Artificial Intelligence Lab Work (2)

レポート解答用紙（Report Answer Sheet）

学生証番号（Student ID): 21522019

名前(Name): Âu Trường Giang（アーウ・チュオン・ザン）

```
#Data D
X = [0.349526784, 1 .6974435, 5.384308891, 2.044150596,
     4.578814506, 3.241690807, 2.535931731, 2.210580888,
     3.397474351, 5.972933146, 5.114704101]

Y = [0.254020646, 0.790556868, -0.81239532, 1.012143475,
     -0.904558188, -0.167456361, 0.482547054, 0.878514378,
     -0.210093715, -0.128786937, -0.866501299]
```

問 1.

（プログラム）

```
#Data D
X = [0.349526784, 1.6974435, 5.384308891, 2.044150596,
     4.578814506, 3.241690807, 2.535931731, 2.210580888,
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Y = [0.254020646, 0.790556868, -0.81239532, 1.012143475,
     -0.904558188, -0.167456361, 0.482547054, 0.878514378,
     -0.210093715, -0.128786937, -0.866501299]

import matplotlib.pyplot as plt
import numpy as np

plt.scatter(X, Y, color='red')
x_sin = np.linspace(0, 6, 100)
plt.plot(x_sin, np.sin(x_sin), color='green', label='sin(x)')
plt.title('Graph of sin function')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.show()
```
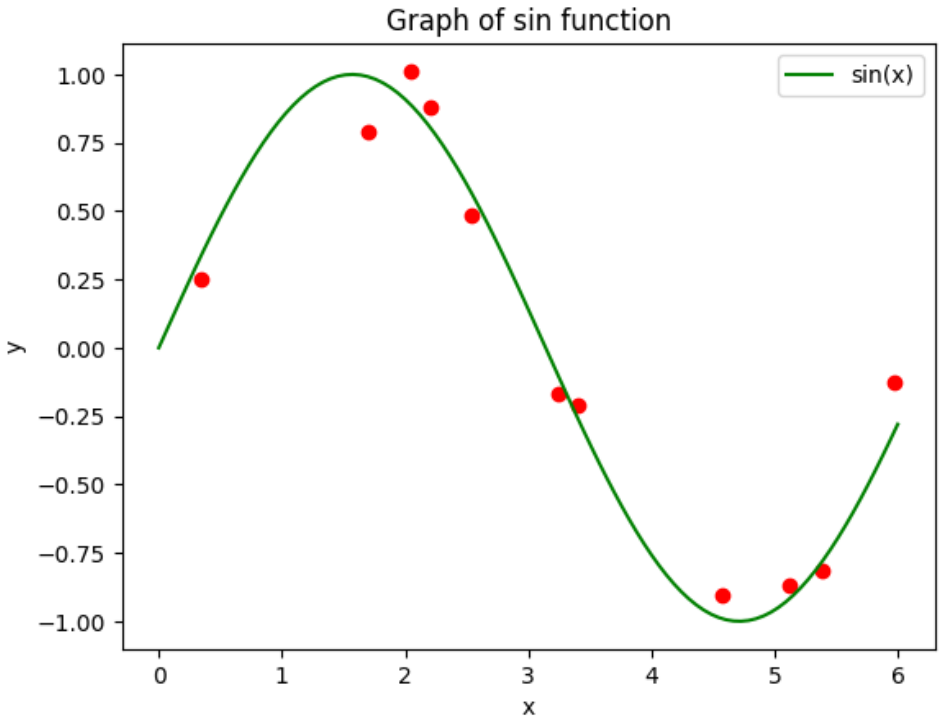

（グラフ）



問 2.

