

Artificial Intelligence Lab Work (2)
レポート解答用紙 (Report Answer Sheet)

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#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)

```
import matplotlib.pyplot as plt
import numpy as np

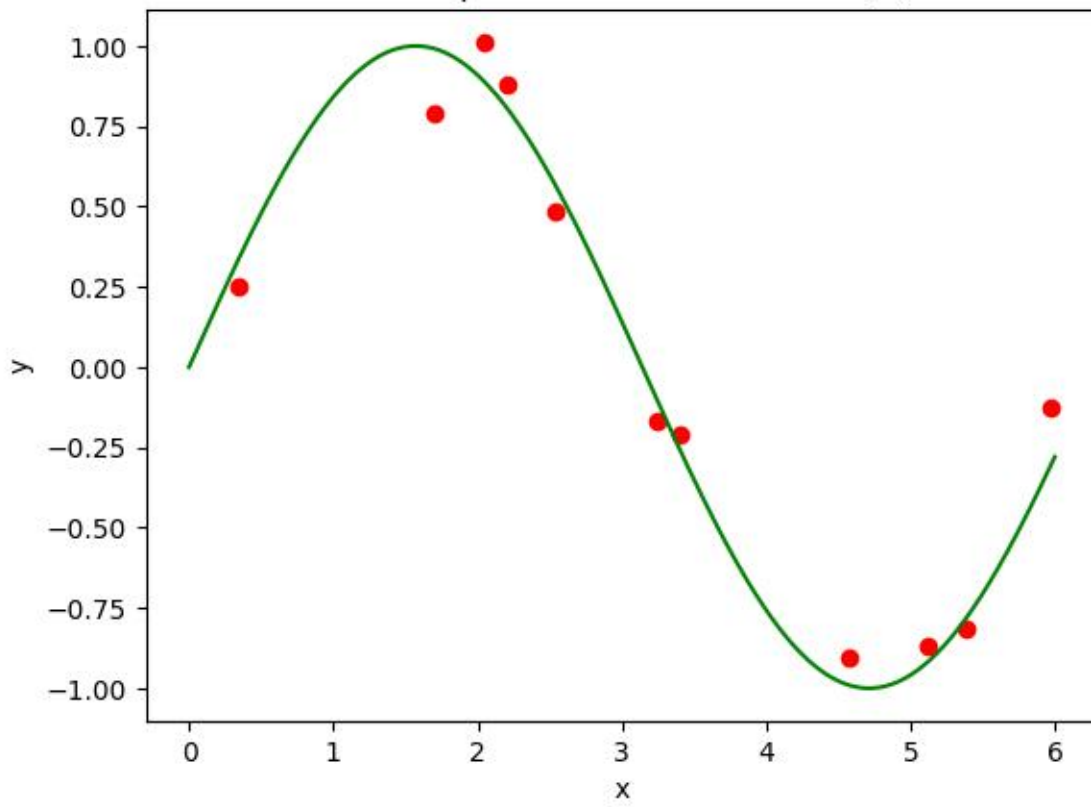
x_dataD = np.array([0.349526784, 1.6974435, 5.384308891, 2.044150596,
4.578814506, 3.241690807, 2.535931731, 2.210580888, 3.397474351,
5.972933146, 5.114704101])
y_dataD = np.array([0.254020646, 0.790556868, -0.81239532, 1.012143475,
-0.904558188, -0.167456361, 0.482547054, 0.878514378, -0.210093715,
-0.128786937, -0.866501299])

x_sin = np.linspace(0, 6, 1000)
y_sin = np.sin(x_sin)

plt.plot(x_sin, y_sin, color='green')
plt.scatter(x_dataD, y_dataD, color='red')
plt.title('Scatter plot of the data D and sin(x)')
plt.xlabel('x')
plt.ylabel('y')
plt.show()
```

(グラフ)

Scatter plot of the data D and $\sin(x)$



問2.

