# Mini-project #1

## Practice Session 19

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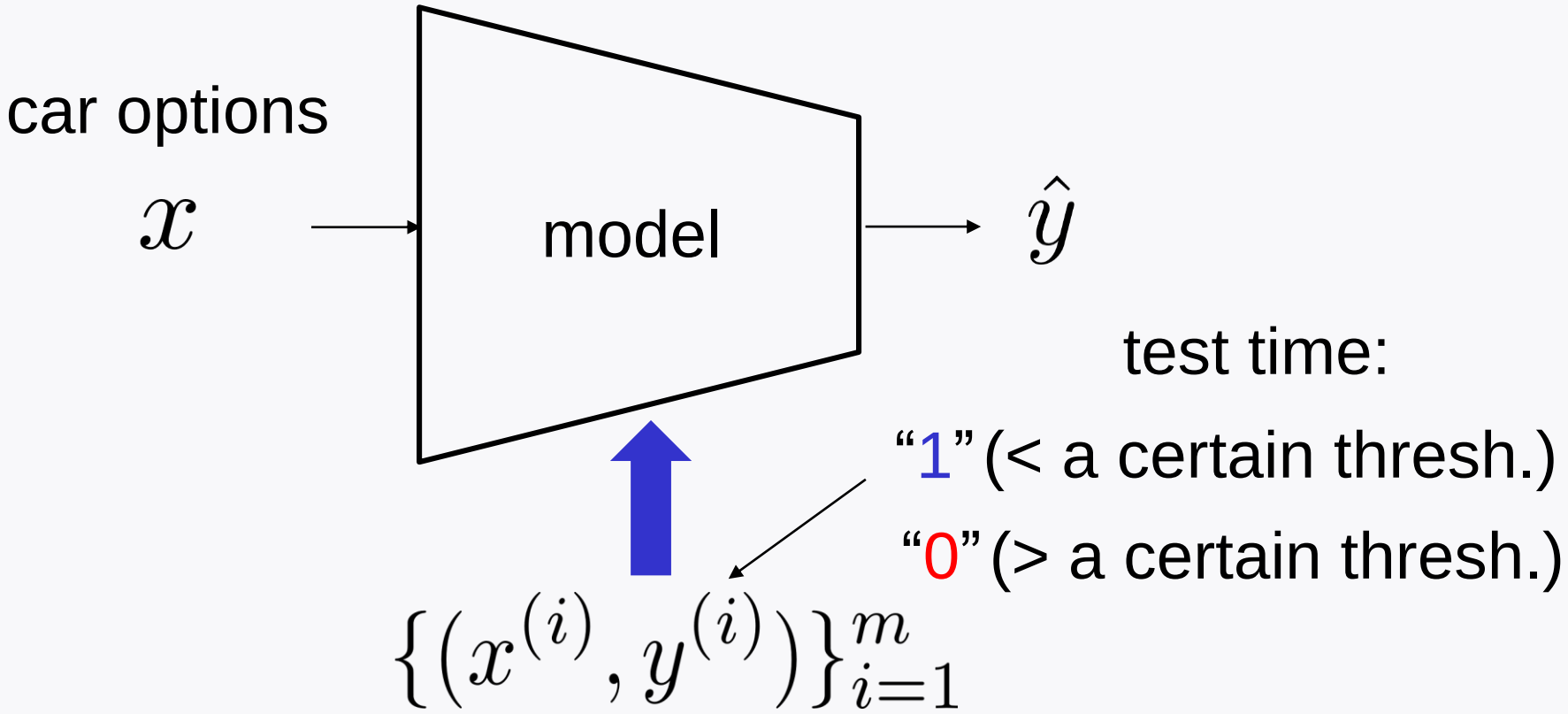
# Recap: Test-time prediction



