玉山金控 E.SUN FHC ×NTU

# AI News Scoring System

智能新聞評分系統


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# Presentation Outline

- Overview
- Data Analysis
- Machine Learning Models
- Feature Analysis
- Conclusion & Future Works

Section I

# Overview

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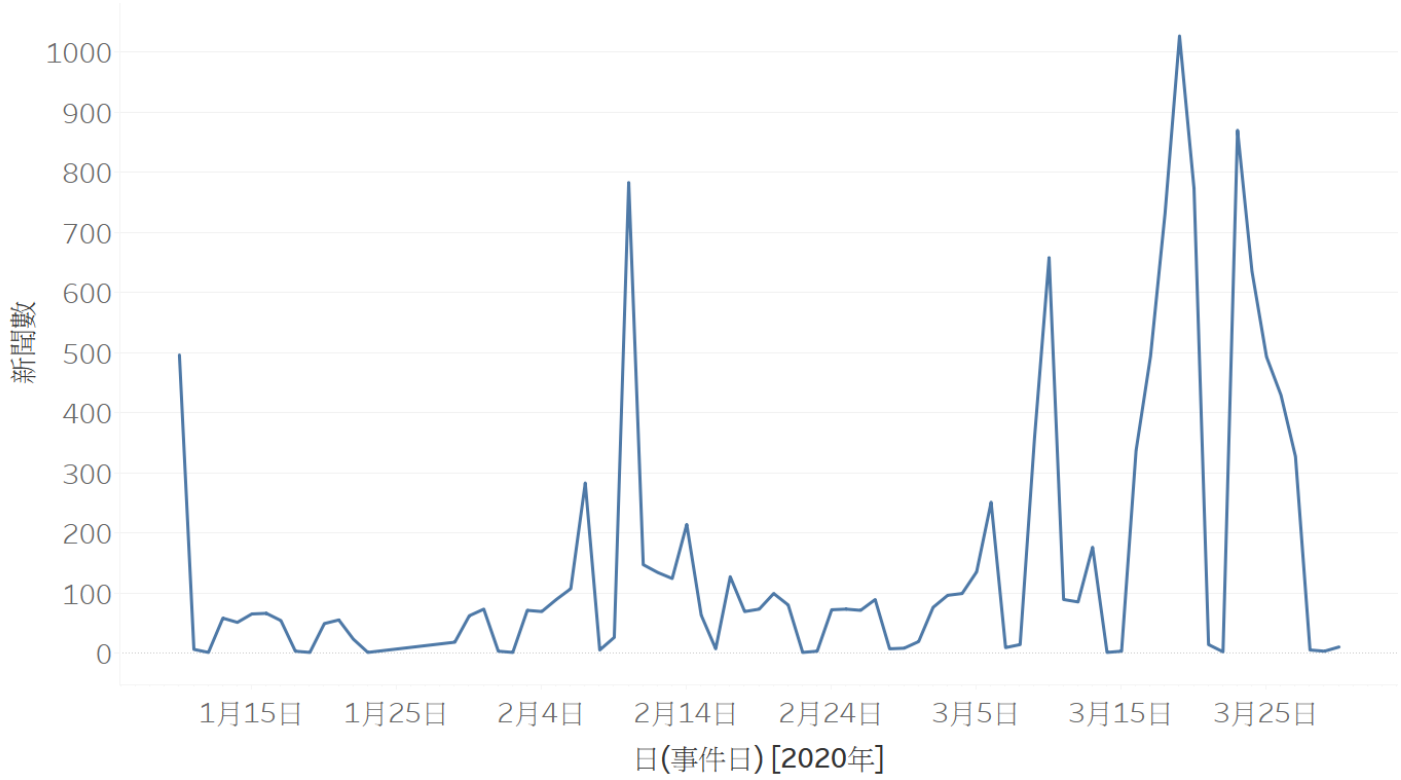
# Project Introduction

- Consultants in TCRI judge financial news and rate them (+3 ~ -3)
- Pain Point
  - Heavy load of news everyday
  - Inconsistent judgement between experts
  - Important events can’t be highlighted right away
- Target:
  - Using machine learning as a support system to help judge the news

# Pain Point - Heavy load of news everyday

- Financial related events that happened from January 2020 to March 2020



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# Pain Point - Inconsistent Judgement between experts

- Similar events was graded differently.
- Even same event was graded differently on the same day.

| 事件內容 | 事件強度 |
|---|---|
| 2019年11月累計營收655,726千元，年減32%。2019年11月單月營收90,853千元，年增32%。。 | 0 |
| 2019年12月累計營收726,769千元，年減29%。2019年12月單月營收71,043千元，年增29%。。 | 1 |
| 2019年09月累計營收6,323,164千元，年增51%。2019年09月單月營收408,266千元，年減23%。。 | 0 |
| 2019年10月累計營收6,645,678千元，年增42%。2019年10月單月營收322,514千元，年減35%。。 | 0 |
| 2019年11月累計營收7,125,647千元，年增35%。2019年11月單月營收479,969千元，年減17%。。 | 1 |
| 2019年10月累計營收361,638千元，年減31%。2019年10月單月營收72,822千元，年增58%。。 | 0 |
| 2019年12月累計營收453,215千元，年減24%。2019年12月單月營收33,933千元，年增35%。。 | 1 |

| 事件內容 | 公司簡稱 | 日(事件日) | 事件強度 |
|---|---|---|---|
| 發言人[redacted]勳，由[redacted]接任。。財務.. | [redacted] | 2019年9月30日 | -1 |
| | | | 0 |
| | | 2019年10月1日 | -1 |
| | | | 0 |



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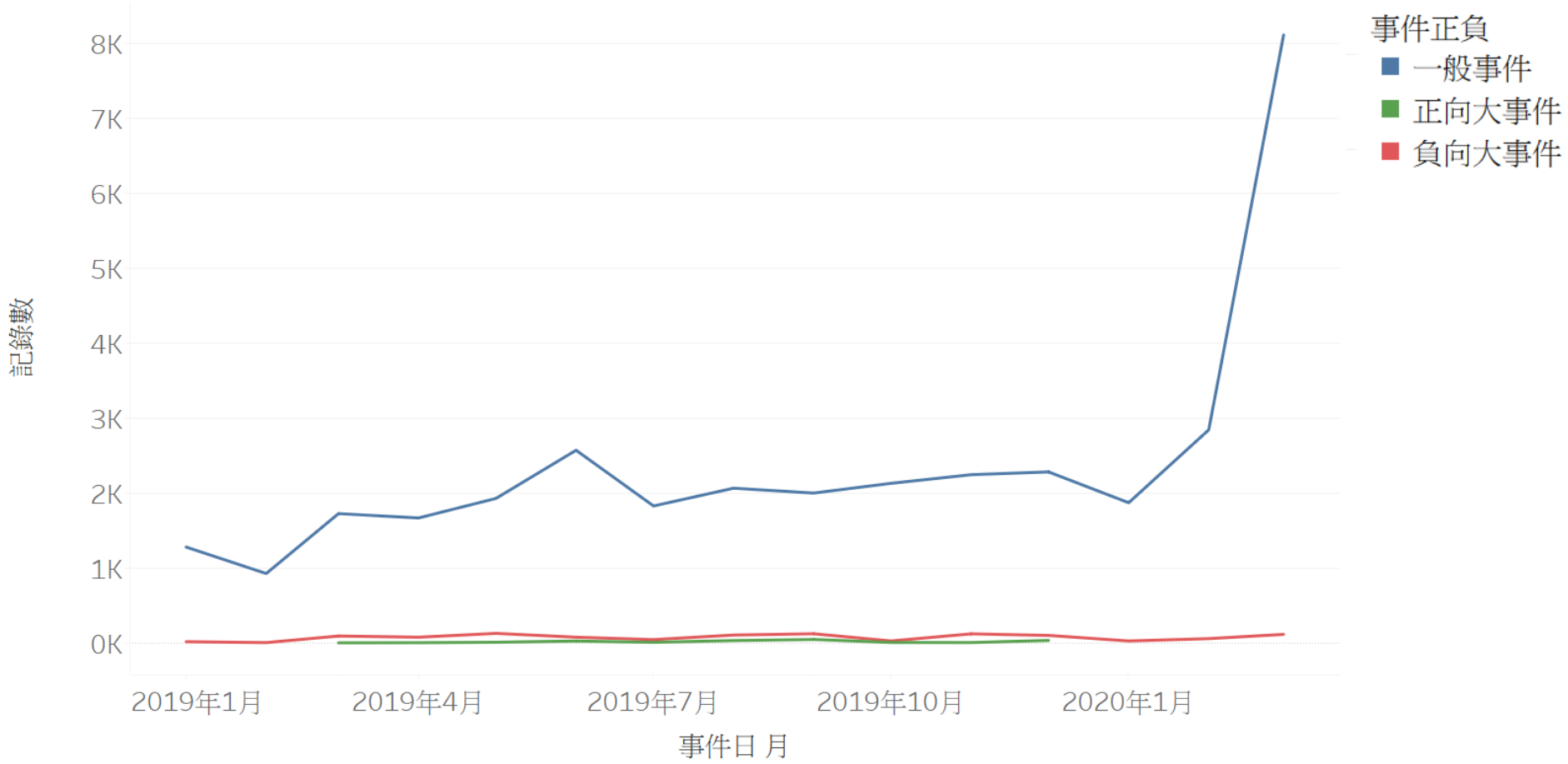
# Pain Point –
# Important events can’t be highlighted right away



