Deep Neural Network 2

파이썬으로 배우는 기계학습

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Deep Neural Network 2

- 학습 목표
  - 딥뉴럴넷 클래스에 배치 경사하강법을 구현한다.
  - 다양한 데이터셋을 이용하여 딥뉴럴넷의 성능을 테스트한다.

- 학습 내용
  - 딥뉴럴넷 클래스에 배치 경사하강법 구현하기
  - **MNIST-Fashion DataSet** 다루기
  - 고양이 인식 문제 도전하기
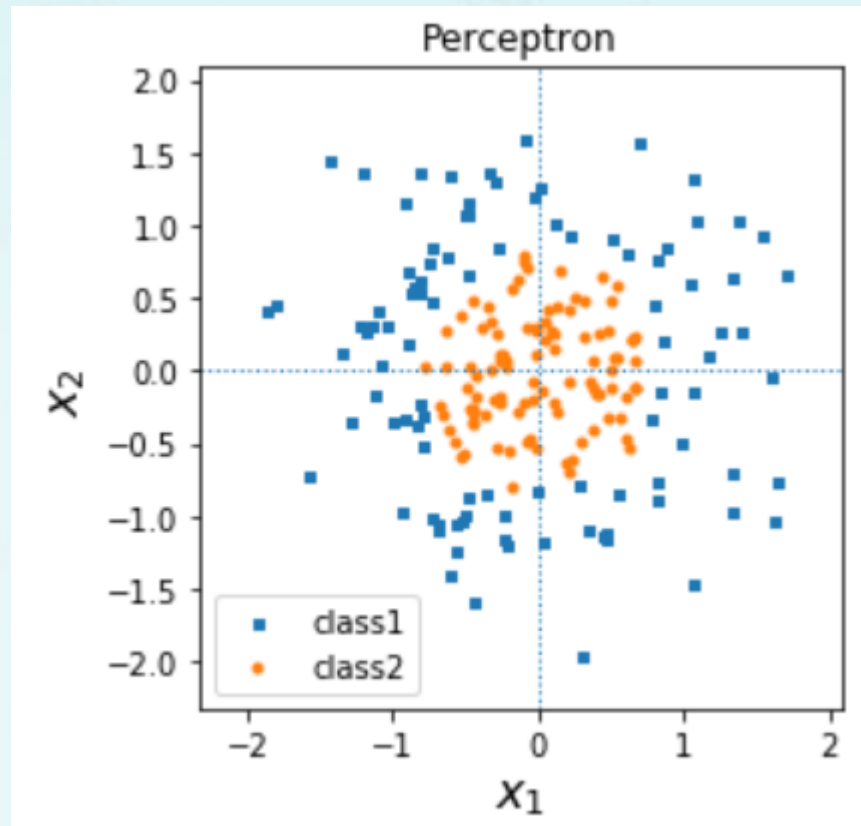
1. DNN 배치 경사하강법: 학습 fit() 메소드

```python
def fit(self, X, y):
    self.cost_ = []
    self.m_samples = len(y)
    Y = joy.one_hot_encoding(y, self.net_arch[-1])

    for epoch in range(self.epochs):
        A0 = np.array(X, ndmin=2).T
        Y0 = np.array(Y, ndmin=2).T

        Z, A = self.forpass(A0)           # for. pass
        cost = self.backprop(Z, A, Y0)    # back prop
        self.cost_.append(np.sqrt(np.sum(cost * cost)))
    return self
```

1. DNN 배치 경사하강법: 예측 predict_() 메소드

```python
# invoked by plot_decsion_regions()
def predict(self, X):
    Z, A2 = self.forpass(X)
    A2 = np.array(A2[len(A2)-1])
    return A2[-1] > 0.5


# used by DeepNeuralNet.evaluate()
def predict_(self, X):
    A0 = np.array(X, ndmin=2).T
    Z, A = self.forpass(A0)
    return A[-1]
```

2. 딥뉴럴네트의 성능: 가우시안 퀀타일스

```python
1  import joy
2  x, y = joy.gaussian_quantiles(random_seed = 0)
3  joy.plot_xyw(x.T, y.squeeze())
```

2. DNN의 성능: 가우시안 퀀타일스

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed=1)
nn1 = DeepNeuralNet_BGD([2, 100, 2],
                eta=0.2, epochs=2000)
nn1.fit(X.T, Y.flatten())
accuracy = nn1.evaluate(X.T, Y.flatten())
print('Accuracy {}%'.format(accuracy))
```

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed = 1)
nn2 = DeepNeuralNet_BGD([2, 60, 30, 10, 2],
                eta=0.2, epochs=2000)
nn2.fit(X.T, Y.flatten())
accuracy = nn2.evaluate(X.T, Y.flatten())
print("Accuracy {}%".format(accuracy))
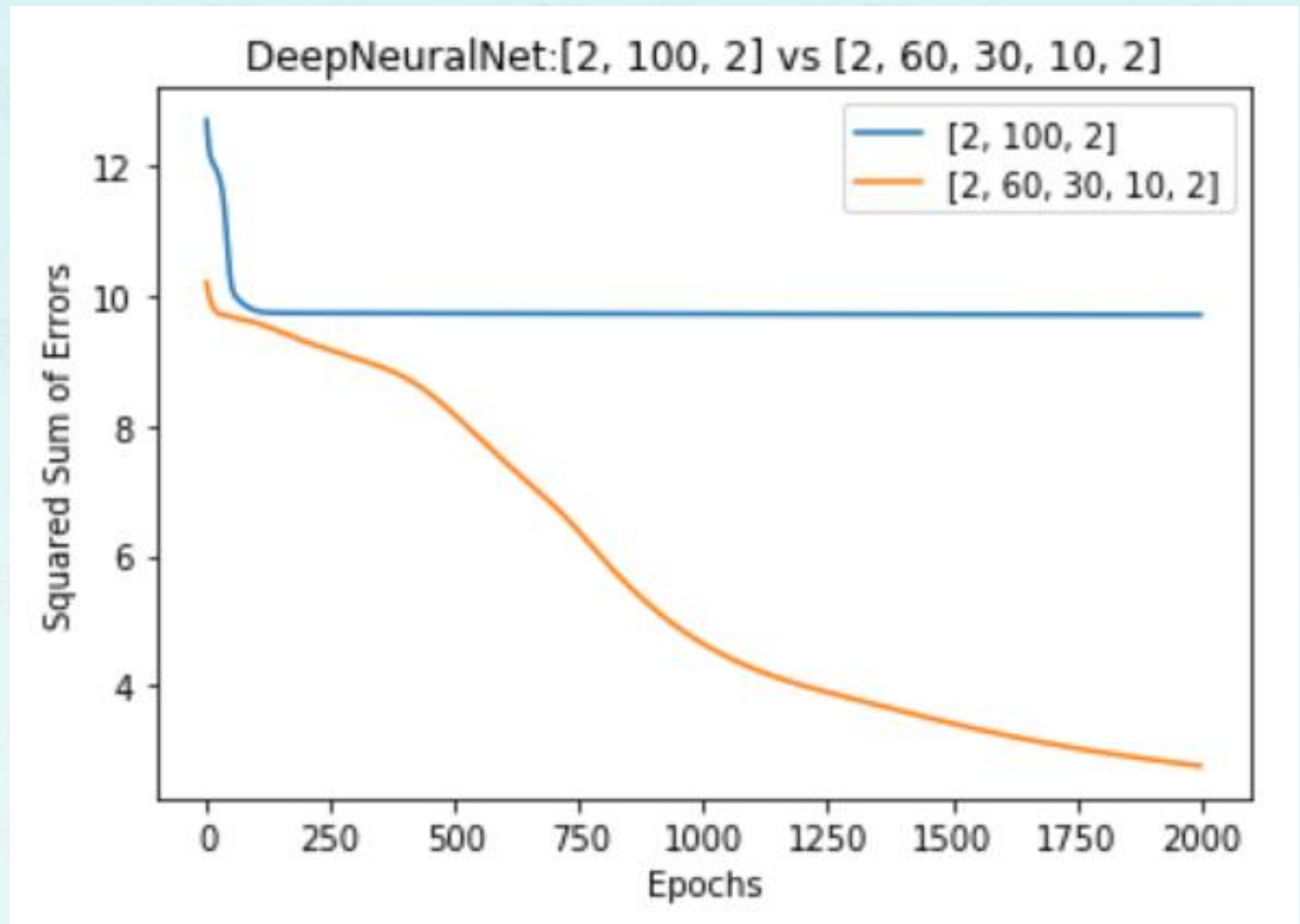```

# 2. DNN의 성능: 가우시안 퀀타일스

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed=1)
nn1 = DeepNeuralNet_BGD([2, 100, 2],
                        eta=0.2, epochs=2000)
nn1.fit(X.T, Y.flatten())
accuracy = nn1.evaluate(X.T, Y.flatten())
print('Accuracy {}%'.format(accuracy))
```

