Name:

ID:

M5 Advanced Challenge 03

1. Consider the following:

The pink points are a subset of the points that make up one side of the border of a path (**P**), let's call this collection of points $\mathbf{B_1}$. The yellow points are a subset of the points that make up the other side of the border of **P,** called $\mathbf{B_2}$. Answer the following questions in regards to a robot attempting to traverse **P**.

- Group the points in $\mathbf{B_1}$ and $\mathbf{B_2}$ in pairs such that every point in $\mathbf{B_1}$ is paired with exactly one point from $\mathbf{B_2}$, the difference in the x-values of a pair should be smaller than any other combination.

  Ex:

  ((5,10), (4.7,15)) is a pair because 5 - 4.7 is the smallest difference available for the point (5,10)

- Compute the midpoint for each pair of points. What is the distance from the midpoint with the smallest x value to the midpoint with the largest x value?

63.21	60
66.11	65.24
70.13	64.45

- Use the scipy.stats.linregress function to generate a best fitting line for the midpoints. Which of the following is the best fitting line?

y = 0.23x + 15.24	y = 0.25x + 32.26
y = 0.17x + 32.26	y = 0.17x + 15.24
y = 0.55x + 21.25	y = 0.25x + 21.25

- Use matplotlib.pyplot to plot the best fitting line and the path formed by the midpoints, paste plot below:

- Generate a Lagrange interpolating polynomial from the midpoints that your robot can use to traverse **P**. Use this polynomial to predict f(x) given x:

Lagrange interpolating polynomials

Given a set of *k* + 1 data points

$$(x_0, y_0), \ldots, (x_j, y_j), \ldots, (x_k, y_k)$$

where no two x_j are the same, the **interpolation polynomial in the Lagrange form** is a linear combination

$$L(x) := \sum_{j=0}^{k} y_j \ell_j(x)$$

of Lagrange basis polynomials

$$\ell_j(x) := \prod_{\substack{0 \le m \le k \\ m \ne j}} \frac{x - x_m}{x_j - x_m} = \frac{(x - x_0)}{(x_j - x_0)} \cdots \frac{(x - x_{j-1})}{(x_j - x_{j-1})} \frac{(x - x_{j+1})}{(x_j - x_{j+1})} \cdots \frac{(x - x_k)}{(x_j - x_k)},$$

x	f(x)
21.1	
44.3	