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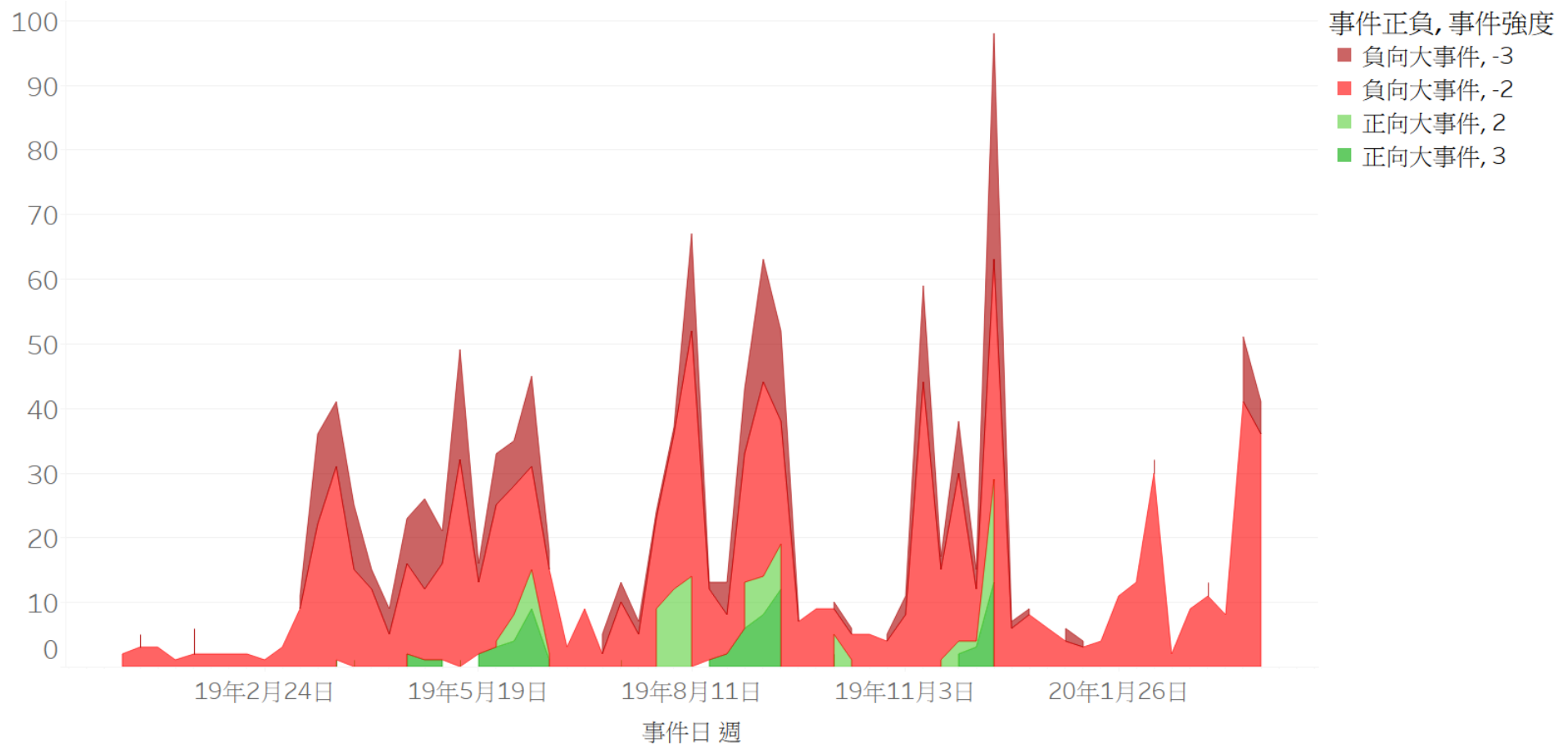
# Pain Point –
# Important events can’t be highlighted right away



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Section II

# Data Analysis

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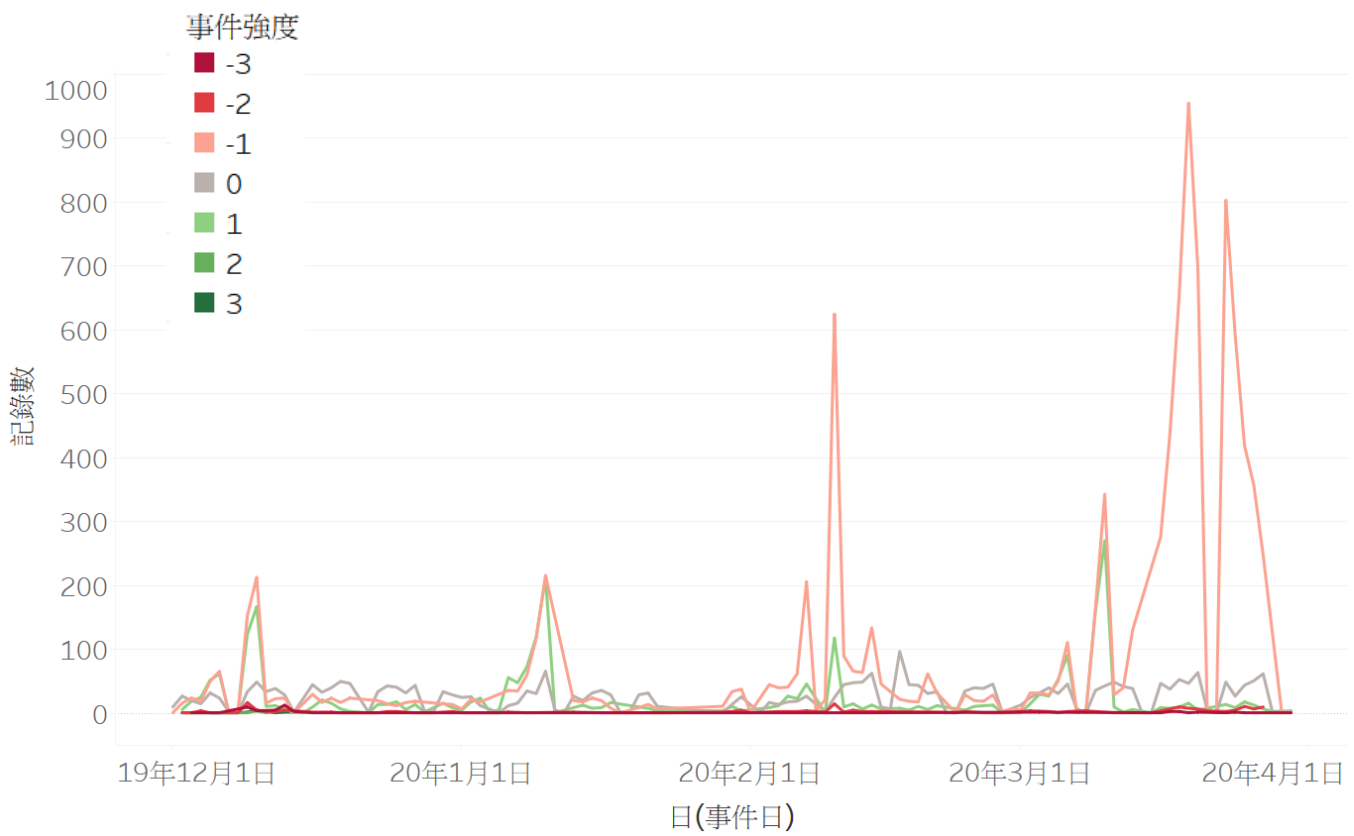
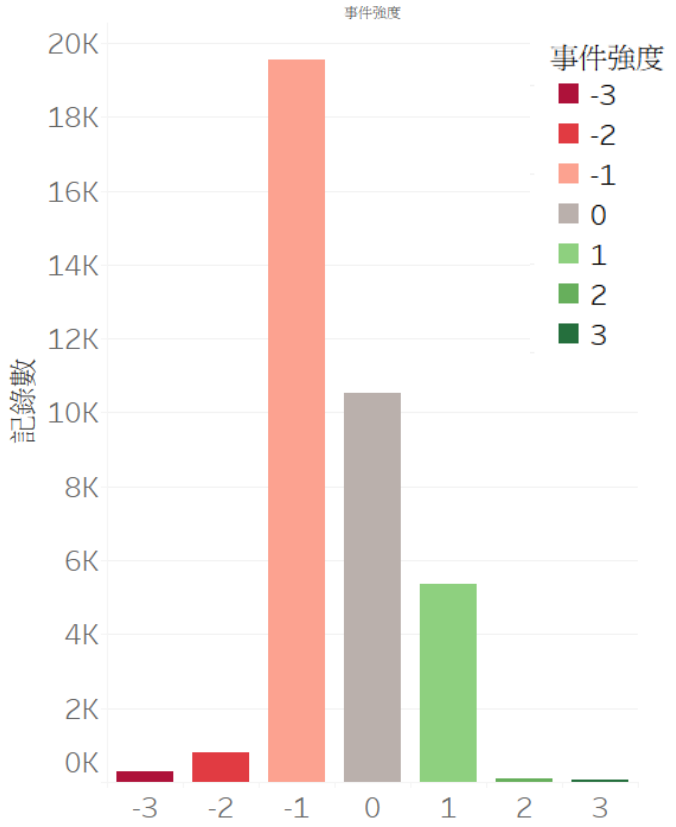
# Data Set – Exploratory Data Analysis (EDA)

- Data description
  - 36,717 rows
  - From January 2019  to March 2020
- Influence of the event
  - -3 ~ +3
- Big event number: 5
  - Small event number: 99
- Corporation number: 1,980
- TCRI types: 1 to 9, C, D, Null
- Contents number: 35,338

