date: February 13 at 3:30pm.

You will not demo this homework to a lab leader; instead, you will upload it to Dropbox when you are *complete*, **even if it is after the due date**. You must also turn in your handwritten answers to the **Discussion Questions** (at the end of this document) before the start of lecture on **February 13**. You can (and should) turn in the Discussion Questions even if you aren't finished with the code.

Overview

In this homework, you will develop an application for calculating various times, distances, and money amounts involving automobile travel. You will use a menu to allow the user to select among the various operations of the calculator; each operation will have a different set of inputs required from the user, and you must validate any input coming from the user.

Program Flow

1. Display the main menu, allowing the user to select among the four calculator operations. Read an integer from the user indicating the desired operation. Verify that the operation is a valid value. If the user does not input a valid selection, print a message and try again.
2. Use `if` and `elif` statements to select the correct operation according to the user's request.
3. Request and read any additional parameters needed for the operation. **Validate all user input** according to the notes in the Operations section below, looping until a value in the correct range is entered. You may assume the user will always enter the correct **type** of data, but might enter data that is not in the correct **range** of values.
4. Perform the desired operation using the provided input values, and output the formatted result.
5. Return to the menu and ask for the next selection. Repeat this until the user decides to Quit.
6. **Use constant variables to represent any "magic numbers" in your calculation.** There should be no random "365", "3600" or any other constant literal in your calculations.

Operations

Your program will support these operations:

1. **Cost of Gas**: compare two cars with different mileages and different fuel costs to see how much money is saved in gasoline over a year.
   (a) Input:
      i. Car 1's mileage (MPG), and average fuel cost per gallon
      ii. Car 2's mileage and average fuel cost per gallon
      iii. The average distance driven each month, in miles.
   (b) Validate:
      i. All inputs are positive.
   (c) Calculate:
      i. How much money it will cost to drive each car for a year.
   (d) Output:
      i. Which car costs less money to drive;

ii. How much that car saves in one year compared to the other car;
iii. Output the savings formatted as a dollar amount, using 2 decimal places at all times.

(e) Restrictions:

i. If the two cars cost the same amount, indicate this to the user.

2. **Used Value**: track a car's value over time as an exponential decrease of its original price.

   (a) Input:

   i. The car's original price in dollars, a positive float, with no $ or other monetary marker.
   ii. How many years to track the car's value over, a positive integer.

   (b) Validate:

   i. All inputs are positive.

   (c) Calculate:

   i. The amount of money the car is worth each year, up to the number of years specified by the user.
   ii. Assume a constant yearly depreciation rate of 18% – that is, each year it loses 18% of its current value (**not** the *original* value).

   (d) Output:

   i. The car's value for each year of its ownership.

   (e) Restrictions:

   i. You may **not** use the `math.pow` function in this calculation.

3. **Stopping Distance**: determine how far a car will travel before stopping when you apply the brakes at a certain speed.

   (a) Input:

   i. The car's initial speed in miles per hour, a positive float.
   ii. An integer representing the condition of the car's tires. A value of 1 means new tires, 2 means good tires, 3 means poor tires.

   (b) Validate:

   i. The speed is a positive value.
   ii. The tire condition is 1, 2, or 3.

   (c) Calculate:

   i. Use the input to determine the friction coefficient μ for the tires. New tires: $\mu = 0.8$; good tires: $\mu = 0.6$; poor tires: $\mu = 0.5$.
   ii. How many feet the car will travel before coming to a stop:

   $$d = \frac{v^2}{2 \cdot \mu \cdot g}$$

   where v is the car's velocity in **feet per second,** g is acceleration due to gravity in **feet per second squared** ($g = 32.174\ ft/s^2$), and d is the final stopping distance in feet.

   (d) Output:

   i. How far the car will travel before stopping.

   (e) Restrictions:

   i. Use constant variables for the three friction coefficients, giving them meaningful names.

4. Quit.

   (a) Your program's loop should terminate and the program should exit.

