Artificial Intelligence II - Third Assignment

Γεωργία Σαράφογλου sdi 1900168

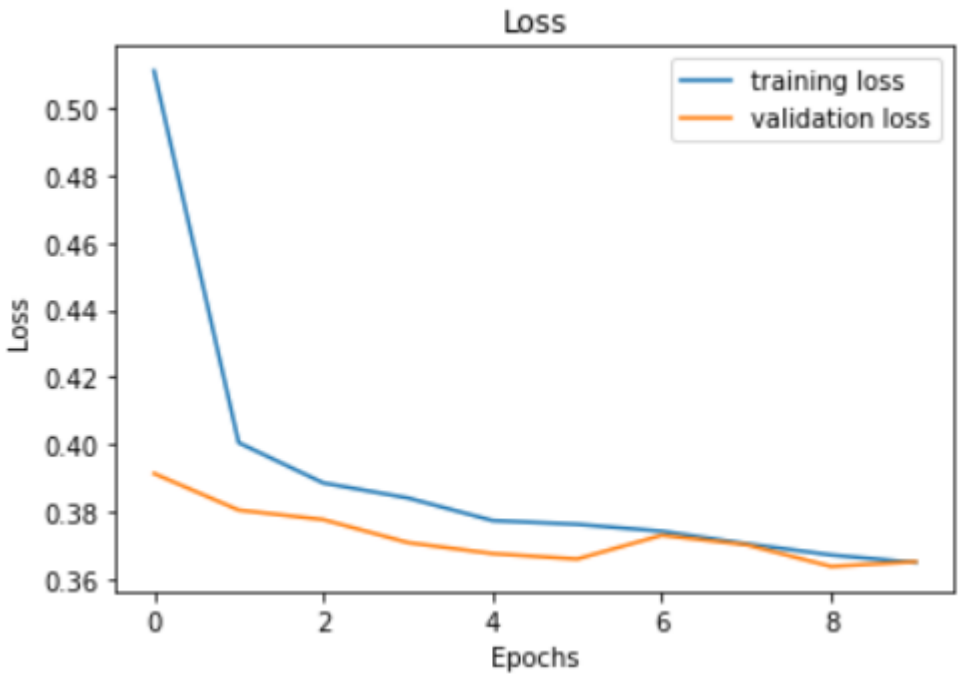
Εισαγωγή

Ξεκίνησα την εργασία χρησιμοποιώντας το text preprocessing τη δεύτερης εργασίας.

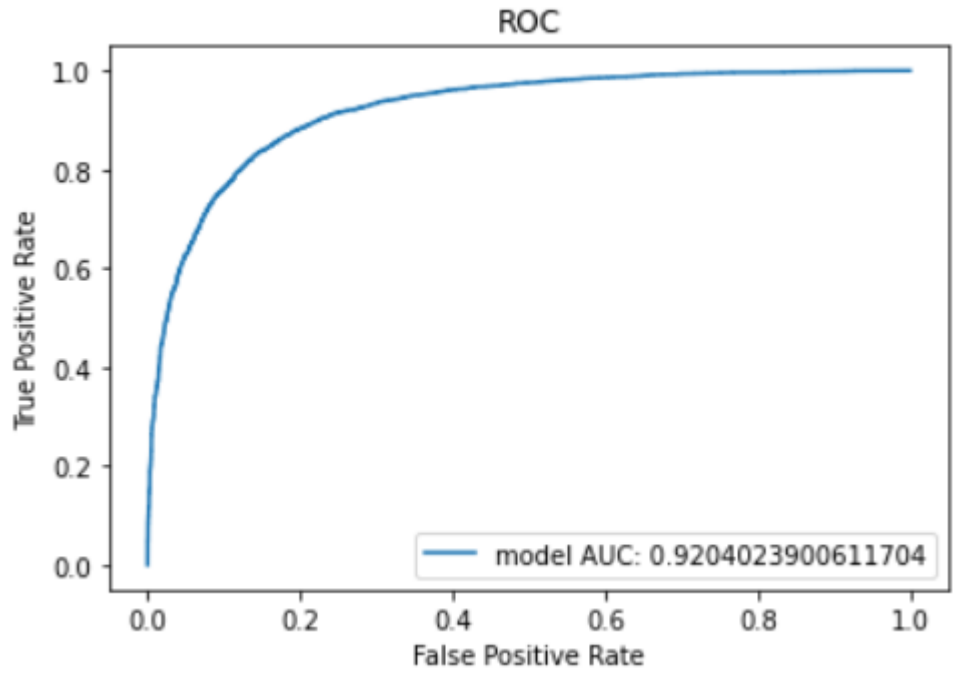
Δοκίμασα πολλές διαφορετικές αρχιτεκτονικές από τις οποίες επέλεξα να κρατήσω αυτή του μοντέλου 16 που ήταν με LSTM cells.