# EDA – Influence of the event



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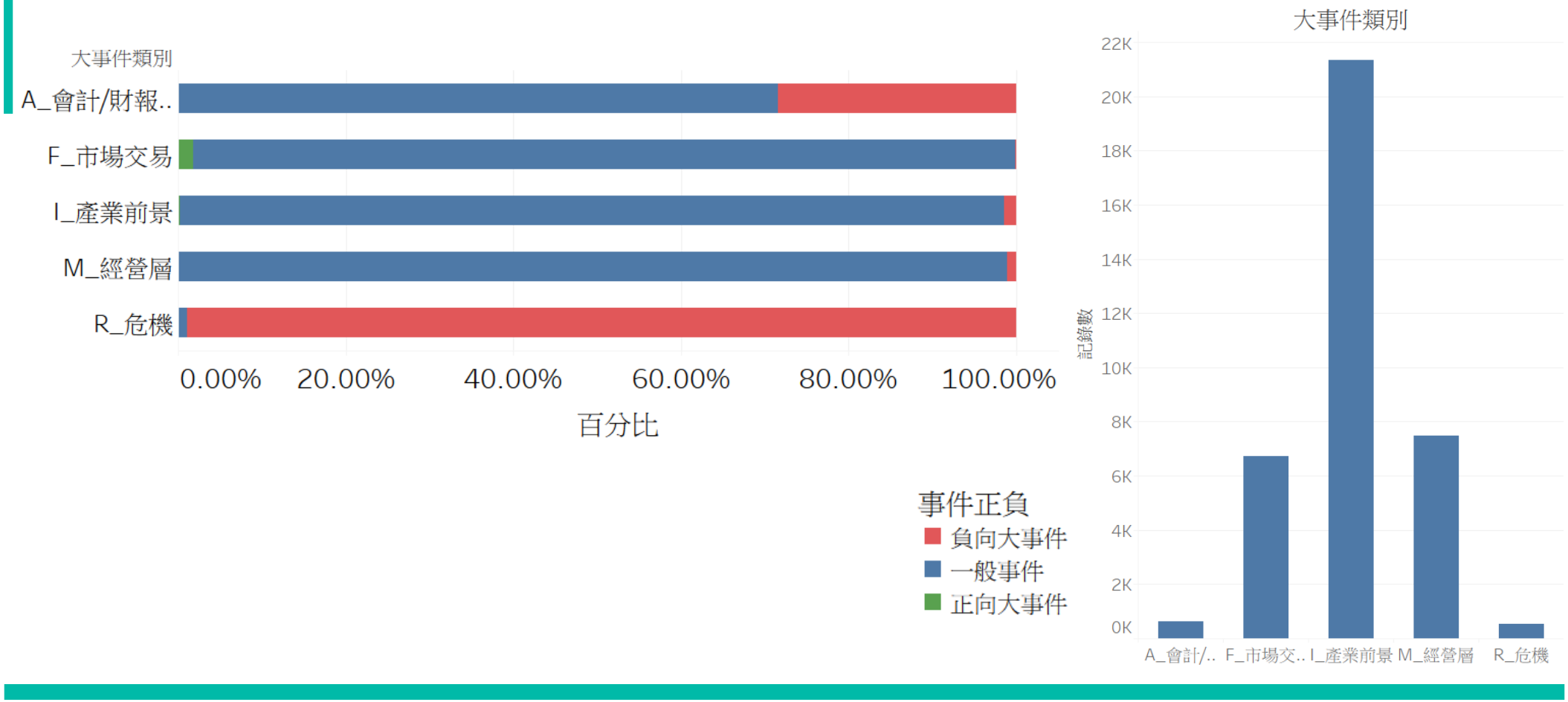
# EDA – Big Event



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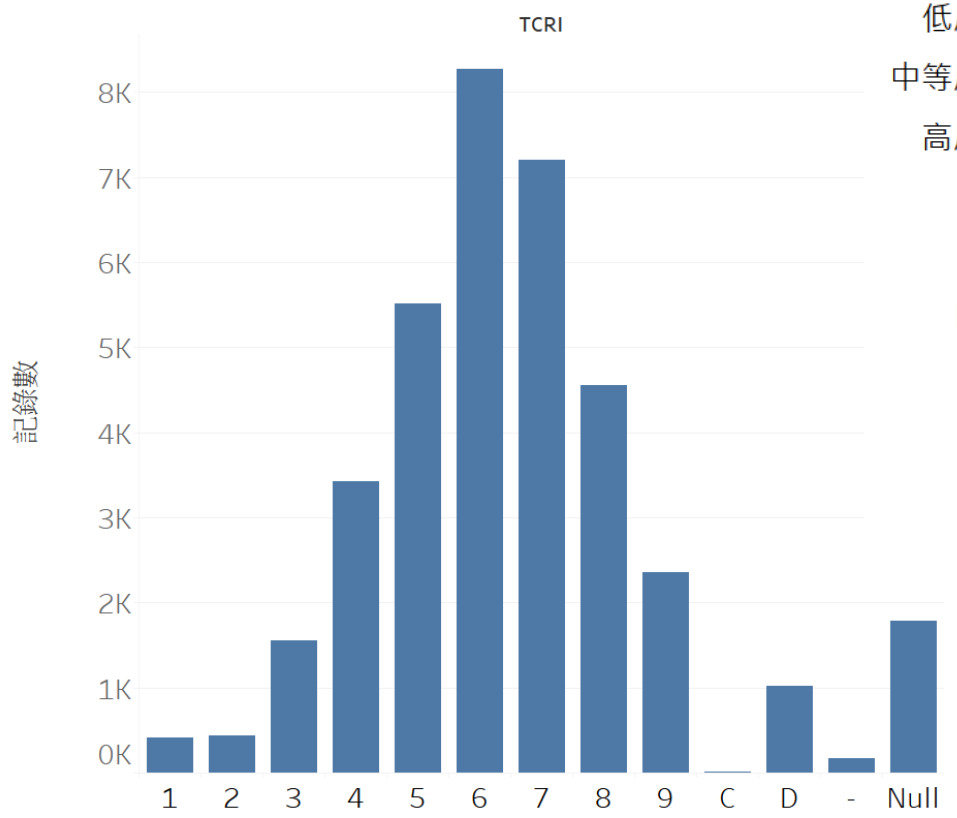
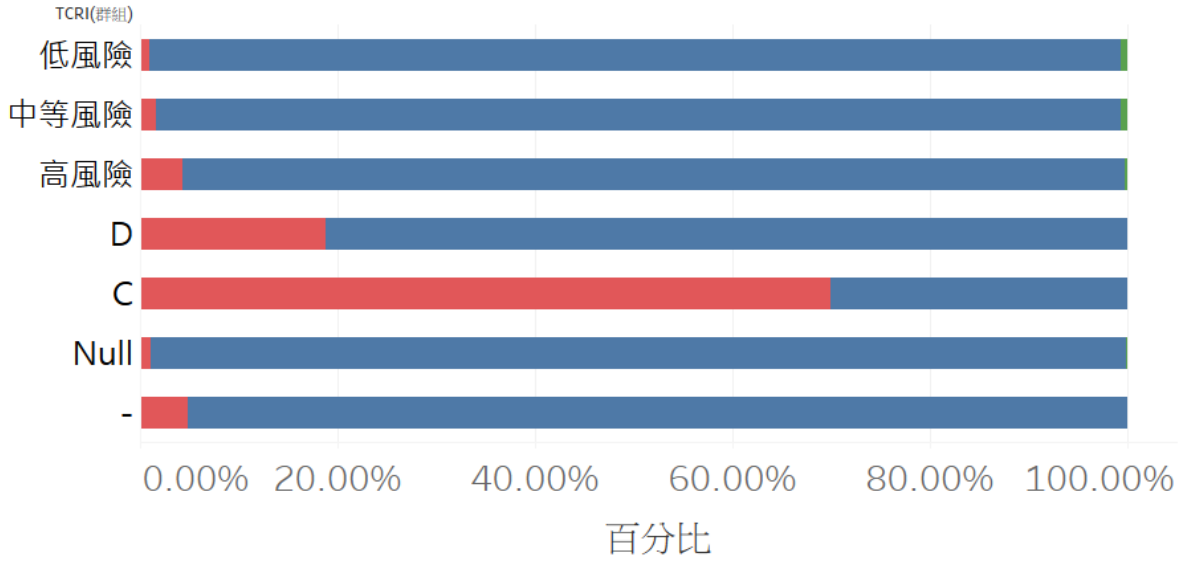
# TCRI Introduction

- What is TCRI:
  - Experts judge most of the public companies except for some industry like financial industry or companies that are founded within four years.
- TCRI Ranking:
  - 1~4 Cash Flow Lending
  - 5~6 Cash Flow Lending/Asset Lending
  - 7~9 Asset Lending Level
  - D Financial Crisis
  - C Didn’t Disclose Financial Statement In Time

From https://www.tej.com.tw/twsite/Default.aspx?TabId=168

# EDA – TCRI




**低風險：TCRI 1 - 4**

**中等風險：TCRI 5 - 6**

**高風險：TCRI 7 - 9**

取自 https://www.tej.com.tw/twsite/Default.aspx?TabId=168



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# Data Preprocessing – Segmentation System


**JIEBA**

| System | CKIP | Jieba(結巴) |
|---|---|---|
| Developer | Academia Sinica | M.S. Student from China |
| Model | BiLSTM + CNN | Trie DAG + HMM |
| Speed | Slower (15 minutes) | Faster (two minutes) |
| Note | No specific dictionary | Precise mode<br>No specific dictionary |

# Problem of Jieba

- Names

```
[['發言人', '林俐婉', '內部', '調動', '由江巍峰', '接任'],
 ['內部', '稽核', '主管', '林', '志強', '內部', '調動', '由', '莊文清', '接任'],
 ['會計', '主管', '藍俊雄', '內部', '調動', '由林鴻名', '接任'],
 ['內部', '稽核', '主管', '游本', '詮', '內部', '調動', '由', '曾筱茜', '接任'],
 ['財務經理', '洪廷宜', '內部', '調動', '由', '王婷', '渝', '接任'],
 ['研發', '主管', '吳政峰', '內部', '調動', '由', '朱清立', '接任'],
 ['總經理', '高', '進義', '離職', '由陳譽', '接任', '發言人', '高', '進義', '離職', '由陳譽', '接任'],
 ['改派',
```

