# 다중 분류 문제 해결하기

## 2. 상관도 그래프

In [3]:
```
import pandas as pd

# 아이리스 데이터를 불러옵니다.
df = pd.read_csv('./data/iris3.csv')
```

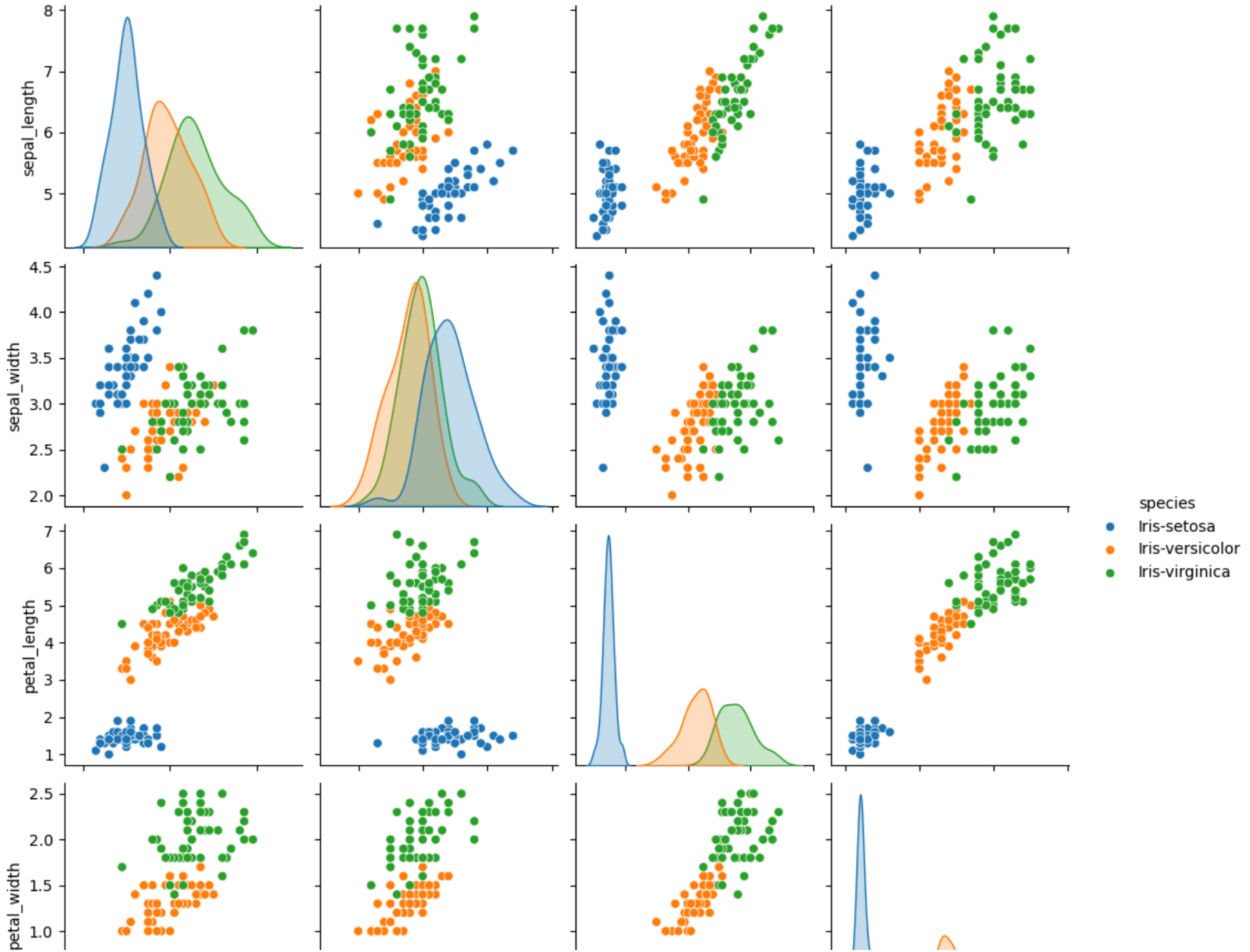
In [4]:
```
# 첫 5줄을 봅니다.
df.head()
```

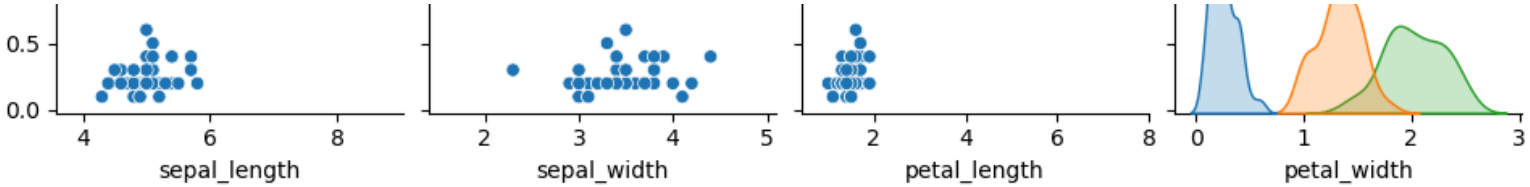
Out[4]:

| | sepal_length | sepal_width | petal_length | petal_width | species |
|---|---|---|---|---|---|
| **0** | 5.1 | 3.5 | 1.4 | 0.2 | Iris-setosa |
| **1** | 4.9 | 3.0 | 1.4 | 0.2 | Iris-setosa |
| **2** | 4.7 | 3.2 | 1.3 | 0.2 | Iris-setosa |
| **3** | 4.6 | 3.1 | 1.5 | 0.2 | Iris-setosa |
| **4** | 5.0 | 3.6 | 1.4 | 0.2 | Iris-setosa |

In [5]:
```
import seaborn as sns
import matplotlib.pyplot as plt

# 그래프로 확인해 봅시다.
sns.pairplot(df, hue='species');
plt.show()
```


sepal_length
sepal_width
petal_length
petal_width
8
7
6
5
4.5
4.0
3.5
3.0
2.5
2.0
7
6
5
4
3
2
1
2.5
2.0
1.5
1.0
species
Iris-setosa
Iris-versicolor
Iris-virginica




## 3. 원-핫 인코딩

In [7]:
```
# 속성을 X, 클래스를 y로 저장합니다.
X = df.iloc[:,0:4]
y = df.iloc[:,4]

# X와 y의 첫 5줄을 출력해 보겠습니다.
print(X[0:5])
print(y[0:5])
```

```
   sepal_length  sepal_width  petal_length  petal_width
0           5.1          3.5           1.4          0.2
1           4.9          3.0           1.4          0.2
2           4.7          3.2           1.3          0.2
