

## 深度學習 RNN模型作業

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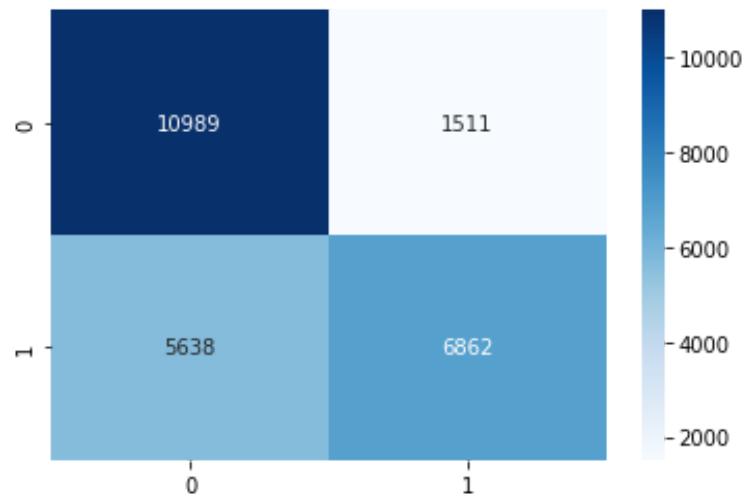
- Simple RNN (total\_words = 1000 , padding max\_len = 500)

```
Model: "sequential_1"
-----
Layer (type)          Output Shape       Param #
=====
embedding_1 (Embedding)    (None, 500, 32)      32000
simple_rnn (SimpleRNN)     (None, 500, 100)     13300
simple_rnn_1 (SimpleRNN)   (None, 500, 50)      7550
simple_rnn_2 (SimpleRNN)   (None, 25)           1900
dense_1 (Dense)           (None, 1)            26
-----
Total params: 54,776
Trainable params: 54,776
Non-trainable params: 0
-----
None
```

詳細資訊

```
Epoch 1/10
157/157 [=====] - 218s 1s/step - loss: 0.6952 - acc: 0.5117 - val_loss: 0.6901 - val_acc: 0.5160
Epoch 2/10
157/157 [=====] - 216s 1s/step - loss: 0.6961 - acc: 0.5312 - val_loss: 0.7375 - val_acc: 0.4962
Epoch 3/10
157/157 [=====] - 215s 1s/step - loss: 0.6965 - acc: 0.5132 - val_loss: 0.6935 - val_acc: 0.5074
Epoch 4/10
157/157 [=====] - 215s 1s/step - loss: 0.6914 - acc: 0.5228 - val_loss: 0.6818 - val_acc: 0.5588
Epoch 5/10
157/157 [=====] - 213s 1s/step - loss: 0.6592 - acc: 0.5839 - val_loss: 0.5977 - val_acc: 0.6756
Epoch 6/10
157/157 [=====] - 215s 1s/step - loss: 0.5765 - acc: 0.6977 - val_loss: 0.5279 - val_acc: 0.7482
Epoch 7/10
157/157 [=====] - 216s 1s/step - loss: 0.6111 - acc: 0.6668 - val_loss: 0.6001 - val_acc: 0.6728
Epoch 8/10
157/157 [=====] - 215s 1s/step - loss: 0.5565 - acc: 0.7078 - val_loss: 0.5523 - val_acc: 0.7228
Epoch 9/10
157/157 [=====] - 215s 1s/step - loss: 0.6010 - acc: 0.6746 - val_loss: 0.5204 - val_acc: 0.7418
Epoch 10/10
157/157 [=====] - 215s 1s/step - loss: 0.5116 - acc: 0.7544 - val_loss: 0.5631 - val_acc: 0.7052
```

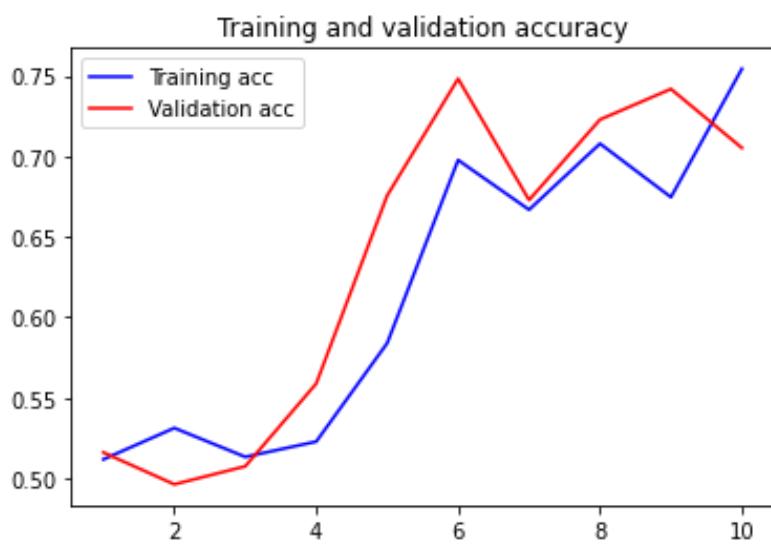
## Training & Validation



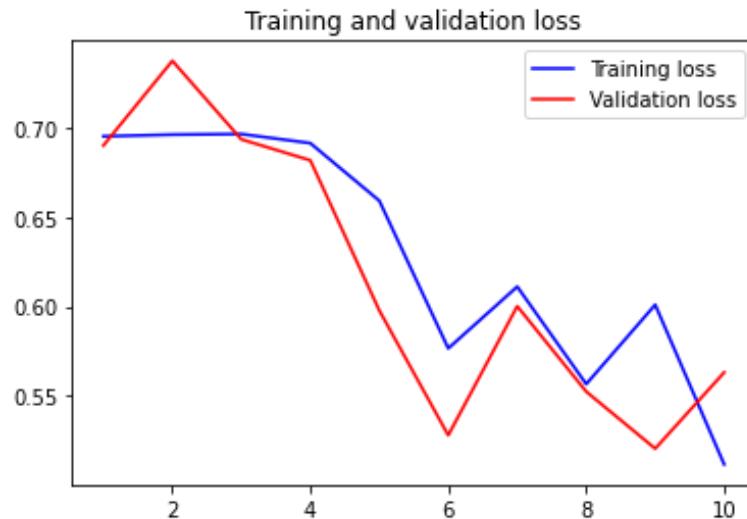
Heatmap

	precision	recall	f1-score	support
0	0.66	0.88	0.75	12500
1	0.82	0.55	0.66	12500
accuracy			0.71	25000
macro avg	0.74	0.71	0.71	25000
weighted avg	0.74	0.71	0.71	25000

Classification Report



Accuracy



Loss

- SimpleRNN (total\_words = 10000 , padding max\_len = 500)

```
↳ Model: "my_rnn_1"
```