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed = 1)
nn2 = DeepNeuralNet_BGD([2, 60, 30, 10, 2],
                         eta=0.2, epochs=2000)
nn2.fit(X.T, Y.flatten())
accuracy = nn2.evaluate(X.T, Y.flatten())
print("Accuracy {}%".format(accuracy))
```

2. DNN의 성능: 가우시안 퀀타일스

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import joy
X, Y = joy.gaussian_quantiles(random_seed=1)
nn1 = DeepNeuralNet_BGD([2, 100, 2],
                eta=0.2, epochs=2000)
nn1.fit(X.T, Y.flatten())
accuracy = nn1.evaluate(X.T, Y.flatten())
print('Accuracy {}%'.format(accuracy))

Accuracy 55.50000000000001%
```

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed = 1)
nn2 = DeepNeuralNet_BGD([2, 60, 30, 10, 2],
                eta=0.2, epochs=2000)
nn2.fit(X.T, Y.flatten())
accuracy = nn2.evaluate(X.T, Y.flatten())
print("Accuracy {}%".format(accuracy))

Accuracy 99.5%
```
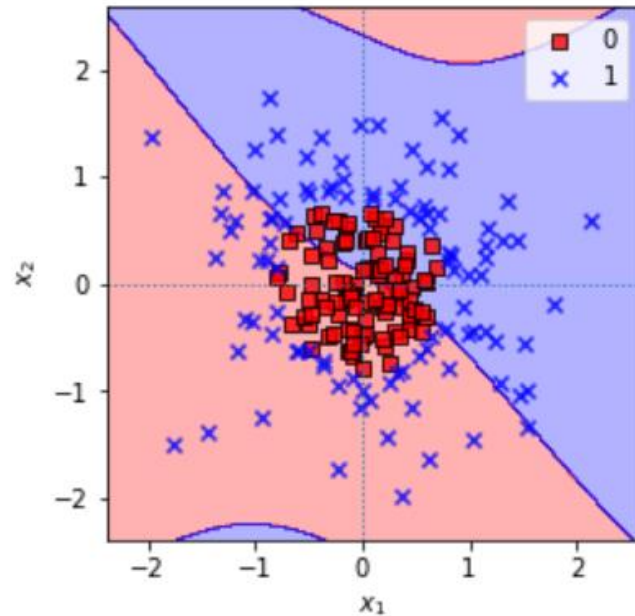
2. DNN의 성능: 가우시안 퀀타일스

2. DNN의 성능: 가우시안 퀀타일스

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed=1)
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                  eta=0.2, epochs=2000)
nn1.fit(X.T, Y.flatten())
accuracy = nn1.evaluate(X.T, Y.flatten())
print('Accuracy {}%'.format(accuracy))
```
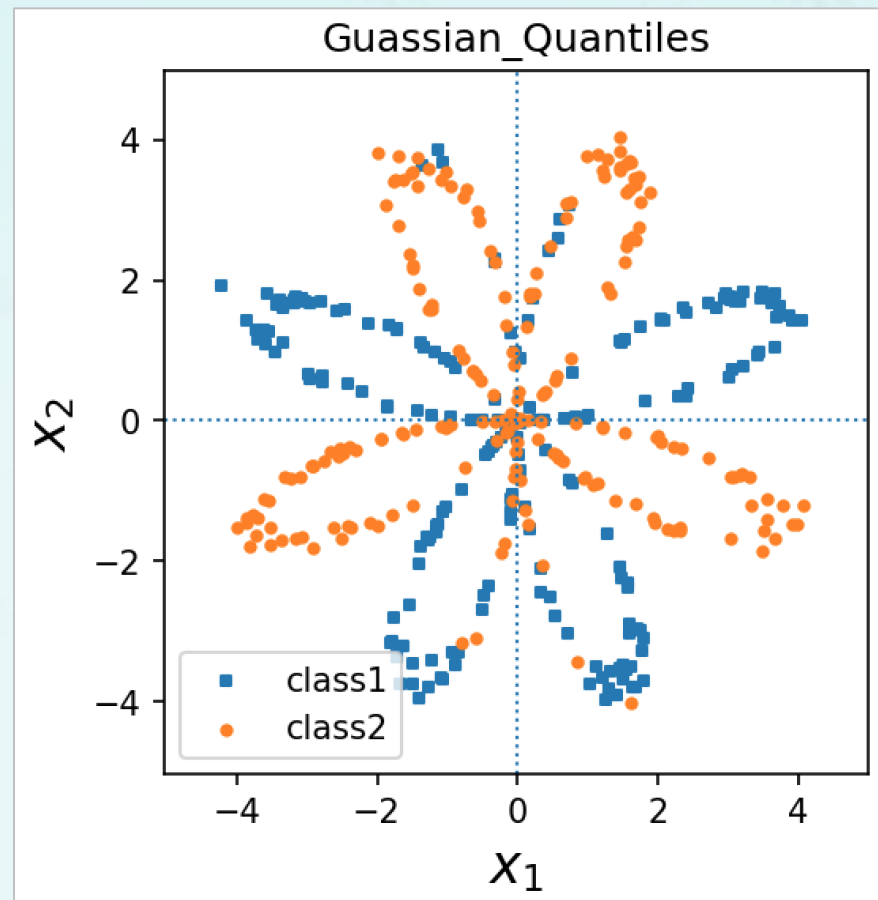
Accuracy 55.50000000000001%

```python
import joy
X, Y = joy.gaussian_quantiles(random_seed = 1)
nn2 = DeepNeuralNet_BGD([2, 60, 30, 10, 2],
                  eta=0.2, epochs=2000)
nn2.fit(X.T, Y.flatten())
accuracy = nn2.evaluate(X.T, Y.flatten())
print("Accuracy {}%".format(accuracy))
```
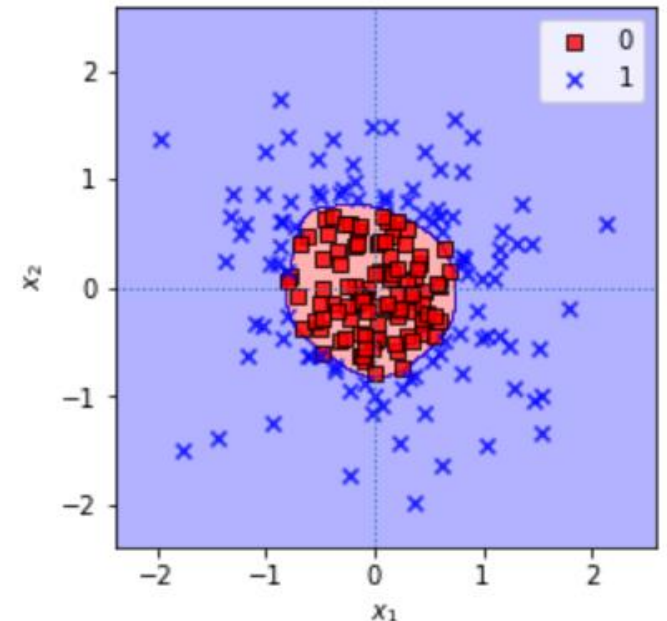
Accuracy 99.5%

2. DNN의 성능: 플라나 데이터

```
1  import joy
2  X, y = joy.planar_data()
3  joy.plot_xyw(X.T, y.squeeze())
```

2. DNN의 성능: 플라나 데이터

```python
1  import joy
2  X, y = joy.planar_data()
3  nn1 = DeepNeuralNet_BGD([2, 150, 2],
4                          eta=0.3, epochs=500)
5  nn1.fit(X.T, y.flatten())
6  accuracy = nn1.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```

```python
1  import joy
2  X, y = joy.planar_data()
3  nn2 = DeepNeuralNet_BGD([2, 100, 30, 20, 2],
4                          eta=0.3, epochs=500)
5  nn2.fit(X.T, y.flatten())
6  accuracy = nn2.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```

