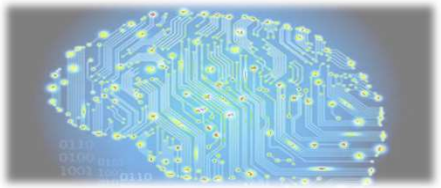
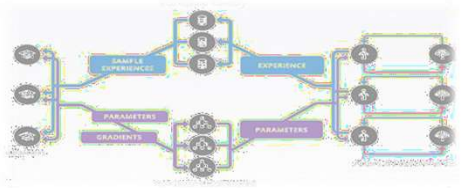
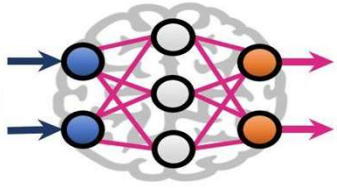
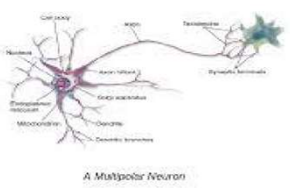
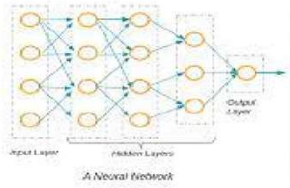







Comparison Long Short-Term Memory Network and Convolution Neural Nework with Nested Cross Validation

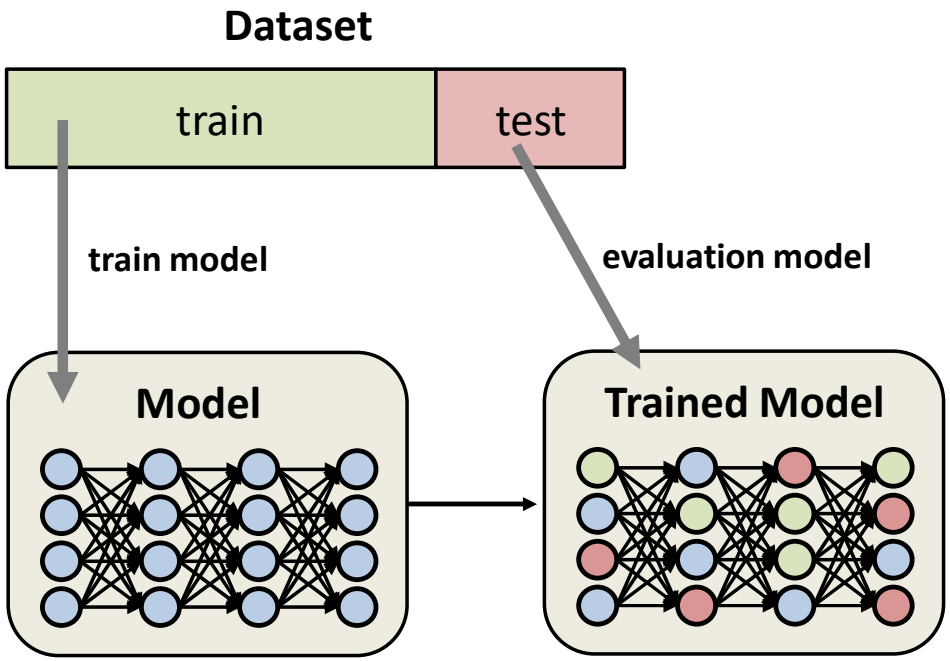
LSTM 네트워크, CNN 네트워크 구현 및 Nested Cross Validation 비교 실험

Geonil Yun,
rjsdlf45@gmail.com
2021. 05. 25.

Introduction

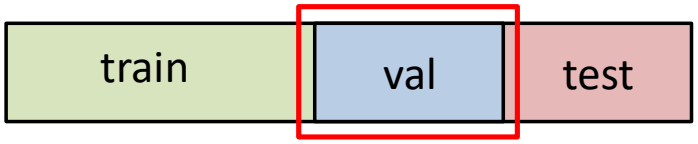
Data Split

- Train-Test split



Problems

- overfitting at train data set
- use validation data set for avoid overfitting and tune hyperparameter



① train model using train data
② validate model using validation data (observe overfitting)
③ evaluate model using test data