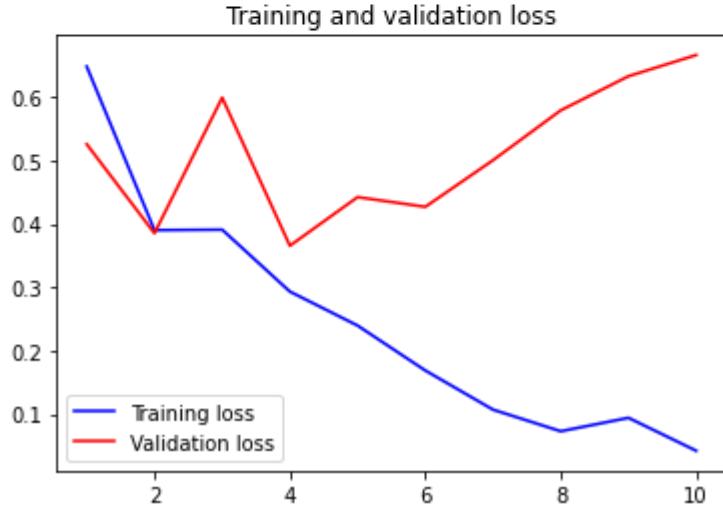
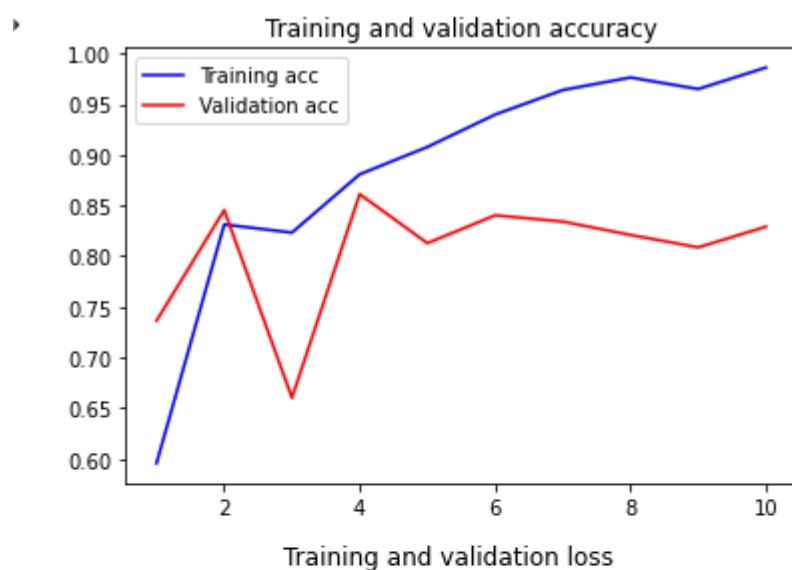
Layer (type)	Output Shape	Param #
embedding_1 (Embedding)	multiple	1000000
simple_rnn_cell_2 (SimpleRN NCell)	multiple	10560
simple_rnn_cell_3 (SimpleRN NCell)	multiple	8256
dense_1 (Dense)	multiple	65

```
Total params: 1,018,881
Trainable params: 1,018,881
Non-trainable params: 0
```

詳細資訊

```
Epoch 1/10  
195/195 [=====] - 74s 199ms/step - loss: 0.6477 - acc: 0.5956 - val_loss: 0.5253 - val_acc: 0.7363  
Epoch 2/10  
195/195 [=====] - 29s 149ms/step - loss: 0.3899 - acc: 0.8313 - val_loss: 0.3850 - val_acc: 0.8455  
Epoch 3/10  
195/195 [=====] - 29s 148ms/step - loss: 0.3906 - acc: 0.8232 - val_loss: 0.5987 - val_acc: 0.6602  
Epoch 4/10  
195/195 [=====] - 29s 149ms/step - loss: 0.2930 - acc: 0.8808 - val_loss: 0.3653 - val_acc: 0.8612  
Epoch 5/10  
195/195 [=====] - 29s 147ms/step - loss: 0.2395 - acc: 0.9078 - val_loss: 0.4419 - val_acc: 0.8128  
Epoch 6/10  
195/195 [=====] - 30s 155ms/step - loss: 0.1687 - acc: 0.9397 - val_loss: 0.4266 - val_acc: 0.8403  
Epoch 7/10  
195/195 [=====] - 29s 148ms/step - loss: 0.1070 - acc: 0.9640 - val_loss: 0.5001 - val_acc: 0.8341  
Epoch 8/10  
195/195 [=====] - 29s 148ms/step - loss: 0.0729 - acc: 0.9764 - val_loss: 0.5787 - val_acc: 0.8210  
Epoch 9/10  
195/195 [=====] - 29s 148ms/step - loss: 0.0941 - acc: 0.9649 - val_loss: 0.6325 - val_acc: 0.8087  
Epoch 10/10  
195/195 [=====] - 29s 148ms/step - loss: 0.0422 - acc: 0.9862 - val_loss: 0.6659 - val_acc: 0.8291
```

## Training & Validation



## Accuracy & Loss

- Simple RNN Conclusion:

( 2層RNN比3層RNN效果更好，並且epochs數越多時validation會下降)

#紅字 數值較大		
	2 層 RNN	3 層 RNN
load_data(num_word =)	10,000	1,000
sequences_padding(maxlen=)		500
參數量	1018881	54776
training	0.98	0.75
testing	0.82	0.70
整體來說，2層RNN比3層RNN表現的好。 load_data時設定的num_word在1000和10000的時候差別不大		

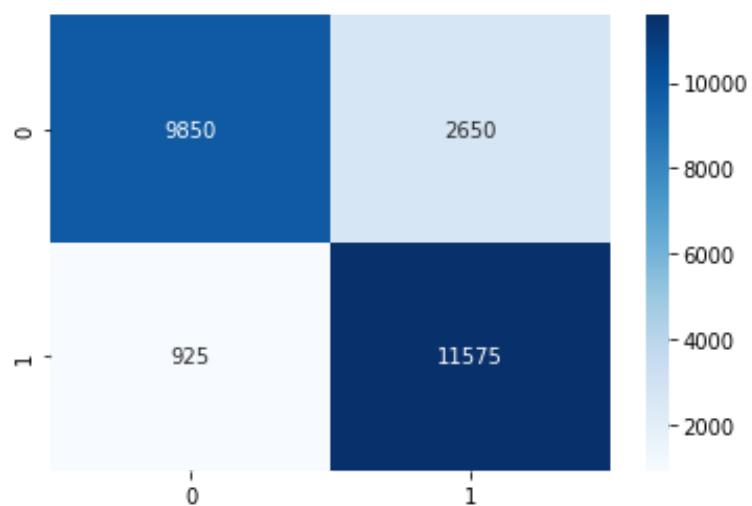
- GRU (total\_words = 1000 , padding max\_len = 500)

```
Model: "sequential_3"
=====
Layer (type)          Output Shape         Param #
=====
embedding_3 (Embedding)    (None, 500, 32)      32000
gru_3 (GRU)            (None, 500, 100)     40200
gru_4 (GRU)            (None, 500, 50)       22800
gru_5 (GRU)            (None, 25)           5775
dense_3 (Dense)        (None, 1)             26
=====
Total params: 100,801
Trainable params: 100,801
Non-trainable params: 0
=====
None
```