- Thousandths

```
'01',
'/',
'02',
'設質',
'1',
',',
'200',
',',
'000',
'股給',
'元宣',
'不限',
'用途',
```



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# Problem of CKIP

- Inconsistency in date segmentation

```
In [71]: words_list
          '一般',
          '交易',
          '。',
          '。'],
         ['內部', '稽核', '主管', '莊金維', '離職
         ['2019',
          '/',
          '01/02',
          '收盤價',
          '17.00',
          '元',
          ',',
          '月',
```

```
In [71]: words_list
          '。'],
         ['辭任', '1', '董', '。',
         ['董事長',
          '本人',
          '正邦',
          '投資',
          '2019/01/02',
          '設質',
          '1,200,000',
          '股',
          '給',
          '元富',
```



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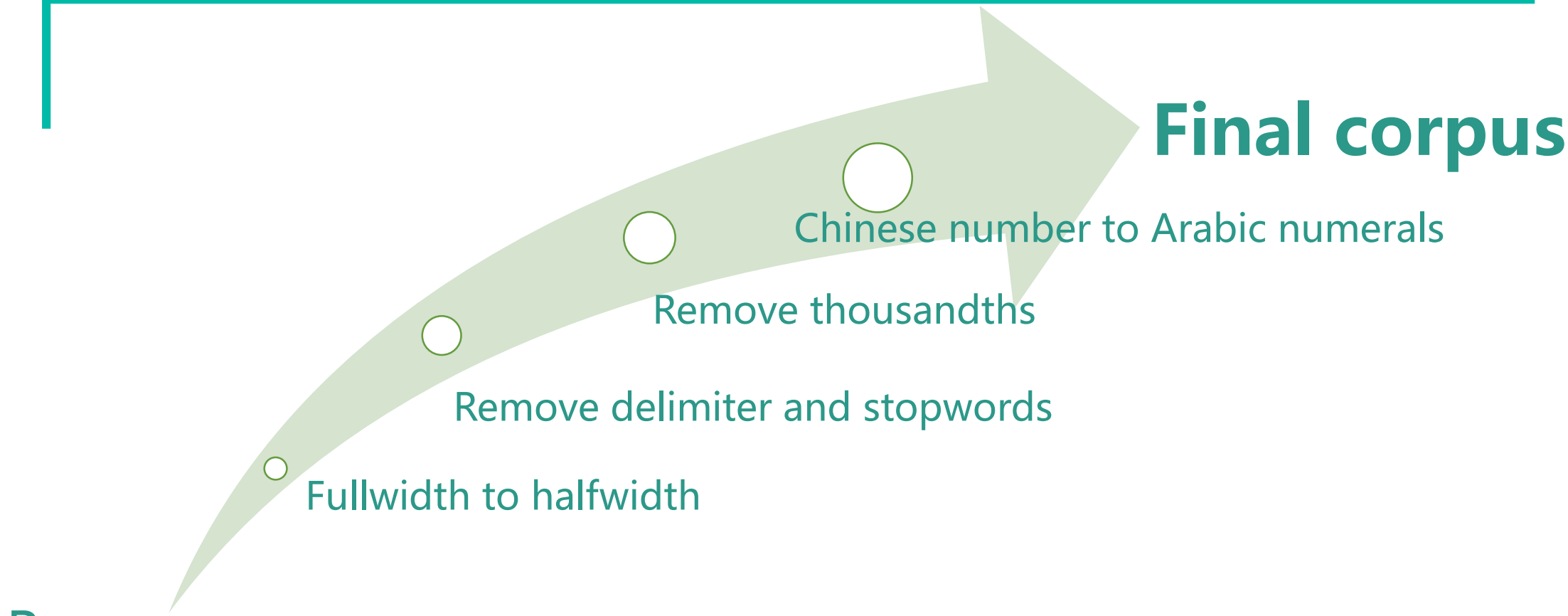
# Other Data Preprocessing



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# Word Embedding – FastText

- Released by Facebook
  - An extension of the word2vec model
- Understanding the meaning of “subword”
  - Based on characters instead of words
- Transform each word from CKIP (Jieba) to embedding
- E.g.: 發言人 林俐婉 內部 調動 由江巍峰 接任

➔ (6, 300) features

```
[[-0.149 , -0.1961,  0.1495, ...,  0.0319, -0.0883,  0.0485],
 [-0.029 , -0.0061,  0.5102, ..., -0.1517, -0.0941, -0.0351],
 [-0.1419,  0.0704,  0.4526, ..., -0.0045, -0.0592, -0.0627],
 [ 0.2194, -0.0813,  0.3686, ..., -0.015 ,  0.0365, -0.0035],
 [ 0.0073, -0.0087,  0.0978, ...,  0.1146,  0.0602,  0.0774],
 [ 0.    ,  0.    ,  0.    , ...,  0.    ,  0.    ,  0.    ]]
```

Section III

# Machine Learning Models

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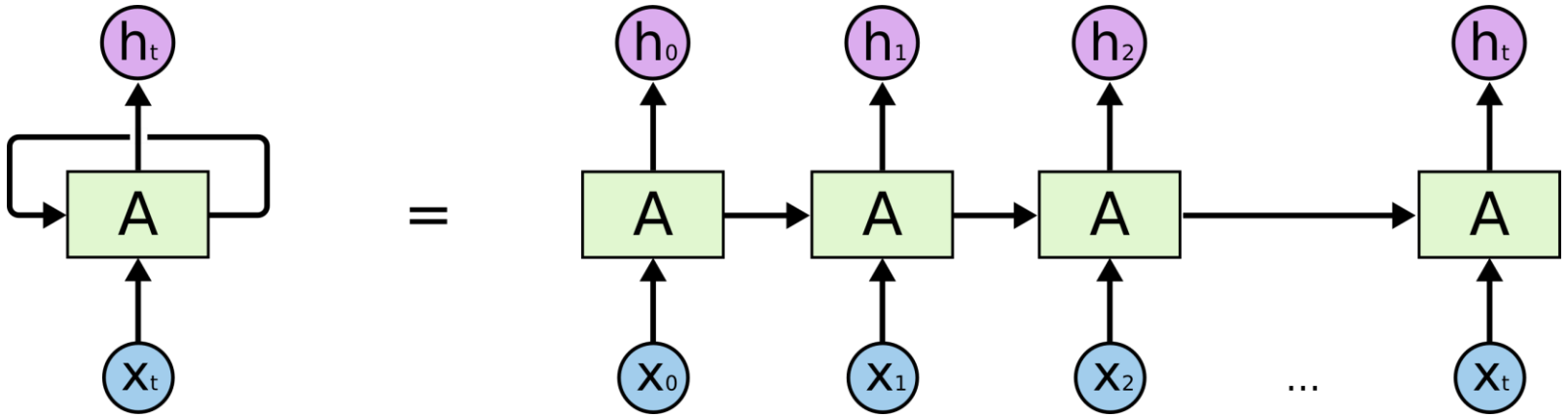
# Recurrent Neural Network

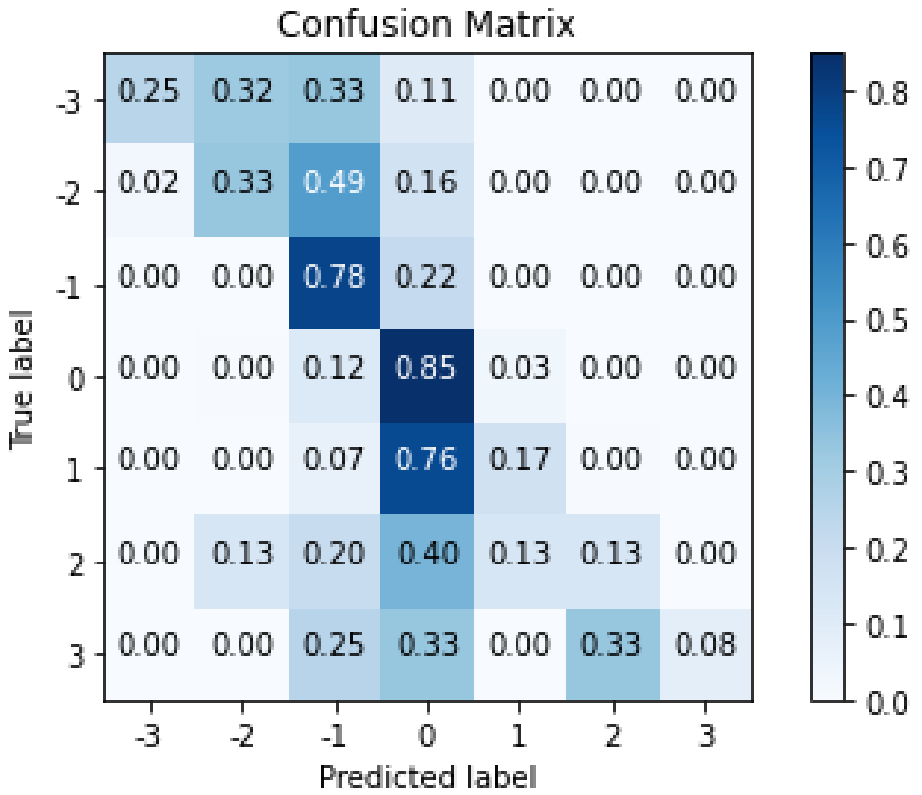
- Extract information from a temporal sequence
- Applications
  - Stock prediction
  - Machine translation
  - Speech synthesis



# Simulation Results – RNN

- Set max_sequence_length to 100
- Single layer LSTM
- Regression

- Train Acc: 0.8149423113296765
- Train MSE: 0.2325784826011588
- Test Acc: 0.696350762527233 2
- Test MSE: 0.3689669900819255