(プログラム)

```

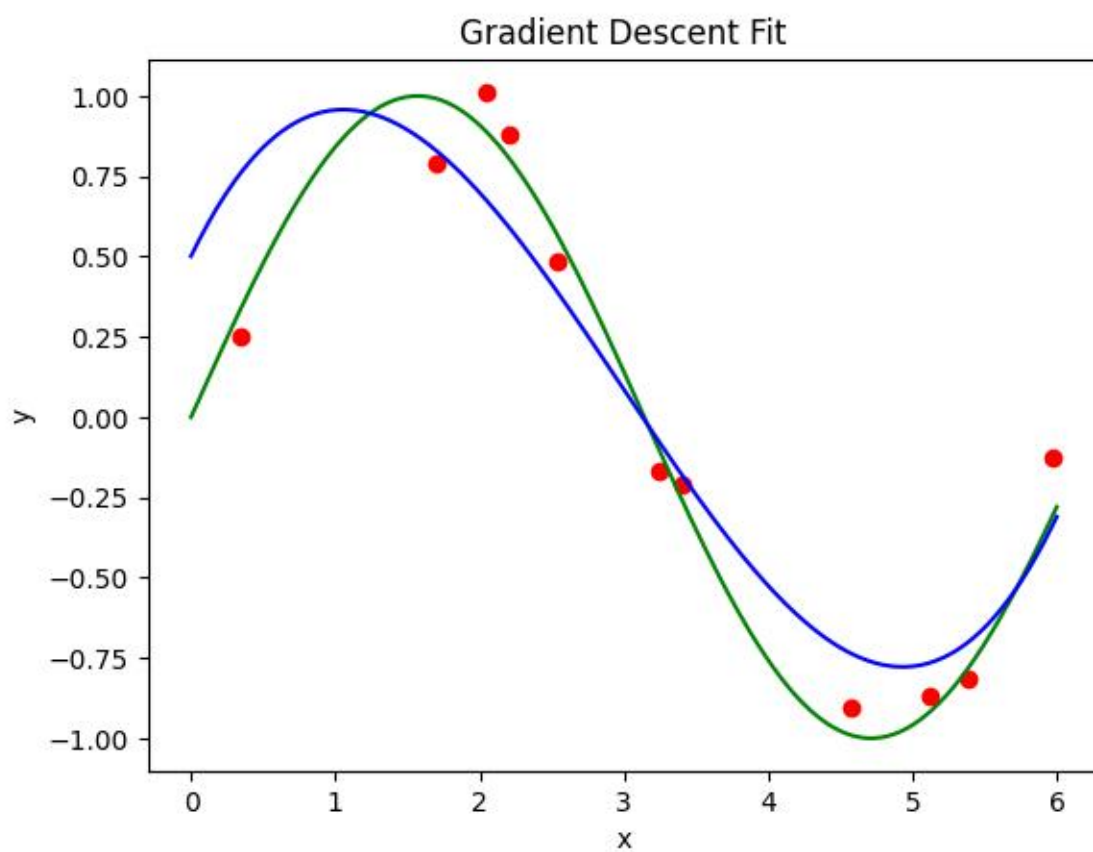
a, b, c, d = 0.0, 0.0, 0.0, 0.0
lr = 0.000008
epochs = 200000

for _ in range(epochs):
    y_pred = a*x_dataD**3 + b*x_dataD**2 + c*x_dataD + d
    error = y_pred - y_dataD
    a -= lr * np.sum(error * x_dataD**3)
    b -= lr * np.sum(error * x_dataD**2)
    c -= lr * np.sum(error * x_dataD)
    d -= lr * np.sum(error)

x_range = np.linspace(0, 6, 1000)
y_sin = np.sin(x_range)
y_poly3 = a*x_range**3 + b*x_range**2 + c*x_range + d

plt.scatter(x_dataD, y_dataD, color="red")
plt.plot(x_range, y_sin, color="green")
plt.plot(x_range, y_poly3, color="blue")
plt.xlabel('x')
plt.ylabel('y')
plt.title("Gradient Descent Fit")
plt.show()
```

(グラフ)



問 3. (a)

(プログラム)

