Activity 1

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, recall_score, precision_score
```

Activty 2

```
df = pd.read_csv('Social_Network_Ads.csv')
df.head(10)
```

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0
5	15728773	Male	27	58000	0
6	15598044	Female	27	84000	0
7	15694829	Female	32	150000	1
8	15600575	Male	25	33000	0
9	15727311	Female	35	65000	0

Next steps: Generate code with `df` View recommended plots New interactive sheet

```
X = df.iloc[:, [2,3]].values
y = df.iloc[:, -1:].values

print(X.shape, y.shape)
```

```
(400, 2) (400, 1)
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

print(X_train.shape, X_test.shape)
print(y_train.shape, y_test.shape)
```

```
(320, 2) (80, 2)
(320, 1) (80, 1)
```

```
X_max = X_train.max(axis=0, keepdims=True)
X_min = X_train.min(axis=0, keepdims=True)

X_train_scaled = (X_train - X_min) / (X_max - X_min)
X_test_scaled = (X_test - X_min) / (X_max - X_min)
```

Activity 3

```
g = lambda z : np.exp(z) / (1 + np.exp(z))

def predict_prob(X, w):
    z = np.dot(X, w.T)
    return g(z)

def predict(X, w):
    y_hat = predict_prob(X, w)
    y_hat = np.where(y_hat >= 0.5, 1, 0)
    return y_hat
```

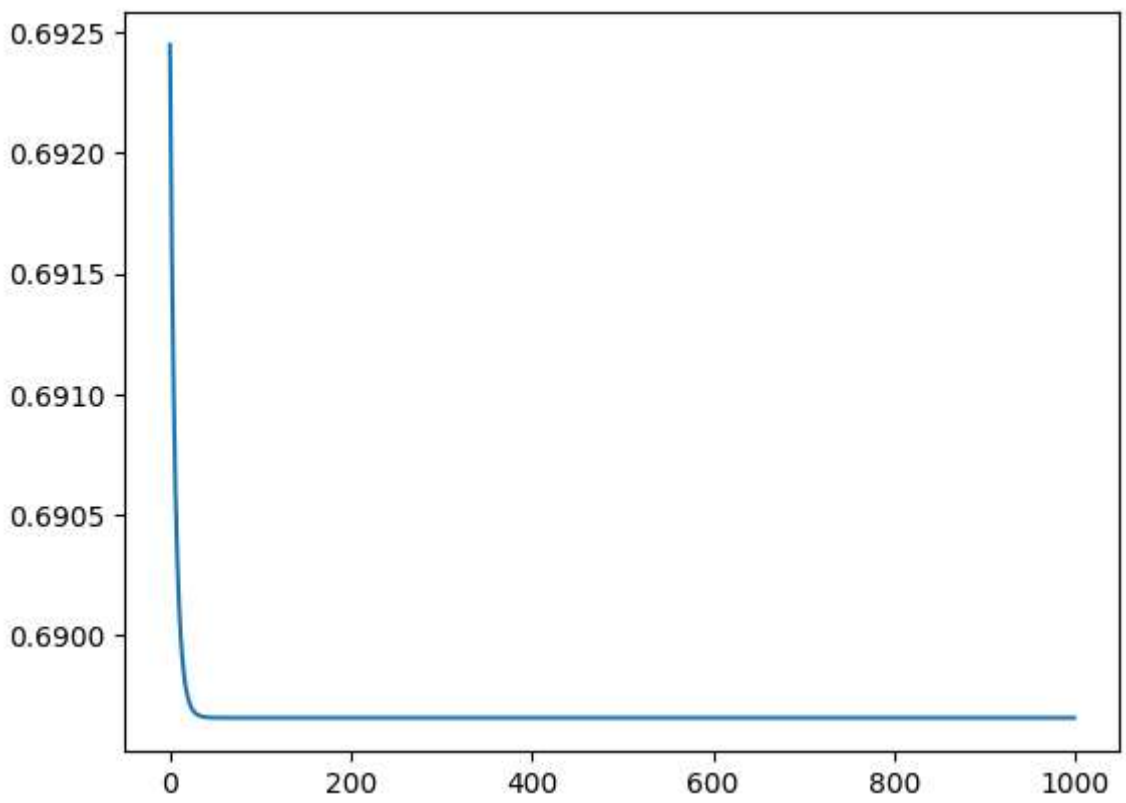
```
def loss(X, y, w):
    y_hat = predict_prob(X, w)
    l = y * np.log(y_hat) + (1 - y) * np.log(1 - y_hat)
    return -np.mean(l)
```

```
def grad(X, y, w):
    y_hat = predict_prob(X, w)
    delta = y_hat - y
    dw = np.dot(X.T, delta)
    return dw.T
```

```
def gradient_descent(X, y, lr=0.02, epochs=1000):
    w = np.zeros((1, X.shape[1]))
    losses = []
    for i in range(epochs):
        dw = grad(X, y, w)
        w -= lr * dw
        losses.append(loss(X, y, w))
    return losses, w
```