# Recap: Loading MB dataset

```
import pandas as pd
data = pd.read_csv('mercedes_test.csv')
data
```

| | ID | y | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X8 | ... | X375 | X376 | X377 | X378 | X379 | X380 | X382 | X383 | X384 | X385 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 0 | 130.81 | k | v | at | a | d | u | j | o | ... | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **1** | 6 | 88.53 | k | t | av | e | d | y | l | o | ... | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2** | 7 | 76.26 | az | w | n | c | d | x | j | x | ... | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| **3** | 9 | 80.62 | az | t | n | f | d | x | l | e | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4** | 13 | 78.02 | az | v | n | f | d | h | d | n | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **4204** | 8405 | 107.39 | ak | s | as | c | d | aa | d | q | ... | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4205** | 8406 | 108.77 | j | o | t | d | d | aa | h | h | ... | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4206** | 8412 | 109.22 | ak | v | r | a | d | aa | g | e | ... | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4207** | 8415 | 87.48 | al | r | e | f | d | aa | l | u | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **4208** | 8417 | 110.85 | z | r | ae | c | d | aa | g | w | ... | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

4209 rows × 378 columns

strings (categorical data)

$$m = 4209 \quad n = 376 (= 378 - 2)$$

# Recap: Preprocessing

```
# Choose categorical data columns
cf = data.select_dtypes(include=['object']).columns
# To change it into "categorical" data type
data[cf]=data[cf].astype('category')
# One hot encoding
data = pd.get_dummies(data)
# Obtain X from data (excluding 'ID' and 'y')
X_df = data.drop(['ID','y'],axis=1)
# Obtain y from data
y_df = data['y']
```

```
# Convert y_df into binary labels
import numpy as np
TF_vector= (y_df<np.median(y_df))
y_df=TF_vector.astype(float)
```

```
# Conver data frame into numpy array
X,y = X_df.values, y_df.values
```

# Recap: Split into train and test datasets

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.1,stratify=y)
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(3788, 563)
(421, 563)
(3788,)
(421,)
```

# Model: DNN

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.regularizers import l2
from tensorflow.keras.optimizers import Adam
from sklearn.model_selection import RandomizedSearchCV
from tensorflow.keras.wrappers.scikit_learn import KerasClassifier
# Enables the use of Scikit-learn APIs for Keras models

def build_model(n_layer=2,lambda_=0,lr=1e-3):
    model = Sequential()
    for i in range(n_layer-1):
        model.add(Dense(20,activation='relu',
                  kernel_regularizer=l2(lambda_),bias_regularizer=l2(lambda_)))

    model.add(Dense(1, activation='sigmoid',
                  kernel_regularizer=l2(lambda_),bias_regularizer=l2(lambda_)))
    optimizer = Adam(learning_rate=lr)
    model.compile(optimizer=optimizer,
                  loss='binary_crossentropy',
                  metrics=['acc'])
    return model
```

# Model: DNN

```
from sklearn.model_selection import RandomizedSearchCV
from tensorflow.keras.wrappers.scikit_learn import KerasClassifier
# Enables the use of Scikit-learn APIs for Keras models

# return a scikit-learn-like Keras model
model = KerasClassifier(build_model)

n_layer = [2,5,10]
lambda_ = [1e-3,1e-2,1e-1,1,10]
grid = {'n_layer':n_layer,'lambda_':lambda_}

cv = RandomizedSearchCV(model,grid,n_iter=15,cv=5)

cv.fit(X_train,y_train,epochs=10,verbose=0)
```