2. DNN의 성능: 플라나 데이터

```
1  import joy
2  X, y = joy.planar_data()
3  nn1 = DeepNeuralNet_BGD([2, 150, 2],
4                          eta=0.3, epochs=500)
5  nn1.fit(X.T, y.flatten())
6  accuracy = nn1.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```

Accuracy 85.5%
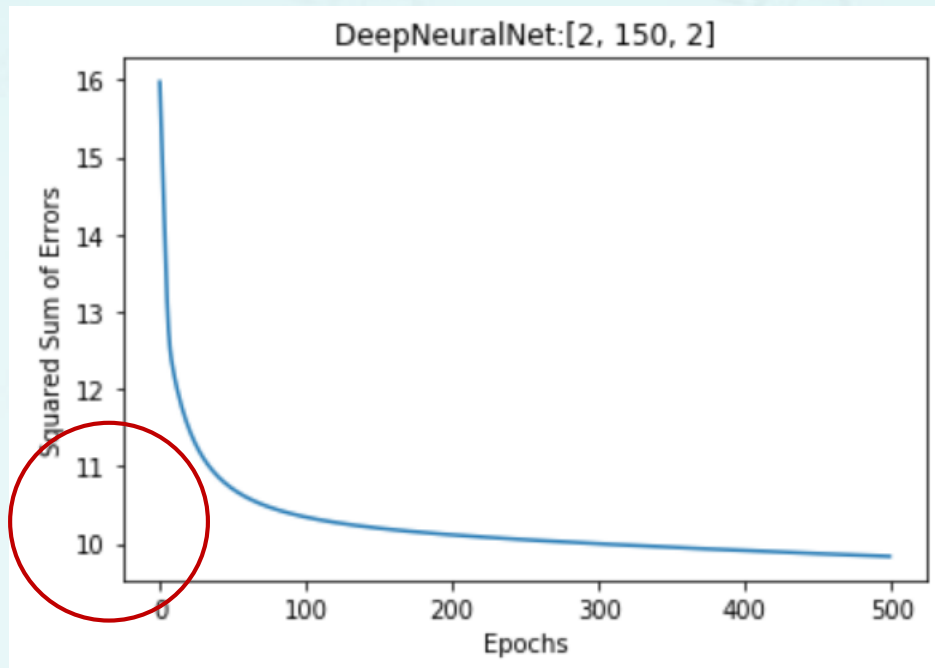
```
1  import joy
2  X, y = joy.planar_data()
3  nn2 = DeepNeuralNet_BGD([2, 100, 30, 20, 2],
4                          eta=0.3, epochs=500)
5  nn2.fit(X.T, y.flatten())
6  accuracy = nn2.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```

Accuracy 87.75%

2. DNN의 성능: 플라나 데이터
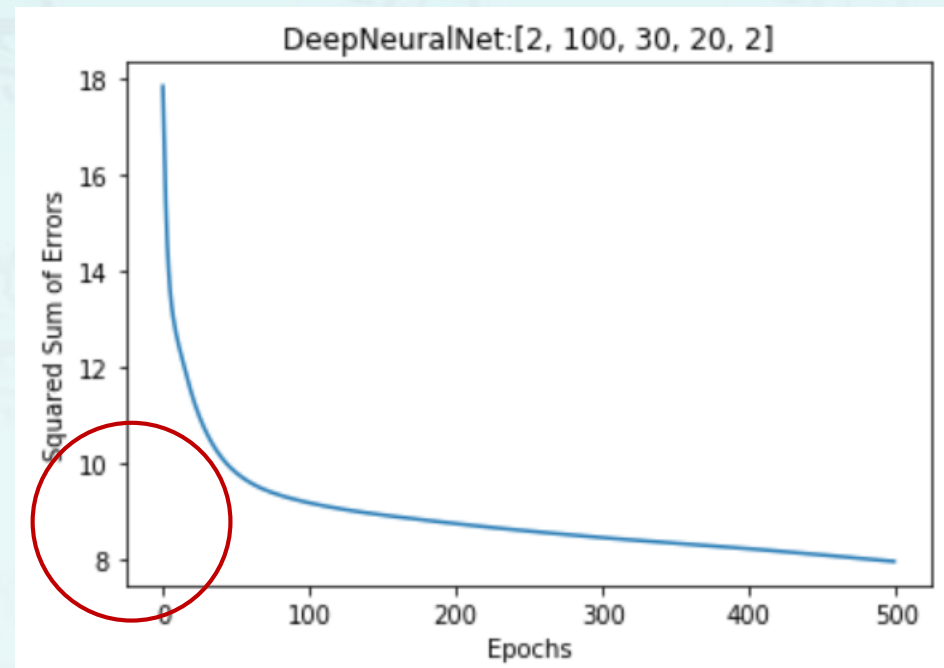
```
1  import joy
2  X, y = joy.planar_data()
3  nn1 = DeepNeuralNet_BGD([2, 150, 2],
4                          eta=0.3, epochs=500)
5  nn1.fit(X.T, y.flatten())
6  accuracy = nn1.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```

Accuracy 85.5%
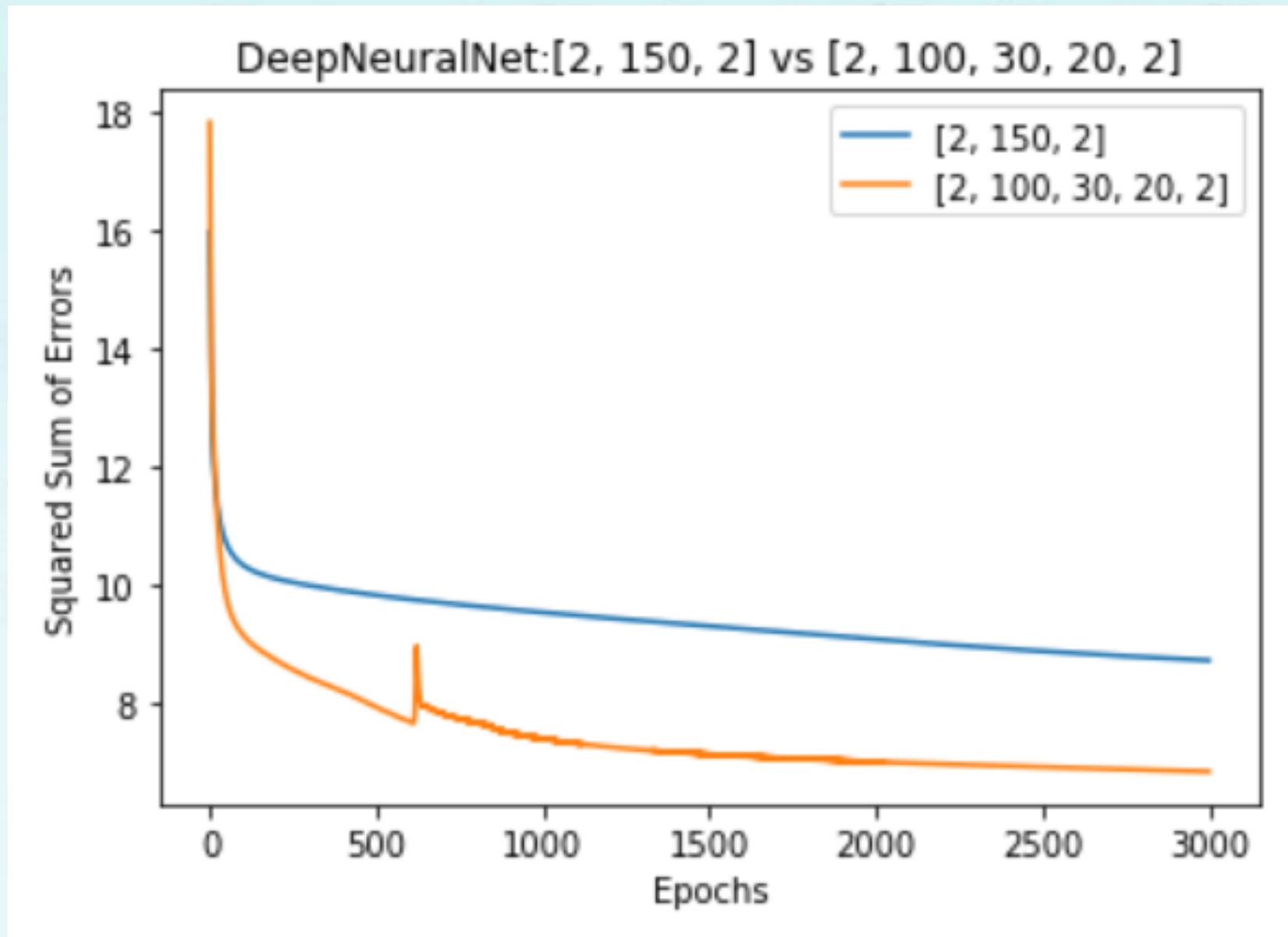
```
1  import joy
2  X, y = joy.planar_data()
3  nn2 = DeepNeuralNet_BGD([2, 100, 30, 20, 2],
4                          eta=0.3, epochs=500)
5  nn2.fit(X.T, y.flatten())
6  accuracy = nn2.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```
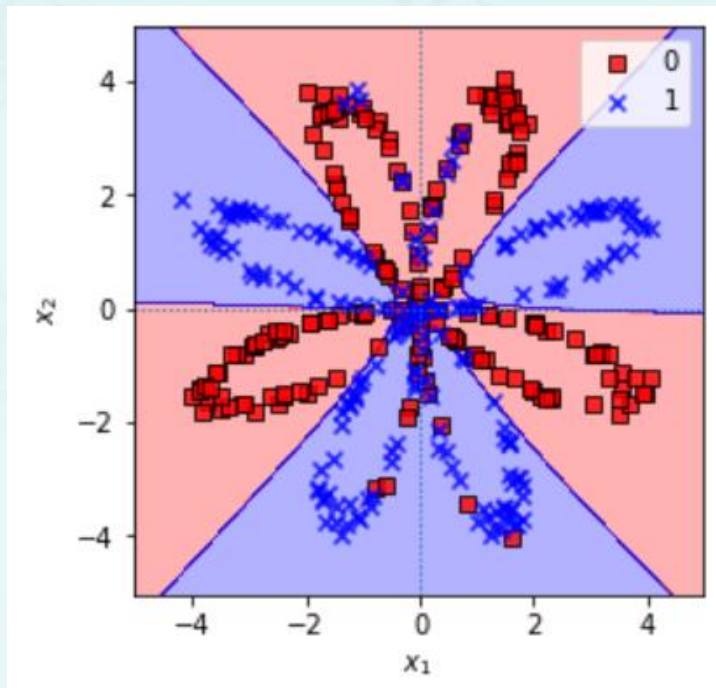
Accuracy 87.75%