Example Output

User input is in *italics*. These do not cover every possible test case. It is up to you to thoroughly test your program before submitting it.

Cost of Gas:

```
Main menu:
1. Cost of Gas
2. Used Value
3. Stopping Distance
4. Quit
Choose a function:
1
Enter car 1's mileage:
0
Enter car 1's mileage:
-40
Enter car 1's mileage:
34
Enter car 1's average gas cost per gallon:
-10
Enter car 1's average gas cost per gallon:
4.10
Enter car 2's mileage:
40
Enter car 2's average gas cost per gallon:
4.20
How many miles do you drive per month?
1000
Car 2 will save $187.06 in a year.
```

```
[Main menu]
Choose a function:
1
Enter car 1's mileage:
40
Enter car 1's average gas cost per gallon:
4.00
Enter car 2's mileage:
20
Enter car 2's average gas cost per gallon:
2.
How many miles do you drive per month?
1000
The two cars cost the same.
```

Used Value:

```
[Main menu]
Choose a function:
2
Enter original car price:
0
```

```
Enter original car price:
18500
Enter number of years:
0
Enter number of years:
10
Year 1 value: $15170.00
Year 2 value: $12439.40
Year 3 value: $10200.31
Year 4 value: $8364.25
Year 5 value: $6858.69
Year 6 value: $5624.12
Year 7 value: $4611.78
Year 8 value: $3781.66
Year 9 value: $3100.96
Year 10 value: $2542.79
```

Stopping Distance:

```
[Main menu]
3
Enter initial speed:
0
Enter initial speed:
70
Enter tire condition (1 = new, 2 = good, 3 = poor):
4
Enter tire condition (1 = new, 2 = good, 3 = poor):
1
At 70 miles per hour, with new tires, the car will stop in 204.75 feet.
```

```
[Main menu]
3
Enter initial speed:
70
Enter tire condition (1 = new, 2 = good, 3 = poor):
3
At 70 miles per hour, with poor tires, the car will stop in 327.61 feet.
```

Discussion Questions

In addition to uploading your code to Dropbox, you must also turn in **handwritten** answers to the following questions.

1. The European Road Safety Observatory (ERSO) has found a relationship between automobile speed and accident risk. Researchers demonstrated that each 1 mph increase in a car's speed is correlated with a 2% increase in accident rate over the slower speed. Use a calculator to find (show your work; recall that $distance = rate \times time$):
   (a) The time it takes to travel 15 miles at 65 mph
   (b) The time it takes to travel 15 miles at 85 mph
   (c) How much (or little) time is saved by traveling at the higher rate
   (d) Use the ERSO model to find the increase in accident rate between traveling 65 mph and traveling 85 mph.

2. Suppose you purchase a new car, and its price is the **last five digits** of your CSULB student ID number. Use the model from the Used Value function of your calculator to estimate how many years it will take before your car is worth half its initial value. Show your work.

3. You are driving on the freeway at 80 mph, trailing the car in front of you by two seconds.[1] Suddenly, the car in front of you – also traveling at 80 mph – brakes to stop; its tires are new, with a friction coefficient of 0.8. Your car, on the other hand, has poor tires with a coefficient of 0.5. Due to distracting music and passengers, you do not react to the front car's brake lights for 1 second. We will determine whether you will crash into the car in front of you before coming to a complete stop:
   (a) If your car is at position 0, at what position is the car in front of you when it begins to brake? (That is, how many feet in front of you is the other car?)
   (b) How far will the car in front of you travel before stopping, according to your Stopping Distance function? What will its position be after stopping?
   (c) Relative to your starting position of 0, at what position will your car be **when you begin to brake**?
   (d) How far will your car travel before stopping?
   (e) Will you hit the car in front of you? Explain, showing your final stopping position vs. the other car's.
   (f) Would you have hit the car if your tires had been in almost-new condition (coefficient = 0.7)? Show your work.

[1] California DMV recommends a 3-second distance for highway travel.