詳細資訊

```
Epoch 1/10
157/157 [=====] - 15s 71ms/step - loss: 0.5794 - acc: 0.6801 - val_loss: 0.4563 - val_acc: 0.7854
Epoch 2/10
157/157 [=====] - 10s 64ms/step - loss: 0.3923 - acc: 0.8283 - val_loss: 0.3663 - val_acc: 0.8438
Epoch 3/10
157/157 [=====] - 10s 64ms/step - loss: 0.3394 - acc: 0.8566 - val_loss: 0.3636 - val_acc: 0.8428
Epoch 4/10
157/157 [=====] - 10s 64ms/step - loss: 0.3313 - acc: 0.8628 - val_loss: 0.3387 - val_acc: 0.8620
Epoch 5/10
157/157 [=====] - 10s 65ms/step - loss: 0.3134 - acc: 0.8716 - val_loss: 0.3302 - val_acc: 0.8666
Epoch 6/10
157/157 [=====] - 10s 65ms/step - loss: 0.3002 - acc: 0.8749 - val_loss: 0.3458 - val_acc: 0.8540
Epoch 7/10
157/157 [=====] - 10s 64ms/step - loss: 0.2913 - acc: 0.8812 - val_loss: 0.3549 - val_acc: 0.8546
Epoch 8/10
157/157 [=====] - 10s 66ms/step - loss: 0.2901 - acc: 0.8827 - val_loss: 0.3491 - val_acc: 0.8634
Epoch 9/10
157/157 [=====] - 10s 64ms/step - loss: 0.2758 - acc: 0.8913 - val_loss: 0.3400 - val_acc: 0.8606
Epoch 10/10
157/157 [=====] - 10s 65ms/step - loss: 0.2693 - acc: 0.8918 - val_loss: 0.3633 - val_acc: 0.8496
```

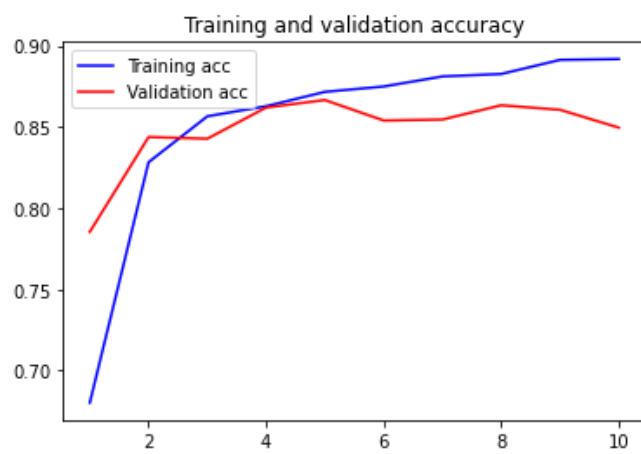
## Training & Validation



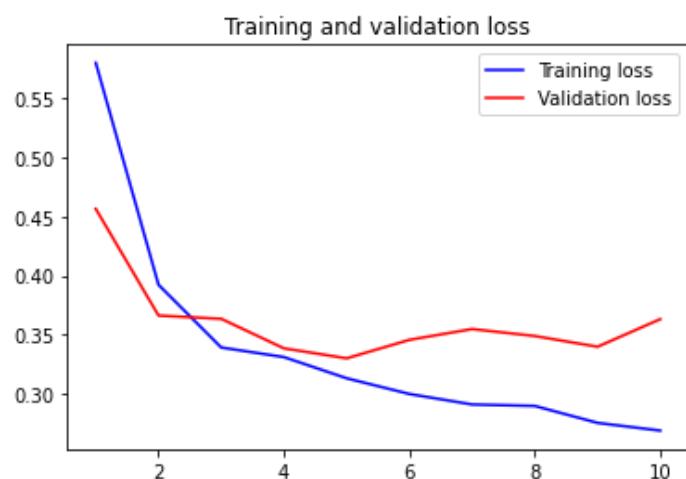
Heatmap

	precision	recall	f1-score	support
0	0.91	0.79	0.85	12500
1	0.81	0.93	0.87	12500
accuracy			0.86	25000
macro avg	0.86	0.86	0.86	25000
weighted avg	0.86	0.86	0.86	25000

## Classification Report



## Accuracy



## Loss

- GRU (total\_words = 10000 , padding max\_len = 80)

↳ Model: "sequential\_1"

Layer (type)	Output Shape	Param #
embedding_1 (Embedding)	(None, None, 128)	1408000
gru_2 (GRU)	(None, None, 128)	99072
gru_3 (GRU)	(None, 128)	99072
dense_1 (Dense)	(None, 1)	129