DeepNeuralNet:[2, 150, 2]

DeepNeuralNet:[2, 100, 30, 20, 2]

2. DNN의 성능: 플라나 데이터

DeepNeuralNet:[2, 150, 2] vs [2, 100, 30, 20, 2]

# 2. DNN의 성능: 플라나 데이터

```
1  import joy
2  X, y = joy.planar_data()
3  nn1 = DeepNeuralNet_BGD([2, 150, 2],
4                          eta=0.3, epochs=3000)
5  nn1.fit(X.T, y.flatten())
6  accuracy = nn1.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```

Accuracy 85.75%
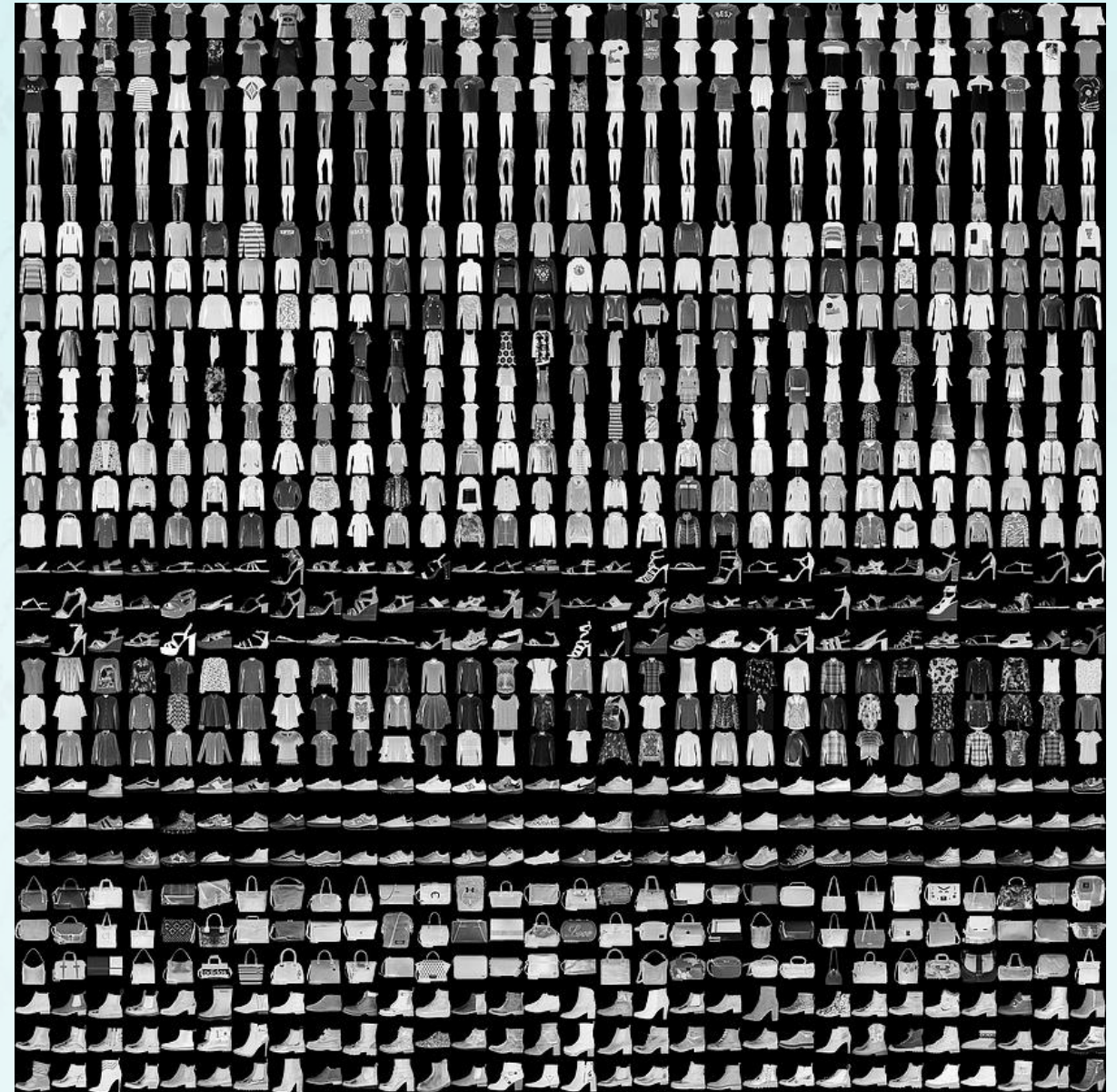
```
1  import joy
2  X, y = joy.planar_data()
3  nn2 = DeepNeuralNet_BGD([2, 100, 30, 20, 2],
4                          eta=0.3, epochs=3000)
5  nn2.fit(X.T, y.flatten())
6  accuracy = nn2.evaluate(X.T, y.flatten())
