GENE 121 **Assignment 6** **Fall 2016**

This assignment will be **completed in pairs**.

At the start of the lab session you should go to the robot station corresponding to your team number. Except the ultrasonic mount, please DO NOT take apart the robot or any of the sensor mounts. All parts should be returned to the front of the lab at the end of the lab session.

In this assignment you will be using:

- Pass by Reference

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 (RobotC)

a) Write a function which waits for the user to press, and release, a button, or the touch sensor. This function should return the number of the button which was pressed, and the amount of time in seconds for which it was held.
   - Hint: How are you going to indicate that the touch sensor was pressed as opposed to an NXT button?

b) Write (at least) 2 functions. **Read all of (b) before coding anything**.
   - The first receives an integer indicating the desired robot movement and a time in seconds. The robot should move according to the following rules:
     i. if the left button was pressed, the robot should rotate left
     ii. if the right button was pressed, the robot should rotate right
     iii. if the orange (centre) button was pressed, the robot should drive forwards
        - During forwards movement, if you sense an object within 30cm of the front of the robot, the robot must slow down to a power of 30.
     iv. if the touch sensor was pressed, the robot should drive backwards

     The robot should move in the specified direction for the specified amount of time.
   - The function described above is quite complicated. Code (at least) one additional function which simplifies the first function in (b) above.

c) Write a program that displays your day and group number, and then for 5 button/touch sensor pushes and releases:
   i. Waits for the user to press and release any button on the brick or touch sensor
   ii. Displays the length of time the button/touch sensor was pressed, in seconds
   iii. **Moves the robot for the length of time that the button was held down**.
      - You must use your functions from (a) and (b).

Demonstrate your program to a TA, and then print and submit your code.

Question 2 (Dev-C++)

A ship in trouble in the "Bermuda triangle" area of the Atlantic Ocean radios in its name and position. A file called **`ships.txt`** contains the names, positions (as latitude and longitude coordinates in degrees and minutes), and maximum speeds (in knots) of any ships that may be able to help. For example,

```
America   30 17    66 57    2
```

indicates that the America is at latitude 30 degrees 17 minutes North and longitude 66 degrees 57 minutes West, and that its maximum speed is 2 knots (nautical miles per hour).

Useful Information:

- You can assume ships able to help are in the Atlantic Ocean and the northern hemisphere (i.e. 0^o <= latitude <= 90^o and 0^o<= longitude <= 105^o)
- See assignment 4 if you forget how latitude and longitude work
- 1 knot = 1.8536 km/h
- Equator is 0^o latitude and the North pole is 90^o

Write, test and debug the following functions:

a) Write a function with header

```
void position(int latDeg, int latMin, int longDeg, int longMin,
              double & x, double & y)
```

that calculates the position of a ship in km.

b) Write a function that receives the positions of 2 ships (in km) and returns the distance between them.

c) Write a function that:
   - Receives the positions of two ships (in km), the ship in trouble, and the ship that may be able to help
   - Receives the speed of a ship (in knots) that may be able to help
   - Returns the time (in hr) for the ship that may be able to help travel to the ship in trouble (Think: What if both ships have a speed of zero?)

d) Write, test and debug a program that:
   - Opens the files `ships.txt`, and checks whether it has opened
   - Receives user input for a ship in trouble and converts its position to kilometres
   - For the ship in trouble, determine the nearest rescue ship
   - Outputs the name and time required for the nearest rescue ship to save the ship in trouble.

<u>The program must call the above functions.</u>

Some times and distances to a ship located at 32 deg 17 min N and 64 deg 49 min W are (for debugging only):

```
         Name    x km   y km     km/h    Dist    Time
Andrea_Doria 6089.15 3638.95        0 55.8998    NEVER
     Bismark 6163.69 3772.15 15.1995 205.434  13.5158
 Black_Pearl 6037.63 4467.75  6.4876 885.437  136.481
```

Submit your program with output where the Waterloo (located at 32 deg 17 min N and 64 deg 49 min W) is the ship in trouble.

Question 3 – Improve Assignment 5

For both questions on assignment 5, you had to create a number of functions. Now that you know pass by reference, how would you code those two questions differently?

Write, and submit, **one** new function header for both question 1 and 2 of assignment 5 which uses pass by reference appropriately. There is no need to write the body of the functions.