Μοντέλο 16

- H1 = 32
- H2 = 32
- H3 = 32
- number of tacked RNN's = 3
- learning rate: 0.001
- with gradient clipping




Training and Validation Accuracy
Accuracy
Epoch
training accuracy
validation accuracy
0.84
0.82
0.80
0.78
0.76
0.74
0.72
0
2
4
6
8


ROC
True Positive Rate
False Positive Rate
model AUC: 0.9204023900611704
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

Metrics

- Loss: 0.364
- Accuracy 0.841
- Precision 0.815
- Recall 0.877
- F1 score 0.845

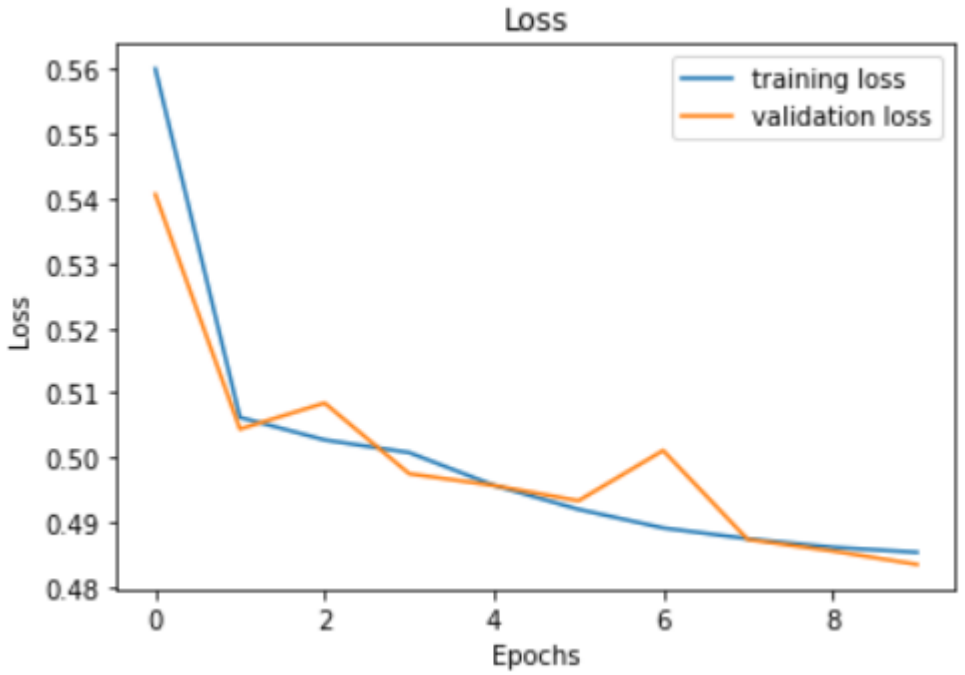
Σύντομη περιγραφή των μοντέλων που δοκίμασα:

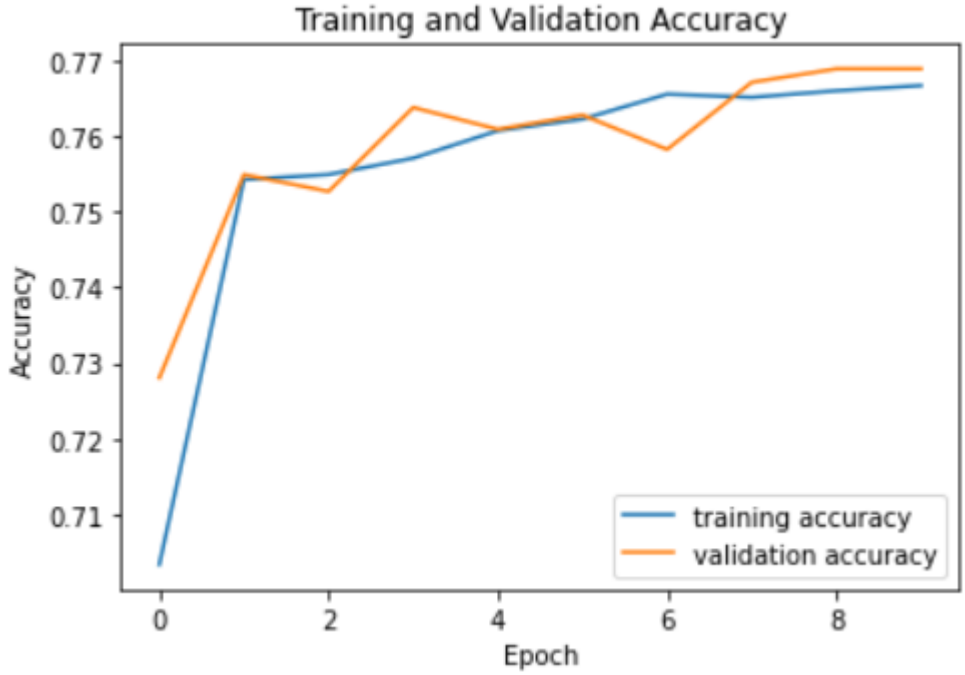
Όλα τα μοντέλα είχαν BCELOSS για Loss function και ADAM optimizer. Τα H είναι τα μεγέθη των ενδιάμεσων hidden layers (αν υπάρχουν) με τη σειρά της αρίθμησης (1 το πρώτο κλπ). Τα παρακάτω μοντέλα χρησιμοποιούν τα 50 sized glove embeddings.