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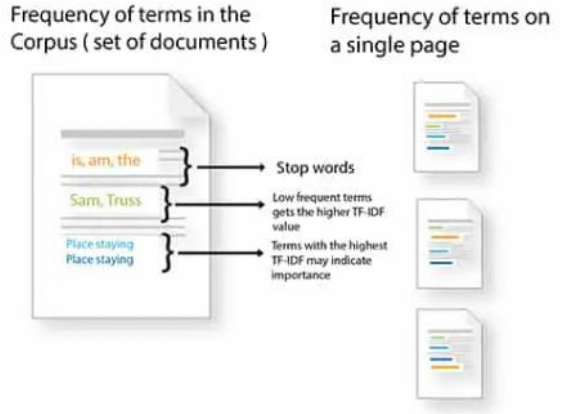
# Problem of RNN

- A huge range of sequence length
  - max_sequence_length = 1442
  - min_sequence_length = 3
  - avg_sequence_length = 50
- RNN can’t effectively extract information from the sentence
- The importance of words in each sentence is ignored

# Term Frequency-Inverse Document Frequency (TF-IDF)

- Term frequency: $\mathrm{tf}_{i,j} = \frac{n_{i,j}}{\sum_k n_{k,j}}$
  - The frequency of $t_i$ in document $d_j$
- Inverse document frequency: $\mathrm{idf}_i = \log \frac{|D|}{|\{j : t_i \in d_j\}|}$
  - $t_i$ is common or rare across all documents
- $\mathrm{tfidf}_{i,j} = \mathrm{tf}_{i,j} \times \mathrm{idf}_i$
  - Evaluate the importance of $t_i$ in document $d_j$
  - Filter out common terms and keep the important words



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# Sentence Embedding

- Use TF-IDF results to weight the word embedding in each sentence
  - TF-IDF: $|dataset| \times |bag\_of\_word| = (36717, 71590)$
  - Word embedding: $|bag\_of\_word| \times dimension = (71590, 300)$
- Sentence embedding: $\text{TFIDF} \times \text{Word Embedding} = (36717, 300)$
- Use 300 dimensions to represent each sentence

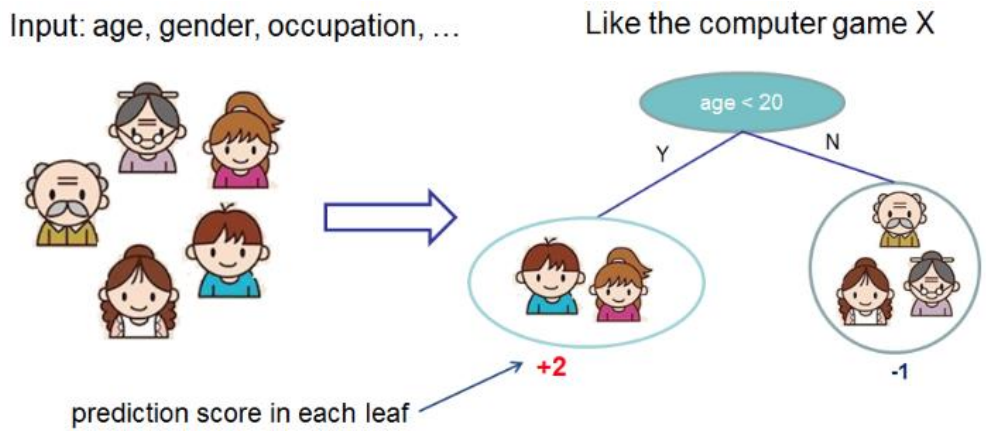
- E.g.: 發言人 林俐婉 內部 調動 由江巍峰 接任

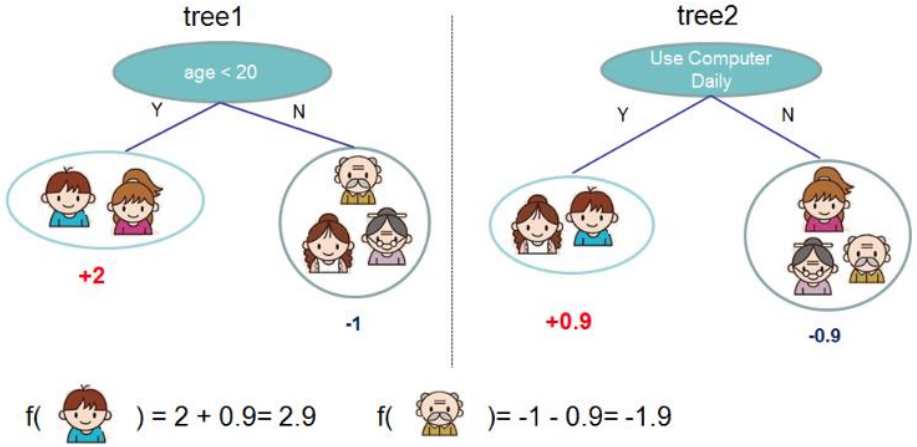
➔ (1, 300) features

# Extreme Gradient Boosting (XGBoost)

- Tree-based classifier
  - Ensemble of many weak prediction models

**XGBoost**
**eXtreme Gradient Boosting**



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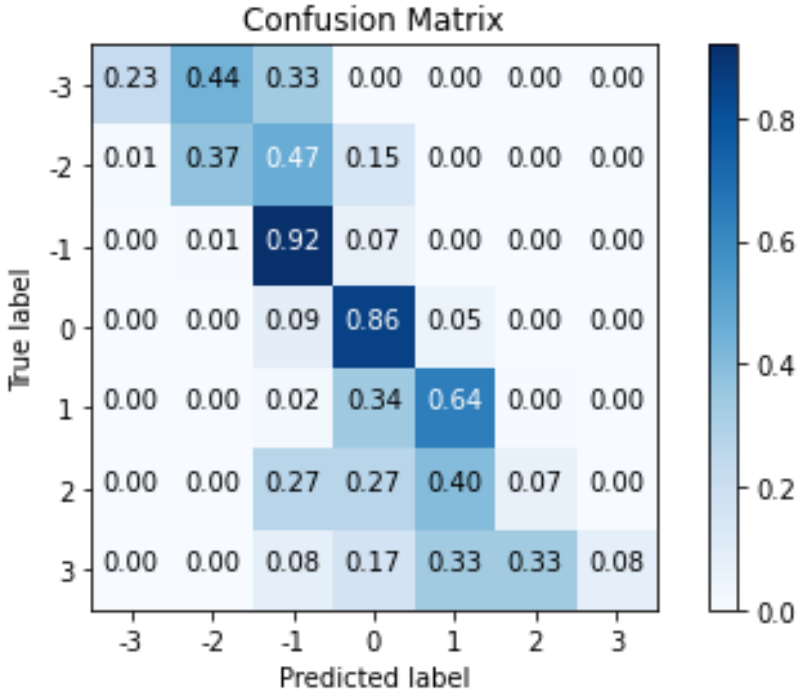
# Simulation Results: XGBoost

- xgb.XGBRegressor(max_depth=6, n_estimators=120)

- Train Acc: 0.9738194940932149
- Train MSE: 0.030195149706289694
- Test Acc: 0.8404139433551199
- Test MSE: 0.17954414897565352

- Slight overfitting



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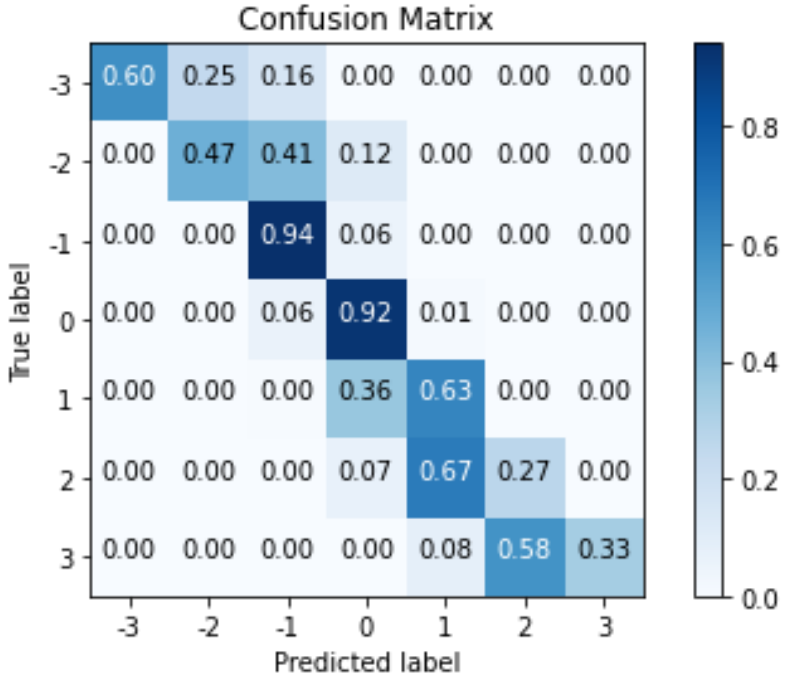
# Simulation Results: DNN

- Three hidden layers: (100, 50, 10)
- Regression

- Train Acc: 0.9078872706638925
- Train MSE: 0.08210409228625334
- Test Acc: 0.8748638344226579
- Test MSE: 0.12685892429858606