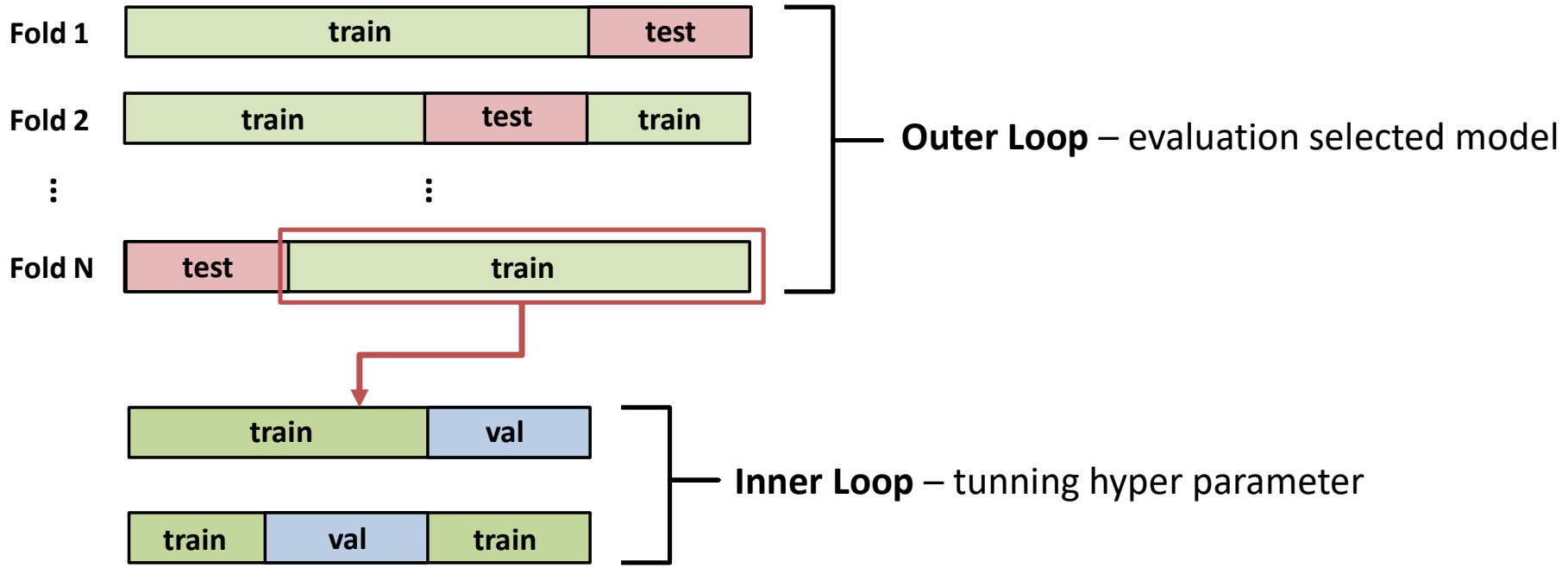
- Also overfitting at validation set (if use one validation set)