# Logs results

```
cv.cv_results_ # logs results
```

```
{'mean_fit_time': array([0.80088468, 0.99679437, 1.30053182, 0.80052128, 1.0428587 ,
       1.31682577, 0.7942235 , 1.02531514, 1.42052927, 0.86476107,
       1.1448904 , 1.43833871, 0.91565795, 1.1521472 , 1.5095562 ]),
 'std_fit_time': array([0.07948719, 0.08256747, 0.08644163, 0.0252914 , 0.07358794,
       0.08842912, 0.02503514, 0.06401977, 0.10777069, 0.04044909,
       0.07504672, 0.06786973, 0.07615218, 0.04095048, 0.12140173]),
 'mean_score_time': array([0.10044403, 0.1201704 , 0.15436425, 0.13417854, 0.12991586,
       0.15232453, 0.09623604, 0.12205276, 0.16975675, 0.10253868,
       0.12651033, 0.16565557, 0.1109097 , 0.12981415, 0.17698035]),
 'std_score_time': array([0.01255555, 0.00358549, 0.00364132, 0.07562545, 0.00795389,
       0.00355397, 0.00266729, 0.003046  , 0.01128532, 0.00450796,
       0.00454143, 0.0088088 , 0.0070474 , 0.00567858, 0.00874225]),
 'param_n_layer': masked_array(data=[2, 5, 10, 2, 5, 10, 2, 5, 10, 2, 5, 10, 2, 5, 10],
              mask=[False, False, False, False, False, False, False, False,
                    False, False, False, False, False, False, False],
       fill_value='?',
            dtype=object),
 'param_lambda_': masked_array(data=[0.001, 0.001, 0.001, 0.01, 0.01, 0.01, 0.1, 0.1, 0.
                    1, 1, 1, 10, 10, 10],
              mask=[False, False, False, False, False, False, False, False,
                    False, False, False, False, False, False, False],
       fill_value='?',
            dtype=object),
 'params': [{'n_layer': 2, 'lambda_': 0.001},
  {'n_layer': 5, 'lambda_': 0.001},
  {'n_layer': 10, 'lambda_': 0.001},
  {'n_layer': 2, 'lambda_': 0.01},
  {'n_layer': 5, 'lambda_': 0.01},
  {'n_layer': 10, 'lambda_': 0.01},
  {'n_layer': 2, 'lambda_': 0.1},
  {'n_layer': 5, 'lambda_': 0.1},
  {'n_layer': 10, 'lambda_': 0.1},
  {'n_layer': 2, 'lambda_': 1},
  {'n_layer': 5, 'lambda_': 1},
  {'n_layer': 10, 'lambda_': 1},
  {'n_layer': 2, 'lambda_': 10},
  {'n_layer': 5, 'lambda_': 10},
  {'n_layer': 10, 'lambda_': 10}],
 'split0_test_score': array([0.86522428, 0.88654351, 0.86147755, 0.88522428, 0.88522428,
       0.88258576, 0.86939311, 0.4828496 , 0.4828496 , 0.4828496 ,
       0.4828496 , 0.4828496 , 0.4828496 , 0.5171504 , 0.5171504 ]),
 'split1_test_score': array([0.88918203, 0.88654351, 0.87730873, 0.89050132, 0.88126647,
       0.86939311, 0.88390499, 0.49472296, 0.49472296, 0.49472296,
       0.49472296, 0.50527704, 0.49472296, 0.49472296, 0.49472296]),
 'split2_test_score': array([0.85883904, 0.86147755, 0.86147755, 0.85751981, 0.86015832,
       0.86015832, 0.83905011, 0.47757256, 0.47757256, 0.47757256,
       0.47757256, 0.47757256, 0.52242744, 0.52242744, 0.47757256]),
 'split3_test_score': array([0.87978864, 0.8678996 , 0.87582564, 0.88110965, 0.87978864,
       0.87054163, 0.84940553, 0.49669749, 0.49669749, 0.62615585,
       0.50330251, 0.50330251, 0.55350065, 0.49669749, 0.49669749]),
 'split4_test_score': array([0.89431965, 0.87318361, 0.88903564, 0.89431965, 0.87978864,
       0.4953765 , 0.87582564, 0.4953765 , 0.4953765 , 0.50462353,
       0.4953765 , 0.4953765 , 0.4953765 , 0.4953765 , 0.4953765 ]),
 'mean_test_score': array([0.88147073, 0.87512956, 0.87302502, 0.88173494, 0.87724527,
       0.79561107, 0.86351588, 0.48944382, 0.48944382, 0.5171849 ,
       0.49076483, 0.49287564, 0.50977543, 0.50527496, 0.49630398]),
 'std_test_score': array([0.01227739, 0.01002989, 0.01048066, 0.01291637, 0.00877195,
       0.15028647, 0.01673   , 0.00774716, 0.00774716, 0.05529023,
       0.0092824 , 0.01098612, 0.02541997, 0.01198441, 0.01256148]),
 'rank_test_score': array([ 2,  4,  5,  1,  3,  7,  6, 14, 14,  8, 13, 12,  9, 10, 11])}
```