Total params: 1,606,273

Trainable params: 1,606,273

Non-trainable params: 0

### 詳細資訊

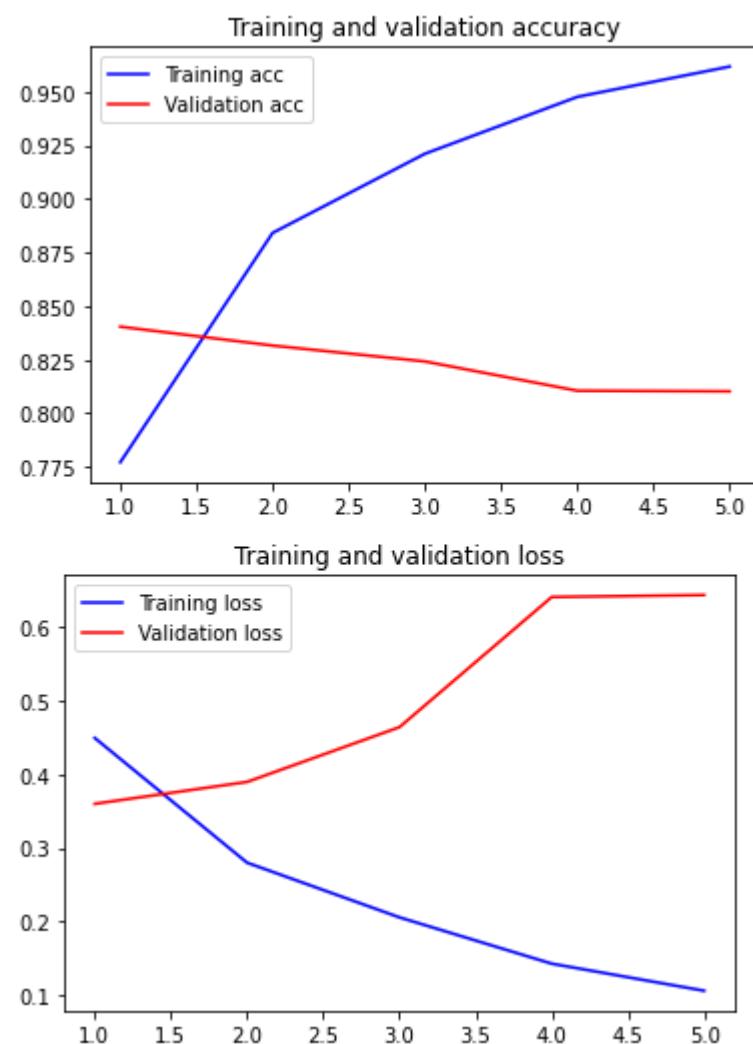
```

Epoch 1/5
195/195 [=====] - 57s 248ms/step - loss: 0.4639 - accuracy: 0.7719 - val_loss: 0.3764 - val_accuracy: 0.8347
Epoch 2/5
195/195 [=====] - 48s 249ms/step - loss: 0.2807 - accuracy: 0.8840 - val_loss: 0.4174 - val_accuracy: 0.8280
Epoch 3/5
195/195 [=====] - 46s 239ms/step - loss: 0.2111 - accuracy: 0.9190 - val_loss: 0.4504 - val_accuracy: 0.8201
Epoch 4/5
195/195 [=====] - 47s 239ms/step - loss: 0.1620 - accuracy: 0.9410 - val_loss: 0.5150 - val_accuracy: 0.8171
Epoch 5/5
195/195 [=====] - 48s 245ms/step - loss: 0.1113 - accuracy: 0.9618 - val_loss: 0.6566 - val_accuracy: 0.8099

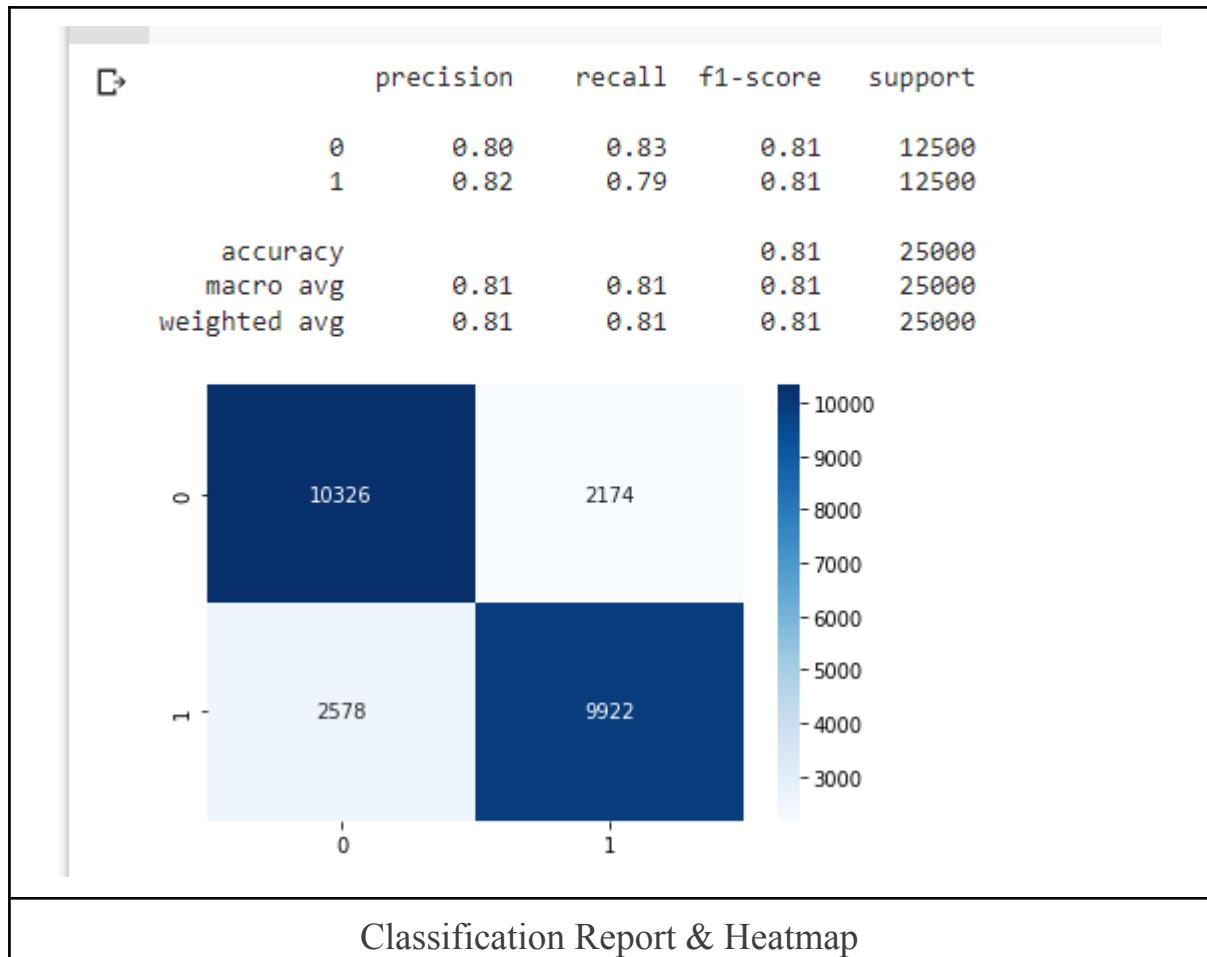
```

### Training & Validation

C



Accuracy &amp; Loss



- GRU (total\_words = 10000 , padding max\_len = 500)

```

Epoch 1/5
195/195 [=====] - 260s 1s/step - loss: 0.4532 - accuracy: 0.7826 - val_loss: 0.3183 - val_accuracy: 0.8686
Epoch 2/5
195/195 [=====] - 246s 1s/step - loss: 0.2366 - accuracy: 0.9073 - val_loss: 0.3224 - val_accuracy: 0.8638
Epoch 3/5
195/195 [=====] - 245s 1s/step - loss: 0.1716 - accuracy: 0.9353 - val_loss: 0.3599 - val_accuracy: 0.8579
Epoch 4/5
195/195 [=====] - 255s 1s/step - loss: 0.1387 - accuracy: 0.9491 - val_loss: 0.3898 - val_accuracy: 0.8653
Epoch 5/5
195/195 [=====] - 256s 1s/step - loss: 0.0894 - accuracy: 0.9693 - val_loss: 0.4829 - val_accuracy: 0.8650

```

Training & Validation

Model: "sequential"

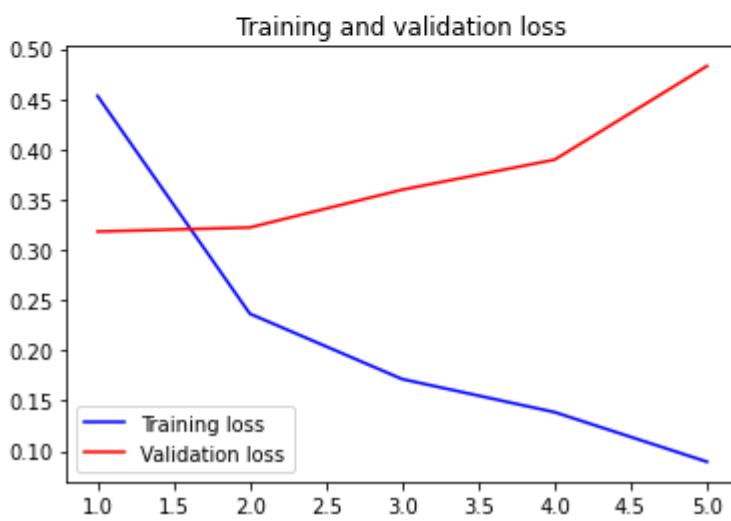
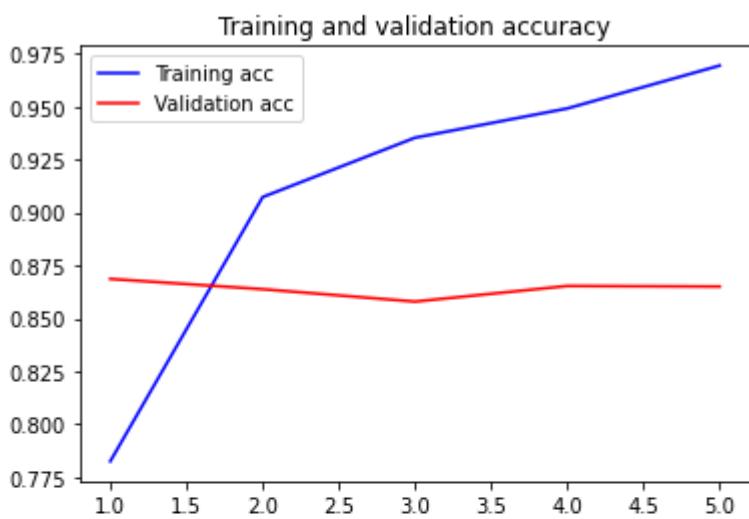
Layer (type)	Output Shape	Param #
embedding (Embedding)	(None, None, 128)	1280000
gru (GRU)	(None, None, 128)	99072
gru_1 (GRU)	(None, 128)	99072
dense (Dense)	(None, 1)	129