```
loss, w = gradient_descent(X_train_scaled, y_train)
plt.plot(loss)
```

```
[<matplotlib.lines.Line2D at 0x7a6043dd4d30>]
```



Activity 4

Cau 1:

```
y_pred = predict(X_test_scaled, w)

print(f'Accuracy: {accuracy_score(y_test, y_pred)}')
print(f'Recall: {recall_score(y_test, y_pred)}')
print(f'Precision: {precision_score(y_test, y_pred)}')
```

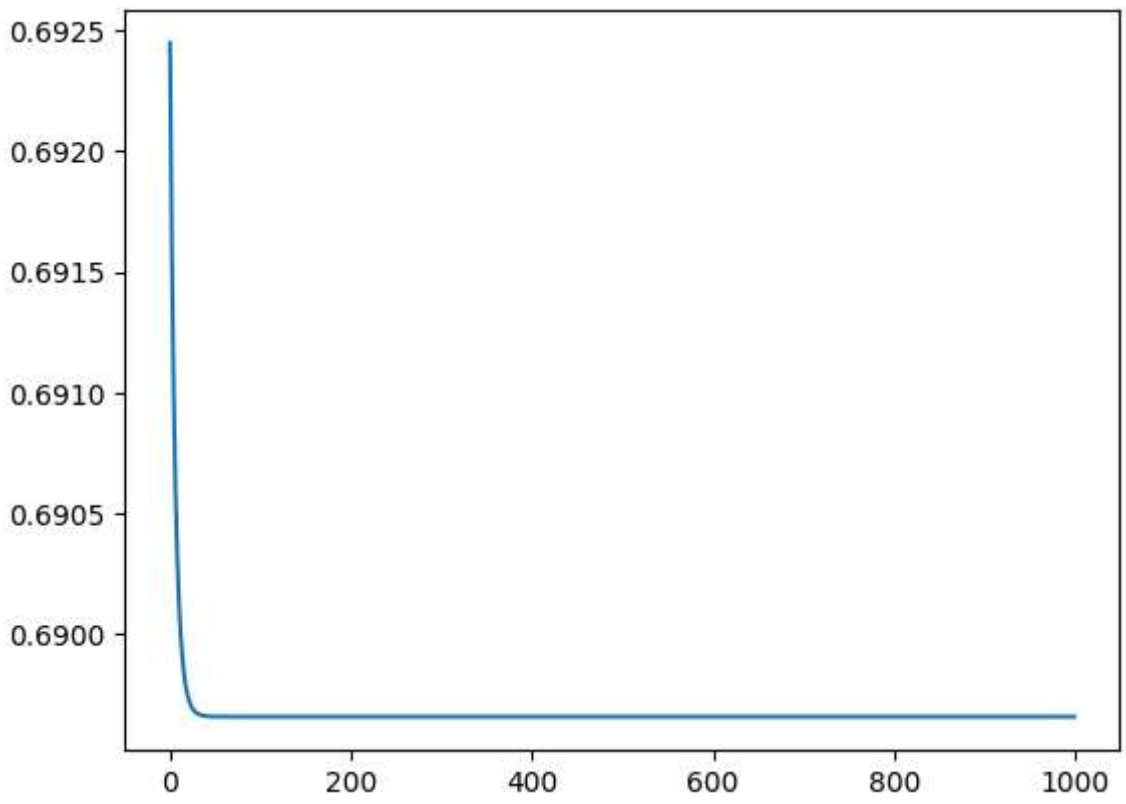
```
Accuracy: 0.65
Recall: 0.5714285714285714
Precision: 0.5
```

Cau 2:

```
class LogisticRegression1:
    def __init__(self, lr=0.02, epochs=1000):
        self.lr = lr
        self.epochs = epochs
        self.w = None
        self.losses = []

    def g(self, z):
        return np.exp(z) / (1 + np.exp(z))

    def predict_prob(self, X):
        z = np.dot(X, self.w.T)
        return self.g(z)

    def predict(self, X):
        y_hat = self.predict_prob(X)
        y_hat = np.where(y_hat >= 0.5, 1, 0)
        return y_hat

    def loss(self, X, y):
        y_hat = self.predict_prob(X)
        l = y * np.log(y_hat) + (1 - y) * np.log(1 - y_hat)
        return -np.mean(l)

    def grad(self, X, y):
        y_hat = self.predict_prob(X)
        delta = y_hat - y
        dw = np.dot(X.T, delta)
        return dw.T

    def fit(self, X, y):
        self.w = np.zeros((1, X.shape[1]))
        for i in range(self.epochs):
            dw = self.grad(X, y)
            self.w -= self.lr * dw
            self.losses.append(self.loss(X, y))

    def evaluate(self, X, y):
        y_pred = self.predict(X)
        print(f'Accuracy: {accuracy_score(y, y_pred)}')
        print(f'Recall: {recall_score(y, y_pred)}')
        print(f'Precision: {precision_score(y, y_pred)}')
```

```
model = LogisticRegression1()
model.fit(X_train_scaled, y_train)
model.evaluate(X_test_scaled, y_test)
plt.plot(model.losses)
```

