

This is an individual assignment in C++.

For extra exam practice, treat Q1 as a final exam question (i.e. try and finish the question during the 2 hour lab period).

This assignment has a total of 30 marks available. You can not receive a mark higher than 20. All of this material is fair game for the final, so solve all questions before Dec. 14. The assignment is due Monday, December 5 at 10pm.

Q1 (10 marks)

A boat-mounted sonar unit was used to determine the depth of a lake in a 10 m x 10 m grid pattern. A file called `depths.txt` contains depths for the lake and elevations of the land around the lake in a 820 m x 780 m rectangular region containing all of the lake. The surface of the lake is at zero height. Lake depths are identified by negative numbers in the data file.

- a) You must write the following functions:
- A function which receives an already opened input file stream and a 2D array of depths data which reads the file into the array
 - A function which receives the 2D array of depths data and a variable indicating the elevation of the boundary between land and water. This function will draw a depiction of the lake using 'w' for water and 'l' for land (or something similar).
 - A function that receives the 2D array of depths data and a variable indicating the elevation of the boundary between land and water. This function will return both the surface area below this boundary and the volume of water below this boundary (i.e. could be used to determine the surface area and volume of the lake).
 - A function that receives the 2D array of depths data and a well-named boolean variable indicating land or water. The function will return the coordinates of the highest elevation on land, or of the deepest depth of the lake.
 - How will you handle a tie? State any and all assumptions.

An *abbreviated and modified* version of the data appears below.

```

181 165 145 130 121 105 80 88 82 90 95
151 125 115 96 91 85 60 38 38 65 90
130 90 68 60 50 30 -2 -18 -1 32 70
99 62 16 -31 -42 -61 -55 -30 3 38 62
88 37 0 0 0 -55 -48 -18 26 40 60
64 36 22 5 -28 -40 -29 -1 26 42 60
66 34 7 -15 -38 -43 -27 -3 25 45 63
67 30 -6 -30 -35 -33 -27 -5 24 42 63
68 28 -7 -30 -34 -32 -20 0 28 45 66
68 28 6 -14 -30 -10 -5 10 30 58 75
67 30 15 0 -15 -8 8 25 41 65 88
65 40 30 12 0 7 21 33 60 80 95
69 60 41 22 8 9 30 56 68 90 101
75 60 55 30 14 30 42 65 85 96 109

```

Sample lake drawing based on data:

```

11111111111
11111111111
111111wwwl1
11lwwwwwl11
1111lwwwl11
111lwwwwwl11
11lwwwwwl11
1lwwwwwl111
1lwwwwwl111
11lwwwwwl111
1111wwl1111
11111111111
11111111111
11111111111

```

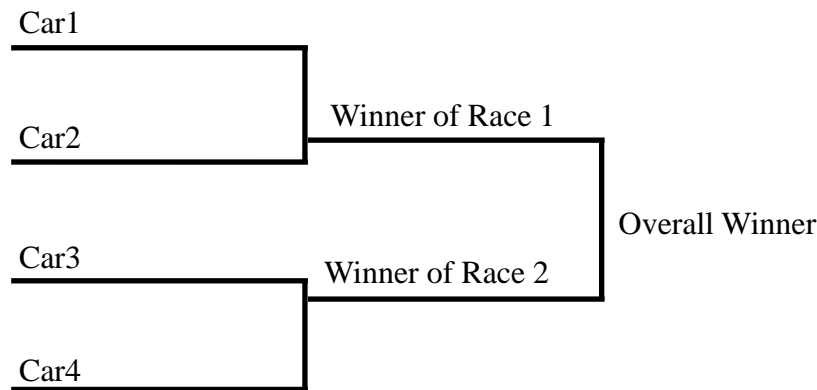
- b) Write a `main()` which does the following:
- i. Opens the file, verifies that it opened
 - ii. Reads the file into an appropriately sized, and named, array, using your function from (a)
 - The file contains a matrix of elevations in tenths of meters (decimetres) entered as integers. **There are 82 rows and 78 columns.**
 - iii. Prints the surface area and volume of the lake
 - iv. There's a sinkhole draining our lake! The level of water has fallen 250cm. Re-print the surface area and volume of the now smaller lake
 - v. Draw the now smaller lake using your function from (a). A depiction of a lake using similar data can be seen below.

Submit your code with output.

Q2 Part A (10 Marks) - Classes

- a) Write a `Racecar` class which has the following public data members:
- Name of the driver
 - Number of the car
 - Make of the car
- Your class should also have the following private data members:
- Max acceleration in m/s^2
 - Max speed in km/h
- Your class needs the following functions:
- Default and data constructor
 - File input function which returns a boolean indicating whether the data was successfully read (assume the data in the file is in the order specified above)
 - Any **necessary** accessors and mutators (Remember: when do you actually need accessors/mutators?)
 - A `copyGearing` function which accepts another `Racecar` object and copies the max acceleration and max speed.
 - A distance travelled function which accepts an initial velocity and elapsed time. The `Racecar` will accelerate at its maximum acceleration rate for the given length of time. The function will return the total distance travelled in metres (Remember: what effect does the max speed have on this calculation?)
 - A time travelled function which accepts an initial velocity and distance travelled. The `Racecar` will accelerate at its maximum acceleration rate over the given distance. The function will return the time taken in seconds (Remember: what effect does the max speed have on this calculation?)

- b) The file “`racecars.txt`” contains 4 Racecars which showed up to race day. All cars will be racing on a quarter mile race track (402 m).
Write a main program which will simulate all races, output the winners of each race, and the winner overall. You must use an array to store these 4 Racecars.
The 4 car bracket can be seen below:



Submit your code with output.

Q2 Part B (5 Marks) - Graphics

Modify your code from Q2 Part A:

- Write a function which uses the graphics classes to output an image representing the speedometer of the racecar.
 - Your speedometer should accurately represent the maximum speed of the car.
- Modify your main to output the speedometers of the cars in the final race. You should output the speeds as they were when the first car crosses the finish line.

Q3 (5 Marks) - Recursion

A palindrome is the same read forwards, or backwards (like the word racecar! Or the number 2110112).

- a) Write a function which receives an integer number with fewer than 10 digits. This function should fill an array with the individual digits of that number.
- b) Write a well-named **recursive** boolean function that accepts an array of integer digits, and the number of digits in the array. This function should return whether the number represented by those digits forms a palindrome, or not.
- c) Write a main which prompts the user for a number and outputs whether it is a palindrome or not. The program should end when the user enters a negative number.

Submit code and output.