Total params: 1,478,273

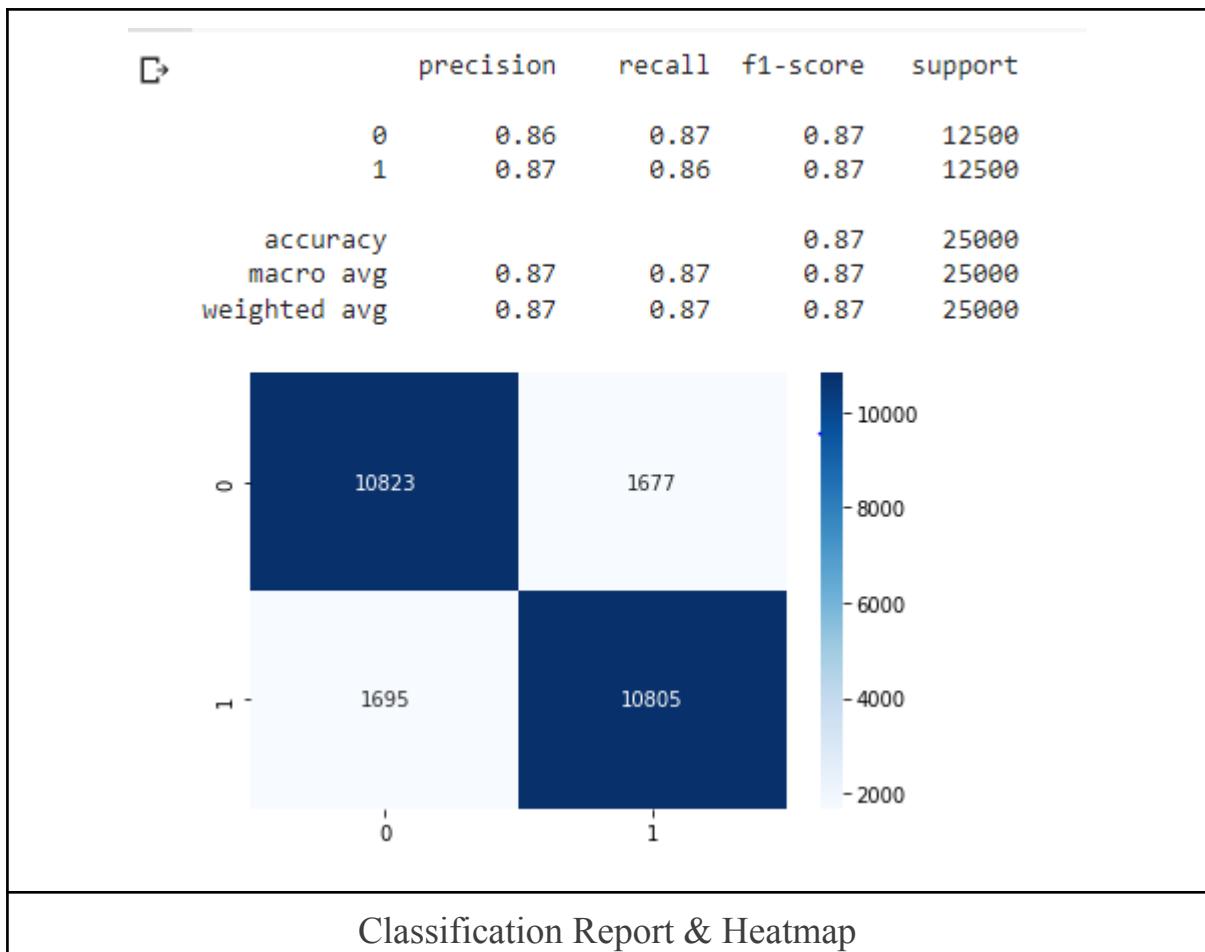
Trainable params: 1,478,273

Non-trainable params: 0

詳細資訊



Accuracy



- GRU Conclusion :(在 epochs = 4 的時候)

#紅字數值較大

	3層 GRU	2層 GRU
training	0.89	0.96
test	0.84	0.80
參數量	100,000	1,000,000
load_data(num_words = 10000) pad_sequences(x_train, maxlen=80)	X	training : 0.96 testing : 0.80
load_data(num_words = 10000) pad_sequences(x_train, maxlen=500)	training: 0.89 testing: 0.84	training : 0.89 testing : 0.86

2層 GRU 在training的時候效果比3層來的高，但是validation的效果3層的GRU效果更好。  
當pad\_sequences一次餵進去embedding的向量從80 -> 500, validation的效果變得更好。

- LSTM (total\_words = 5000 , padding max\_len = 1000)

↳ Model: "sequential"

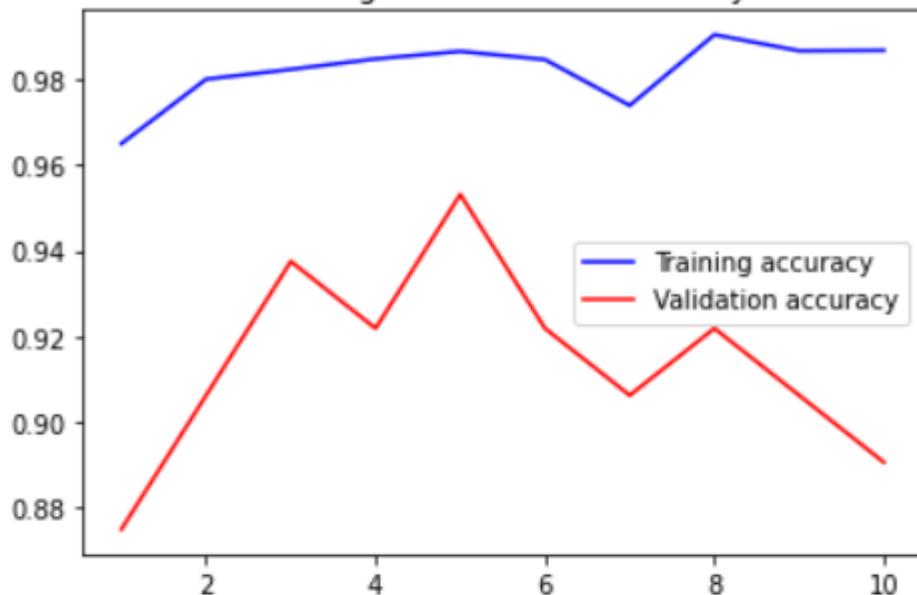
Layer (type)	Output Shape	Param #
=====		
embedding (Embedding)	(None, 500, 32)	160000
lstm (LSTM)	(None, 100)	53200
dense (Dense)	(None, 1)	101
=====		
Total params: 213,301		
Trainable params: 213,301		
Non-trainable params: 0		
=====		
None		