- Better than XGBoost



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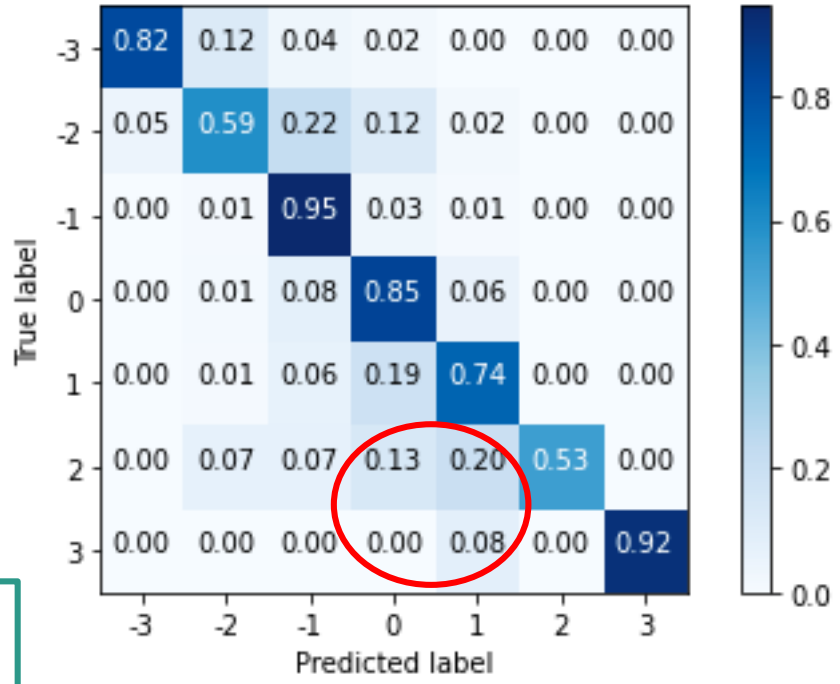
# Simulation Results: K Nearest Neighbors (KNN)

- K=3

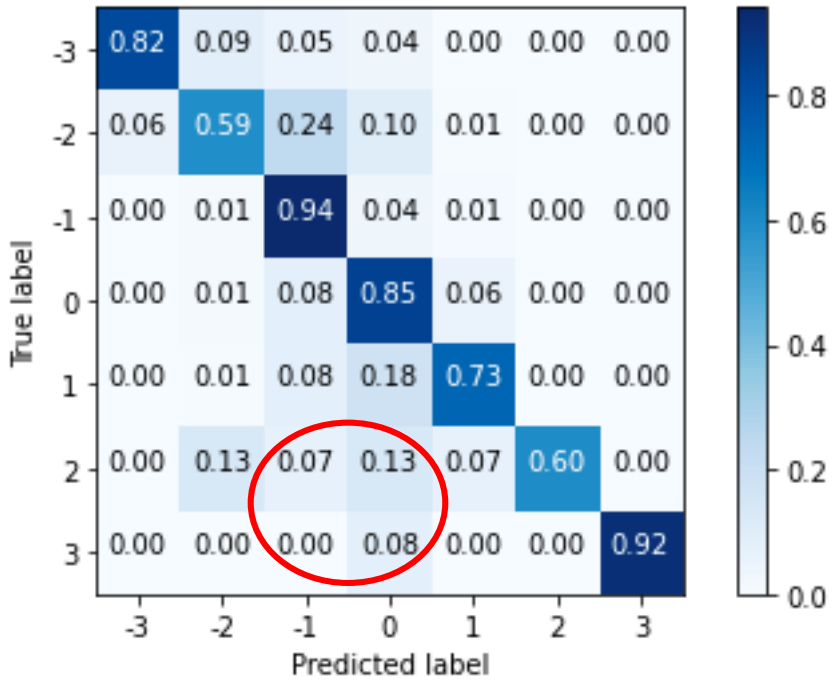
Similar accuracy as NN, but worse MSE

CKIP Confusion Matrix




Test Acc: 0.8775871459694989
Test MSE: 0.2120980392156862

Jieba Confusion Matrix




Test Acc: 0.8759531590413944
Test MSE: 0.21541394335511982



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# Problem of KNN

- “Imbalance data”→ Hard to select the best “k” to enhance the accuracy of minority

```
2
緯創軟體第 2 季營收 14.09 億元，季增 9.64%、年增 47.57%，毛利率 26.06%，營益率 9.85%，稅後純益 1.43。億
元，季增 73.63%、年增 64.47%，每股純益 2.37 元。上半年營收 26.93 億元，年增 52%，毛利率 25.04%，營。益率
8.82%，稅後純益 2.26 億元，年增 97.8%，每股純益 3.74 元。緯軟公布 7 月合併營收，達 4.77 億元，。月增 0.3
7 %、年增 40.95%，累計前 7 月合併營收 31.7 億元，年增 50.22%。緯軟上半年營收動能來自各地區的。業務成長包含
中國、台灣、香港、日本及美國，上半年各地區營收占比為中國 54%、台灣及香港 28%、日本 15%、。其他地區則為 3%。。

Out[41]: array([0.        , 0.33333333, 0.        , 0.        , 0.33333333,
                0.33333333, 0.        ])

Out[52]: array([0. , 0.2, 0.2, 0.2, 0.2, 0.2, 0. ])
```

- Hard to quantify Numerical Value

2019年10月累計營收833,569千元，年減18%。2019年10月單月營收124,687千元，年增68%。。

2019年12月累計營收626,923千元，年減2%。2019年12月單月營收65,838千元，年增61%。。

Section IV

# Feature Analysis

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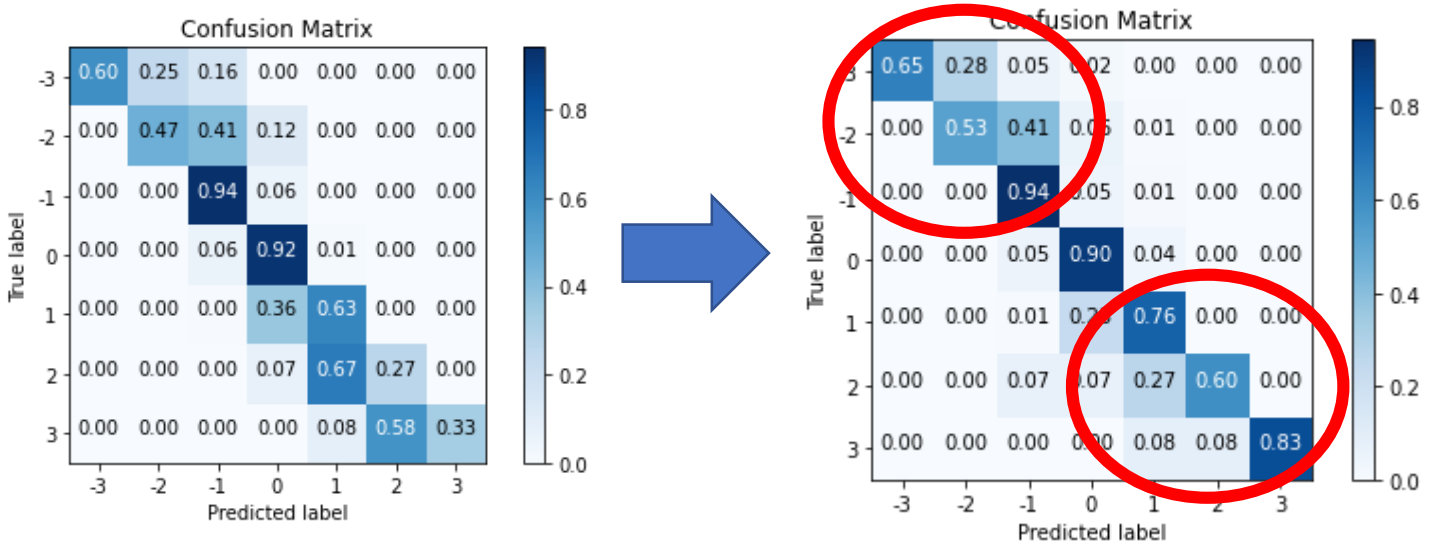
# Feature Analysis: Big Event & Small Event

- Train Acc: 0.9309249101569889
- Train MSE: 0.06798529576694025
- Test Acc: 0.8924291938997821
- Test MSE: 0.1149138222915533




Effectively improve the prediction accuracy of important event



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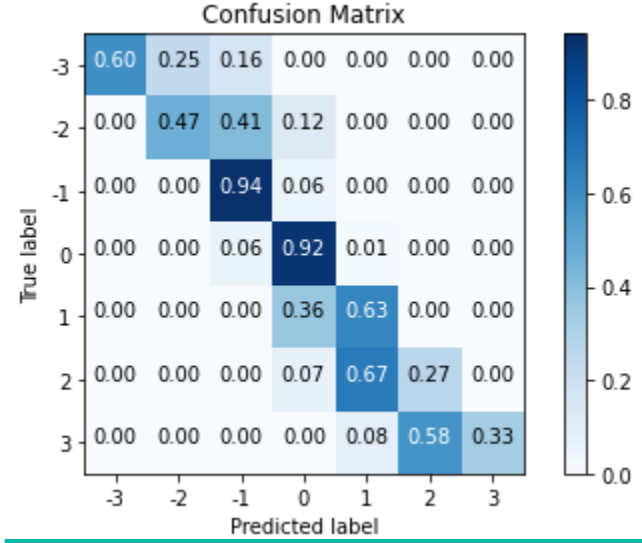
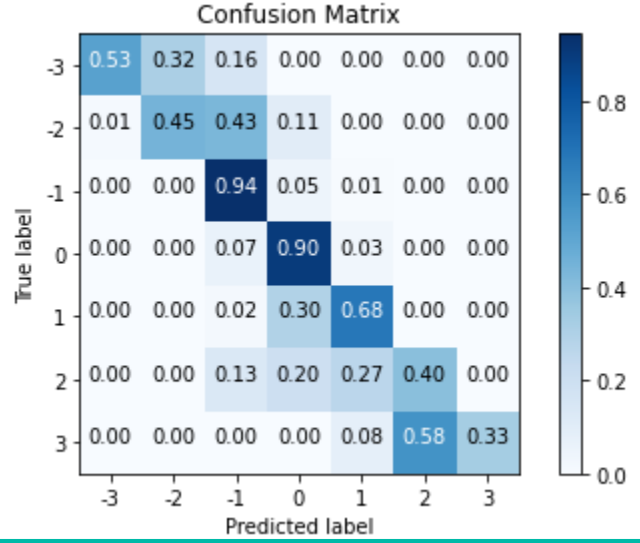
# Feature Analysis: Stock

