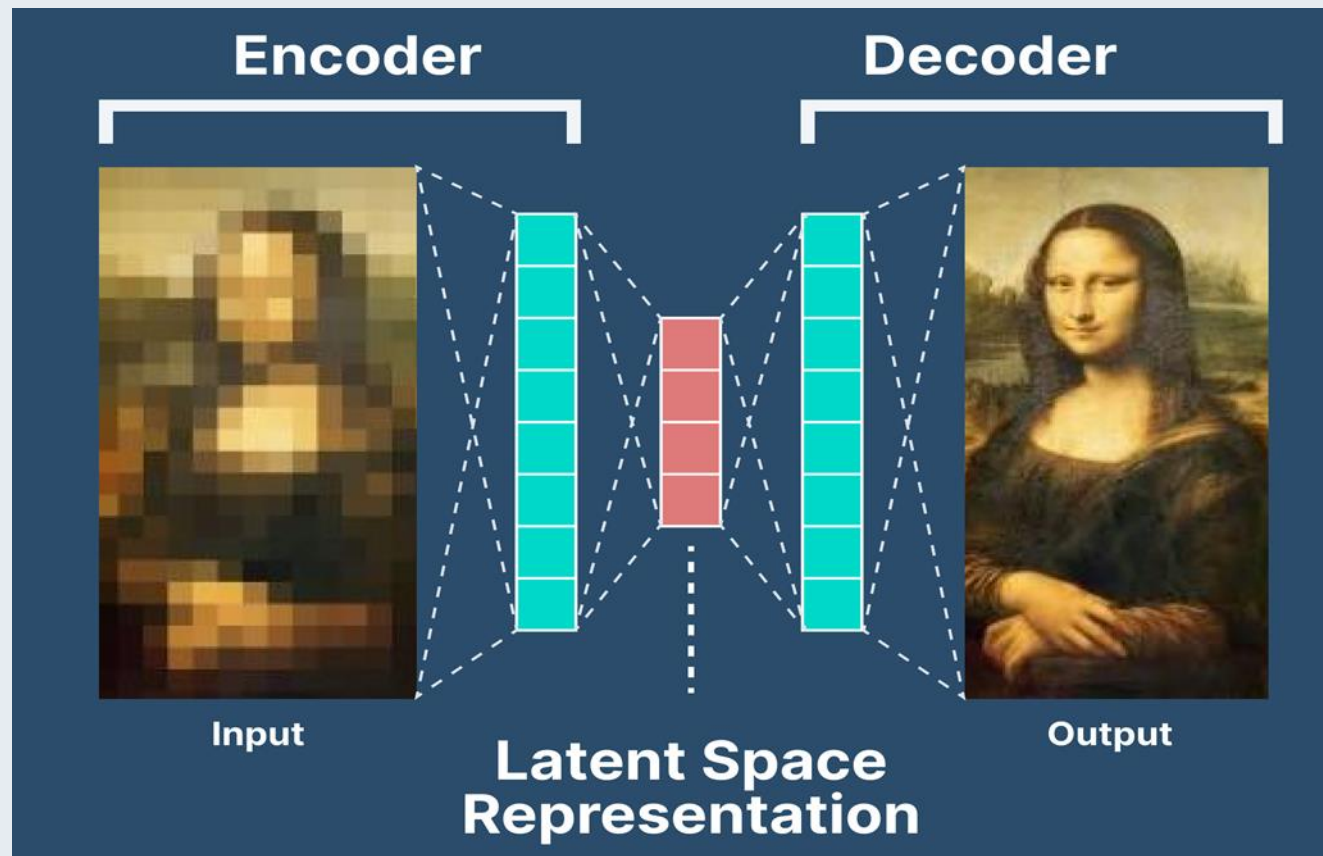


# 오토인코더 (Auto Encoder)

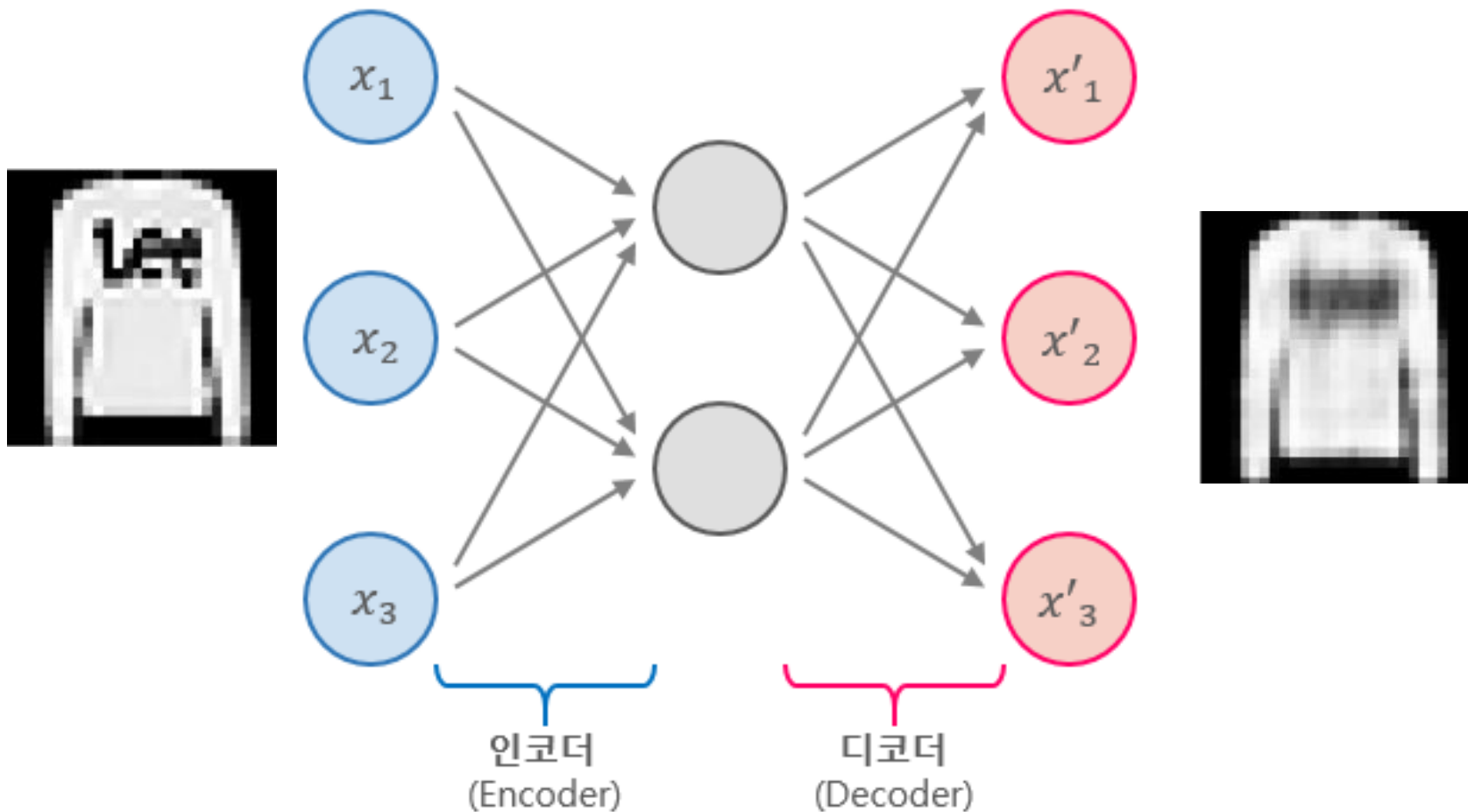


# 오토인코더 (Auto Encoder)

오토인코더는 원본 이미지 벡터의 차원을 축소하여 은닉 레이어에 주요 특징을 추출합니다.  
그리고, 은닉 레이어에 추출된 핵심 정보만을 학습하여 원본 이미지와 비슷하게 복원한 이미지를 출력합니다.

