Flam Assignment

Research And Development

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Domain: R & D

1.What is a Parametric Equation ???

I. When independent variables forms a curve or surface (Parametric Equation)
II. Independent Variable = parameters
III. Each variable has its own function.

Eg:

X=f(k) Y=g(k)

2.From the Given Question:

Problem:

Find the values of unknown variables in the given parametric equation of a curve :

$$x = \left(t * \cos(\theta) - e^{M*abs(t)} * \sin(0.3 * t) * \sin(\theta) + X \right)$$

$$y = \left(42 + t * \sin(\theta) + e^{M*abs(t)} * \sin(0.3 * t) * \cos(\theta)\right)$$

Given range for unknown params is

$$0° < \theta < 50°,$$
$$-0.05 < M < 0.05,$$
$$0 < X < 100$$

parameter ‘t’ has range:

$$6<t<60$$

Unknowns :

θ ,M,X

Objective : To check the predicted curve match the given points

Approach:

1.Intially Understand how the curve of the graph will look like for the given X and Y Parameters

2.Understanding and mapping the data to parameter t from the given problem

3. From the given **xy_data.csv** file there are 1500 points which each row has it corresponding steps

$$t_i = 6 + (1499 \times i) / (60 - 6), \quad \text{for } i = 0, 1, \ldots, 1499$$

3.Computing predicted x,y coordinates

Substitute different values to the parameters θ ,M,X

3.1 Convert to radians(because trigonometric functions use radians)

$$\theta\_rad = \theta \times (\pi / 180)$$

θ (angle in degrees) and θ_rad(angle in radians)

3.2 Exponential term : e_i = exp(M * |t_i|)

3.3 Predicted x coordinate:

x_pred,i = t_i * cos(θ_rad) - e_i * sin(0.3 * t_i) * sin(θ_rad) + X

3.4 Predicted y coordinate:

$$y\_pred,i = 42 + t\_i * \sin(\theta\_rad) + e\_i * \sin(0.3 * t\_i) * \cos(\theta\_rad)$$

4.Measuring the Distance :

4.1 To measure the L1 Distance (also known as Manhattan Distance). This measures how far two points are by adding up the absolute difference between x and y coordinates

4.2 This method helps us to find the distance by moving along grid like paths (like moving in different paths instead of straight line from source to destination)

Eq 4 $E(\theta, M, X) = \Sigma (|x\_pred,i - x\_i| + |y\_pred,i - y\_i|)$ for i = 0 to 1499

5.Estimation

Estimating θ (the angle)

Estimating X (horizontal shift)

Estimating M (exponential growth or decay)

- After performing we guess the value of θ,X,M and apply these values in the L1 error formula (Eq 4)
- Testing how the error changes when parameter are adjusted slightly
- Using 5-6 subset points to calculate the L1 error
- The above parameters are iteratively changed and adjusted and recalculating the L1 error

Target output: continue the process to get the smallest error so we get the E(θ, M, X) values

Output sample screenshots:

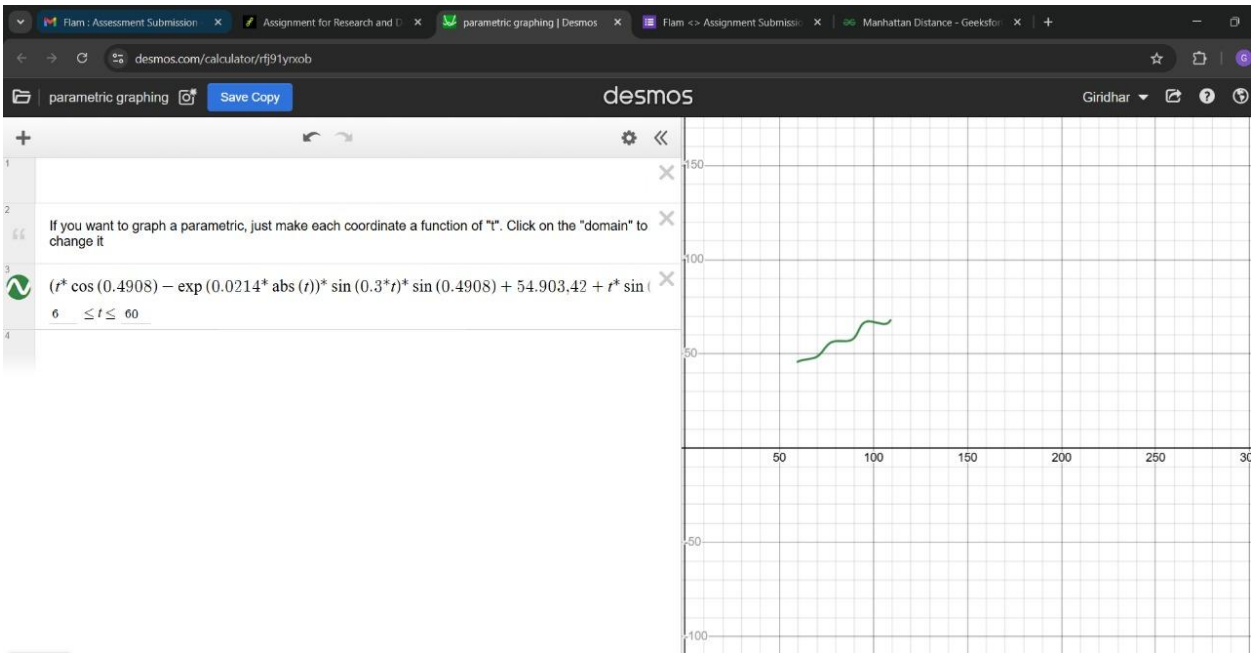

Fig 1: Desmos graph

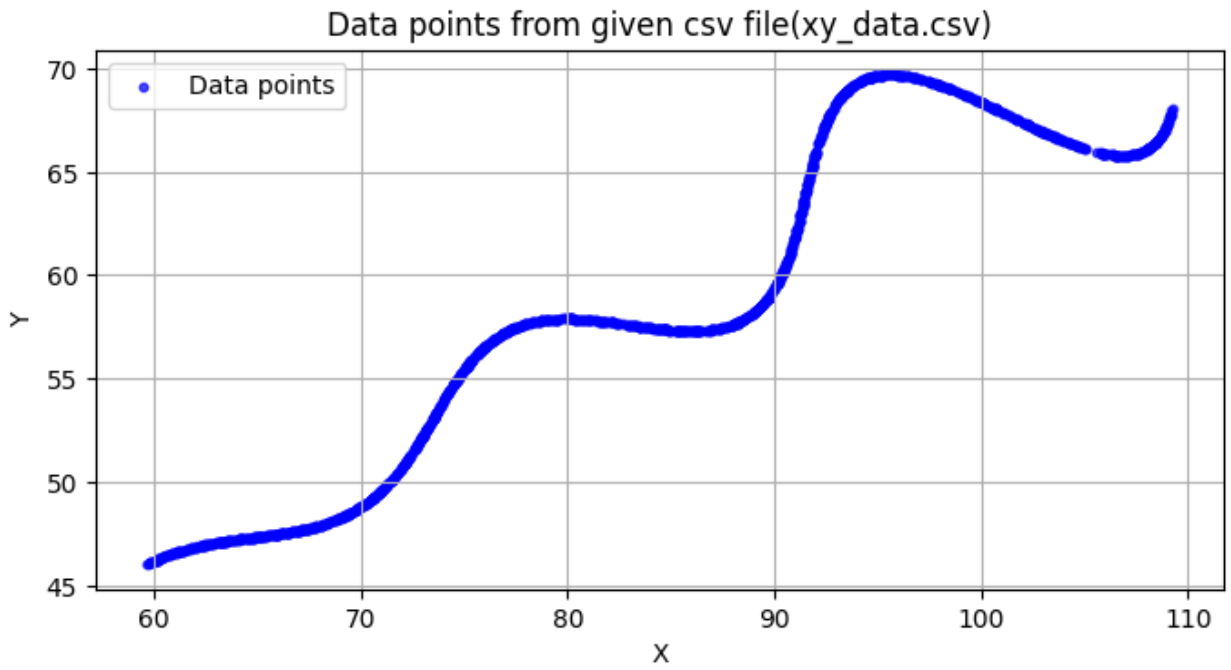

Fig 2: Data points of (xy_data.csv)

References :

Lamar University. (n.d.). *Parametric equations*. In *Paul's Online Math Notes*. Retrieved from https://tutorial.math.lamar.edu/classes/calcii/parametriceqn.aspx

GeeksforGeeks. (n.d.). *Manhattan distance*. Retrieved from https://www.geeksforgeeks.org/data-science/manhattan-distance/