(プログラム)

```
#Data D
X = [0.349526784, 1.6974435, 5.384308891, 2.044150596,
     4.578814506, 3.241690807, 2.535931731, 2.210580888,
     3.397474351, 5.972933146, 5.114704101]

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     -0.904558188, -0.167456361, 0.482547054, 0.878514378,
     -0.210093715, -0.128786937, -0.866501299]

def cubic(a, b, c, d, x):
  return a*x**3 + b*x**2 + c*x + d

import numpy as np
import matplotlib.pyplot as plt

lr = 0.000008
epoch = 200_000

a = 0
b = 0
c = 0
d = 0

for e in range(epoch):
  grad_a = 0
  grad_b = 0
  grad_c = 0
  grad_d = 0
  loss = 0

  for i in range(len(X)):
    x = X[i]
    y = Y[i]
    grad_a = grad_a - 2*x**3*(y - a*x**3 - b*x**2 - c*x - d)
    grad_b = grad_b - 2*x**2*(y - a*x**3 - b*x**2 - c*x - d)
    grad_c = grad_c - 2*x*(y - a*x**3 - b*x**2 - c*x - d)
    grad_d = grad_d - 2*(y - a*x**3 - b*x**2 - c*x - d)
    loss = loss + (y - a*x**3 - b*x**2 - c*x - d)**2
  a = a - lr*grad_a
  b = b - lr*grad_b
  c = c - lr*grad_c
  d = d - lr*grad_d
  print('epoch:', e)
  print('a:', a, 'b:', b, 'c:', c, 'd:', d, 'loss:', loss)
```
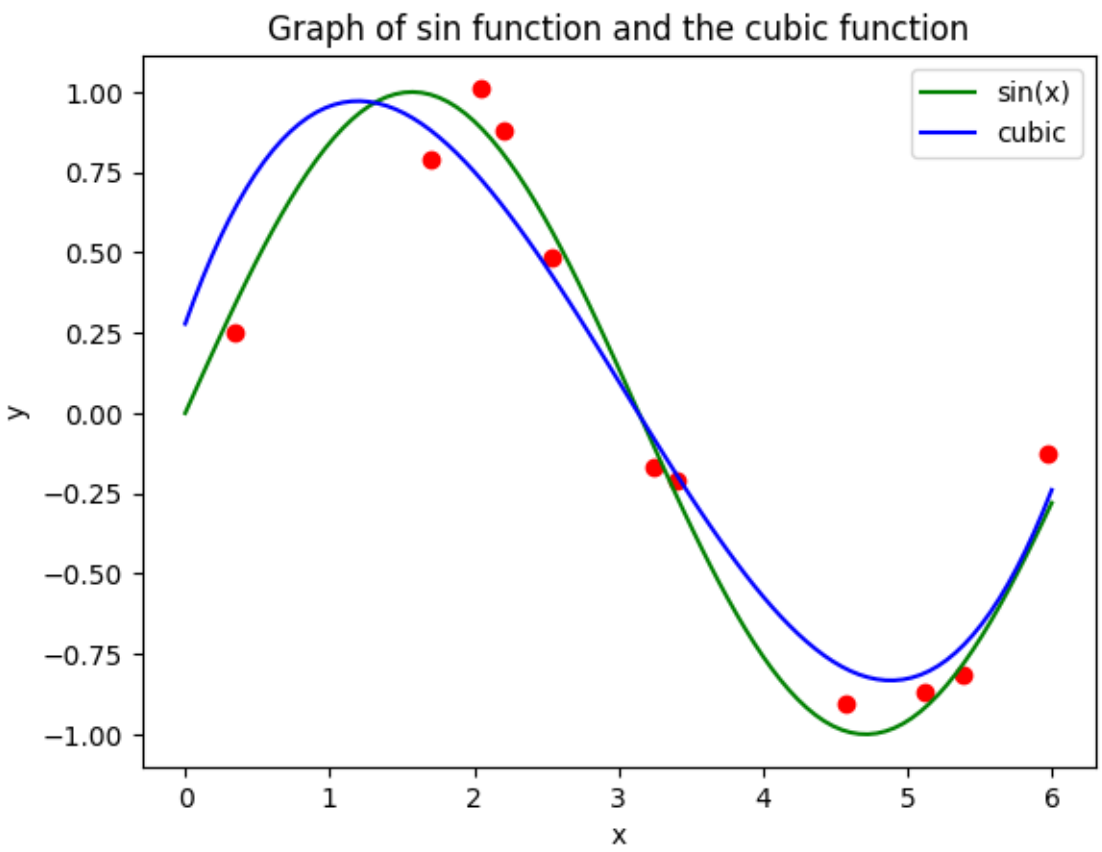

```
plt.scatter(X, Y, color='red')
x_sin = np.linspace(0, 6, 100)
plt.plot(x_sin, np.sin(x_sin), color='green', label='sin(x)')
plt.plot(x_sin, cubic(a, b, c, d, x_sin), color='blue', label='cubic')
plt.title('Graph of sin function and the cubic function')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.show()
```