7  print("Accuracy {}%".format(accuracy))
```
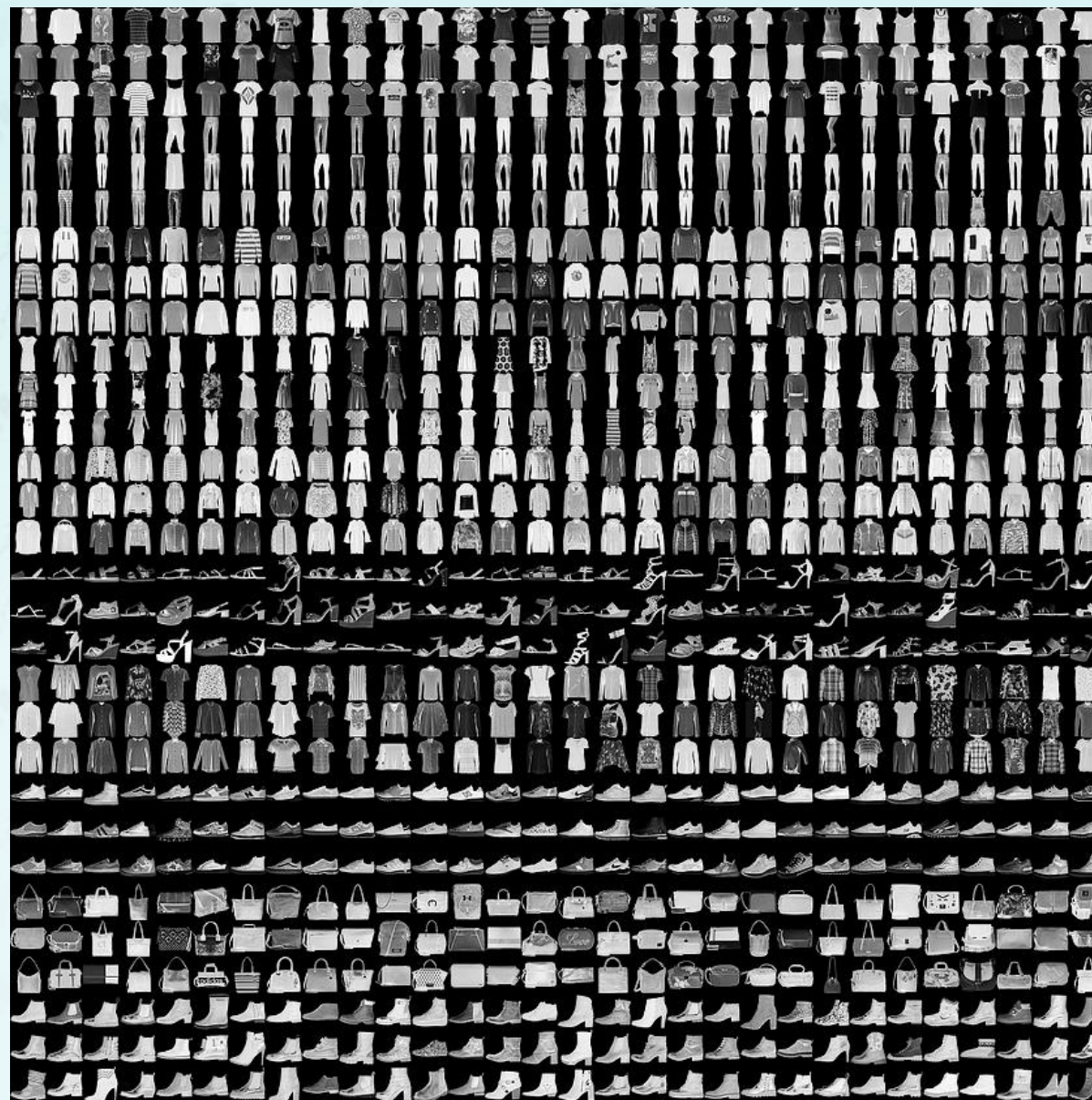
Accuracy 91.0%
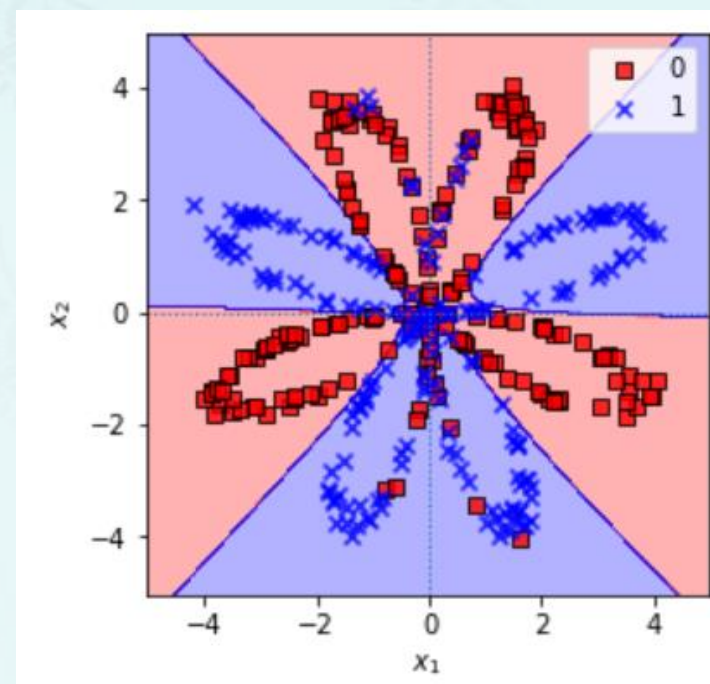
3. MNIST-Fashion DataSet: 개요

- 잘란도**(Zalando)**의 패션 작품의 데이터 셋
  - **60,000**개의 학습 자료
  - **10,000**개의 테스트 데이터
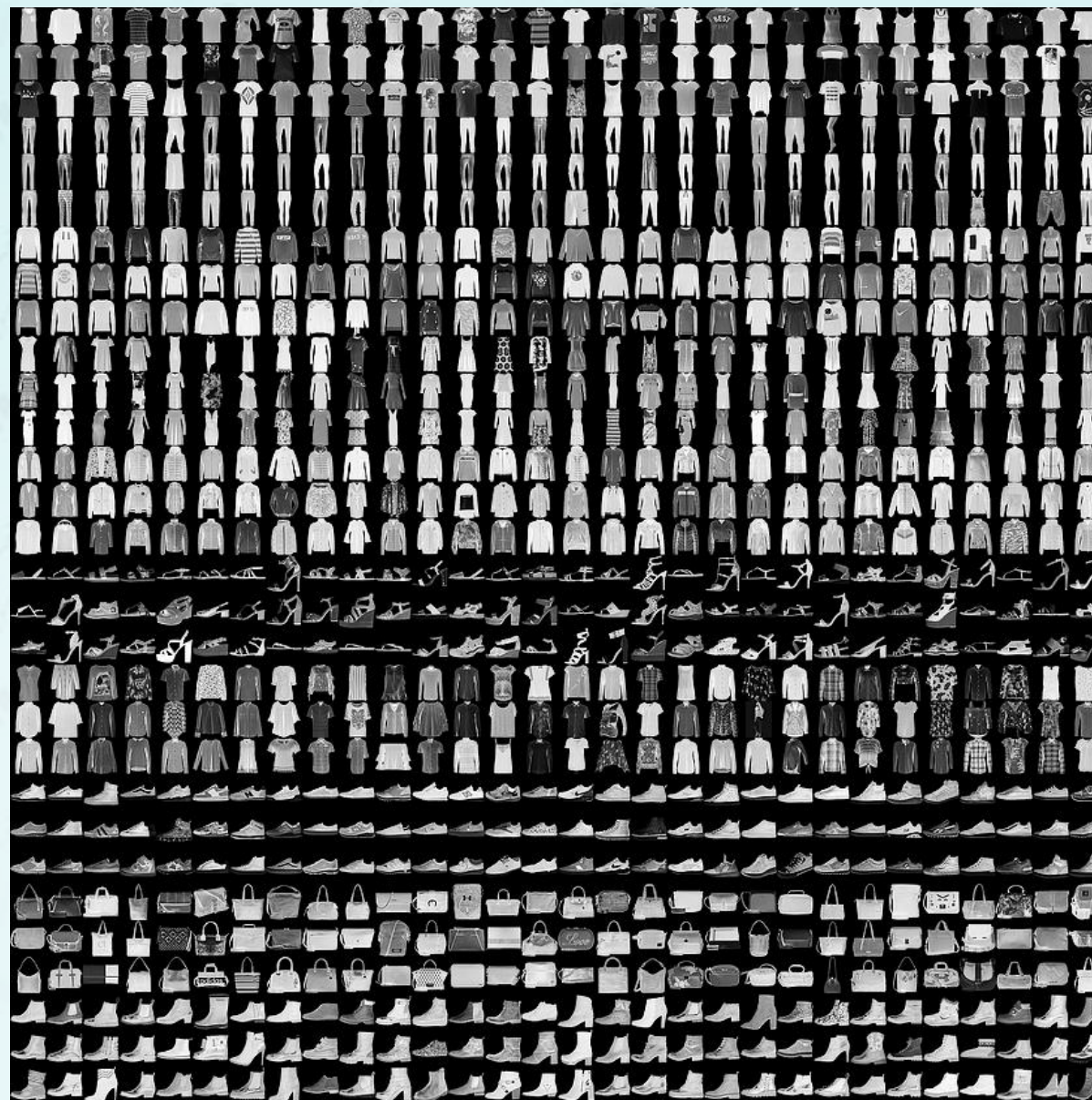 - **28x28** 크기의 **grayscale image**

3. MNIST-Fashion DataSet: 기존 MNIST의 문제점
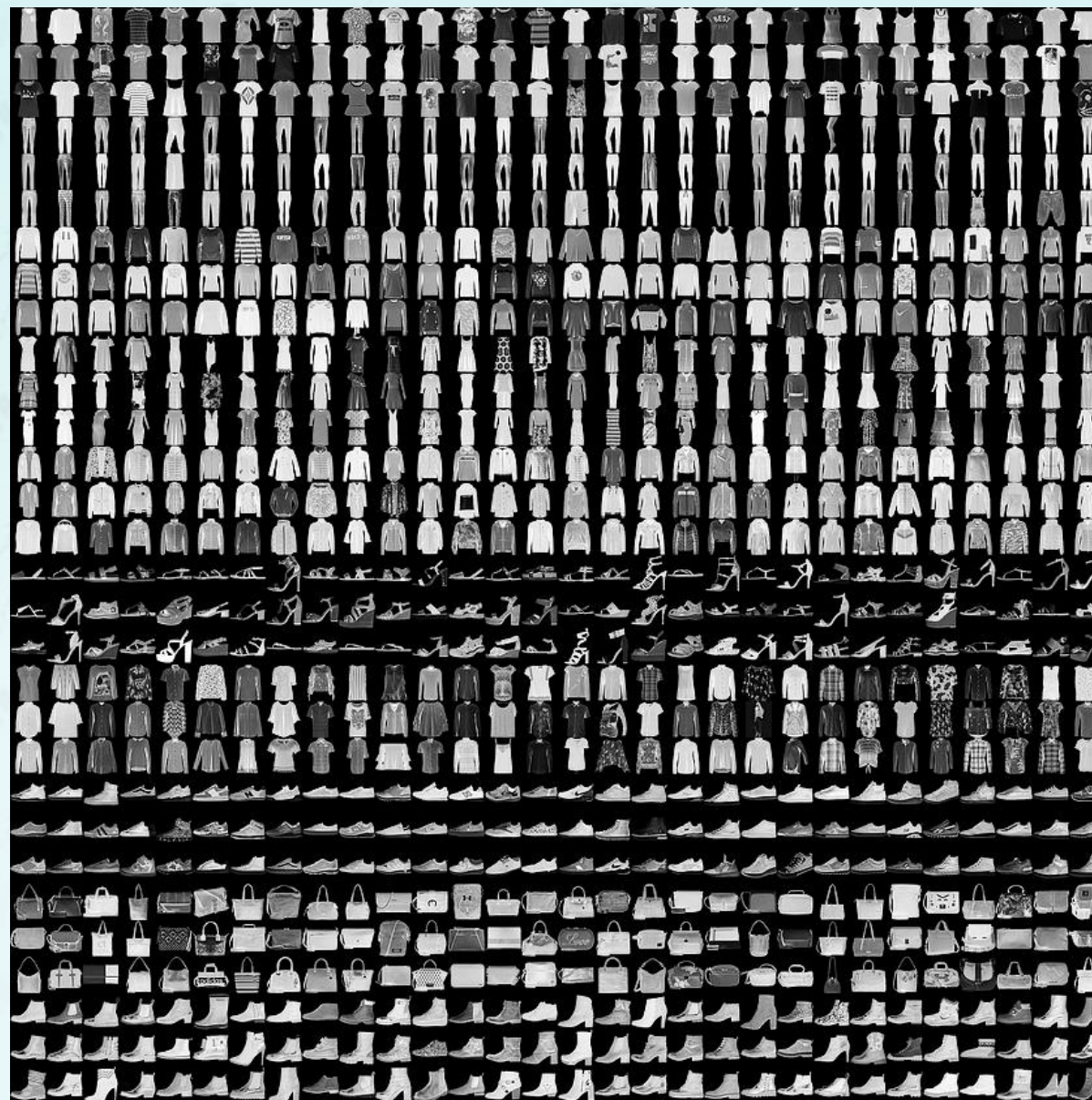
1. 학습하기 매우 쉬움

3. MNIST-Fashion DataSet: 기존 MNIST의 문제점

1. 학습하기 매우 쉬움
2. 너무 많이 사용되고 인용됨

3. MNIST-Fashion DataSet: 기존 MNIST의 문제점

1. 학습하기 매우 쉬움
2. 너무 많이 사용되고 인용됨
3. 최근 영상처리 관련 자료를 대표
   할 수 없음

3. MNIST-Fashion DataSet: 데이터와 클래스 레이블

