1806ICT Programming Fundamentals

Week 9 : Structures

1. Given a structure that stores the x and y coordinates for a point on the X-Y Cartesian plane:

```
struct point {
      double x;
      double y;
};
typedef struct point Point;
```

Use the struct in your program to

   a. Write a function to compute the Euclidean distance between two points
   b. Write a function that returns 1 if the two points are “equal”, and 0 otherwise. Since the x and y coordinates are floating point values, use a tolerance value of 0.000001 in your comparison
   c. Write a main program to test your functions

2. Define a `Rect` type for rectangles that are parallel to the x-axis and y-axis in the X-Y Cartesian plane. A rectangle is represented by its lower left and upper right endpoints, with the points defined using the `Point` type. Using `Rect` in your program,
   a. Write a function to compute the area of a rectangle
   b. Write a function that returns 1 if a point falls within a rectangle, and 0 otherwise. This function will take in two parameters, a `Point` variable and a `Rect` variable.

   Write a main program to test your functions

3. Write a program that computes the area and circumference (or perimeter) for a variety of geometric figures. You can use the following definitions of structure types for a circle, square, and rectangle, and a definition of a union type with a component of each figure type.

```
typedef struct
{     Point top_left;
      double area;
      double perimeter;
      double side;
} squareType;

typedef struct
{     Point top_left;
      Point bottom_right;
      double area;
      double perimeter;
} rectangleType;

typedef struct
{
      Point centre;
      double area;
```

```
          double circumference;
          double radius;
         squareType bounding_box;
     } circleType;


     typedef union
     {
          circleType circle;
          squareType square;
          rectangleType rectangle;
     } figureData;

     typedef struct
     {
        char shape;   // denotes the correct interpretation of the union
        figureData fig;
     } figureType;
```

The `char` variable `shape` can be used to identify the geometric figure for which the computation of area and circumference (or perimeter) is being done.

Your program will ask the user to enter either `c` (for circle), `s` (for square) and `r` (for rectangle) and the corresponding dimensions for those geometric figures. It should also have at least the following functions:

```
     figureType computeArea(figureType object)
     figureType computePerimeter(figureType object)
     void printFigure(figureType object)
     bool intersect(figureType object1, figureType object2)
```

Sample run:

Input	Output
c 1 2 2	Area of circle = 12.57, Perimeter of circle = 12.57
s 3 4 3	Area of square = 9, Perimeter of square = 12
r 5 6 1 5	Area of rectangle = 5, Perimeter of rectangle = 12
s 3 4 3 r 5 6 1 5	Yes, they overlap

4. Write a program to add two fractions, and display the resultant fraction. Use a structure to store the numerator and denominator of a fraction as follows:

```
struct fract {
     int numerator;
     int denominator;
};
typedef struct fract Fraction;
```

Write four functions that take in two `Fraction` variables, and return the results of sum, the difference, the product, the division and the modulus in another `Fraction`.

Write a fifth function that multiplies a fraction by an integer. In all cases the returned `Fraction` must be reduced to its lowest terms (i.e. any common factors between the numerator and denominator are removed).