

Practice Problems for PE07

For **PE07**, you'll complete one problem which will ask you to write a function to process vectors and structures. You have to know about how to pass the parameters correctly (input, output, input-output) and how to write functions that return a vector, using references and const correctly.

Below you'll find a few of the sample problems. Note, these are NOT necessarily the problems that appear on the test, but they should give you a feel for the structure and type of problems.



1 THE FINDSTARS PROBLEM

Using the Star structure defined in the file, write the function named `findStars()`. The function takes two input parameters: a vector of Stars and a string representing a star name or part of a star name. The function returns a vector of int representing the Draper numbers of the stars where the name was found. Use `string::find()` to search the star names. Remember that `string::find()` return `string::npos` when the search parameter is not found.

```
vector<int> numbers;  
numbers = findStars(vStars, "VEG");
```

2 THE magnitudeBetween PROBLEM

Using the Star structure defined in the file, write the function named `magnitudeBetween()`. The function takes three input parameters: a vector of Stars as well as a lower and upper bounds. The function returns a vector of `int` containing Draper number of the stars whose magnitude falls between the two bounds (exclusive).

```
vector<size_t> indexes;  
indexes = magnitudeBetween(vStars, 1.5, 3.4);
```

3 THE starsBetween PROBLEM

Using the Star structure defined in the file. Write the function named `starsBetween()`. The function takes three input parameters: a vector of Stars as well as a lower and upper bounds for the magnitude of the star. The function returns a double representing the average magnitude of the stars falling between the two bounds (exclusive). If no stars are in the range, then return -1. In addition, the function has an output parameter that returns the names of the stars that are included.

```
vector<string> names;  
double avg = starsBetween(vStars, names, 2.3, 2.4);
```

Input parameter *Output parameter*

4 THE longestHop PROBLEM

Using the Star structure defined in the file, write the function named `longestHop()`. The function takes one input parameter: a vector of Stars that represents a "travel itinerary". Visit every pair of stars in-order (0-1, 1-2, 2-3, etc.) and measure the distance between them. The function should return a vector of Star containing the two stars that are represent the longest "hop" or span between two stars in the trip.

We'll assume that the stars are in 2D space and that you measure the distance using this formula. You may write a function to do so.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

```
vector<Star> longest = longestHop(vStars);
```

5 THE roundTrip PROBLEM

Using the Star structure defined in the file, write the function named `roundTrip()`. The function takes one input parameter: a vector of Stars that represents a "travel itinerary". Visit every pair of stars in-order (0-1, 1-2, 2-3, etc.) and add up the distance between them. When you reach the last star, include in your sum the distance between it and the first. The function returns the round-trip distance as a double. The function also has one output parameter that returns the average magnitude of all of the stars visited.

We'll assume that the stars are in 2D space and that you measure the distance using this formula. You may write a function to do so.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

```
double average;  
double distance = roundTrip(vStars, average);
```

Input parameter *Output parameter*

6 THE closestDistance PROBLEM

Using the Star structure defined in the file, write the function named `closestDistance()`. The function takes one input parameter: a vector of Stars that represents a "travel itinerary". Visit every pair of stars in-order (0-1, 1-2, 2-3, etc.) and measure the distance between them. The function should return a vector of Star containing the two stars that are closest to each other in the trip.

We'll assume that the stars are in 3D space and that you measure the distance using this formula. You may write a function to do so.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

```
vector<Star> closest = closestDistance(vStars);
```

7 THE bestMileage PROBLEM

Using the Car structure defined in the file, taken from the 2017 EPA testing results, write the function named `bestMileage()`. The function takes one input parameter: a vector of Cars that represents the testing data. The vector is sorted by manufacturer, so all cars of a particular manufacturer are together in the vector. The function also has an output parameter, a vector of string that contains both the manufacturer and the model concatenated together, separated by a semicolon, like this: "BMW;430i Coupe"

Each entry is the car with the best mileage from each manufacturer. The function returns the average mileage of the selected cars.

```
vector<string> vMileage;  
double average = bestMileage(vCars, vMileage);
```

Input parameter → *Output parameter*

Here is the Car structure.

```
// The structure (don't change these)  
- struct Car {  
    string mfg, model;  
    int horsepower, cylinders;  
    double mpg;  
};
```

8 THE bestValue PROBLEM

Using the Camera structure defined in the file, write the function named `bestValue()`.

```
// The structure (don't change these)  
- struct Camera {  
    string manufacturer;  
    string model;  
    int releaseYear;  
    int resolution;  
    int weight;  
    double price;  
};
```

The function takes one input parameter: a vector of Camera. The vector is sorted by manufacturer, so all cameras of a particular manufacturer are together in the vector. The function returns a vector of string, with the manufacturer, model number and price concatenated together exactly in this format.

Agfa:ePhoto 1280:\$179.00

(You'll need to use an `ostringstream` to do this.) We'll say that the best value is determined by dividing the resolution by the price. The higher number "wins".

```
vector<string> value = bestValue(vCameras);
```