```python
1  import joy
2  import matplotlib.pyplot as plt
3  (X, y), (Xt, yt) = joy.load_fashion_mnist(
4                      normalize=False, flatten=False)
5  joy.show_mnist(X[0], savefig='Fashion-MNIST1')
6  joy.show_mnist(X[3], savefig='Fashion-MNIST2')
7  joy.show_mnist(X[5], savefig='Fashion-MNIST3')
```
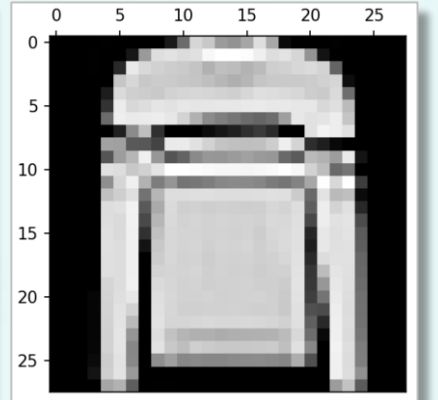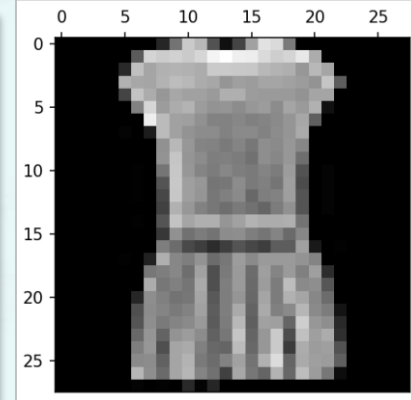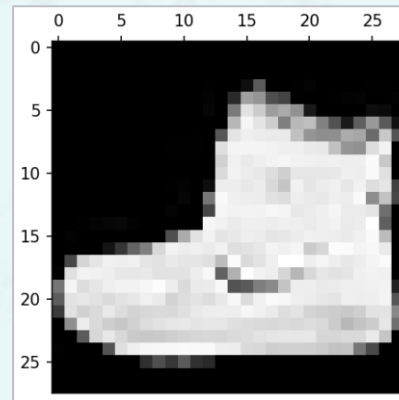
3. MNIST-Fashion DataSet: 데이터와 클래스 레이블

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import joy
import matplotlib.pyplot as plt
(X, y), (Xt, yt) = joy.load_fashion_mnist(
                    normalize=False, flatten=False)
joy.show_mnist(X[0], savefig='Fashion-MNIST1')
joy.show_mnist(X[3], savefig='Fashion-MNIST2')
joy.show_mnist(X[5], savefig='Fashion-MNIST3')
```
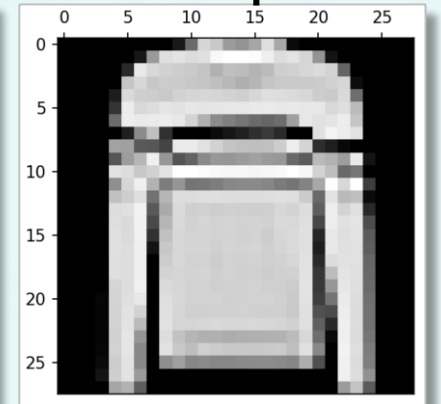
3. MNIST-Fashion DataSet: 데이터와 클래스 레이블

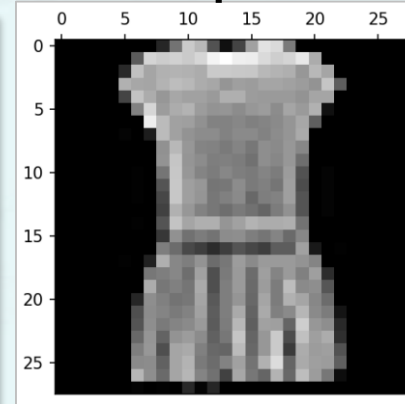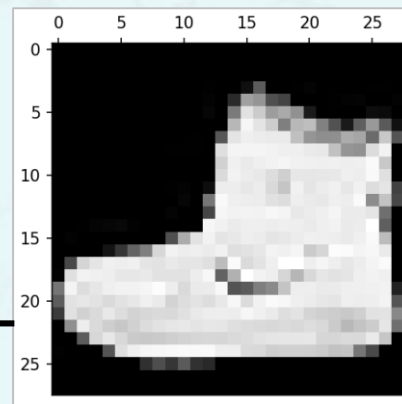| Label	Description
0	T-shirt/top
1	Trouser
2	Pullover
3	Dress
4	Coat
5	Sandal
6	Shirt
7	Sneaker
8	Bag
9	Ankle boot

```python
import joy
import matplotlib.pyplot as plt
(X, y), (Xt, yt) = joy.load_fashion_mnist(
                    normalize=False, flatten=False)
joy.show_mnist(X[0], savefig='Fashion-MNIST1')
joy.show_mnist(X[3], savefig='Fashion-MNIST2')
joy.show_mnist(X[5], savefig='Fashion-MNIST3')
```

3. MNIST-Fashion DataSet: 학습 정확성 평가

```
1  (X, y), (Xtest, ytest) = joy.load_fashion_mnist()
2  nn = DeepNeuralNet_BGD([784, 100, 10],
3                          eta = 0.1, epochs = 1000)
4  nn.fit(X[:6000], y[:6000])
5  accuracy = nn.evaluate(Xtest[:1000], ytest[:1000])
6  print('Accuracy {}%'.format(accuracy))
```

```
1  (X, y), (Xtest, ytest) = joy.load_fashion_mnist()
2  nn2 = DeepNeuralNet_BGD([784, 200, 100, 50, 10],
3                          eta = 0.1, epochs = 1000)
4  nn2.fit(X[:6000], y[:6000])
5  accuracy = nn2.evaluate(Xtest[:1000], ytest[:1000])
6  print('Accuracy {}%'.format(accuracy))
```

3. MNIST-Fashion DataSet: 학습 정확성 평가

```
1  (X, y), (Xtest, ytest) = joy.load_fashion_mnist()
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3. MNIST-Fashion DataSet: 학습 정확성 평가

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4  nn.fit(X[:6000], y[:6000])
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6  print('Accuracy {}%'.format(accuracy))
```

Accuracy 75.6%

```
1  (X, y), (Xtest, ytest) = joy.load_fashion_mnist()
2  nn2 = DeepNeuralNet_BGD([784, 200, 100, 50, 10],
3                          eta = 0.1, epochs = 1000)
4  nn2.fit(X[:6000], y[:6000])
5  accuracy = nn2.evaluate(Xtest[:1000], ytest[:1000])
6  print('Accuracy {}%'.format(accuracy))
```

