```
In [2]: # !pip List
```

1. 환경 준비

```
In [4]: # 텐서플로 라이브러리 안에 있는 케라스 API에서 필요한 함수들을 불러옵니다.
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

# 데이터를 다루는 데 필요한 라이브러리를 불러옵니다.
import numpy as np
```

2. 데이터 준비

```
In [6]: # 준비된 수술 환자 데이터를 불러옵니다.
Data_set = np.loadtxt("./data/ThoraricSurgery3.csv", delimiter=",")
X = Data_set[:,0:16] # 환자의 진찰 기록을 X로 지정합니다.
y = Data_set[:,16] # 수술 1년 후 사망/생존 여부를 y로 지정합니다.
```

3. 구조 결정

```
In [8]: # 딥러닝 모델의 구조를 결정합니다.
model = Sequential()
model.add(Dense(30, input_dim=16, activation='relu'))
model.add(Dense(1, activation='sigmoid'))
```

C:\Users\user\AppData\Roaming\Python\Python312\site-packages\keras\src\layers\core\dense.py:87: UserWarning: Do not pass an `in put_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first la yer in the model instead.

```
super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

4. 모델 실행

```
In [10]: # 딥러닝 모델을 실행합니다.
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
history=model.fit(X, y, epochs=30, batch_size=16)
```

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	15	zms/step	-	accuracy:	0.2967	-	1055:	2.2655
	0s	1ms/step	_	accuracy:	0.8055	_	loss:	0.7083
3/30								
	0s	1ms/step	-	accuracy:	0.8124	-	loss:	0.5495
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	2/30 3/30 4/30 5/30 6/30 6/30 7/30 8/30 10/30 11/30 11/30 11/30 11/30 15/30 16/30 17/30 18/30	1s 2/30 0s 3/30 0s 4/30 0s 5/30 0s 6/30 0s 6/30 0s 8/30 0s 8/30 0s 8/30 0s 10/30 0s 11/30 0s	1s 2ms/step 2/30	1s 2ms/step - 2/30 0s 1ms/step - 3/30 0s 1ms/step - 4/30 0s 1ms/step - 5/30 6/30 0s 1ms/step - 6/30 0s 1ms/step - 7/30 8/30 0s 1ms/step - 8/30 0s 1ms/step - 10/30 0s 1ms/step - 11/30 15/30 0s 1ms/step - 15/30 15/3	1s 2ms/step - accuracy: 2/30 0s 1ms/step - accuracy: 4/30 0s 1ms/step - accuracy: 5/30 0s 1ms/step - accuracy: 6/30 0s 1ms/step - accuracy: 6/30 0s 1ms/step - accuracy: 8/30 0s 1ms/step - accuracy: 8/30 0s 1ms/step - accuracy: 10/30 0s 1ms/step - accuracy: 11/30 0s 1ms/step - accuracy: 12/30 0s 1ms/step - accuracy: 12/30 0s 1ms/step - accuracy: 13/30 0s 1ms/step - accuracy: 14/30 0s 1ms/step - accuracy: 15/30 0s 1ms/step - accuracy: 16/30 0s 1ms/step - accuracy: 18/30 0s 1ms/step - accuracy:	1s 2ms/step - accuracy: 0.2967 2/30 0s 1ms/step - accuracy: 0.8055 3/30 0s 1ms/step - accuracy: 0.8124 4/30 0s 1ms/step - accuracy: 0.8472 5/30 0s 1ms/step - accuracy: 0.8448 6/30 0s 1ms/step - accuracy: 0.8303 7/30 0s 1ms/step - accuracy: 0.8303 7/30 0s 1ms/step - accuracy: 0.8631 8/30 0s 1ms/step - accuracy: 0.8631 9/30 0s 2ms/step - accuracy: 0.8324 10/30 0s 1ms/step - accuracy: 0.8801 11/30 0s 1ms/step - accuracy: 0.8861 12/30 0s 1ms/step - accuracy: 0.8716 13/30 0s 1ms/step - accuracy: 0.8464 14/30 0s 1ms/step - accuracy: 0.8448 15/30 0s 1ms/step - accuracy: 0.8464 15/30 0s 1ms/step - accuracy: 0.8468 11/30 0s 1ms/step - accuracy: 0.8468 11/30 0s 1ms/step - accuracy: 0.8604 18/30 0s 1ms/step - accuracy: 0.8604 18/30 0s 2ms/step - accuracy: 0.8534 19/30 0s 2ms/step - accuracy: 0.8335	1s 2ms/step - accuracy: 0.2967 - 2/30 0s 1ms/step - accuracy: 0.8055 - 3/30 4/30 0s 1ms/step - accuracy: 0.8124 - 6/30 6/30 0s 1ms/step - accuracy: 0.8448 - 6/30 0s 1ms/step - accuracy: 0.8431 - 9/30 0s 2ms/step - accuracy: 0.8631 - 9/30 11/30 0s 1ms/step - accuracy: 0.8801 - 11/30 12/30 0s 1ms/step - accuracy: 0.8581 - 12/30 0s 1ms/step - accuracy: 0.8716 - 13/30 14/30 0s 1ms/step - accuracy: 0.8464 - 14/30 0s 1ms/step - accuracy: 0.8464 - 16/30 0s 1ms/step - accuracy: 0.8717 - 16/30 0s 1ms/step - accuracy: 0.8266 - 17/30 0s 1ms/step - accuracy: 0.8266 - 17/30 0s 1ms/step - accuracy: 0.8534 - 19/30 0s 2ms/step - accuracy: 0.8534 - 19/30 0s 2ms/step - accuracy: 0.8335 - 20/30	1s 2ms/step - accuracy: 0.2967 - loss: 2/30 0s 1ms/step - accuracy: 0.8055 - loss: 3/30 0s 1ms/step - accuracy: 0.8124 - loss: 4/30 0s 1ms/step - accuracy: 0.8472 - loss: 5/30 0s 1ms/step - accuracy: 0.8448 - loss: 6/30 0s 1ms/step - accuracy: 0.8448 - loss: 6/30 0s 1ms/step - accuracy: 0.8303 - loss: 7/30 0s 1ms/step - accuracy: 0.8448 - loss: 8/30 0s 1ms/step - accuracy: 0.8448 - loss: 10/30 0s 1ms/step - accuracy: 0.8631 - loss: 11/30 0s 1ms/step - accuracy: 0.8801 - loss: 11/30 0s 1ms/step - accuracy: 0.8581 - loss: 12/30 0s 1ms/step - accuracy: 0.8716 - loss: 13/30 0s 1ms/step - accuracy: 0.8464 - loss: 14/30 0s 1ms/step - accuracy: 0.8448 - loss: 15/30 0s 1ms/step - accuracy: 0.8448 - loss: 16/30 0s 1ms/step - accuracy: 0.8604 - loss: 17/30 0s 1ms/step - accuracy: 0.8604 - loss: 18/30 0s 2ms/step - accuracy: 0.8335 - loss:

```
30/30 -
                                   0s 1ms/step - accuracy: 0.8522 - loss: 0.4181
        Epoch 22/30
                                   0s 1ms/step - accuracy: 0.8120 - loss: 0.4529
        30/30 -
        Epoch 23/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8758 - loss: 0.3673
        Epoch 24/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8552 - loss: 0.4039
        Epoch 25/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8428 - loss: 0.4119
        Epoch 26/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8740 - loss: 0.3601
        Epoch 27/30
                                   0s 1ms/step - accuracy: 0.8673 - loss: 0.3975
        30/30 -
        Epoch 28/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8536 - loss: 0.4084
        Epoch 29/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8923 - loss: 0.3394
        Epoch 30/30
        30/30 -
                                   0s 1ms/step - accuracy: 0.8464 - loss: 0.4356
In [11]: print("\n Accuracy: %.4f" % (model.evaluate(X, y)[1]))
        15/15 -
                                  - 0s 2ms/step - accuracy: 0.8313 - loss: 0.4460
         Accuracy: 0.8511
In [12]: print("\n loss: %.4f" % (model.evaluate(X, y)[0]))
                                 - 0s 2ms/step - accuracy: 0.8313 - loss: 0.4460
        15/15 -
```

loss: 0.4053