Lab 2: Transitioning from procedural approach to object oriented approach

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- In lab 1 the code for performing fraction arithmetic had many issues including:

1. Global variables: are accessible by all functions, which can lead to unintended modifications.
2. Poor Encapsulation: the program is difficult to manage and extend.
3. Difficulty in maintenance and scalability: adding new features or modifying existing ones can lead to complex and error prone code.
4. Inflexibility: the code is difficult adapt to new requirements. e.g. try adding a function which can calculate powers of fractions such as $(1/2)^2$

- The **revised code** uses `struct` which simplifies the code, making it more readable, managable and accessible.

Tasks for this lab

1. Taking help from the revised code. Try to create a `struct` **Point**. Point represent a point on cartesian coordinate plane. Each point is a pair (x,y) where both x and y are integers.

2. Write function to calculate Distance between two points.
   The Euclidean distance between two points (x_1, y_1) and (x_2, y_2) in a 2D Cartesian coordinate plane is calculated using the following formula:
   Distance $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

3. Write another function `mid_point` The formula for finding the midpoint between two points (x_1, y_1) and (x_2, y_2) on a 2D Cartesian coordinate plane is:
   Midpoint $= \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

4. Write function `translate` to translate a point.
   The formula to translate a point (x, y) by a given translation vector (dx, dy) is:
   $(x', y') = (x + dx, y + dy)$

5. write `main` function, create 2 point variables and call the above defined functions appropriately.

Explanation of distance calculation:

- (x_1, y_1) and (x_2, y_2) are the coordinates of the two points.
- The difference between the x-coordinates $(x_2 - x_1)$ and the difference between the y-coordinates $(y_2 - y_1)$ are squared.
- These squared differences are then summed.
- Finally, the square root of this sum is taken to get the Euclidean distance, which is the straight-line distance between the two points.

Example:

Given two points $A(1,2)$ and $B(4,6)$, the Euclidean distance between them is calculated as follows:

Distance $= \sqrt{(4-1)^2 + (6-2)^2} = \sqrt{3^2 + 4^2} = \sqrt{9+16} = \sqrt{25} = 5$

So, the distance between points $A(1,2)$ and $B(4,6)$ is 5 units.

Explanation of Mid Point calculation:

- The midpoint's x-coordinate is the average of the x-coordinates of the two points: $\frac{x_1+x_2}{2}$.
- The midpoint's y-coordinate is the average of the y-coordinates of the two points: $\frac{y_1+y_2}{2}$.
- This point lies exactly halfway between the two points on the line segment connecting them.

Example:

Given two points $A(1,2)$ and $B(5,6)$, the midpoint M is calculated as follows:

$M = \left(\frac{1+5}{2}, \frac{2+6}{2}\right) = \left(\frac{6}{2}, \frac{8}{2}\right) = (3,4)$

So, the midpoint between points $A(1,2)$ and $B(5,6)$ is $M(3,4)$.

Explanation of translate calculation:

- (x,y): The original coordinates of the point before translation.
- (dx,dy): The translation vector, where:
  - dx is the distance to move the point along the x-axis.
  - dy is the distance to move the point along the y-axis.
- (x',y'): The new coordinates of the point after translation.

Example:

If you have a point $A(3,4)$ and you want to translate it by $dx = 2$ units along the x-axis and $dy = -3$ units along the y-axis, the new coordinates A' will be:

$(x',y') = (3+2, 4+(-3)) = (5,1)$

So, the point $A(3,4)$ is translated to $A'(5,1)$.