# Store logs results into csv file

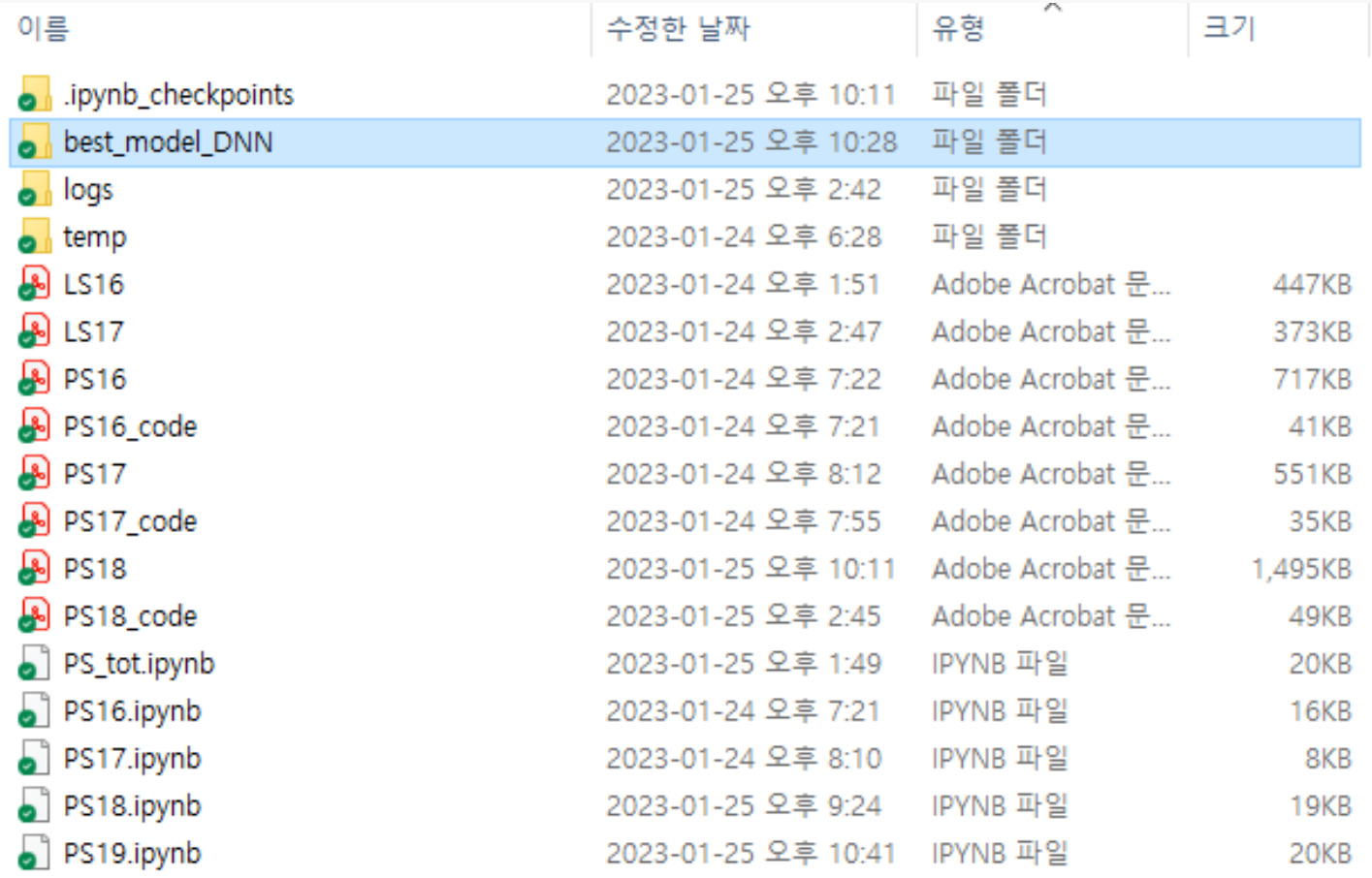
```
# Store logs into csv file
import pandas as pd
df_DNN=pd.DataFrame.from_dict(cv.cv_results_,orient='columns')
# Select columns to be stored
columns = ['params','mean_test_score','std_test_score','rank_test_score']
df_DNN = df_DNN[columns]
df_DNN.to_csv("logs_DNN.csv")
```

