Coding Assignment-5

Computational Methods & Applications

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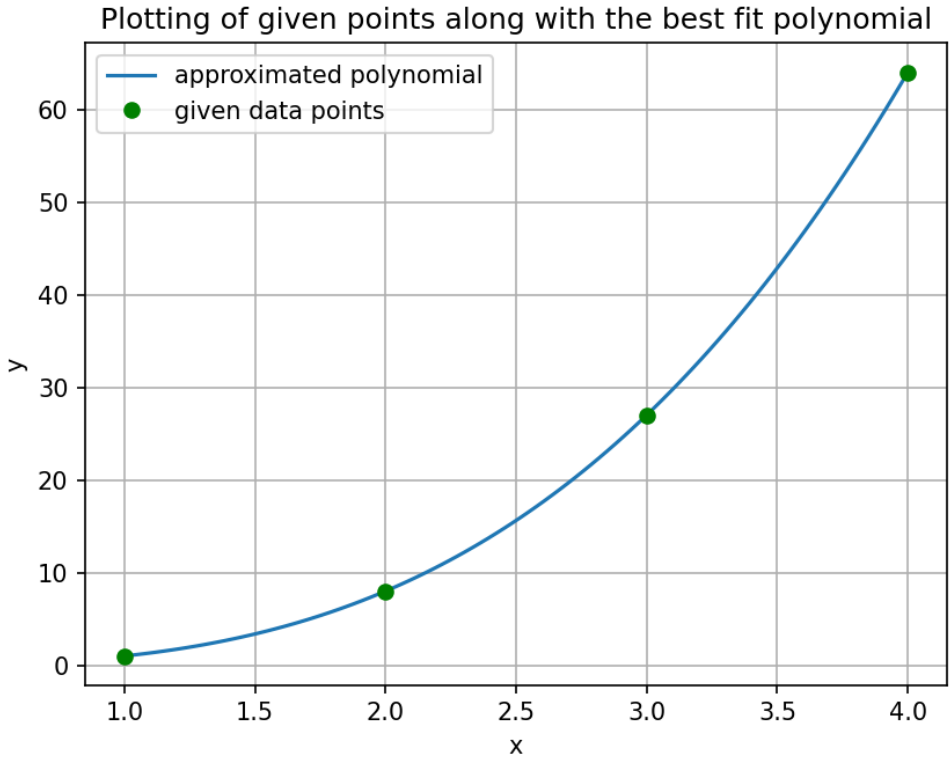
Q.1) Output:

```
Best_Fit_Polynomial([(1, 1), (2, 8), (3, 27), (4, 64)], 3)
```

Result:




```
Coefficients of the Best fit polynomial are:
 0.0 0.0 0.0 1.0
```

Explanation: Here , we have used least square approximation to get the 'best fist polynomial' over the data set.