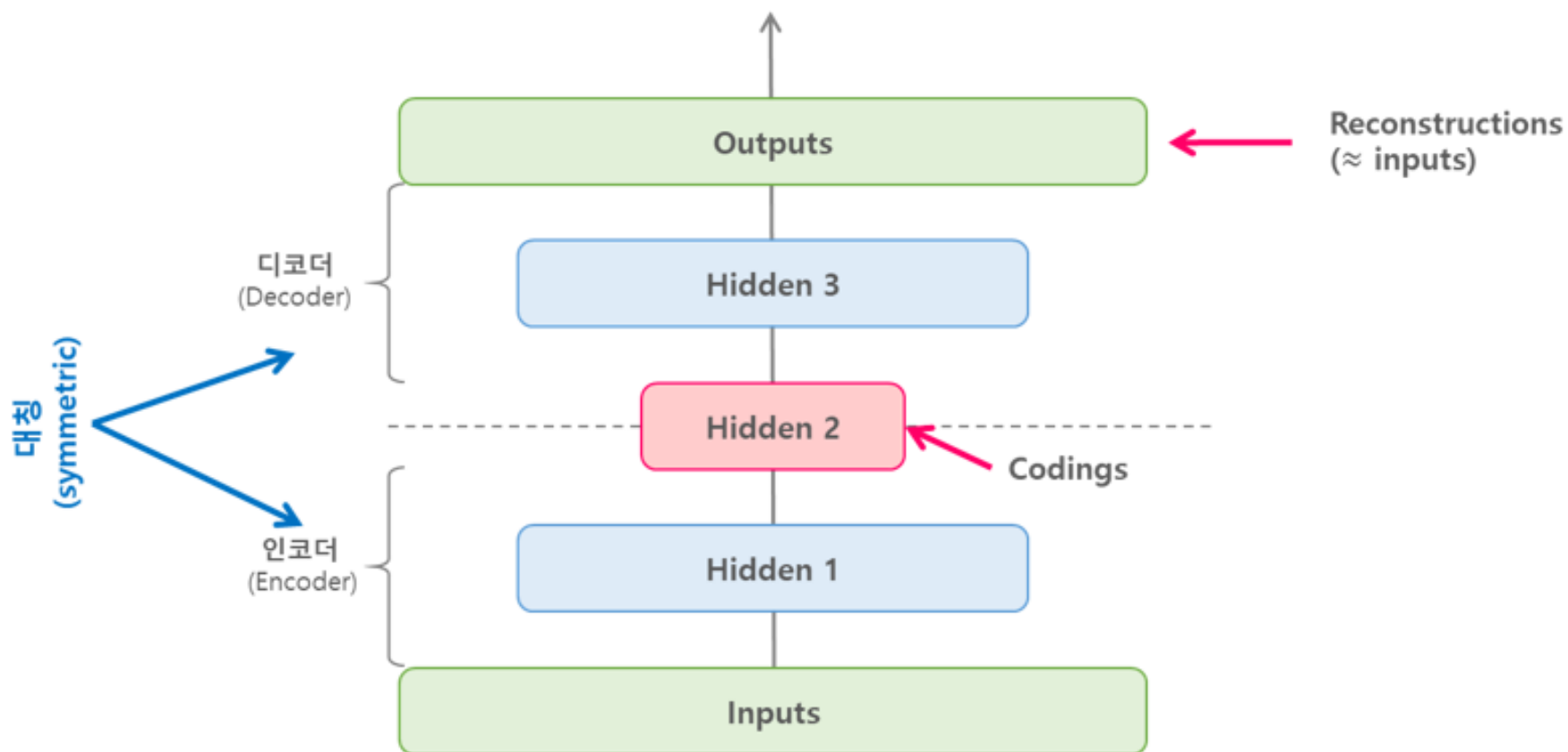
## ■ AutoEncoder

- Unsupervised Learning
- Representation Learning
- Dimensionality Reduction
- Generative Model Learning



# Stacked AutoEncoder

Stacked AutoEncoder는 여러개의 히든 레이어를 가지는 Auto Encoder이며, 레이어를 추가할수록 AutoEncoder가 더 복잡한 코딩을 학습할 수 있습니다.



# 기본 오토인코더

두 개의 Dense 레이어로 autoencoder를 정의합니다. 이미지를 64차원 잠재 벡터로 압축하는 encoder와 잠재 공간에서 원본 이미지를 재구성하는 decoder입니다.

```
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import tensorflow as tf

from sklearn.metrics import accuracy_score, precision_score, recall_score
from sklearn.model_selection import train_test_split
from tensorflow.keras import layers, losses
from tensorflow.keras.datasets import fashion_mnist
from tensorflow.keras.models import Model
```

```
(x_train, _), (x_test, _) = fashion_mnist.load_data()
```

```
x_train = x_train.astype('float32') / 255.
```

```
x_test = x_test.astype('float32') / 255.
```

```
print (x_train.shape)
```

```
print (x_test.shape)
```

# 기본 오토인코더

```
latent_dim = 64
```

```
class Autoencoder(Model):  
    def __init__(self, encoding_dim):  
        super(Autoencoder, self).__init__()  
        self.latent_dim = latent_dim  
        self.encoder = tf.keras.Sequential([  
            layers.Flatten(),  
            layers.Dense(latent_dim, activation='relu'),  
        ])  
        self.decoder = tf.keras.Sequential([  
            layers.Dense(784, activation='sigmoid'),  
            layers.Reshape((28, 28))  
        ])
```

```
    def call(self, x):  
        encoded = self.encoder(x)  
        decoded = self.decoder(encoded)  
        return decoded
```

```
autoencoder = Autoencoder(latent_dim)
```

# 기본 오토인코더

```
autoencoder.compile(optimizer='adam', loss=losses.MeanSquaredError())
```

`x_train` 을 입력과 대상으로 사용하여 모델을 훈련합니다.