（グラフ）



問 3. (a)

(プログラム)

```
#Data D
X = [0.349526784, 1.6974435, 5.384308891, 2.044150596,
     4.578814506, 3.241690807, 2.535931731, 2.210580888,
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     -0.904558188, -0.167456361, 0.482547054, 0.878514378,
     -0.210093715, -0.128786937, -0.866501299]

import matplotlib.pyplot as plt
import numpy as np

X3 = []
for x in X:
  X3 = X3 + [[1, x, x**2, x**3]]
X3 = np.array(X3)
Y3 = np.array([Y]).T

Z1 = np.matmul(X3.T, X3)
Z2 = np.linalg.inv(Z1)
Z3 = np.matmul(Z2, X3.T)
w = np.matmul(Z3, Y3)
print(w)

def cubic_new(x):
  return w[3][0]*x**3 + w[2][0]*x**2 + w[1][0]*x + w[0][0]

plt.scatter(X, Y, color='red')
x_sin = np.linspace(0, 6, 100)
plt.plot(x_sin, np.sin(x_sin), color='green', label='sin(x)')
plt.plot(x_sin, cubic_new(x_sin), color='blue', label='cubic')
plt.title('Graph of sin and cubic function')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.show()
```
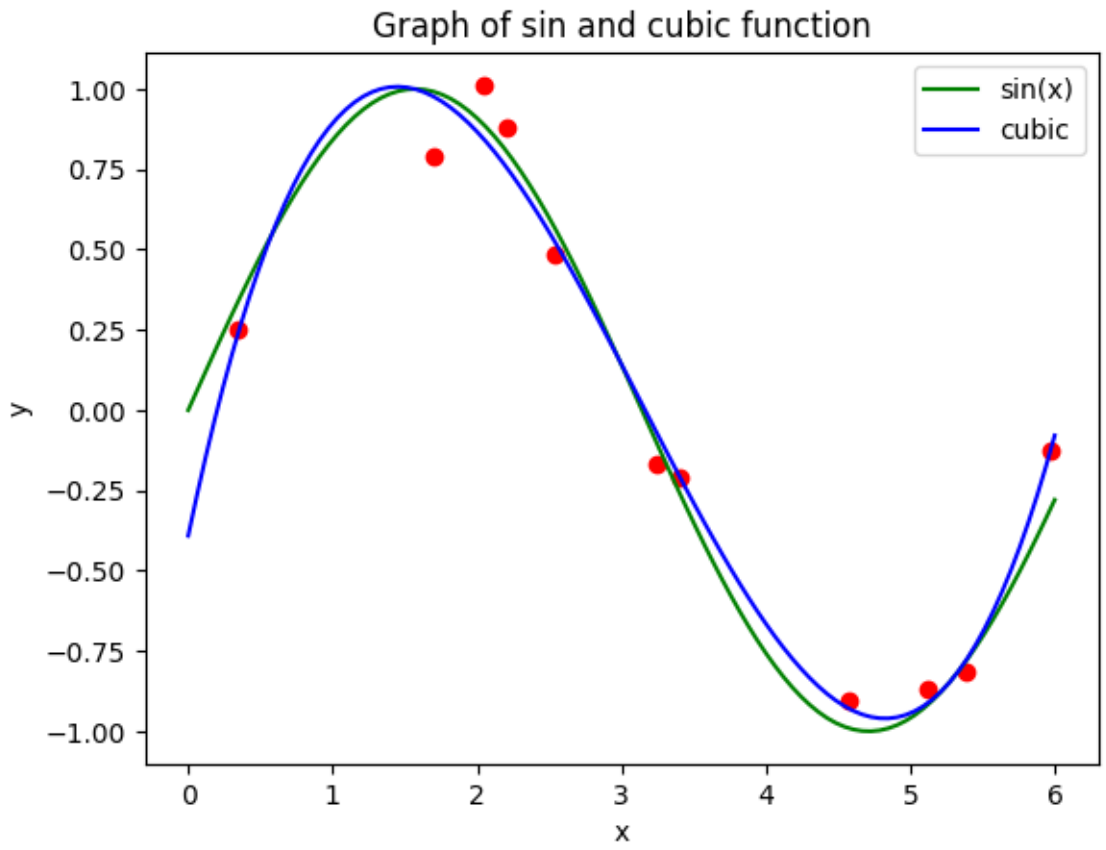