⇨ **proposed "Cross Validation"**

Cross Validation

Nested Cross Validation

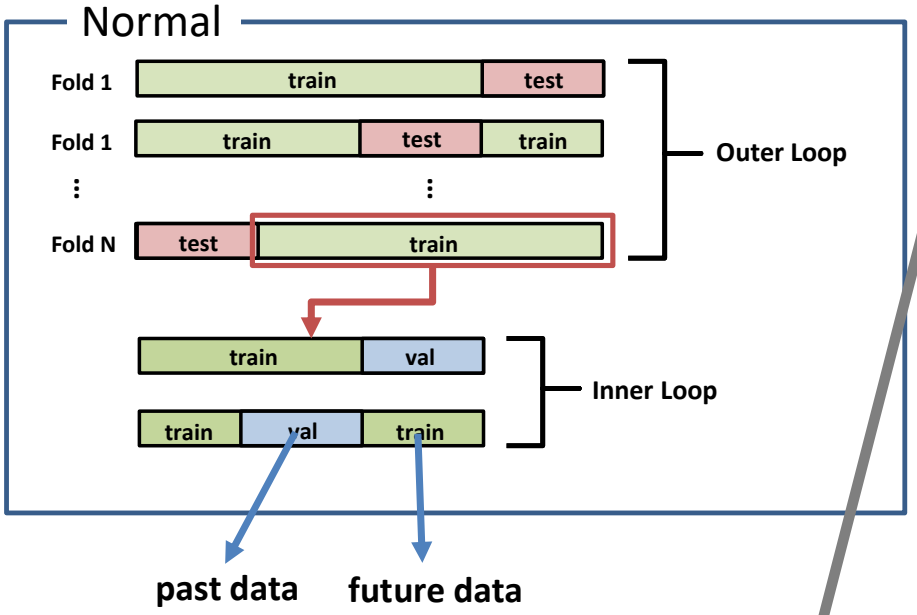
- General Nested CV



Cross Validation

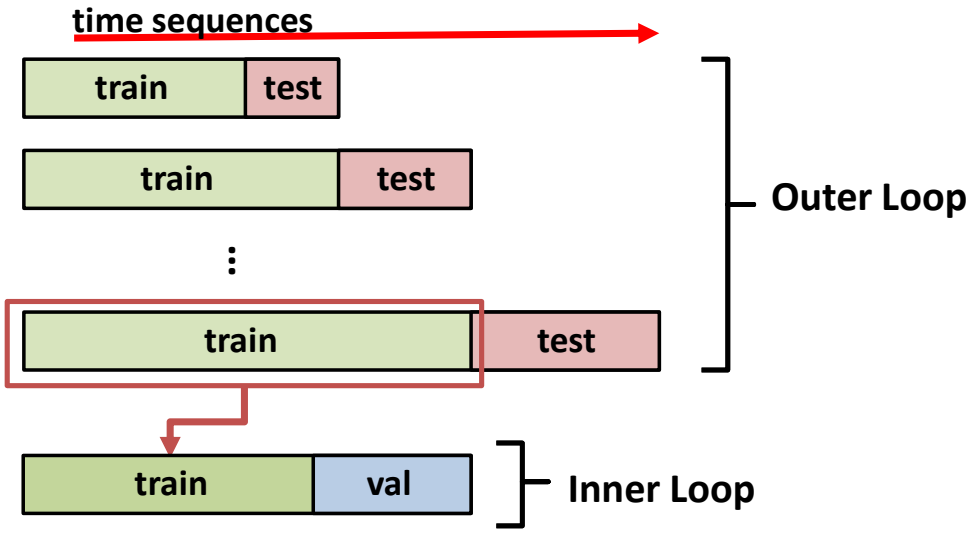
Nested Cross Validation

- Problem in **Time series data**



➢ train **future** data & predict **past** data

Nested Cross Validation for time series



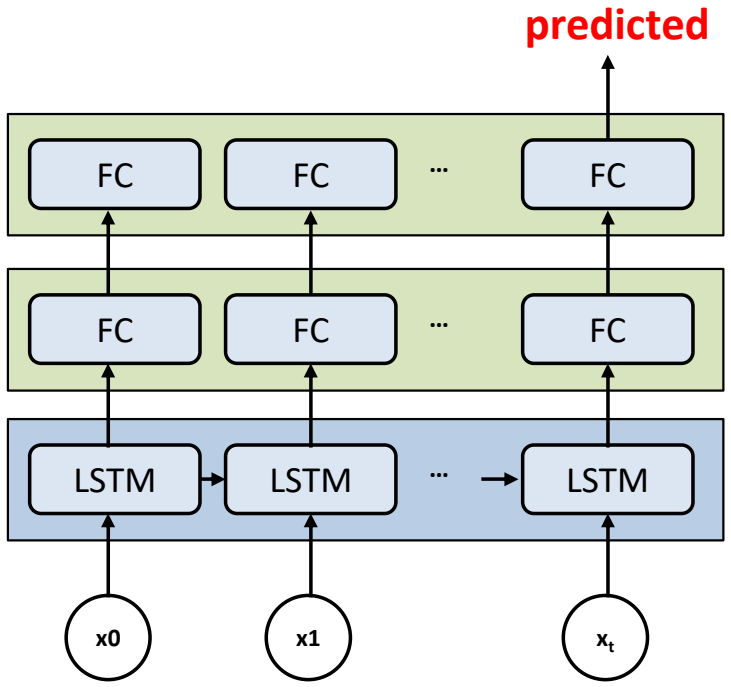
➢ train **past** data & predict **future** data

➢ handling time series data in Nested CV

Experimental setting

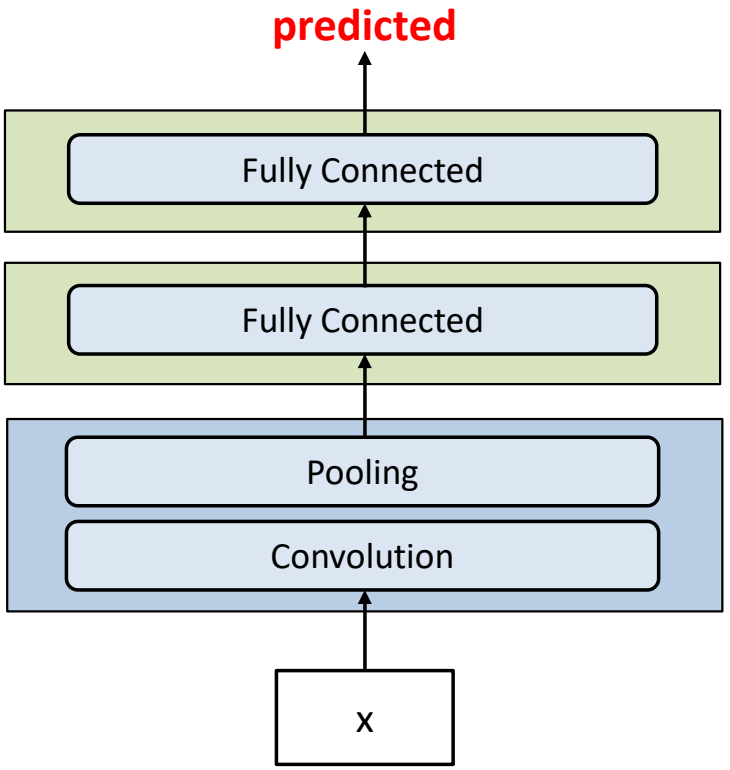
Structure (LSTM)