`encoder` 는 데이터셋을 784차원에서 잠재 공간으로 압축하는 방법을 배우고,

`decoder` 는 원본 이미지를 재구성하는 방법을 배웁니다..

```
autoencoder.fit(x_train, x_train,  
                epochs=10,  
                shuffle=True,  
                validation_data=(x_test, x_test))
```

Epoch 1/10

1875/1875 [=====] - 7s 2ms/step - loss: 0.0236 - val\_loss: 0.0130

Epoch 2/10

1875/1875 [=====] - 4s 2ms/step - loss: 0.0114 - val\_loss: 0.0104

Epoch 3/10

# 기본 오토인코더

```
encoded_imgs = autoencoder.encoder(x_test).numpy()
decoded_imgs = autoencoder.decoder(encoded_imgs).numpy()
```

```
n = 10
plt.figure(figsize=(20, 4))
for i in range(n):
    # display original
    ax = plt.subplot(2, n, i + 1)
    plt.imshow(x_test[i])
    plt.title("original")
    plt.gray()
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)

    # display reconstruction
    ax = plt.subplot(2, n, i + 1 + n)
    plt.imshow(decoded_imgs[i])
    plt.title("reconstructed")
    plt.gray()
    ax.get_xaxis().set_visible(False)
    ax.get_yaxis().set_visible(False)
plt.show()
```

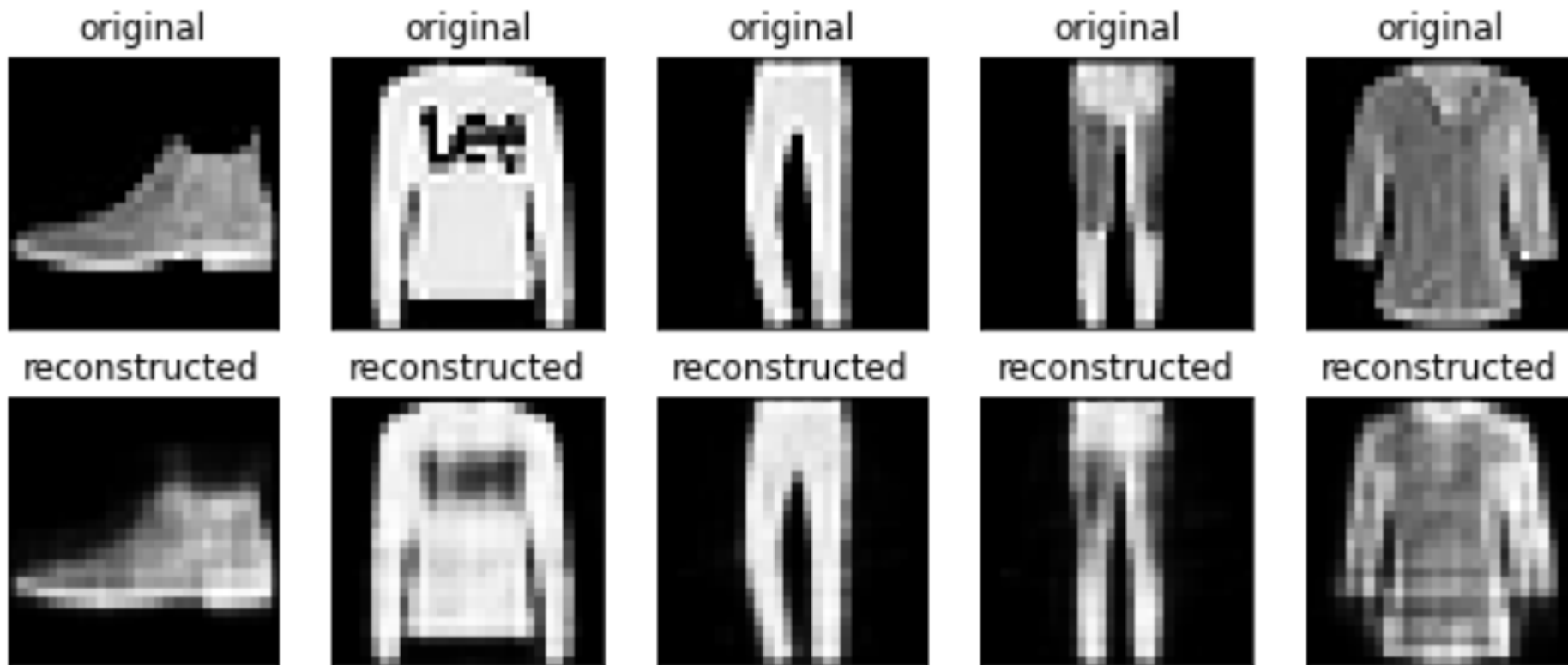
# 기본 오토인코더

```
images = model.predict(X_test)
```

```
num = 5
plt.figure(figsize=(20, 8))
for i in range(num):
    # 원본 이미지
    ax = plt.subplot(2, num, i + 1)
    plt.imshow(X_test[i].reshape((28, 28)), cmap='gray')
    plt.title("Original %s" % str(i))
    plt.axis('off')
    # 복원 이미지
    ax = plt.subplot(2, num, i + num + 1)
    plt.imshow(images[i], cmap='gray')
    plt.title("Auto-encoded %s" % str(i))
    plt.axis('off')
plt.show()
```



