Fit Me!

Finding data points on a graph is obvious. Just substitute values and find the other value. However, finding the graph that fits best to a given data set is somewhat difficult. But there are methods for that.

$A_i \equiv (x_i, y_i)$ is the given data set. i.e. $\forall\ i \in \mathbb{Z}, i = 1,2,3,4, \dots, n$

For a given order n, you have to find which polynomial is best fits to the data set.

The polynomial is in the form of $y = \beta_0 + \beta_1 x^1 + \beta_2 x^2 + \beta_3 x^3 + \cdots + \beta_n x^n$ your object is to find these β_i s $\forall\ i \in \mathbb{Z}, i = 1,2,3,4, \dots, n$.

By solving it in the following method you can find $\beta_i\ values$.

$$Let\ , \quad X = \begin{bmatrix} \sum_{i=1}^{n} x_i^{\,0} & \sum_{i=1}^{n} x_i^{\,1} & \sum_{i=1}^{n} x_i^{\,2} & \cdots & \sum_{i=1}^{n} x_i^{\,n} \\ \sum_{i=1}^{n} x_i^{\,1} & \sum_{i=1}^{n} x_i^{\,2} & \sum_{i=1}^{n} x_i^{\,3} & \cdots & \sum_{i=1}^{n} x_i^{\,n+1} \\ \sum_{i=1}^{n} x_i^{\,2} & \sum_{i=1}^{n} x_i^{\,3} & \sum_{i=1}^{n} x_i^{\,4} & \cdots & \sum_{i=1}^{n} x_i^{\,n+2} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \sum_{i=1}^{n} x_i^{\,n} & \cdots & \cdots & \cdots & \sum_{i=1}^{n} x_i^{\,2n} \end{bmatrix}, \quad B = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \vdots \\ \beta_n \end{bmatrix}, \quad Y = \begin{bmatrix} \sum_{i=1}^{n} y_i x_i^{\,0} \\ \sum_{i=1}^{n} y_i x_i^{\,1} \\ \sum_{i=1}^{n} y_i x_i^{\,2} \\ \vdots \\ \sum_{i=1}^{n} y_i x_i^{\,n} \end{bmatrix}$$

$$Then, \qquad XB = Y$$

$$X^{-1}XB = X^{-1}Y$$

$$B = X^{-1}Y$$

For finding the inverse for the matrix you can use Gauss elimination method or any other method.

Note: You can't use any of the libraries. (Sutch as NumPy, scipy, and other python libraries are restricted)

Input Format:

First line containing the order n.
second line containing comma separated 50 x values.
Third line containing comma separated 50 y values.

Output format:

Space separated coefficients of the polynomial β_is. In $\beta_0\ \ \beta_1\ \ \beta_2\ \ \beta_3\ \ \dots \beta_n$ order. (correct to 5 decimal places)

Example input:

2

1.0, 1.1020408163265305,1.2040816326530612, 1.306122448979592, 1.4081632653061225, 1.510204081632653, 1.6122448979591837, 1.7142857142857144, 1.816326530612245, 1.9183673469387754, 2.020408163265306, 2.122448979591837, 2.2244897959183674, 2.326530612244898, 2.428571428571429, 2.5306122448979593, 2.63265306122449, 2.7346938775510203, 2.836734693877551, 2.938775510204082, 3.0408163265306123, 3.142857142857143, 3.2448979591836737, 3.3469387755102042, 3.4489795918367347, 3.5510204081632653, 3.6530612244897958, 3.7551020408163267, 3.857142857142857, 3.9591836734693877, 4.061224489795919, 4.163265306122449, 4.26530612244898, 4.36734693877551, 4.469387755102041, 4.571428571428571, 4.673469387755102, 4.775510204081632, 4.877551020408164, 4.979591836734694, 5.081632653061225, 5.183673469387755, 5.285714285714286, 5.387755102040816, 5.4897959183673475, 5.591836734693878, 5.6938775510204085, 5.795918367346939, 5.8979591836734695, 6.0

4.536477379325476, 4.464451100874717, 5.063007758153328, 5.862839728492743, 7.4065044279215595, 7.796142999061382, 8.368096186390167, 10.076185277605544, 9.325217551609061, 11.201223880934103, 12.315713420484721, 12.820143619703774, 15.125582805532755, 15.737008658221614, 16.662009865260124, 18.938362699403367, 20.930060357482446, 22.313097754610073, 23.26276614074735, 24.22510461364256, 26.850487559176063, 28.191344716816356, 30.823585757235005, 33.207172716034776, 33.24992234836219, 35.793414980508174, 38.157721914561655, 40.62374386949249, 42.386382408359424, 45.03143670621515, 46.42439339801259, 48.99375529704981, 51.34828124914797, 54.23651493321689, 56.93495762202397, 59.61041443518771, 62.75020944259577, 65.27897021347772, 69.02606558045318, 71.62086942285143, 74.81395978687625, 78.22183822564446, 80.9480933655819, 82.91349396726987, 86.76417486622776, 89.69729495681183, 94.32728106158422, 97.54616042887133, 100.00215519216387, 104.04492250532681

Example output:

2.95460,-1.60032,3.07743

Explanation

After fitting the given data to a 2nd order polynomial according to the given method the answer is, $y = 2.9546010568737984 - 1.6003215089440346x + 3.0774291888810694\, x^2$, to 5 decimal places the coefficients will be,

2.95460,-1.60032,3.07743