3           4.6          3.1           1.5          0.2
4           5.0          3.6           1.4          0.2
0    Iris-setosa
1    Iris-setosa
2    Iris-setosa
3    Iris-setosa
4    Iris-setosa
Name: species, dtype: object
```

In [8]:
```
# 원-핫 인코딩 처리를 합니다.
y = pd.get_dummies(y)

# 원-핫 인코딩 결과를 확인합니다.
print(y[0:5])
```

| | Iris-setosa | Iris-versicolor | Iris-virginica |
|---|---|---|---|
| 0 | True | False | False |
| 1 | True | False | False |
| 2 | True | False | False |
| 3 | True | False | False |
| 4 | True | False | False |

# 4. 소프트맥스

In [10]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

# 모델 설정
model = Sequential()
model.add(Dense(12,  input_dim=4, activation='relu'))
model.add(Dense(8,  activation='relu'))
model.add(Dense(3, activation='softmax'))
model.summary()

# 모델 컴파일
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])

# 모델 실행
history=model.fit(X, y, epochs=30, batch_size=5)
```

```
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)
```

**Model: "sequential"**

| Layer (type) | Output Shape | Param # |
|---|---|---|
| dense (Dense) | (None, 12) | 60 |
| dense_1 (Dense) | (None, 8) | 104 |
| dense_2 (Dense) | (None, 3) | 27 |

**Total params:** 191 (764.00 B)

**Trainable params:** 191 (764.00 B)

**Non-trainable params:** 0 (0.00 B)