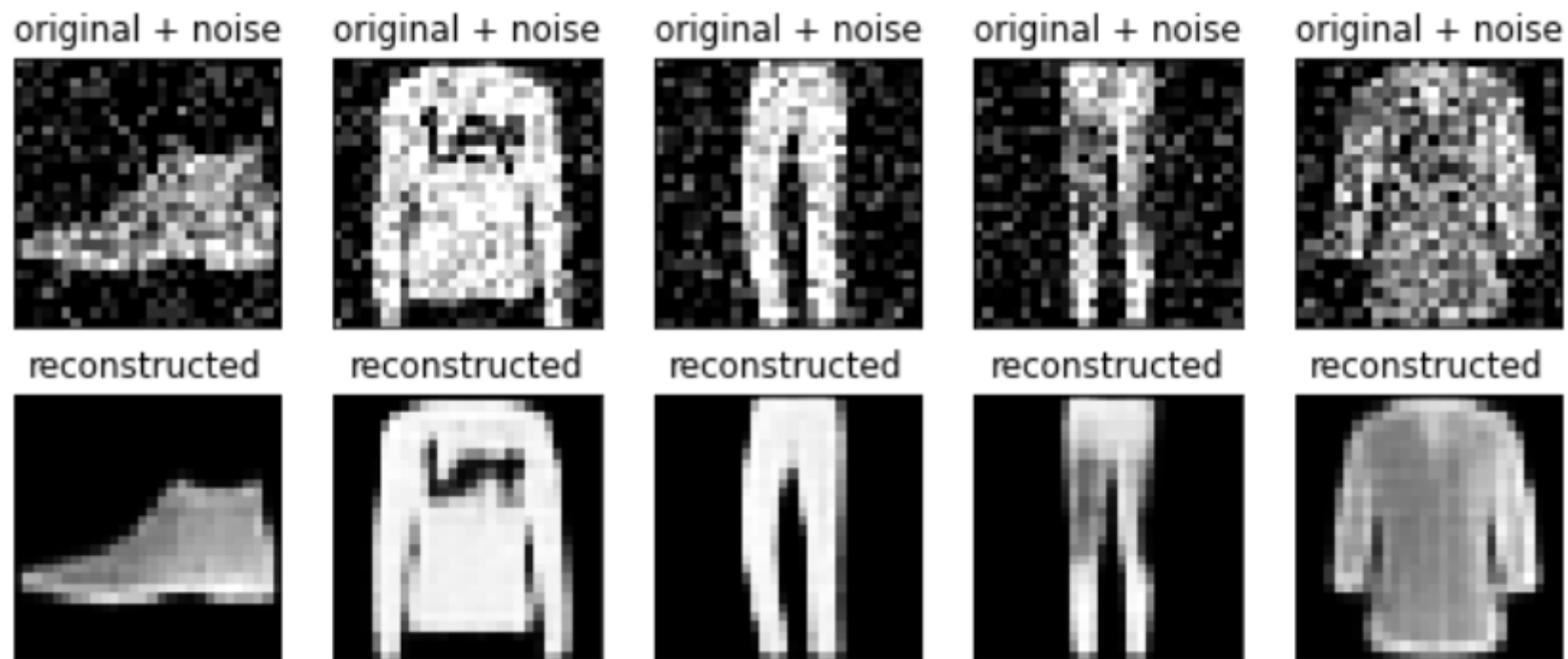
# 기본 오토인코더



# 이미지 노이즈 제거

```
class Denoise(Model):  
    def __init__(self):  
        super(Denoise, self).__init__()  
        self.encoder = tf.keras.Sequential([  
            layers.Input(shape=(28, 28, 1)),  
            layers.Conv2D(16, (3,3), activation='relu', padding='same', strides=2),  
            layers.Conv2D(8, (3,3), activation='relu', padding='same', strides=2)])  
  
        self.decoder = tf.keras.Sequential([  
            layers.Conv2DTranspose(8, kernel_size=3, strides=2, activation='relu', padding='same'),  
            layers.Conv2DTranspose(16, kernel_size=3, strides=2, activation='relu', padding='same'),  
            layers.Conv2D(1, kernel_size=(3,3), activation='sigmoid', padding='same')])  
  
    def call(self, x):  
        encoded = self.encoder(x)  
        decoded = self.decoder(encoded)  
        return decoded
```