詳細資訊

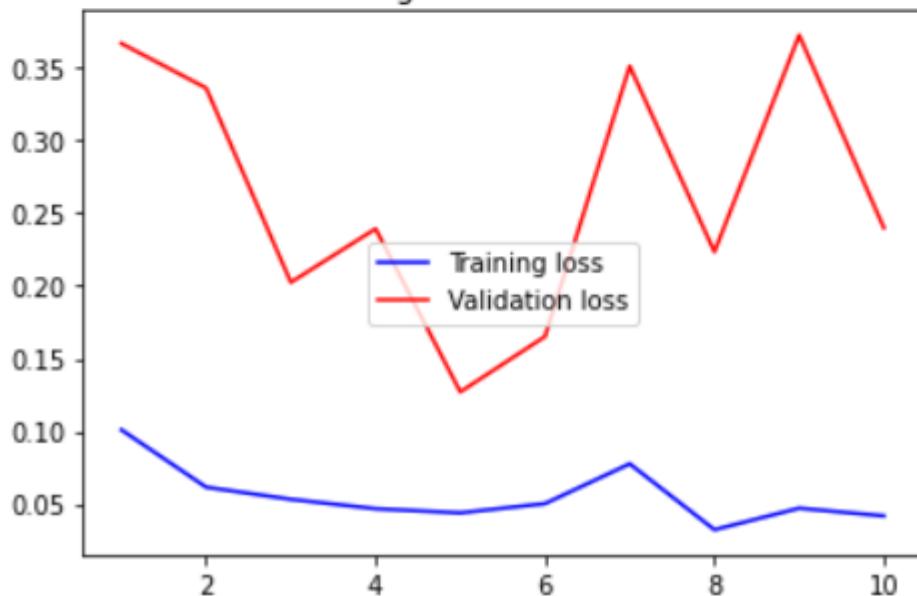
```
Epoch 1/10
390/390 [=====] - 228s 585ms/step - loss: 0.2188 - accuracy: 0.9187 - val_loss: 0.1638 - val_accuracy: 0.9219
Epoch 2/10
390/390 [=====] - 219s 562ms/step - loss: 0.2038 - accuracy: 0.9226 - val_loss: 0.2341 - val_accuracy: 0.8906
Epoch 3/10
390/390 [=====] - 220s 565ms/step - loss: 0.1825 - accuracy: 0.9330 - val_loss: 0.2204 - val_accuracy: 0.8906
Epoch 4/10
390/390 [=====] - 220s 565ms/step - loss: 0.1619 - accuracy: 0.9402 - val_loss: 0.2869 - val_accuracy: 0.9219
Epoch 5/10
390/390 [=====] - 221s 568ms/step - loss: 0.1576 - accuracy: 0.9421 - val_loss: 0.2617 - val_accuracy: 0.8750
Epoch 6/10
390/390 [=====] - 220s 564ms/step - loss: 0.1486 - accuracy: 0.9445 - val_loss: 0.2736 - val_accuracy: 0.9219
Epoch 7/10
390/390 [=====] - 220s 565ms/step - loss: 0.1096 - accuracy: 0.9603 - val_loss: 0.3001 - val_accuracy: 0.8750
Epoch 8/10
390/390 [=====] - 221s 567ms/step - loss: 0.1308 - accuracy: 0.9519 - val_loss: 0.2790 - val_accuracy: 0.9062
Epoch 9/10
390/390 [=====] - 219s 563ms/step - loss: 0.1226 - accuracy: 0.9563 - val_loss: 0.2624 - val_accuracy: 0.9062
Epoch 10/10
390/390 [=====] - 220s 563ms/step - loss: 0.0858 - accuracy: 0.9713 - val_loss: 0.2397 - val_accuracy: 0.8906
<keras.callbacks.History at 0x7f99857c6a50>
```

Training & Validation

Training and validation accuracy



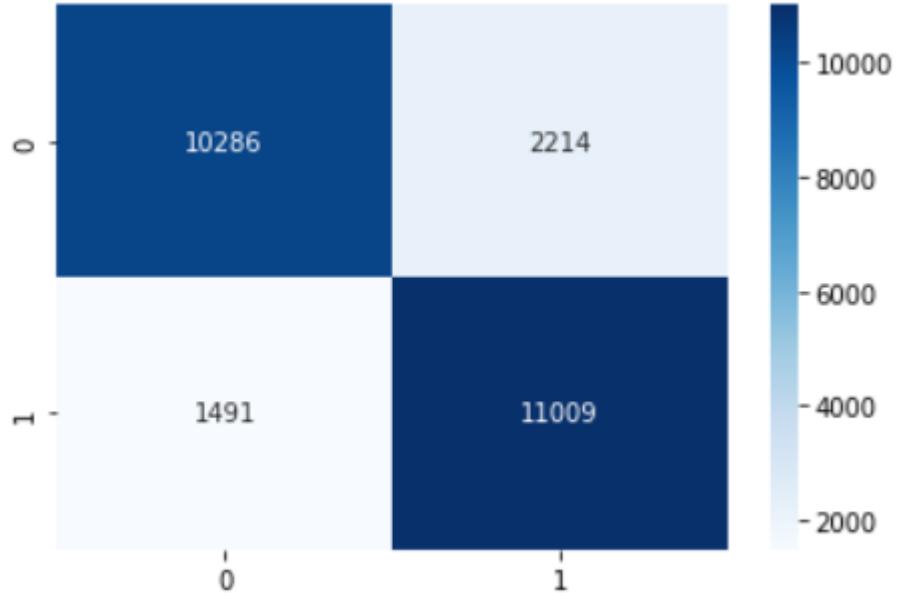
Training and validation loss



Accuracy & Loss

	precision	recall	f1-score	support
0	0.87	0.82	0.85	12500
1	0.83	0.88	0.86	12500
accuracy			0.85	25000
macro avg	0.85	0.85	0.85	25000
weighted avg	0.85	0.85	0.85	25000

Classification Report



Heatmap

- LSTM (total\_words = 1000 , padding max\_len = 500)

Model: "sequential"

Layer (type)	Output Shape	Param #
<hr/>		
embedding (Embedding)	(None, 500, 32)	32000
lstm (LSTM)	(None, 100)	53200
dense (Dense)	(None, 1)	101
<hr/>		
Total params: 85,301		
Trainable params: 85,301		
Non-trainable params: 0		
<hr/>		
None		

