Week 5 — October 4, 2018

Homework

- Read chapter 11 pp. 429–461 in "Beginning C"
- Read chapter 6 in "Writing Scientific Software"

Exercises

1. Do exercise 11-1 in "Beginning C"
2. Take this quiz to test your understanding of *structures*
3. Write a short program that (i) prompts the user to enter three points in $\mathbb{R}^2$ that define a triangle, and (ii) computes and prints the area of the triangle. Your program should use structures and functions.

   Hint: Define a structure that represents a point in $\mathbb{R}^2$ and another structure that represents a triangle. Write a function that takes a triangle structure as input and returns its area, e.g., using Heron's formula. (Food for thought: when is Heron's formula cancellation-prone?)

4. Extend your code from exercise 3 with a function that can check if a point is inside a triangle. Write a program to test it.

   Hint: To check if a point (x, y) is inside a triangle with vertices (x_1, y_1), (x_2, y_2), and (x_3, y_3), if suffices to check that the so-called barycentric coordinates of (x, y) are nonnegative. Given the vertices (x_1, y_1), (x_2, y_2), and (x_3, y_3), the barycentric coordinates of (x, y) are given by

$$\begin{aligned}
\lambda_1 &= \frac{(y_2 - y_3)(x - x_3) + (x_3 - x_2)(y - y_3)}{(y_2 - y_3)(x_1 - x_3) + (x_3 - x_2)(y_1 - y_3)} \\
\lambda_2 &= \frac{(y_3 - y_1)(x - x_3) + (x_1 - x_3)(y - y_3)}{(y_2 - y_3)(x_1 - x_3) + (x_3 - x_2)(y_1 - y_3)} \\
\lambda_3 &= 1 - \lambda_1 - \lambda_2.
\end{aligned}$$

5. Extend your code from exercise 3 with a function that can check if two triangles are congruent. Write a program to test it.

   Hint: See Wikipedia entry about congruence of triangles.

6. Go to CodeJudge to do the "Week 05" exercise.

Optional exercises

1. Consider the following structure declaration:

   ```
   struct my_struct {
     int i;
     short j;
     char c;
   };
   ```

   Write a program with a variable of type `struct my_struct` and print out the size of each of the fields (`i`, `j`, and `c`) as well as the size of the struct itself. Do the sizes of the three fields add up to the size of the struct?

   Hint: Use the `sizeof` operator.

2. Skim through the following Wikipedia entry to learn about common data structures: List of data structures