```
Epoch 1/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 1ms/step - accuracy: 0.6916 - loss: 1.2516
Epoch 2/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.6927 - loss: 0.9105
Epoch 3/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.6811 - loss: 0.8089
Epoch 4/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8087 - loss: 0.7232
Epoch 5/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8643 - loss: 0.6775
Epoch 6/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8260 - loss: 0.6177
Epoch 7/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8667 - loss: 0.5825
Epoch 8/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8007 - loss: 0.5109
Epoch 9/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9269 - loss: 0.5191
Epoch 10/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8839 - loss: 0.4657
Epoch 11/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8958 - loss: 0.4597
Epoch 12/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9572 - loss: 0.4111
Epoch 13/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.9346 - loss: 0.3873
Epoch 14/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9648 - loss: 0.3914
Epoch 15/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9431 - loss: 0.4047
Epoch 16/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9406 - loss: 0.3350
Epoch 17/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9540 - loss: 0.3394
Epoch 18/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9237 - loss: 0.3223
Epoch 19/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9399 - loss: 0.3161
Epoch 20/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9703 - loss: 0.2862
Epoch 21/30
```

```
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9731 - loss: 0.2570
Epoch 22/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9681 - loss: 0.2608
Epoch 23/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9622 - loss: 0.2772
Epoch 24/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9841 - loss: 0.2172
Epoch 25/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9566 - loss: 0.2408
Epoch 26/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9595 - loss: 0.2511
Epoch 27/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9527 - loss: 0.2331
Epoch 28/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9711 - loss: 0.2047
Epoch 29/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9877 - loss: 0.1961
Epoch 30/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9730 - loss: 0.2052
```

# 5. 아이리스 품종 예측 실행

In [12]:

```python
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# 아이리스 데이터를 불러옵니다.
df = pd.read_csv('./data/iris3.csv')

# 속성을 X, 클래스를 y로 저장합니다.
X = df.iloc[:,0:4]
y = df.iloc[:,4]

# 원-핫 인코딩 처리를 합니다.
y = pd.get_dummies(y)
```

```python
# 모델 설정
model = Sequential()
model.add(Dense(12,  input_dim=4, activation='relu'))
model.add(Dense(8,  activation='relu'))
model.add(Dense(3, activation='softmax'))
model.summary()

# 모델 컴파일
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])

# 모델 실행
history=model.fit(X, y, epochs=30, batch_size=5)
```

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

**Model: "sequential_1"**

| Layer (type) | Output Shape | Param # |
|---|---|---|
| dense_3 (Dense) | (None, 12) | 60 |
| dense_4 (Dense) | (None, 8) | 104 |
| dense_5 (Dense) | (None, 3) | 27 |

**Total params:** 191 (764.00 B)

**Trainable params:** 191 (764.00 B)

**Non-trainable params:** 0 (0.00 B)

```
Epoch 1/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 1ms/step - accuracy: 0.3210 - loss: 1.0302
Epoch 2/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.5959 - loss: 0.8017
Epoch 3/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7981 - loss: 0.7016
Epoch 4/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8772 - loss: 0.6490
Epoch 5/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.7736 - loss: 0.6004
Epoch 6/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8478 - loss: 0.5393
Epoch 7/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8345 - loss: 0.5306
Epoch 8/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.8327 - loss: 0.4892
Epoch 9/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9069 - loss: 0.4653
Epoch 10/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.9652 - loss: 0.4419
Epoch 11/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9193 - loss: 0.4184
Epoch 12/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9526 - loss: 0.4167
Epoch 13/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9481 - loss: 0.3988
Epoch 14/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9422 - loss: 0.3479
Epoch 15/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9723 - loss: 0.3584
Epoch 16/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9590 - loss: 0.3568
Epoch 17/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9852 - loss: 0.3336
Epoch 18/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9450 - loss: 0.3305
Epoch 19/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.9296 - loss: 0.3523
Epoch 20/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9573 - loss: 0.3032
Epoch 21/30
```

```
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9778 - loss: 0.3096
Epoch 22/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9602 - loss: 0.2796
Epoch 23/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9636 - loss: 0.3011
Epoch 24/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9670 - loss: 0.3077
Epoch 25/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9827 - loss: 0.2789
Epoch 26/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9498 - loss: 0.2793
Epoch 27/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9544 - loss: 0.2690
Epoch 28/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9634 - loss: 0.2427
Epoch 29/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9816 - loss: 0.2261
Epoch 30/30
30/30 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - accuracy: 0.9761 - loss: 0.2113
```

In [13]:
```
score=model.evaluate(X, y)
print('Test accuracy:', score[1])
```

```
5/5 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.9790 - loss: 0.1594
Test accuracy: 0.9733333587646484
```

In [14]:
```
print('Test loss', score[0])
```

```
Test loss 0.22447362542152405
```