# 이미지 노이즈 제거

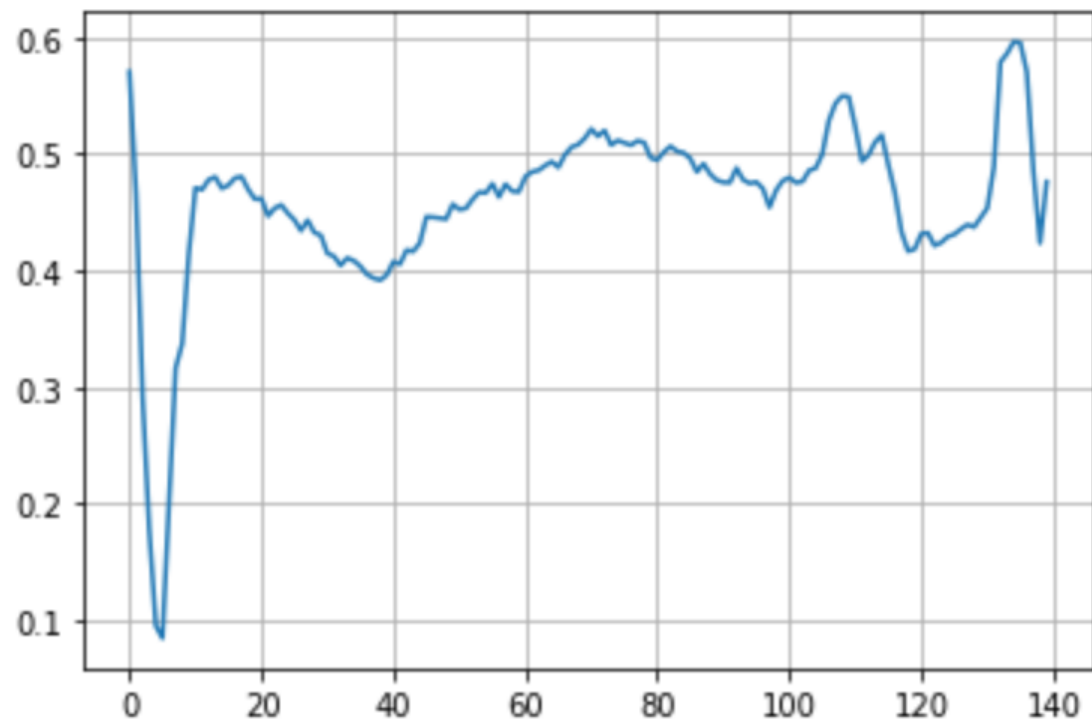


# 이상치 탐지

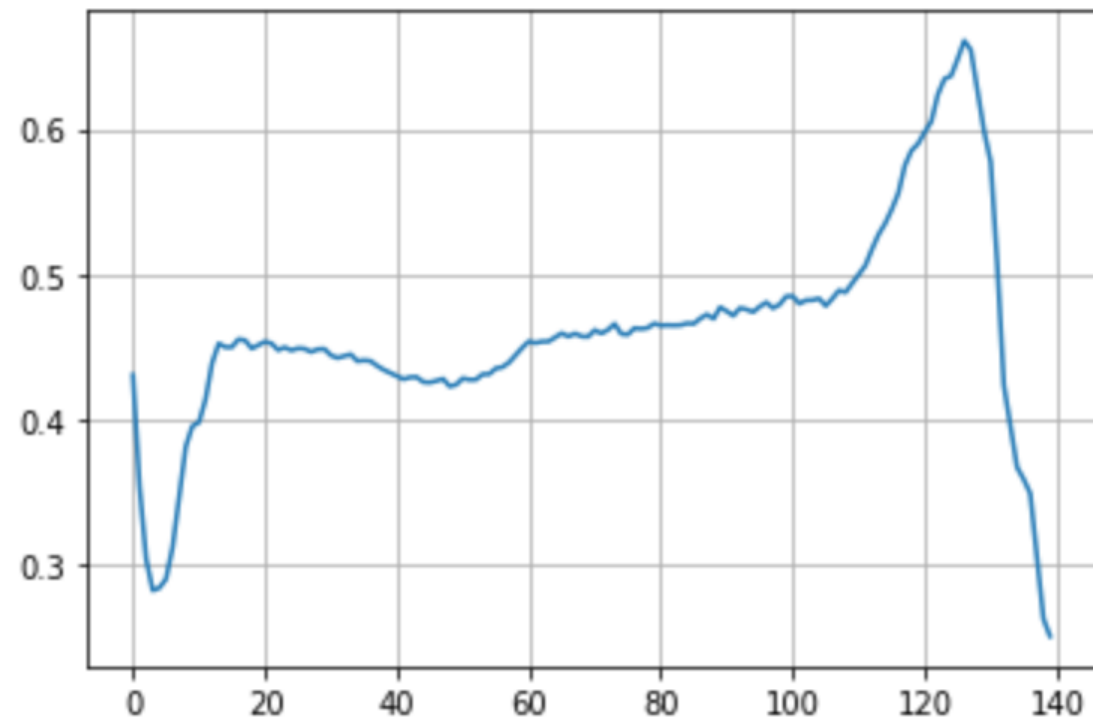
```
class AnomalyDetector(Model):  
    def __init__(self):  
        super(AnomalyDetector, self).__init__()  
        self.encoder = tf.keras.Sequential([  
            layers.Dense(32, activation="relu"),  
            layers.Dense(16, activation="relu"),  
            layers.Dense(8, activation="relu")])  
  
        self.decoder = tf.keras.Sequential([  
            layers.Dense(16, activation="relu"),  
            layers.Dense(32, activation="relu"),  
            layers.Dense(140, activation="sigmoid")])  
  
    def call(self, x):  
        encoded = self.encoder(x)  
        decoded = self.decoder(encoded)  
        return decoded
```

