Problem 260: Coloring the Planet

Difficulty: Medium

Author: Gary Hoffmann, Denver, Colorado, United States

Originally Published: Code Quest 2025

Problem Background

You have joined a team developing a digital twin of the Earth for the National Oceanic and Atmospheric Administration. This new system will help climate scientists better understand the changing climate. Your team selects sea surface temperature as the first variable to show and you've been assigned the job of converting the temperature values into colors so that the scientists can visually inspect the temperature data coming out of the digital twin.

The colors will be selected by a color bar (gradient) based upon the sea surface temperature in kelvin.

Problem Description

Please note that this problem overrules the general guidelines for rounding numbers provided in the Reference Materials.

Your program will be given the color bar as a list of control points (position on the bar and the color they represent). The color bar will be provided as a row containing the number of control points and the start, end temperature of the color bar (in Kelvin). That will be followed by a single row for each control point which will have the position of the point (0 = start of the bar, 1 = the end of the bar) followed by a red, green, and blue color values (from 0 to 255) for that control point.

The following is an example color bar with sample input:

```
5 273 315
0 0 0 255
0.25 0 255 255
0.5 0 255 0
0.75 255 255 0
1 255 0 0
```

Your program must read in a sea surface temperature and use a linear interpolation between the control points to determine the correct color for that temperature and print a single line containing the red, green, and blue components of the color. Because the linear interpolation will return a floating-point number, use a floor function to strip off the decimal portion of the red, green and blue values.

A linear interpolation can be used to estimate a value in between two known points (our control points in this problem). The formula for a linear interpolation is (where a and b are the points and t ranges from 0 to 1):

$$lerp(a, b, t) = (1 - t) * a + t * b$$

For example:

$$lerp(5, 10, 0.0) = 5$$

$$lerp(5, 10, 0.5) = 7.5$$

$$lerp(5, 10, 1.0) = 10$$

In order to align your calculations with RGB color values, you'll need to **round your results down** if they contain decimals.

The formula for finding the position of a value relative to the minimum and maximum endpoints will need to be used in your calculations.

$$\frac{(value - min)}{(max - min)}$$

Sample Input

The first line of your program's input, received from the standard input channel, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing three integers separated by spaces, representing a color bar definition. These integers represent:
  - N, the number of control points
  - L, the low temperature in kelvin
  - H, the high temperature in kelvin
- N lines representing control points, each containing the following values separated by spaces:
  - A decimal number between 0 and 1 inclusive representing the position of the control point along the line. Control points will be listed in ascending order by this position.
  - An integer between 0 and 255 inclusive representing the red value of that control point
  - An integer between 0 and 255 inclusive representing the green value of that control point
  - An integer between 0 and 255 inclusive representing the blue value of that control point
- A line including an integer, between L and H inclusive, representing the temperature in kelvin that needs to be converted into a color.

Due to its length, the sample input is provided on the next page to avoid breaking across pages.

```
2
5 273 315
0 0 0 255
0.25 0 255 255
0.5 0 255 0
0.75 255 255 0
1 255 0 0
300
2 250 350
0 0 0 255
1 255 0 0
310
```

Sample Output

For each test case, your program must print the red, green, and blue values as integers **(use the floor function to ensure these are integers)** separated by a space, representing the color for that temperature.

```
145 255 0
153 0 102
```