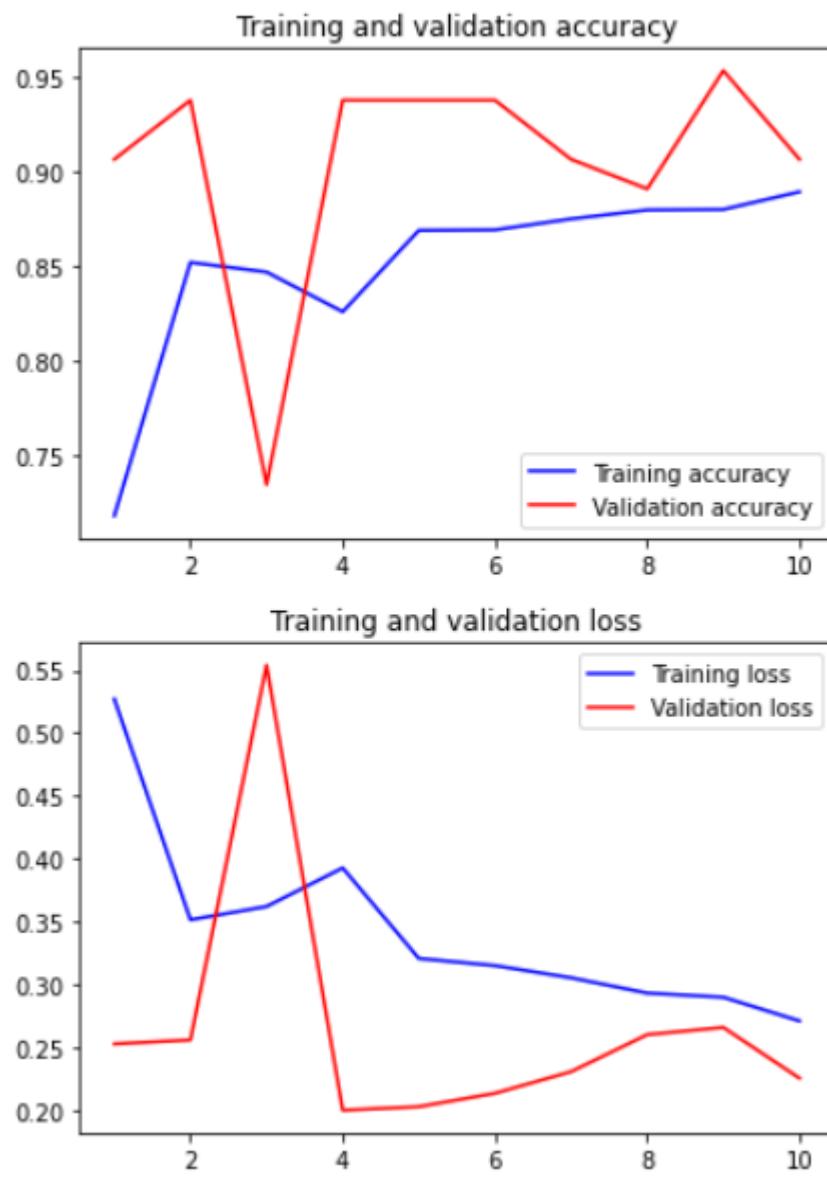
## 詳細資訊

```

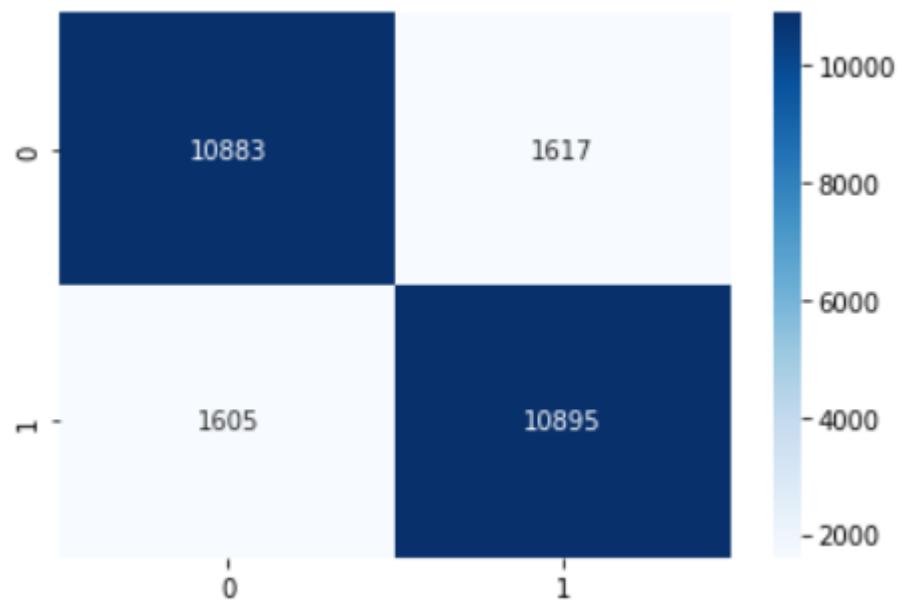
Epoch 1/10
390/390 [=====] - 237s 594ms/step - loss: 0.5271 - accuracy: 0.7179 - val_loss: 0.2526 - val_accuracy: 0.9062
Epoch 2/10
390/390 [=====] - 225s 578ms/step - loss: 0.3514 - accuracy: 0.8518 - val_loss: 0.2557 - val_accuracy: 0.9375
Epoch 3/10
390/390 [=====] - 222s 570ms/step - loss: 0.3619 - accuracy: 0.8467 - val_loss: 0.5541 - val_accuracy: 0.7344
Epoch 4/10
390/390 [=====] - 222s 569ms/step - loss: 0.3927 - accuracy: 0.8257 - val_loss: 0.1998 - val_accuracy: 0.9375
Epoch 5/10
390/390 [=====] - 221s 567ms/step - loss: 0.3206 - accuracy: 0.8687 - val_loss: 0.2026 - val_accuracy: 0.9375
Epoch 6/10
390/390 [=====] - 221s 566ms/step - loss: 0.3149 - accuracy: 0.8690 - val_loss: 0.2133 - val_accuracy: 0.9375
Epoch 7/10
390/390 [=====] - 220s 563ms/step - loss: 0.3052 - accuracy: 0.8748 - val_loss: 0.2305 - val_accuracy: 0.9062
Epoch 8/10
390/390 [=====] - 220s 563ms/step - loss: 0.2930 - accuracy: 0.8795 - val_loss: 0.2600 - val_accuracy: 0.8906
Epoch 9/10
390/390 [=====] - 219s 563ms/step - loss: 0.2897 - accuracy: 0.8798 - val_loss: 0.2657 - val_accuracy: 0.9531
Epoch 10/10
390/390 [=====] - 219s 561ms/step - loss: 0.2709 - accuracy: 0.8891 - val_loss: 0.2253 - val_accuracy: 0.9062

```

## Training & Validation



Accuracy & Loss



Heatmap

	precision	recall	f1-score	support
0	0.87	0.87	0.87	12500
1	0.87	0.87	0.87	12500
accuracy			0.87	25000
macro avg	0.87	0.87	0.87	25000
weighted avg	0.87	0.87	0.87	25000

Classification Report

- LSTM (total\_words = 1000 , padding max\_len = 500)

```
Model: "sequential_2"
```

