GENE 121 **Assignment 3** **Fall 2016**

This assignment will be **completed in pairs**. You have been matched automatically with a partner.

In this assignment you will be using **if-else** statements to make decisions and loops for repetition. Be careful to make your logic clear and as efficient as possible. By efficient, we mean:
(a) Nest your "if" statements wherever possible to avoid repetition of checking Boolean conditions.
(b) Think carefully about how to minimize the number of Boolean conditions that you use.

Don't forget to include a signed header for your assignment, and to make sure that both students in the group have an electronic copy of the code when it is complete.

Question 1

The number *e* (C++ constant: `M_E`) can be approximated with 87/32. The approximation can be improved if three, or more, digit integers are used; i.e. *e* = num/den.

Your program should:

- Prompt the user for the number of digits to use for the numerator and denominator
  - Use a do-while to verify the user enters a valid number
- Use a double nested loop to determine the values of numerator and denominator that result in the closest approximation for *e*.
- Print out your numerator and denominator, the calculated value of e, the percent error when compared to `M_E`, and the number of iterations needed to calculate these values.

For example, here is the output when 2 digit integers are used:

```
Enter number of digits to use in calculation:
2

Best approximation is 87/32
2.71875 0.0172230684858865
# iterations: 1560
```

To improve run time of your program, how can you improve your code to make it more efficient (ie. reduce the number of loop iterations). **Tell us one way you would, or already did, improve your code's run time efficiency**.

Submit your code with output for 2, 3, 4, and 5 digit integers.

Question 2

The file "`worldTime.txt`" contains the name of a location with the current local time. The number of locations in the file is unknown. A sample of the file can be seen below:

```
Waterloo        1200
Newfoundland    1330
     :           :
```

We want to simulate an analog clock using a computer program. Your program should:

- Open the input file and verify that it opened correctly
- Output the name of the city with the local time in 12-hr time, including am or pm
- Output the (x, y) position of the hour and minute hands
    - Important info:
        - The origin is the centre of the clock face
        - The hour hand is 6cm long
        - The minute hand is 10cm long

Sample output for Newfoundland can be seen below:

```
Newfoundland 1:30 pm
hour hand (x,y): (4.24, 4.24)
minute hand (x,y): (0.00, -10.00)
```

Submit your code with output.

Question 3

A water taxi / delivery service company uses a boat on Georgian Bay to transport people and goods from the main dock to various islands and ports on the mainland around the bay. The service charge for a trip is $15.00 for each stop and $2.10 per kilometre of travel. Some people are billed for the return trip to the home dock, and others are not. A GPS records the (x, y) positions for each stop. The position of the main dock is (0,0).

The file called **`taxi.txt`** contains the data representing whether the customer should be charged for the return trip (**`1`=return trip** or **`0`=no return trip**), the number of stops, and the positions of the stops, for all the trips made in August. For example:

```
0    1    0   10.2
1    2    0     -3     4    -3
0    4    0     -3     4    -3    -7.5   2.6      5.1   6
             :                        :
```

Explanation for the first line of data:

- No return trip
- Taxi made 1 stop
- Taxi drove 10.2 km north from (0,0) to (0,10.2)

Second line:

- Return trip
- Taxi made 2 stops
- Taxi drove 3 km south from (0,0) to (0,-3)
- Taxi drove 4 km east from (0,-3) to (4,-3)
- Taxi returned home from (4,-3) to (0,0)

Assume all trips are made in a straight line. Use appropriate data types (**`int`**, **`double`**, **`bool`**). Your program should:

- Check that the file has opened correctly
- Output to a file:
    - For the first four trips and every tenth thereafter (ie. the 14th, 24th, and so on): the trip number, distance and cost for the current trip, and the current totals for distance and cost for August
    - Total distance driven by the water taxi and the total amount of money collected by the operator for all of the trips in August

Format your output using **`setw()`** and **`setprecision()`** in a table similar to the one shown below:

```
Trip #  Return  # Stop  Distance      Cost     Total Dist     Total Cost
1         0        1     10.20       36.42       10.20          36.42
2         1        2     12.00       55.20       22.20          91.62
3         0        4     32.84      128.97       55.04         220.59
                :                                    :
```

Hint: The total distance for August is > 1800 km.

Submit your code with the output described above.