MSE for Loss = $\frac{1}{2}\sum(y-t)^2$



- input data shape : (batch, 24, 8)

Structure (CNN)



- input data shape : (batch, 1, 24, 8)

Experimental setting

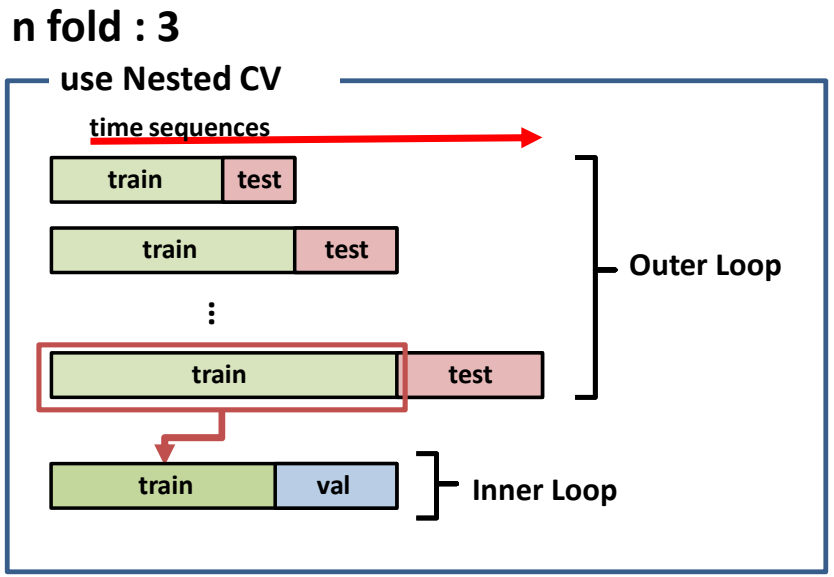
Dataset

Beijing Air pollution (uci-dataset/00381)

times	pm 2.5	Dew Point	temperature	pressure	wind direction	wind speed	snow	rain
Y-m-d H	129.0	-16	-4.0	1020.0	SE	1.79	0	0

Cross validation

parameter	CNN	LSTM
filter size	3, 5	
filter num	30	
hidden size	100	
input length	24	
output length	1	
epoch	10	10
batch size	64	
learning rate	0.1, 0.01	0.1, 0.01, 0.001



Comparison results

- **Nested Cross Validation for CNN(rmse)**

fold 1/3 => best model(rmse) : 26.41

learning rate \ filter size	3	5
0.1	37.99	89.52
0.01	35.66	142.59

fold 2/3 => best model(rmse) : 28.64

learning rate \ filter size	3	5
0.1	128.21	85.51
0.01	26.70	27.15

fold 3/3 => best model(rmse) : 22.61

learning rate \ filter size	3	5
0.1	40.34	82.20
0.01	30.16	129.89

- **Nested Cross Validation for LSTM(rmse)**

fold 1/3 => best model(rmse) : 23.32

learning rate	0.1	0.01	0.001
rmse	99.08	32.98	35.29

fold 2/3 => best model(rmse) : 22.56

learning rate	0.1	0.01	0.001
rmse	127.81	38.54	22.74

fold 3/3 => best model(rmse) : 21.47

learning rate	0.1	0.01	0.001
rmse	87.76	23.08	22.51

- **Average RMSE (LSTM) : 22.45**
- **Average RMSE (CNN) : 25.88**

Comparison results

Metrics	LSTM	CNN
Mean Squared Error(MSE)	461.12	511.42
Root MSE(RMSE)	21.47	22.61
Mean Absolute Error(MAE)	13.37	13.74

Code

Model	view with code
LSTM	https://colab.research.google.com/drive/1oNW4HzBzmrjyWcWZbjFMtksP1vTV9lO2?usp=sharing
CNN	https://colab.research.google.com/drive/1Ccd7l65bJwiD2HW8XmOKTHO1PEUMuQl3?usp=sharing
LSTM-CV	https://colab.research.google.com/drive/1De0Tn_iD5NQBKAu_eKr3PWZwvcnNTu97?usp=sharing
CNN-CV	https://colab.research.google.com/drive/1HmjdyXbwUASZxzS40v4opc9myAuuhcrF?usp=sharing

Thank you