- Train Acc: 0.926423302439947 1
- Train MSE: 0.06658710773337446
- Test Acc: 0.878131808278867 (0.874863834422657 9)
- Test MSE: 0.1335647368088782




Only slight improvement



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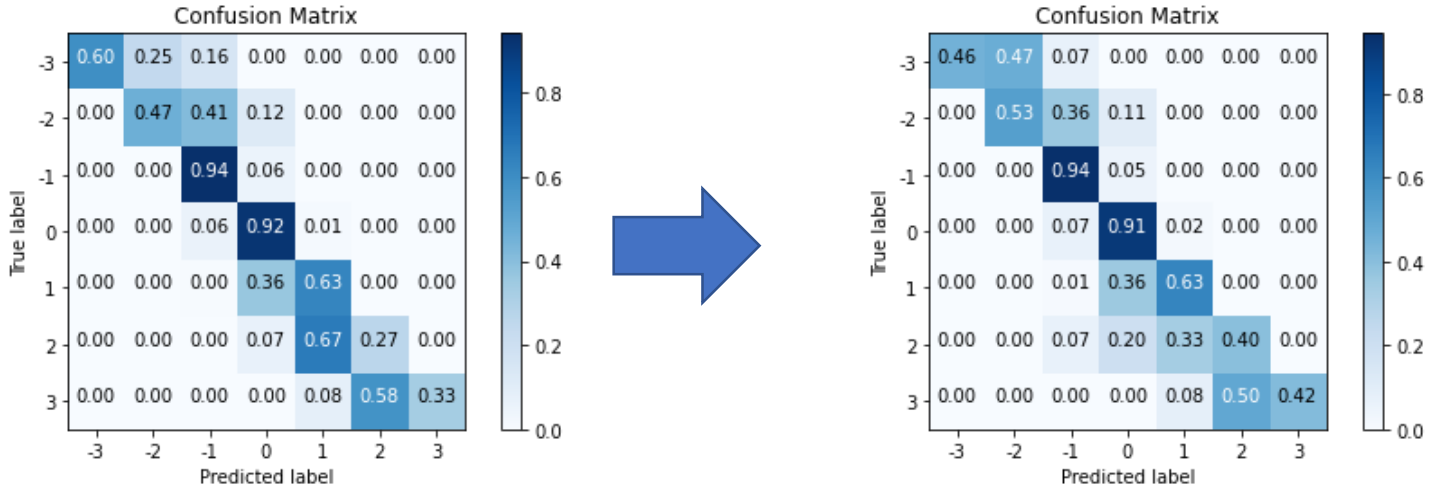
# Feature Analysis: TCRI

- Train Acc: 0.9082277283903916
- Train MSE: 0.08263161848890271
- Test Acc: 0.8737745098039216 (0.8748638344226579)
- Test MSE: 0.1283124475097719 4







Can’t improve accuracy



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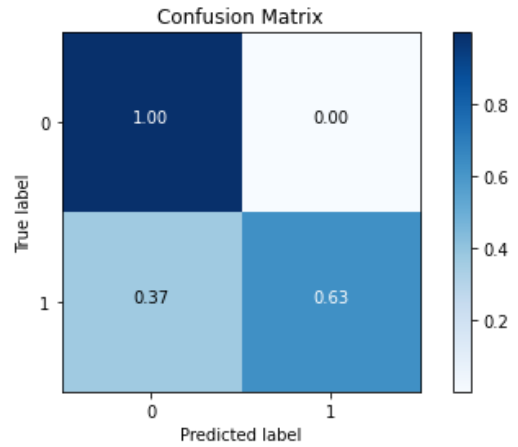
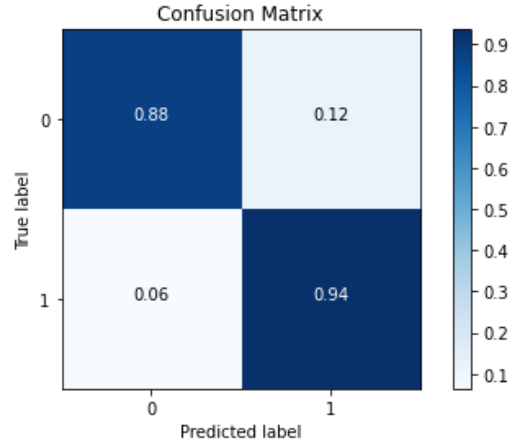
# Importance of Event Prediction

- Absolute value >= 2 ➔ important
- Only 3.467% is important ➔ imbalance
- Test Acc: 0.984856209150327
- Test MSE: 0.013307634




- Absolute value >= 1 ➔ important
- 71.332% is important
- Test Acc: 0.9195261437908496
- Test MSE: 0.059115127



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Section V

# Conclusion & Future Work

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# Conclusion & Future Work

- Conclusion
  - Achieve about 87% prediction accuracy with small MSE
  - Preprocessing is important (KNN)
  - TF-IDF is useful

- Future Work
  - Dataset - imbalanced data
  - More powerful model - BERT

# Work Assignment

- 鄧傑方 : TF-IDF, NN Modeling, Demo, PPT
- 連奕茹 : KNN, Video Making, PPT
- 林韋丞 : EDA, PPT
- 林聖硯 : Data Preprocessing, Video Making, PPT

# Other Information

**Video**

https://youtu.be/G6nf6FLQOTA

**Demo**

http://140.112.20.131:1402/

- Github link: https://github.com/JieFangD/AI-News-Scoring-System

# Section VI

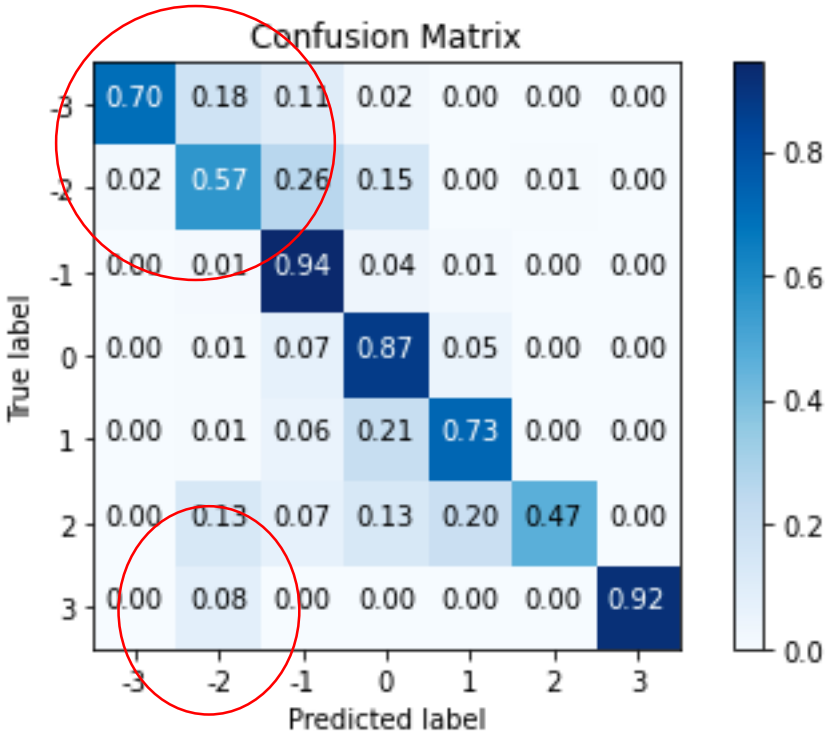
# Appendix

# K Nearest Neighbors (KNN)

- Select the best “K”

```
 'mean_test_score': array([0.85643278, 0.86565894, 0.8712423 , 0.86926769, 0.87114016,
        0.87001668, 0.86991455, 0.86865489, 0.86824635, 0.867225  ,
        0.86508018, 0.86371838, 0.86368434, 0.86187996, 0.86205018,
        0.86075648, 0.85983727, 0.85936064, 0.85878187, 0.85837334,
        0.85772648, 0.85684132, 0.85592211, 0.85571784, 0.85452627]),
 'std_test_score': array([0.00211875, 0.00169534, 0.00312784, 0.00369274, 0.00347863,
        0.00331665, 0.00353533, 0.00370731, 0.00510545, 0.00384426,
        0.00379534, 0.00376731, 0.00392009, 0.00361048, 0.00341584,
        0.00459027, 0.00514016, 0.00517077, 0.00484017, 0.00532159,
        0.00563123, 0.0049465 , 0.00471049, 0.00503715, 0.00548359]),
 'rank_test_score': array([22,  9,  1,  5,  2,  3,  4,  6,  7,  8, 10, 11, 12, 14, 13, 15, 1
6,
        17, 18, 19, 20, 21, 23, 24, 25], dtype=int32)}
```