# 이상치 탐지

A Normal ECG



An Anomalous ECG



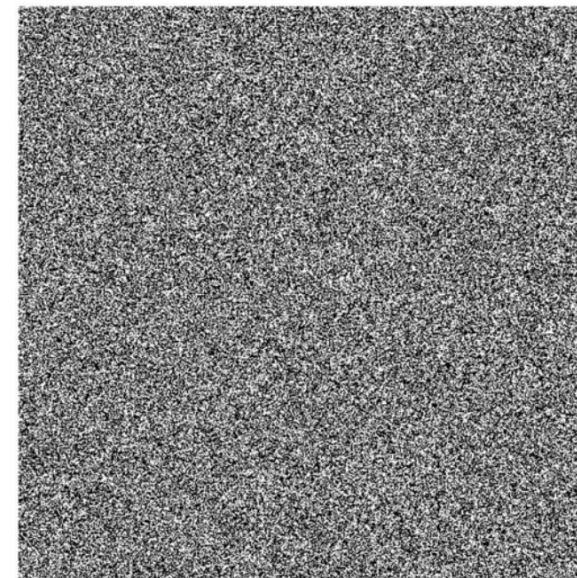
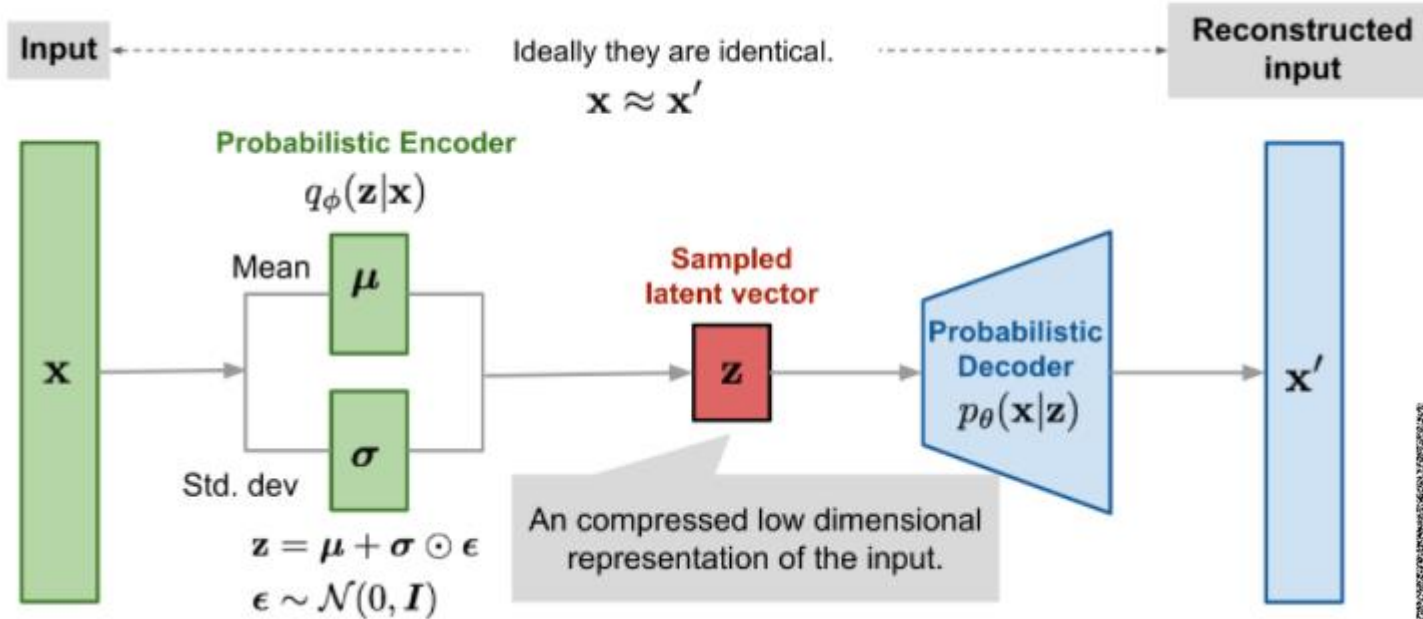
# 오토인코더 구현 실습



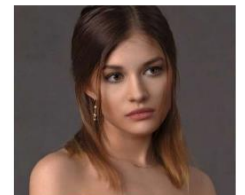
<https://www.tensorflow.org/tutorials/generative/autoencoder?hl=ko>

# VAE (Variational AutoEncoder)

<https://gaussian37.github.io/dl-concept-vae/>