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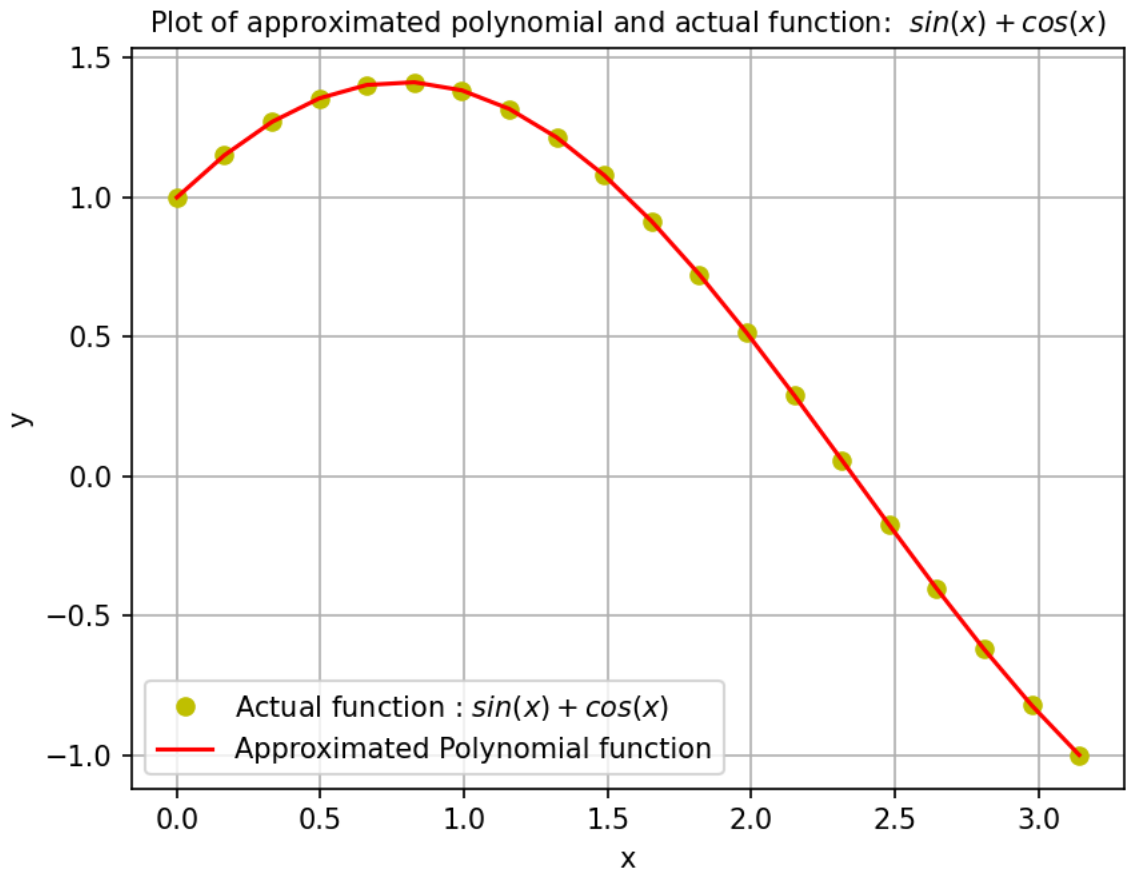
Q.2) Output:

```
Best_Fit_Polynomial(10)
```

(It'll result the Best Fit Polynomial of Sin(x)+Cos(x) over [-1,1])

Result:

```
Coefficients of the Best fit polynomial are:
 1.000000002187246 0.9999998548051187 -0.49999809099974407 -0.1666764933391099 0.04169228323438104 0.008295064212066838 -0.001354117256102757 2 -0.
0002179112099593679 5 3.129064875572406e-05 1.682107387248214e-06 -2.723674958316401 5e-07
```



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Q.3)Output:

```
LegendrePolynomial(5)
```

(It'll result the Legendre polynomial of degree 5)

Result:

```
Coefficients of the required Legendre polynomial are:
 0.0 1.875 0.0 -8.75 0.0 7.875
```

.....

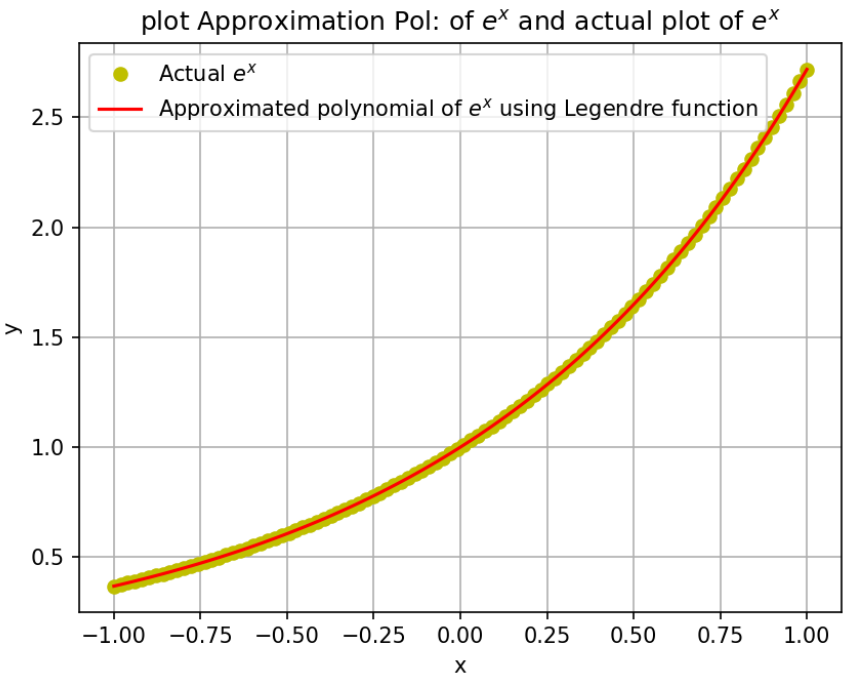
Q.4) Explanation: To compute the least-square approximation of e ^x in the interval [−1, 1] using the first n Legendre polynomials , we have used the following below formula for input n (=degree):