（グラフ）


Graph of sin and cubic function
sin(x)
cubic
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
y
0
1
2
3
4
5
6
x

問 3. (b)

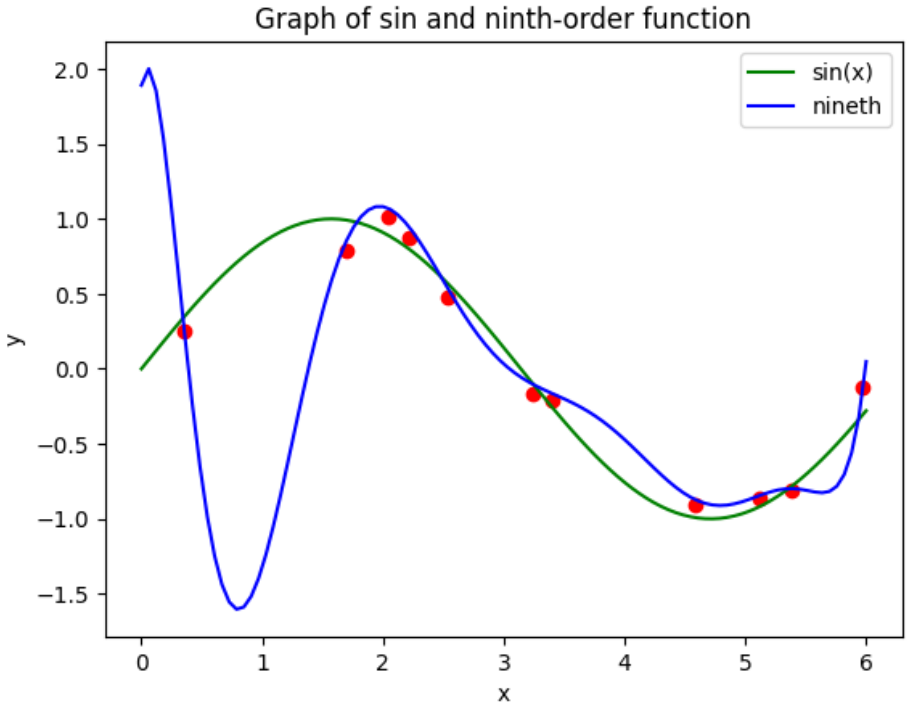
(プログラム)

```
#Data D
X = [0.349526784, 1.6974435, 5.384308891, 2.044150596,
     4.578814506, 3.241690807, 2.535931731, 2.210580888,
     3.397474351, 5.972933146, 5.114704101]

Y = [0.254020646, 0.790556868, -0.81239532, 1.012143475,
     -0.904558188, -0.167456361, 0.482547054, 0.878514378,
     -0.210093715, -0.128786937, -0.866501299]

import matplotlib.pyplot as plt
import numpy as np

X9 = []
for x in X:
  t = []
  for i in range(10):
    t.append(x**i)
  X9 = X9 + [t]

X9 = np.array(X9)
Y9 = np.array([Y]).T

Z1 = np.matmul(X9.T, X9)
Z2 = np.linalg.inv(Z1)
Z3 = np.matmul(Z2, X9.T)
w = np.matmul(Z3, Y9)
print(w)

def nineth(x):
  v = 0
  for i in range(10):
    v += w[i][0]*x**i
  return v

plt.scatter(X, Y, color='red')
x_sin = np.linspace(0, 6, 100)
plt.plot(x_sin, np.sin(x_sin), color='green', label='sin(x)')
plt.plot(x_sin, nineth(x_sin), color='blue', label='nineth')
plt.title('Graph of sin and ninth-order function')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.show()
```