logs_DNN.csv

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | params | mean_test_score | std_test_score | rank_test_score |
| 2 | 0 | {'n_layer': 2, 'lambda_': 0.001} | 0.880150437 | 0.012390875 | 3 |
| 3 | 1 | {'n_layer': 5, 'lambda_': 0.001} | 0.871702981 | 0.009922373 | 5 |
| 4 | 2 | {'n_layer': 10, 'lambda_': 0.001} | 0.873552036 | 0.016688979 | 4 |
| 5 | 3 | {'n_layer': 2, 'lambda_': 0.01} | 0.883054197 | 0.012948202 | 1 |
| 6 | 4 | {'n_layer': 5, 'lambda_': 0.01} | 0.880679882 | 0.011110238 | 2 |
| 7 | 5 | {'n_layer': 10, 'lambda_': 0.01} | 0.79782958 | 0.1538105 | 7 |
| 8 | 6 | {'n_layer': 2, 'lambda_': 0.1} | 0.865622532 | 0.025063451 | 6 |
| 9 | 7 | {'n_layer': 5, 'lambda_': 0.1} | 0.491025543 | 0.006963835 | 13 |
| 10 | 8 | {'n_layer': 10, 'lambda_': 0.1} | 0.491025543 | 0.006963835 | 13 |
| 11 | 9 | {'n_layer': 2, 'lambda_': 1} | 0.491025543 | 0.006963835 | 13 |
| 12 | 10 | {'n_layer': 5, 'lambda_': 1} | 0.492080951 | 0.008143987 | 12 |
| 13 | 11 | {'n_layer': 10, 'lambda_': 1} | 0.494984365 | 0.010192118 | 11 |
| 14 | 12 | {'n_layer': 2, 'lambda_': 10} | 0.533545125 | 0.050735938 | 8 |
| 15 | 13 | {'n_layer': 5, 'lambda_': 10} | 0.508181858 | 0.007879908 | 9 |
| 16 | 14 | {'n_layer': 10, 'lambda_': 10} | 0.498683184 | 0.011282819 | 10 |

# Save the best model

```
best_model_DNN=cv.best_estimator_
best_model_DNN.model.save('best_model_DNN')
```



| 이름 | 수정한 날짜 | 유형 | 크기 |
|---|---|---|---|
| .ipynb_checkpoints | 2023-01-25 오후 10:11 | 파일 폴더 | |
| best_model_DNN | 2023-01-25 오후 10:28 | 파일 폴더 | |
| logs | 2023-01-25 오후 2:42 | 파일 폴더 | |
| temp | 2023-01-24 오후 6:28 | 파일 폴더 | |
| LS16 | 2023-01-24 오후 1:51 | Adobe Acrobat 문... | 447KB |
| LS17 | 2023-01-24 오후 2:47 | Adobe Acrobat 문... | 373KB |
| PS16 | 2023-01-24 오후 7:22 | Adobe Acrobat 문... | 717KB |
| PS16_code | 2023-01-24 오후 7:21 | Adobe Acrobat 문... | 41KB |
| PS17 | 2023-01-24 오후 8:12 | Adobe Acrobat 문... | 551KB |
| PS17_code | 2023-01-24 오후 7:55 | Adobe Acrobat 문... | 35KB |
| PS18 | 2023-01-25 오후 10:11 | Adobe Acrobat 문... | 1,495KB |
| PS18_code | 2023-01-25 오후 2:45 | Adobe Acrobat 문... | 49KB |
| PS_tot.ipynb | 2023-01-25 오후 1:49 | IPYNB 파일 | 20KB |
| PS16.ipynb | 2023-01-24 오후 7:21 | IPYNB 파일 | 16KB |
| PS17.ipynb | 2023-01-24 오후 8:10 | IPYNB 파일 | 8KB |
| PS18.ipynb | 2023-01-25 오후 9:24 | IPYNB 파일 | 19KB |
| PS19.ipynb | 2023-01-25 오후 10:41 | IPYNB 파일 | 20KB |

# Load the best model

```
from tensorflow.keras.models import load_model
loaded_model = load_model('best_model_DNN')
loaded_model.evaluate(X_test, y_test)
```

```
14/14 [==============================] - 0s 890us/step - loss: 0.3867 - acc: 0.
8789

[0.38672053813934326, 0.8788598775863647]
```