Layer (type)	Output Shape	Param #
<hr/>		
embedding_2 (Embedding)	(None, 500, 32)	32000
lstm (LSTM)	(None, 500, 100)	53200
lstm_1 (LSTM)	(None, 500, 50)	30200
lstm_2 (LSTM)	(None, 25)	7600
dense_2 (Dense)	(None, 1)	26
<hr/>		
Total params: 123,026		
Trainable params: 123,026		
Non-trainable params: 0		
<hr/>		
None		

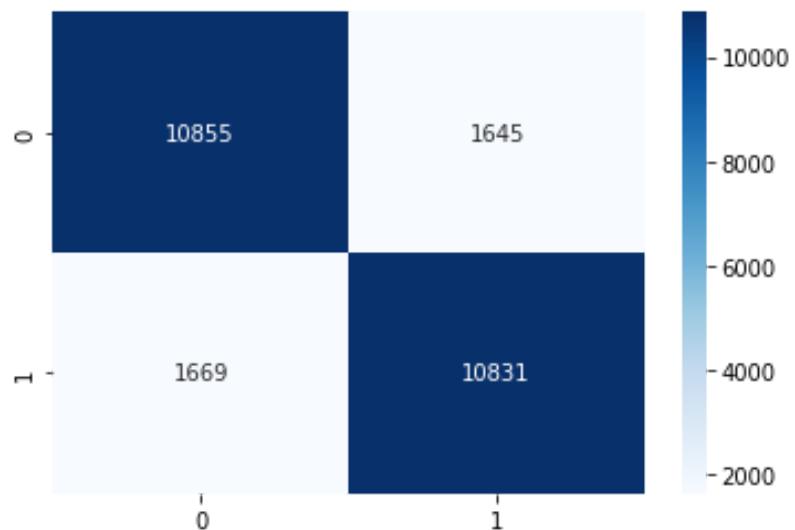
## 詳細資訊

```
Epoch 1/10
157/157 [=====] - 15s 74ms/step - loss: 0.6529 - acc: 0.5917 - val_loss: 0.6936 - val_acc: 0.4944
Epoch 2/10
157/157 [=====] - 11s 68ms/step - loss: 0.6867 - acc: 0.5156 - val_loss: 0.6904 - val_acc: 0.5122
Epoch 3/10
157/157 [=====] - 11s 69ms/step - loss: 0.6866 - acc: 0.5143 - val_loss: 0.6931 - val_acc: 0.4938
Epoch 4/10
157/157 [=====] - 11s 68ms/step - loss: 0.6929 - acc: 0.5113 - val_loss: 0.6929 - val_acc: 0.4940
Epoch 5/10
157/157 [=====] - 10s 67ms/step - loss: 0.6905 - acc: 0.5163 - val_loss: 0.6937 - val_acc: 0.4944
Epoch 6/10
157/157 [=====] - 11s 67ms/step - loss: 0.6890 - acc: 0.5228 - val_loss: 0.6855 - val_acc: 0.6384
Epoch 7/10
157/157 [=====] - 11s 67ms/step - loss: 0.5911 - acc: 0.6680 - val_loss: 0.5202 - val_acc: 0.7522
Epoch 8/10
157/157 [=====] - 10s 67ms/step - loss: 0.4050 - acc: 0.8242 - val_loss: 0.3542 - val_acc: 0.8584
Epoch 9/10
157/157 [=====] - 11s 67ms/step - loss: 0.3467 - acc: 0.8545 - val_loss: 0.3453 - val_acc: 0.8572
Epoch 10/10
157/157 [=====] - 11s 67ms/step - loss: 0.3229 - acc: 0.8651 - val_loss: 0.3256 - val_acc: 0.8690
```

## Training & Validation

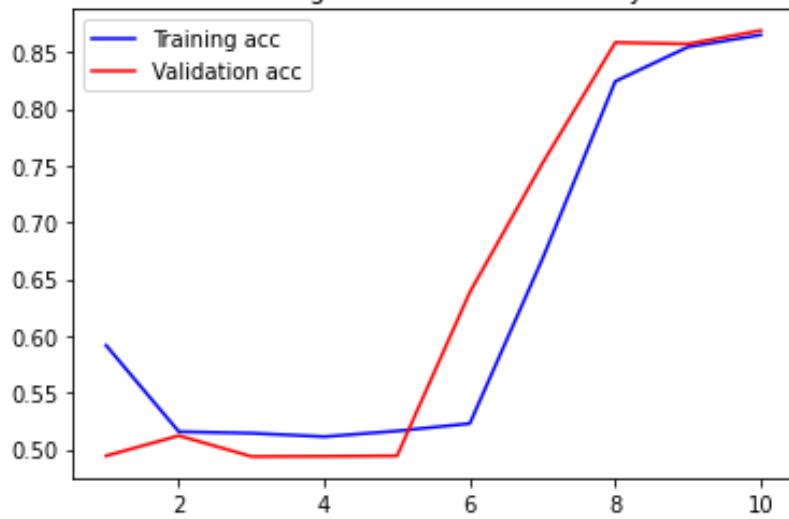
	precision	recall	f1-score	support
0	0.87	0.87	0.87	12500
1	0.87	0.87	0.87	12500
accuracy			0.87	25000
macro avg	0.87	0.87	0.87	25000
weighted avg	0.87	0.87	0.87	25000

Classification Report



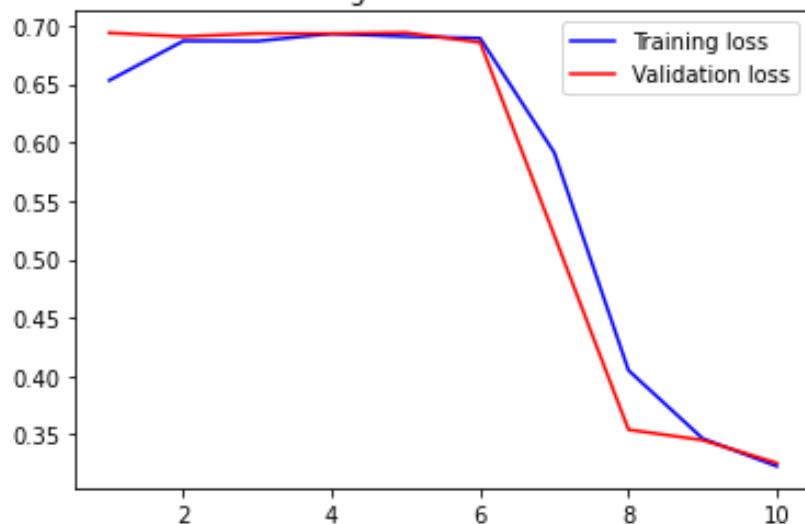
Heatmap

Training and validation accuracy



Accuracy

Training and validation loss



Loss

- LSTM Conclusion :

整體表現來看 LSTM的 test 效果最好

#紅字 數值較大

	1層 LSTM	1層 LSTM	3層 LSTM
training	0.97	0.88	0.86
test	0.89	0.90(?)	0.86
參數量	213,301	85,301	123,026
load_data (num_word =)	5000	1,000	1,000
sequences_padding (maxlen=)		500	
整體來說， 1層LSTM表現的比3層的LSTM更好。			