```
Accuracy: 0.65
Recall: 0.5714285714285714
Precision: 0.5
[<matplotlib.lines.Line2D at 0x7a6043e9e7a0>]
```



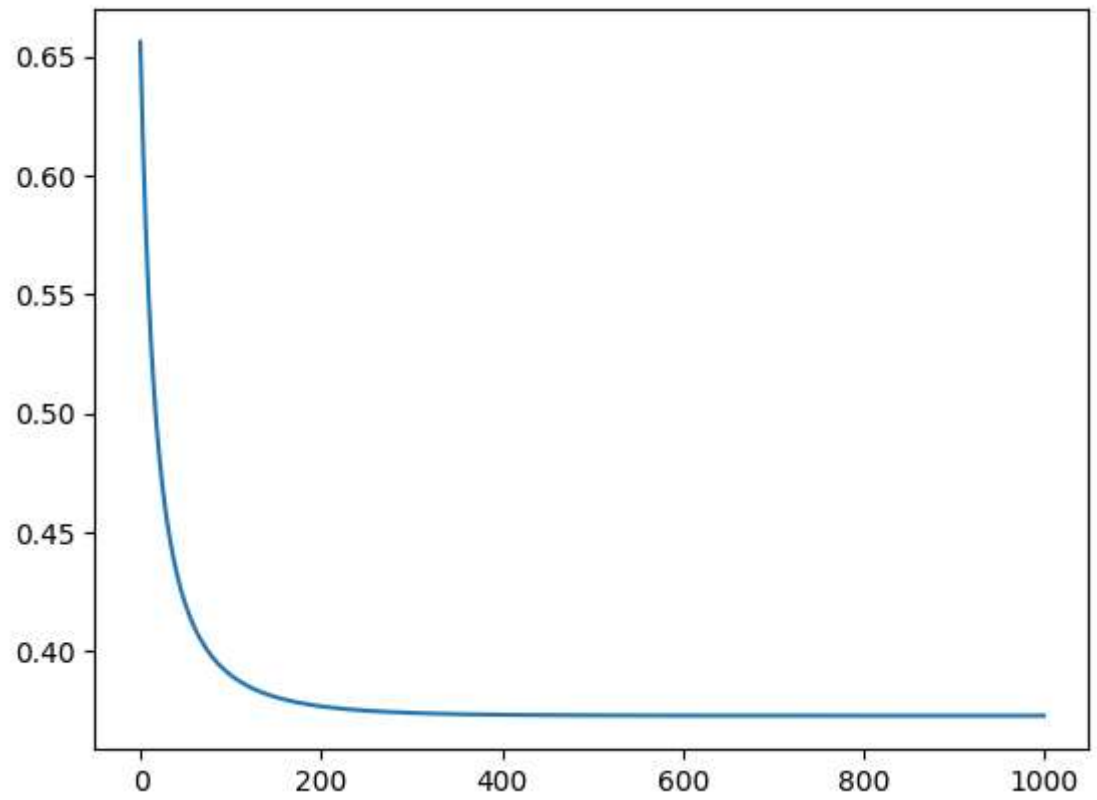
Cau 3:

```
class LinearRegression:
    def __init__(self, lr=0.01, epochs=1000):
        self.lr = lr
        self.epochs = epochs
        self.w = None
        self.losses = []

    def g(self, z):
        return np.exp(z) / (1 + np.exp(z))

    def predict_prob(self, X):
        z = np.dot(X, self.w.T)
        return self.g(z)

    def predict(self, X):
        y_hat = self.predict_prob(X)
        y_hat = np.where(y_hat >= 0.5, 1, 0)
        return y_hat

    def loss(self, X, y):
        y_hat = self.predict_prob(X)
        l = y * np.log(y_hat) + (1 - y) * np.log(1 - y_hat)
        return -np.mean(l)

    def grad(self, X, y):
        y_hat = self.predict_prob(X)
        delta = y_hat - y
        dw = np.dot(X.T, delta)
        return dw.T

    def fit(self, X, y):
        X_bias = np.c_[np.ones(X.shape[0]), X]
        self.w = np.zeros((1, X_bias.shape[1]))
        for i in range(self.epochs):
            dw = self.grad(X_bias, y)
            self.w -= self.lr * dw
            self.losses.append(self.loss(X_bias, y))
```

```
    def evaluate(self, X, y):
        X_bias = np.c_[np.ones(X.shape[0]), X]
        y_pred = self.predict(X_bias)
        print(f'Accuracy: {accuracy_score(y, y_pred)}')
        print(f'Recall: {recall_score(y, y_pred)}')
        print(f'Precision: {precision_score(y, y_pred)}')
```

```
model = LinearRegression()
model.fit(X_train_scaled, y_train)
model.evaluate(X_test_scaled, y_test)
plt.plot(model.losses)
```

```
Accuracy: 0.8875
Recall: 0.75
Precision: 0.9130434782608695
[<matplotlib.lines.Line2D at 0x7a6043ebffd0>]
```



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