Accuracy 83.2%

3. MNIST-Fashion DataSet: 학습 정확성 평가

```
1  (X, y), (Xtest, ytest) = joy.load_fashion_mnist()
2  nn = DeepNeuralNet_BGD([784, 100, 10],
3                          eta = 0.1, epochs = 1000)
4  nn.fit(X[:6000], y[:6000])
5  accuracy = nn.evaluate(Xtest[:1000], ytest[:1000])
6  print('Accuracy {}%'.format(accuracy))
```
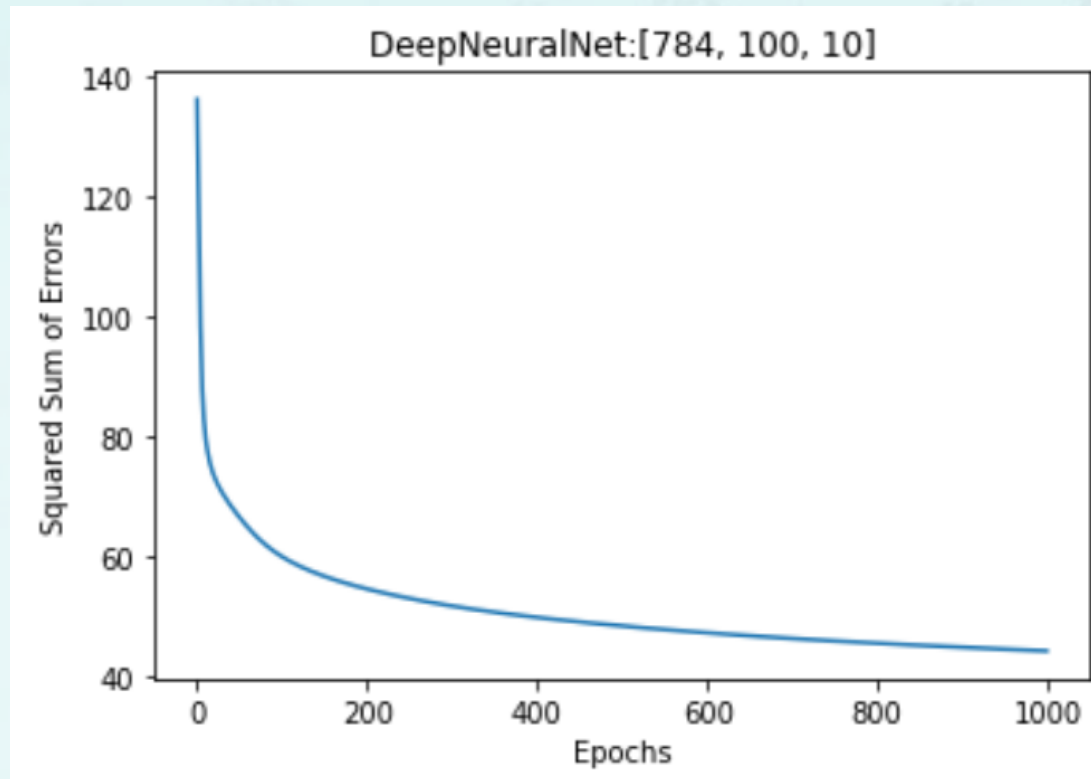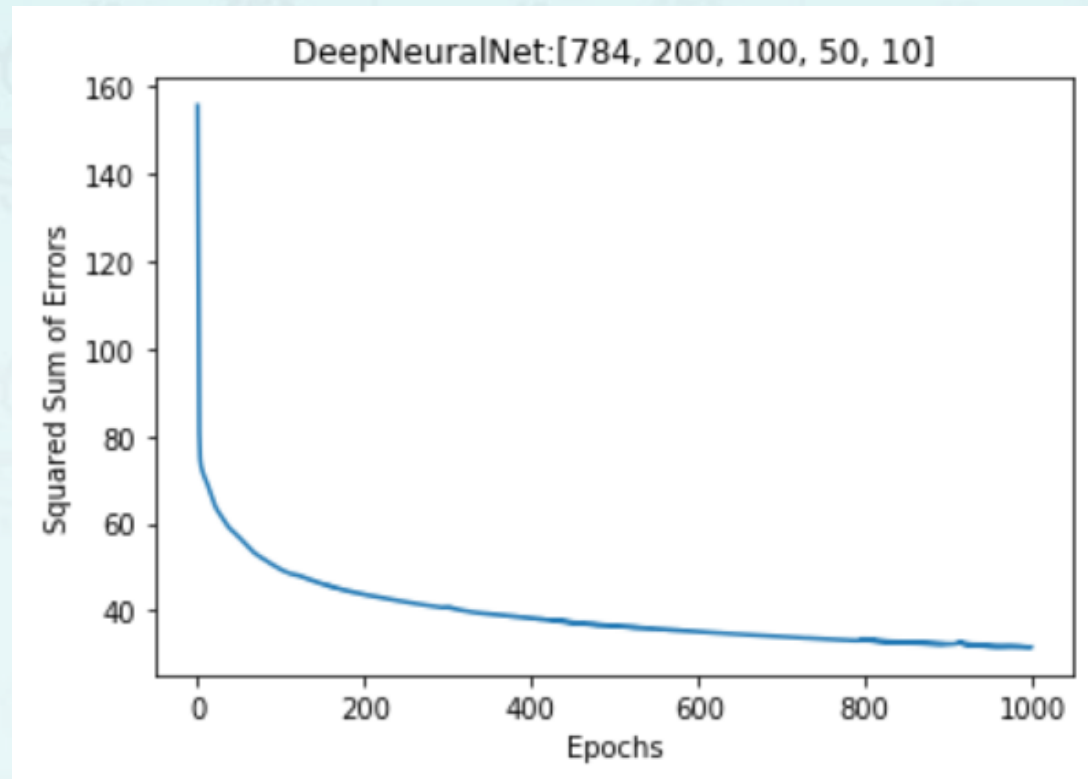
Accuracy 75.6%

```
1  (X, y), (Xtest, ytest) = joy.load_fashion_mnist()
2  nn2 = DeepNeuralNet_BGD([784, 200, 100, 50, 10],
3                           eta = 0.1, epochs = 1000)
4  nn2.fit(X[:6000], y[:6000])
5  accuracy = nn2.evaluate(Xtest[:1000], ytest[:1000])
6  print('Accuracy {}%'.format(accuracy))
```

Accuracy 83.2%

3. MNIST-Fashion DataSet: 학습 정확성 평가

DeepNeuralNet:[784, 100, 10] vs [784, 200, 100, 50, 10]

[784, 100, 10]
[784, 200, 100, 50, 10]

4. 고양이 DataSet: 컴퓨터 vs 사람

- 컴퓨터 vs 사람

$$3.14159\ 26535$$
$$\times\ 2.71828\ 18284$$
$$\times\ 1.41421\ 35623$$
$$\times\ 1.61803\ 39887$$
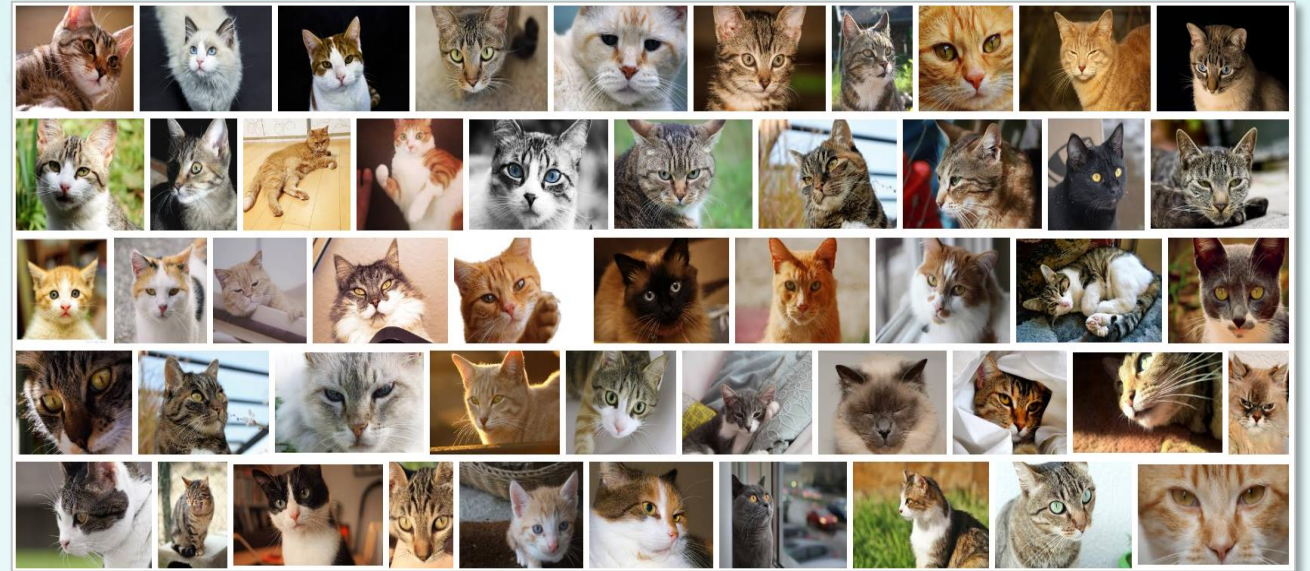
4. 고양이 DataSet: 컴퓨터 vs 사람

```python
1  import joy
2  X, y, Xtest, ytest, classes = joy.load_cat_data()
3  plt.imshow(X[0])
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```
1  import joy
2  X, y, Xtest, ytest, classes = joy.load_cat_data()
3  plt.imshow(X[0])
```