← 2D random noise  $z$



data  $x$

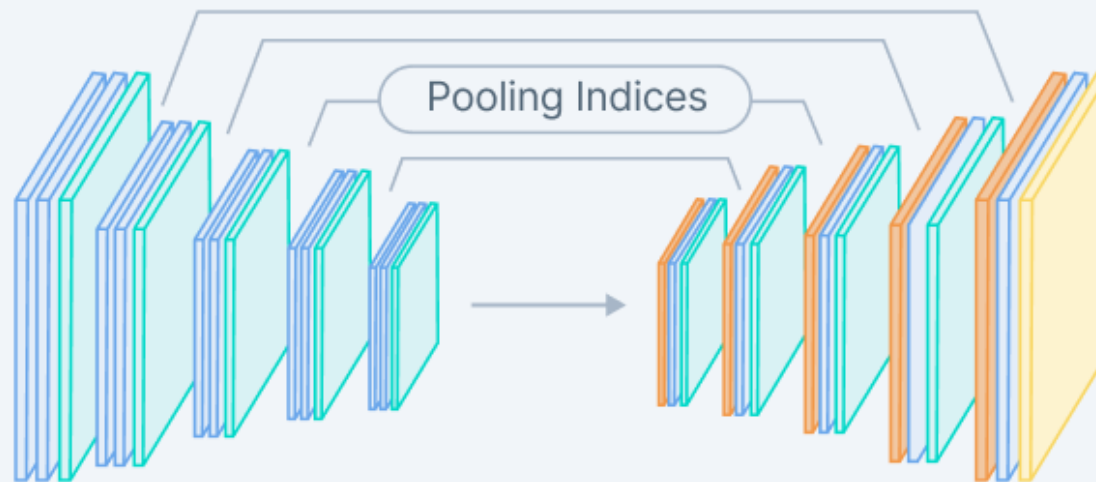
# Autoencoders in Deep Learning : Tutorial & Use Cases

<https://www.v7labs.com/blog/autoencoders-guide>

Input



RGB Image



Output



Segmentation



THANK YOU

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