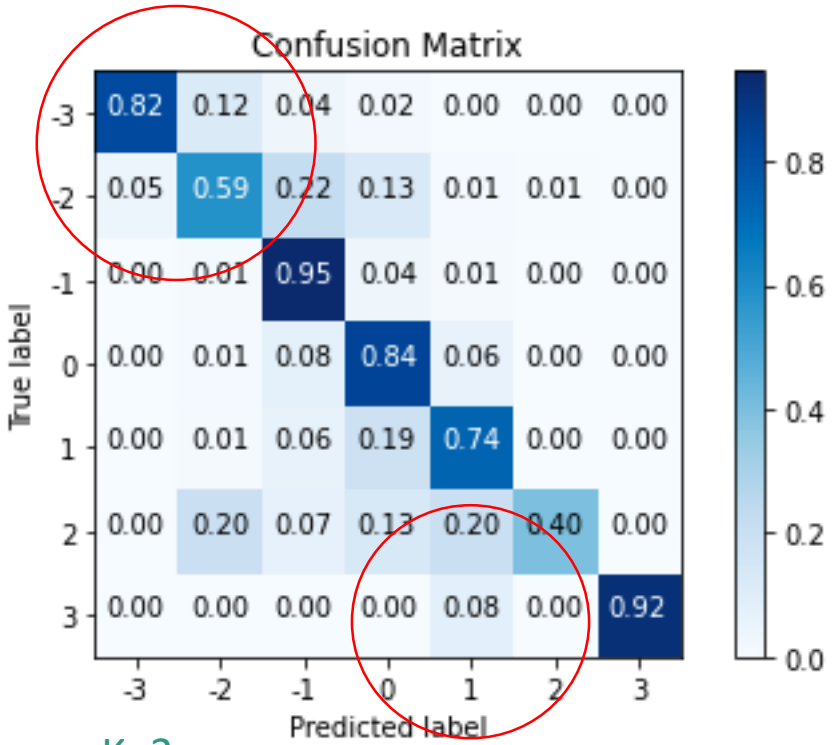
# CKIP: K=3 vs K=5




K=5:

Test Acc: 0.880718954248366

Test MSE: 0.2017973856209150 4




K=3:

Test Acc: 0.876633986928104

Test MSE: 0.2184095860566448 7



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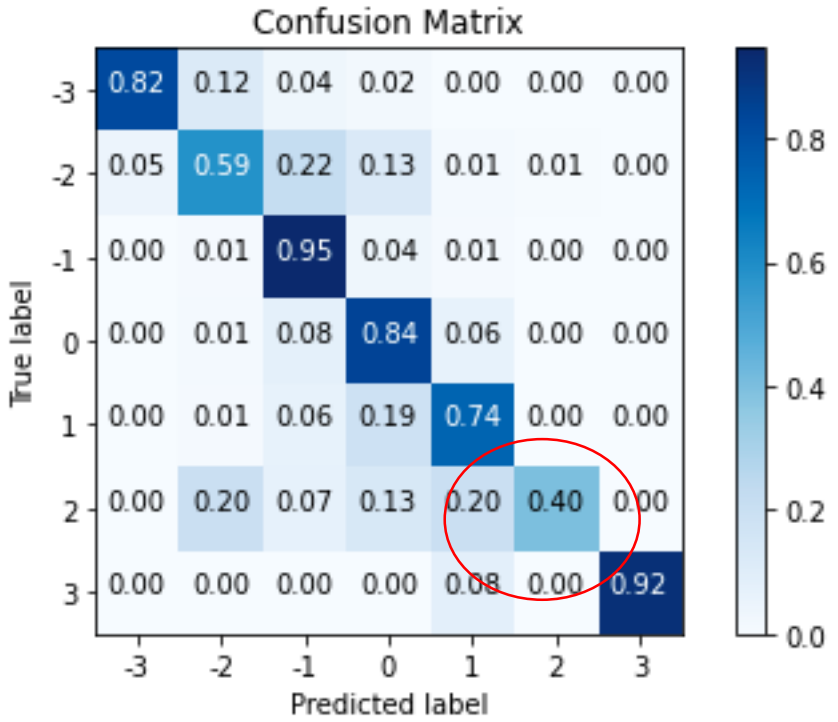
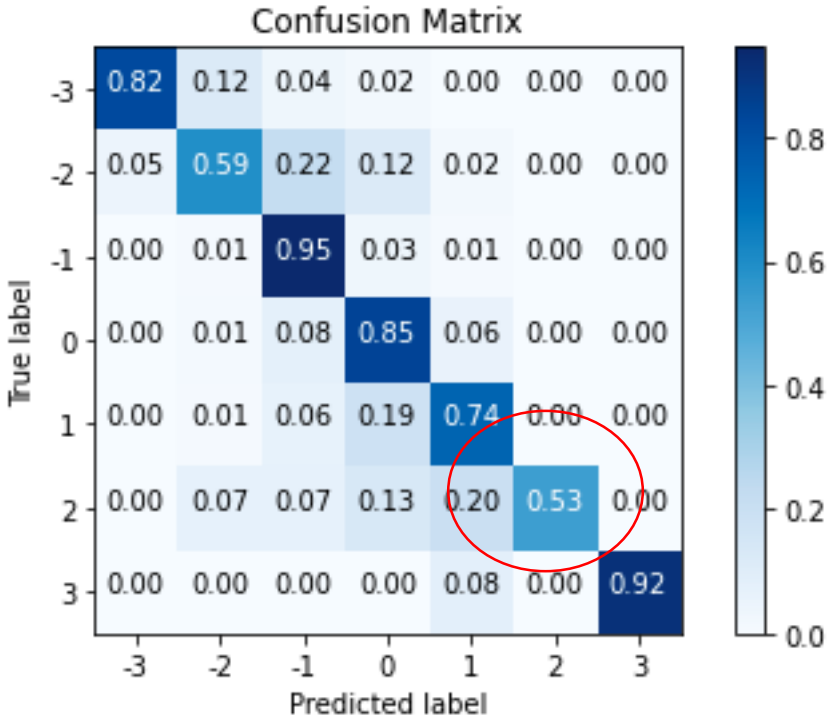
# Improvement of CKIP




K=3:

Test Acc: 0.876633986928104 6

Test MSE: 0.21840958605664487




K=3:

Test Acc: 0.8775871459694989

Test MSE: 0.21200980392156862



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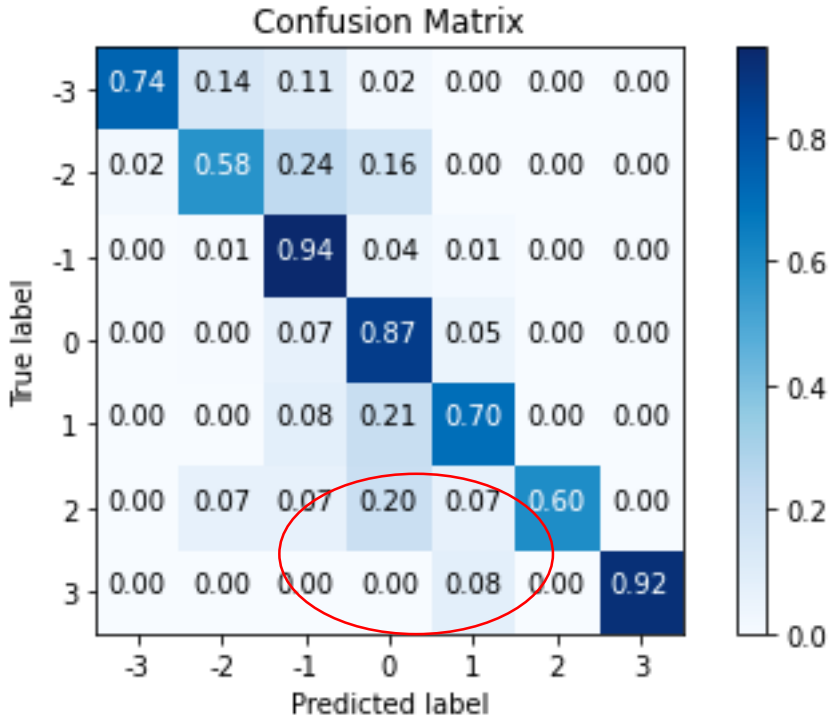
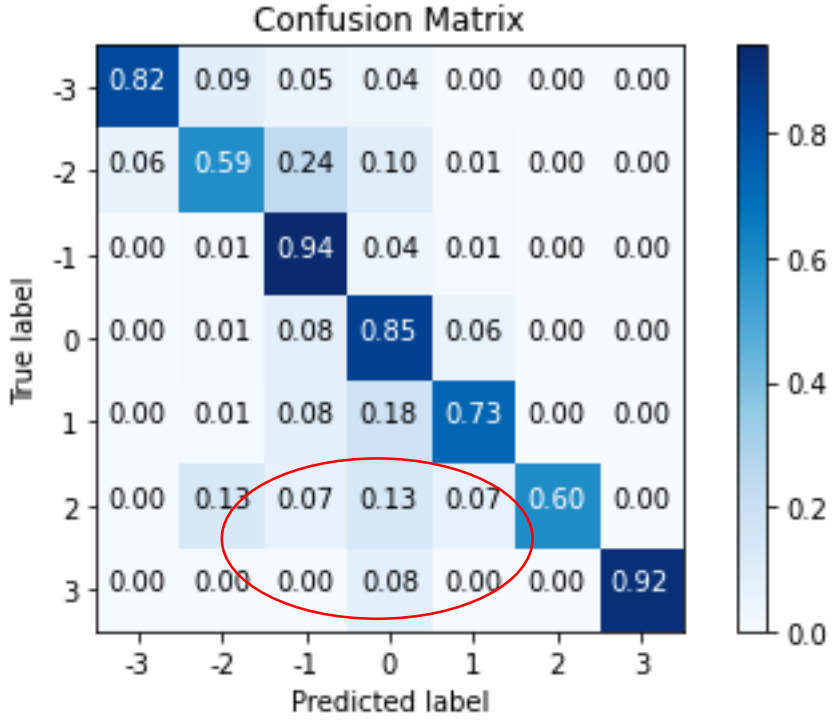
# Jieba: K=3 vs K=5




K=5

Test Acc: 0.8779956427015251

Test MSE: 0.2079248366013072




K=3:

Test Acc: 0.8759531590413944

Test MSE: 0.21541394335511982



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