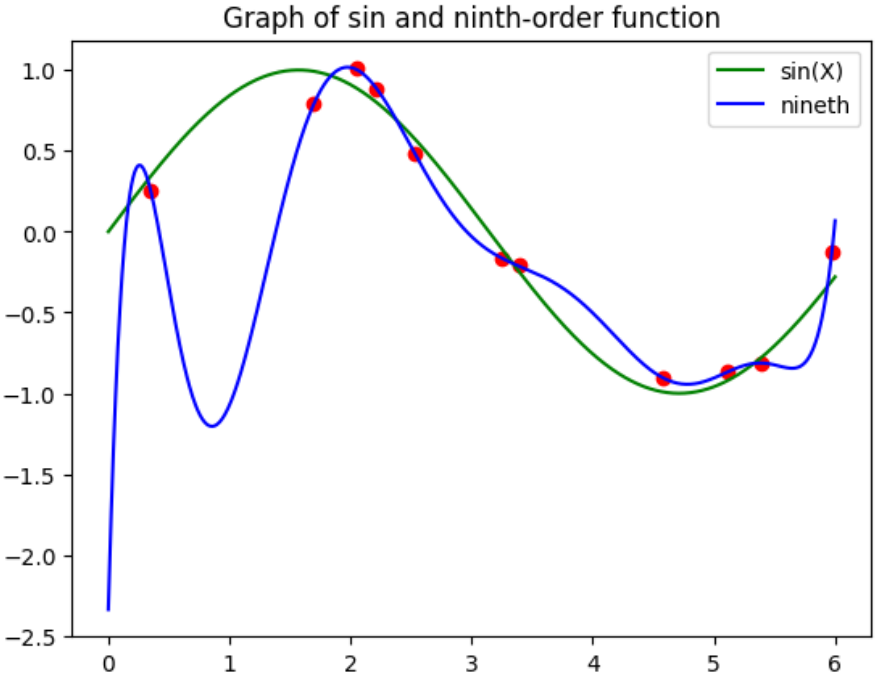
OR

```
#Data D
X = [0.349526784, 1.6974435, 5.384308891, 2.044150596,
     4.578814506, 3.241690807, 2.535931731, 2.210580888,
     3.397474351, 5.972933146, 5.114704101]

Y = [0.254020646, 0.790556868, -0.81239532, 1.012143475,
     -0.904558188, -0.167456361, 0.482547054, 0.878514378,
     -0.210093715, -0.128786937, -0.866501299]

import matplotlib.pyplot as plt
import numpy as np

X_ = np.array(X)
Y_= np.array(Y)

A = np.vstack([np.ones(len(X_)), X_**1, X_**2, X_**3, X_**4, X_**5¥
               , X_**6, X_**7, X_**8, X_**9]).T
w = np.linalg.lstsq(A, Y_, rcond=None)[0]
print(w)
x_sin = np.linspace(0, 6, 1000)
y_sin = w[0] + w[1]*x_sin*1 + w[2]*x_sin**2 + w[3]*x_sin**3+ w[4]*x_sin**4¥
+ w[5]*x_sin**5+ w[6]*x_sin**6  +w[7]*x_sin**7+w[8]*x_sin**8 + w[9]*x_sin**9
plt.plot(x_sin, np.sin(x_sin), color= 'green', label = 'sin(X)')
plt.plot(x_sin, y_sin, color= 'blue', label = 'nineth')
plt.title('Graph of sin and ninth-order function')
plt.legend()
plt.scatter(X, Y, color= 'red')
plt.show()
```

（グラフ）


Graph of sin and ninth-order function
sin(x)
nineth
y
x

OR


Graph of sin and ninth-order function
sin(X)
nineth