$e^x = \sum_{k=0}^{n-1} C_k P_k(x)$, Where $C_k = \frac{\int_{-1}^{1} e^x L_k(x)dx}{\int_{-1}^{1} L_k(x)^2 dx}$; L_k(x) means the Legendre polynomial of k-th order.

Output:

```
p=Polynomial()
p.legend_approximation(10)
```

Result:



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Q.5)Output:

```
Chebyshev_Polynomial(5)
```

(It'll result the Chebyshev polynomial of degree 5)

Result:

```
Coefficients of the required Chebyshev polynomial are:
 0 5 0 -20 0 16
```

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Q.6)Output:

(1)

```
p=Polynomial()
p.Print_firstFive_Chebyshev_pols()
```

Result:

```
Printing first 5 Chebyshev polynomials

The coefficients of  0 -th degree Chebyshev polynomial is:  Coefficients of the required Chebyshev polynomial are:
 1
The coefficients of  1 -th degree Chebyshev polynomial is:  Coefficients of the required Chebyshev polynomial are:
 0 1
The coefficients of  2 -th degree Chebyshev polynomial is:  Coefficients of the required Chebyshev polynomial are:
 -1 0 2
The coefficients of  3 -th degree Chebyshev polynomial is:  Coefficients of the required Chebyshev polynomial are:
 0 -3 0 4
The coefficients of  4 -th degree Chebyshev polynomial is:  Coefficients of the required Chebyshev polynomial are:
 1 0 -8 0 8
```

(2)

```
p=Polynomial()
p.Orthogonality()
```

(It'll print the integration values of the polynomials to check the orthogonality and if they are orthogonal, it will print "ORTHOGONAL")

Result:

```
Intrgration of 0 deg: chebyshev Pol: and 2 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 0 deg: chebyshev Pol: and 3 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 0 deg: chebyshev Pol: and 4 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 1 deg: chebyshev Pol: and 2 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 1 deg: chebyshev Pol: and 3 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 1 deg: chebyshev Pol: and 4 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 2 deg: chebyshev Pol: and 3 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 2 deg: chebyshev Pol: and 4 deg: chebyshev Pol: along with weight function w(x) is :
 0.0
Intrgration of 3 deg: chebyshev Pol: and 4 deg: chebyshev Pol: along with weight function w(x) is :
 0.0


ORTHOGONAL
```

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Q.7)Output:

```
Best_Fit_FourierApproximation(8)
```

(It'll result best fit Fourier approximated polynomial of degree 8)

Result:

```
co-effecients of cosines are  [3.6760779103749774, 1.4704311641499912, -0.7352155820749962, 0.43247975416176204, -0.28277522387499693, 0.1987069140743238, -0.147
0431164149995, 0.11311008954999857]

co-effecients of sines are  [3.6760779103749774, -2.9408623282999815, 2.2056467462249865, -1.7299190166470477, 1.413876119374991, -1.19224148444594, 1.02930181490
49926, -0.9048807163999936]
```