Full Stack Web Development Tech Internship

Duration: 2 hours

Deadline: Friday, April 4th 2025 18:00

Algorithm

Write a program that allows a user to enter from the console a canvas **Width** and a **Height**. The origin of this canvas is the bottom left corner. Its coordinates are O(0, 0). The origin does not need to be entered by the user, it is only a reference point.

A separate file called **input.txt** contains a list of rectangles.

Each rectangle is declared on a separate line.

Each line contains the name of the rectangle, the bottom left corner X coordinate, the bottom left corner Y coordinate, the Width and the Height.

The separator is a space. There are no spaces after the Height, and there are no blank lines in the file. The file does not have a header row.

All coordinates, widths and heights are integers.

A **Rectangle** class and a method named **FindOverlap** that determines the overlap between two rectangles are already provided. If no overlap exists between the two rectangles received as parameters, the method returns null.

a. List all rectangles from the file that are included completely in the declared canvas area.
b. Using the result from point a as the source, list all rectangles that do not overlap with another rectangle.
c. Using the result from point a as the source, list all rectangles that are included completely in another rectangle.
d. What validations would you add and where?
e. Is it possible to compute the area of the canvas not covered by any rectangle? Does the number of rectangles that can overlap in a given area of the canvas matter? How would you do it and what are the limitations of the approach. **(optional)**

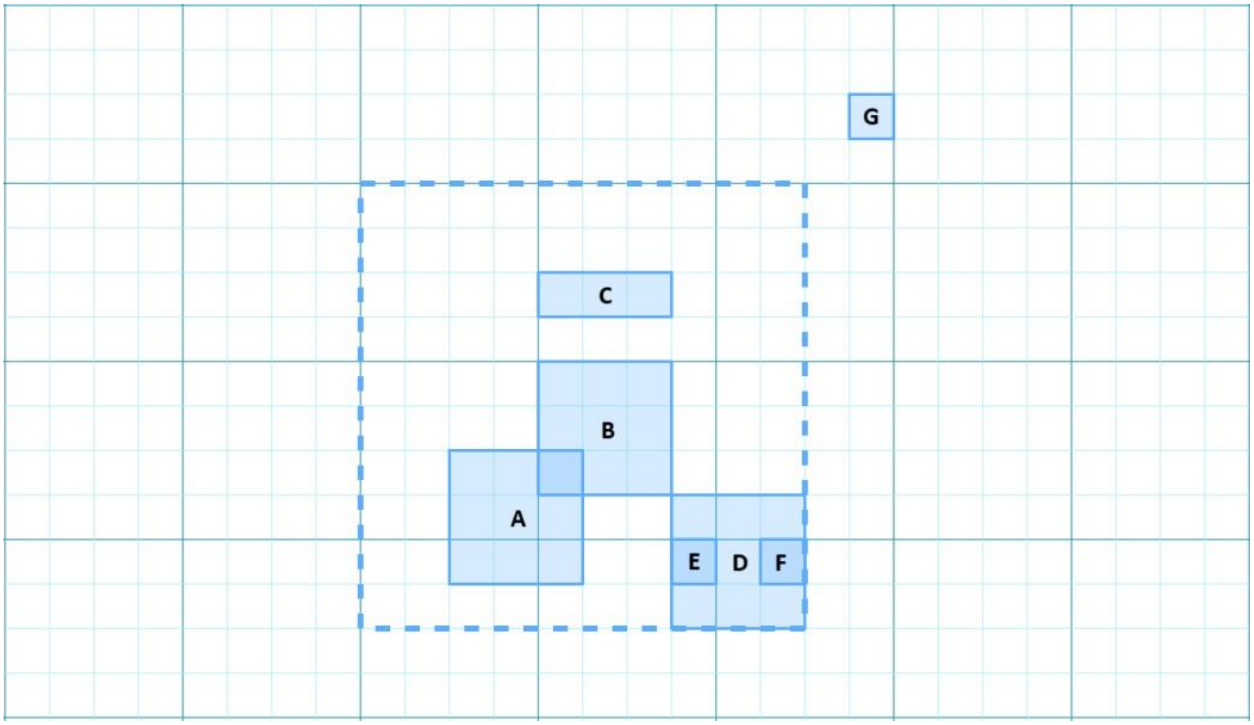
Note:

Although a working program would be nice, I am more interested in the reasoning and the steps you would take from reading the input to generating the output. I suggest you use a pen and paper instead of an IDE. You can use pseudocode or your favourite programming language. The last point is entirely optional.

The inputs and outputs in the screenshots are just an example, the logic should work with any canvas width or height and different file contents.

```
public class Rectangle
{
    public string Name { get; set; }
    public int X { get; set; }
    public int Y { get; set; }
    public int Width { get; set; }
    public int Height { get; set; }

    public Rectangle(string name, int x, int y, int width, int height)
    {
        Name = name;
        X = x;
        Y = y;
        Width = width;
        Height = height;
    }
}
```

```
public class Util
{
    public static Rectangle FindOverlap(Rectangle rect1, Rectangle rect2)
    {
        int overlapX = Math.Max(rect1.X, rect2.X);
        int overlapY = Math.Max(rect1.Y, rect2.Y);

        int overlapWidth = Math.Min(rect1.X + rect1.Width, rect2.X + rect2.Width) - overlapX;
        int overlapHeight = Math.Min(rect1.Y + rect1.Height, rect2.Y + rect2.Height) - overlapY;

        return overlapWidth > 0 && overlapHeight > 0
            ? new Rectangle($"{rect1.Name} - {rect2.Name}", overlapX, overlapY, overlapWidth, overlapHeight)
            : null;
    }

    public static bool Equals(Rectangle rect1, Rectangle rect2)
    {
        return rect1.X == rect2.X && rect1.Y == rect2.Y && rect1.Width == rect2.Width && rect1.Height == rect2.Height;
    }
}
```



input.txt

File Edit View

```
A 2 1 3 3
B 4 3 3 3
C 4 7 3 1
D 7 0 3 3
E 7 1 1 1
F 9 1 1 1
G 11 11 1 1
```