X[0]
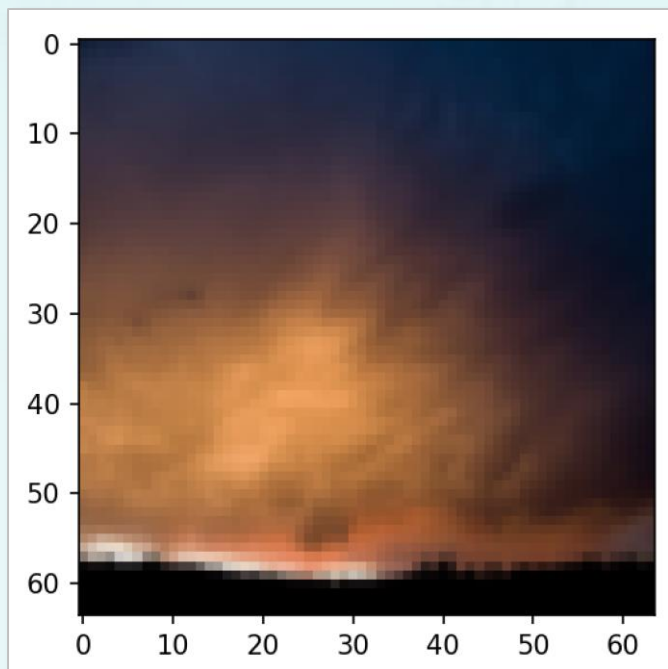
X[1]
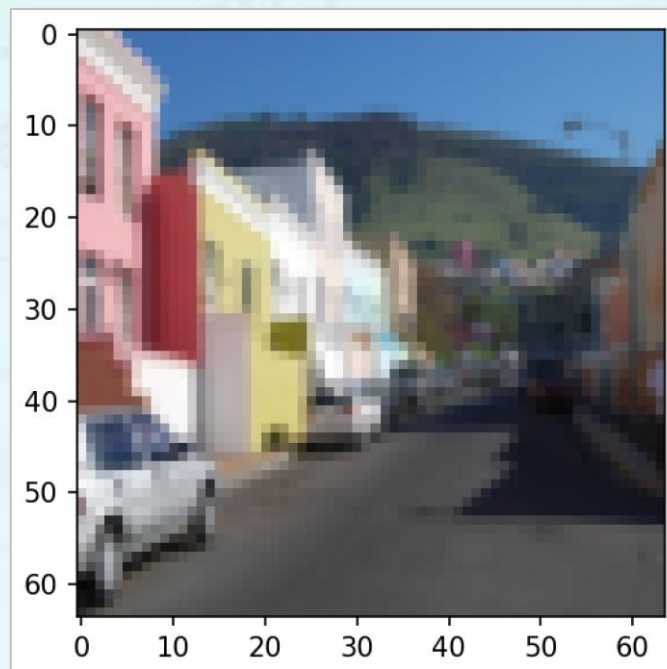
X[2]

4. 고양이 DataSet: 컴퓨터 vs 사람

```python
1  print("Number of train examples:", X.shape[0])
2  print("Number of test  examples:", Xtest.shape[0])
3  print("One image size:({}, {}, {})".
4        format(X.shape[1], X.shape[1], 3))
5  print("train X shape:", X.shape)
6  print("train y shape:", y.shape)
7  print("test  X shape:", Xtest.shape)
8  print("test  y shape:", ytest.shape)
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```python
1  print("Number of train examples:", X.shape[0])
2  print("Number of test  examples:", Xtest.shape[0])
3  print("One image size:({}, {}, {})".
4        format(X.shape[1], X.shape[1], 3))
5  print("train X shape:", X.shape)
6  print("train y shape:", y.shape)
7  print("test  X shape:", Xtest.shape)
8  print("test  y shape:", ytest.shape)
```

```
Number of train examples: 209
Number of test  examples: 50
One image size:(64, 64, 3)
train X shape: (209, 64, 64, 3)
train y shape: (1, 209)
test  X shape: (50, 64, 64, 3)
test  y shape: (1, 50)
```
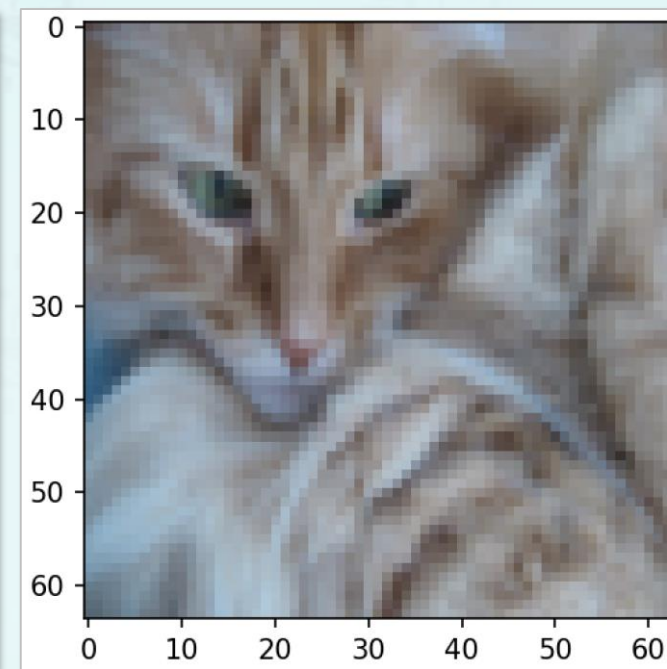
4. 고양이 DataSet: 컴퓨터 vs 사람

```
1  print("Number of train examples:", X.shape[0])
2  print("Number of test  examples:", Xtest.shape[0])
3  print("One image size:({}, {}, {})".
4        format(X.shape[1], X.shape[1], 3))
5  print("train X shape:", X.shape)
6  print("train y shape:", y.shape)
7  print("test  X shape:", Xtest.shape)
8  print("test  y shape:", ytest.shape)
```

```
Number of train examples: 209
Number of test  examples: 50
One image size:(64, 64, 3)
train X shape: (209, 64, 64, 3)
train y shape: (1, 209)
test  X shape: (50, 64, 64, 3)
test  y shape: (1, 50)
```

```
1  X_flatten = X.reshape(X.shape[0], -1)
2  Xtest_flatten = Xtest.reshape(Xtest.shape[0], -1)
3  X = X_flatten/255.
4  Xtest = Xtest_flatten/255.
5  print ("train X shape:", X.shape)
6  print ("test  X shape:", Xtest.shape)
```

```
train X shape: (209, 12288)
test  X shape: (50, 12288)
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```python
1  print("Number of train examples:", X.shape[0])
2  print("Number of test  examples:", Xtest.shape[0])
3  print("One image size:({}, {}, {})".
4         format(X.shape[1], X.shape[1], 3))
5  print("train X shape:", X.shape)
6  print("train y shape:", y.shape)
7  print("test  X shape:", Xtest.shape)
8  print("test  y shape:", ytest.shape)
```

```
Number of train examples: 209
Number of test  examples: 50
One image size:(64, 64, 3)
train X shape: (209, 64, 64, 3)
train y shape: (1, 209)
test  X shape: (50, 64, 64, 3)
test  y shape: (1, 50)
```

```python
1  X_flatten = X.reshape(X.shape[0], -1)
2  Xtest_flatten = Xtest.reshape(Xtest.shape[0], -1)
3  X = X_flatten/255.
4  Xtest = Xtest_flatten/255.
5  print ("train X shape:", X.shape)
6  print ("test  X shape:", Xtest.shape)
```

```
train X shape: (209, 12288)
test  X shape: (50, 12288)
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```python
import joy
dnn = DeepNeuralNet_BGD([12288, 100, 50, 2],
                        eta = 0.3, epochs = 164)
dnn.fit(X, y.flatten())
self = dnn.evaluate(X, y.flatten())
print('Accuracy self: {}%'.
      format(np.round(self, 2)))
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```python
1  import joy
2  dnn = DeepNeuralNet_BGD([12288, 100, 50, 2],
3                            eta = 0.3, epochs = 164)
4  dnn.fit(X, y.flatten())
5  self = dnn.evaluate(X, y.flatten())
6  print('Accuracy self: {}%'.
7       format(np.round(self, 2)))
```

```
Accuracy self: 97.61%
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```python
1  import joy
2  dnn = DeepNeuralNet_BGD([12288, 100, 50, 2],
3                          eta = 0.3, epochs = 178)
4  dnn.fit(X, y.flatten())
5  test = dnn.evaluate(Xtest, ytest.flatten())
6  print('Accuracy self: {}%'.
7        format(np.round(test, 2)))
```

4. 고양이 DataSet: 컴퓨터 vs 사람

```
1  import joy
2  dnn = DeepNeuralNet_BGD([12288, 100, 50, 2],
3                           eta = 0.3, epochs = 178)
4  dnn.fit(X, y.flatten())
5  test = dnn.evaluate(Xtest, ytest.flatten())
6  print('Accuracy self: {}%'.
7        format(np.round(test, 2)))
```

```
Accuracy self: 80.0%
```

Deep Neural Network 2

- 학습 정리
  - 다층 신경망 **DeepNeuralNet** 성능 테스트
  - **MNIST-Fashion** 데이터 셋
  - 고양이와 고양이가 아닌 데이터 분류

- 차시 예고
  - **13-2** 기계학습 오픈소스 프레임워크

13주차(3/3)

Deep Neural Network 2

파이썬으로 배우는 기계학습

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