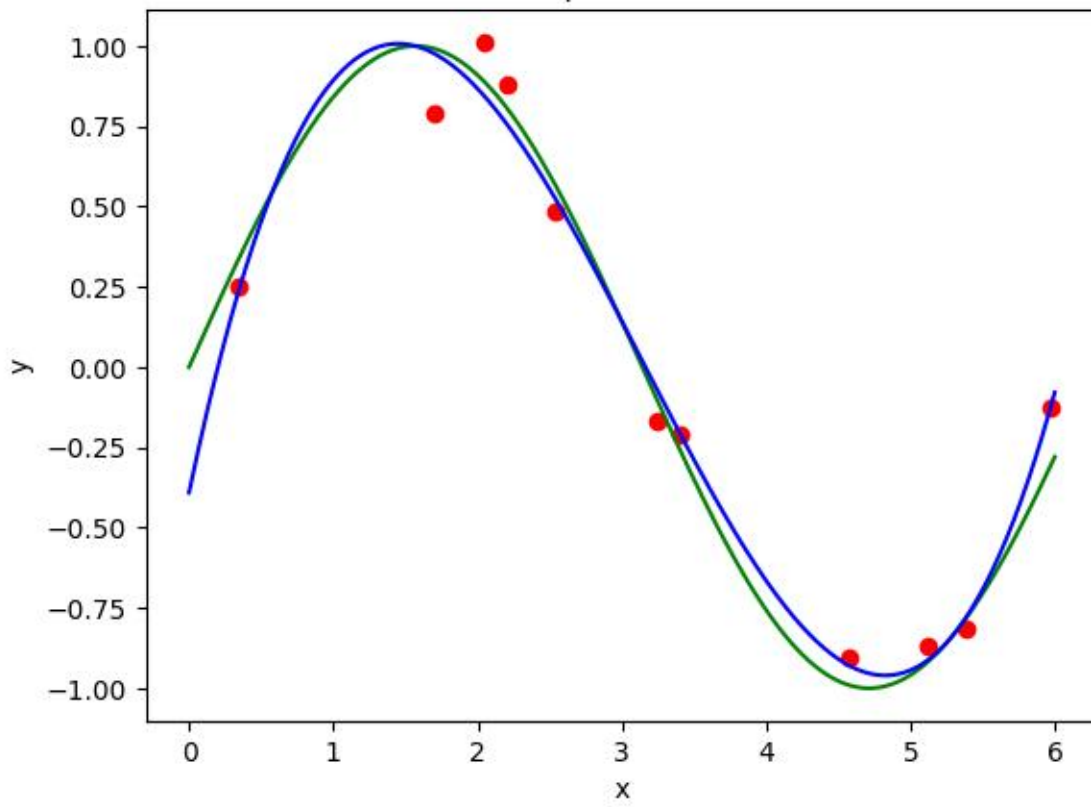
```
X = np.vstack((np.ones_like(x_dataD), x_dataD, x_dataD**2, x_dataD**3)).T
w = np.linalg.inv(X.T @ X) @ X.T @ y_dataD # phân tích nghiệm

x_range = np.linspace(0, 6, 1000)
X_pred = np.vstack((np.ones_like(x_range), x_range, x_range**2,
x_range**3)).T
y_pred = X_pred @ w

plt.scatter(x_dataD, y_dataD, color="red")
plt.plot(x_range, np.sin(x_range), color="green")
plt.plot(x_range, y_pred, color="blue")
plt.xlabel('x')
plt.ylabel('y')
plt.title("Least Squares Cubic Fit")
plt.show()
```

(グラフ)

Least Squares Cubic Fit



問 3. (b)

(プログラム)

```

X9 = np.vstack([x_dataD**i for i in range(10)]).T
w9 = np.linalg.inv(X9.T @ X9) @ X9.T @ y_dataD

x_range = np.linspace(0, 6, 1000)
X9_pred = np.vstack([x_range**i for i in range(10)]).T
y9_pred = X9_pred @ w9

plt.scatter(x_dataD, y_dataD, color="red")
plt.plot(x_range, np.sin(x_range), color="green")
plt.plot(x_range, y9_pred, color="blue")
plt.xlabel('x')
plt.ylabel('y')
plt.title("Least Squares 9th Fit")
plt.show()
```

(グラフ)

Least Squares 9th Fit