Console

```
Canvas width: 10
Canvas height: 10

Rectangles in canvas:
Name: A, X: 2, Y: 1, Width: 3, Height: 3
Name: B, X: 4, Y: 3, Width: 3, Height: 3
Name: C, X: 4, Y: 7, Width: 3, Height: 1
Name: D, X: 7, Y: 0, Width: 3, Height: 3
Name: E, X: 7, Y: 1, Width: 1, Height: 1
Name: F, X: 9, Y: 1, Width: 1, Height: 1

Rectangles with no overlap:
Name: C, X: 4, Y: 7, Width: 3, Height: 1

Rectangles in another rectangle:
Name: E, X: 7, Y: 1, Width: 1, Height: 1
Name: F, X: 9, Y: 1, Width: 1, Height: 1

Free area in canvas: 71
```

OOP

1. What does static do? Can I call a static method from an instance method? How about an instance method from a static method?

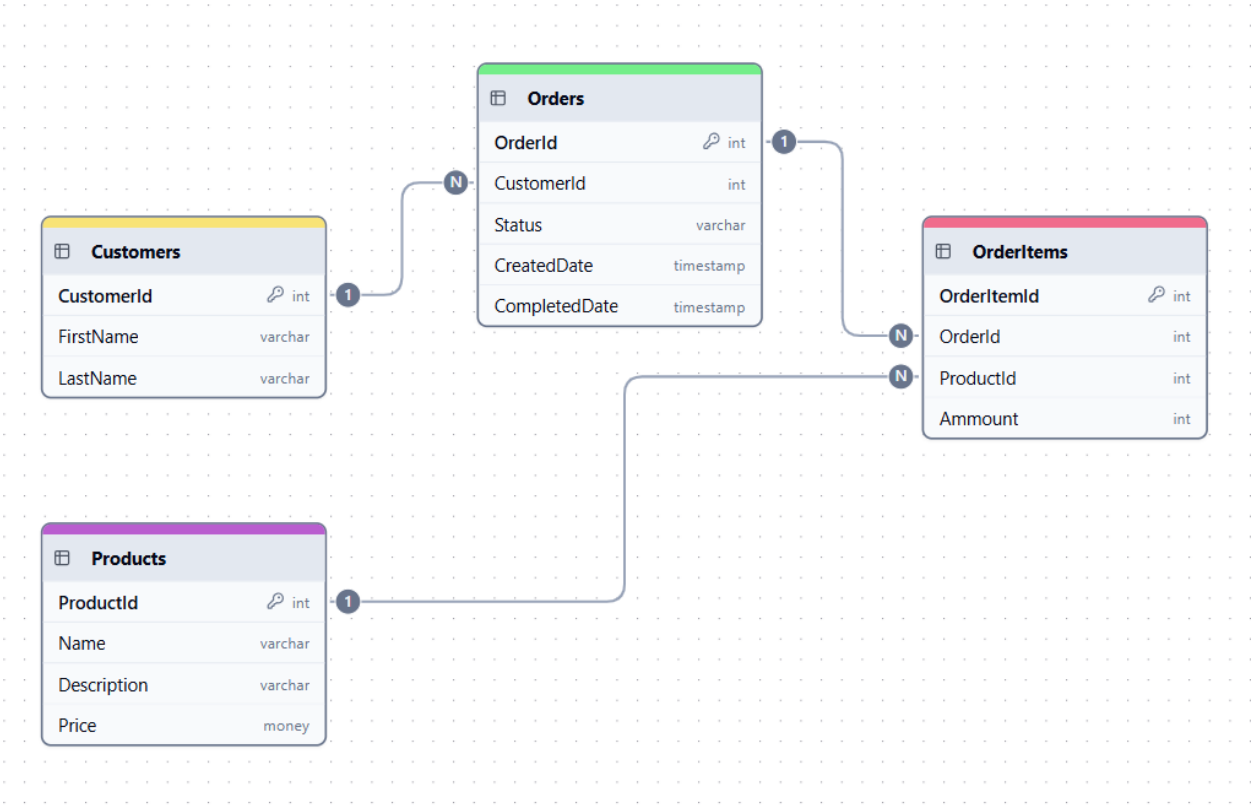
2. What is polymorphism? Can you give me an example using the Animal, Cat and Dog classes each having the same MakeSound method?

3. What is an Exception and how does a try catch finally block work? When is each called? Can you give me an example?

4. What is the difference between an abstract class and an interface? Can I inherit more than one?

5. What is the difference between an array and a list? How is a list able to grow while an array has to have a declared size?

SQL



1. What language is commonly used to interrogate relational databases? What kind of operations can you perform with it?

2. What is a primary key? What about a foreign key? Can I link information from multiple tables in a SELECT without them? Why do we need them then?

3. What happens to child rows, linked through a foreign key relation to their parent, when the parent is deleted? Can you control that?

4. How do you represent many to many relations?

5. You have the following tables Customer, Order, OrderItems, Product.

a. Write a select statement that retrieves the first name and last name of all customers that bought a product with the name 'Dubai Chocolate' between two given dates (for example '2025-01-01' to '2025-01-31').
b. Write a select statement that retrieves the order with the most order items.
c. Write a select statement that retrieves all customers and the total value of all products they purchased.