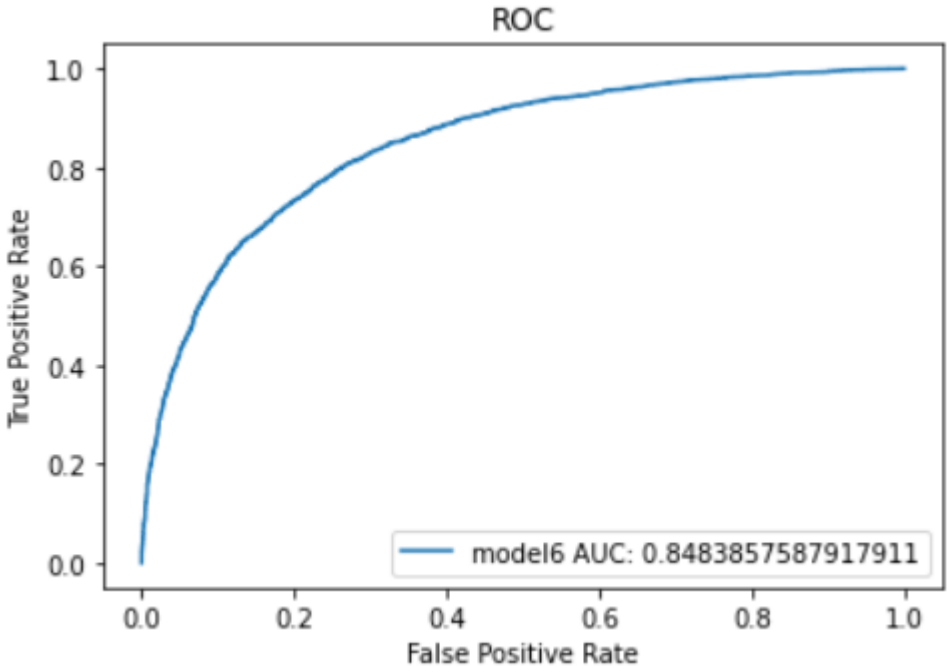
LSTM cell type:

Μοντέλο 1

- H1 = 32
- number of tacked RNN's = 2
- learning rate: 0.001


Loss
training loss
validation loss
Loss
Epochs
0.56
0.55
0.54
0.53
0.52
0.51
0.50
0.49
0.48
0
2
4
6
8


Training and Validation Accuracy
training accuracy
validation accuracy
Accuracy
Epoch
0.77
0.76
0.75
0.74
0.73
0.72
0.71
0
2
4
6
8

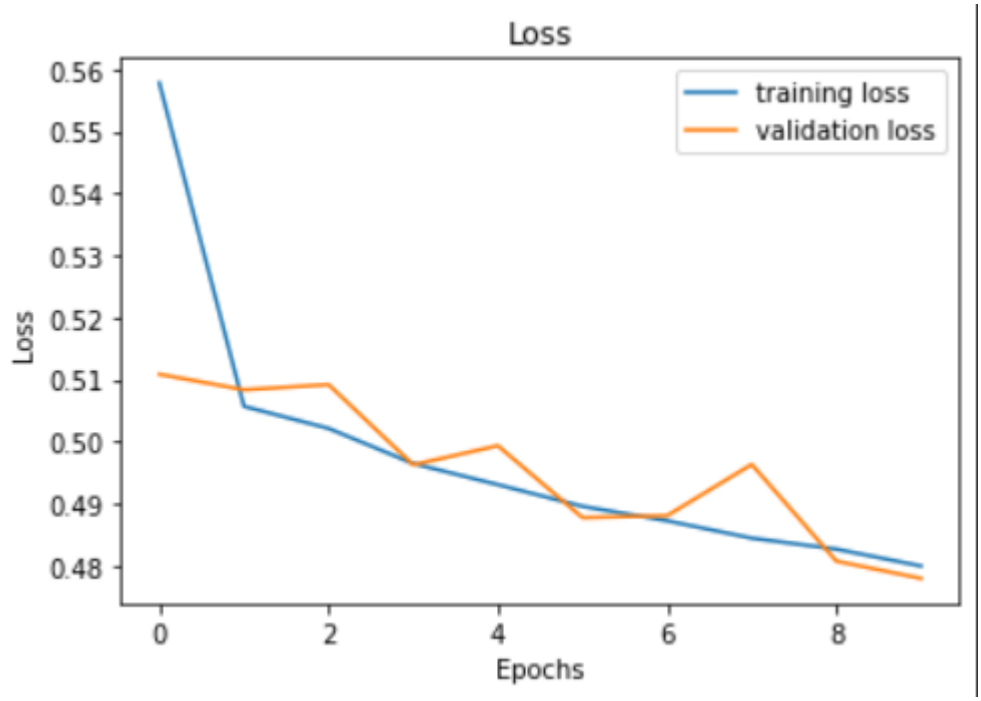


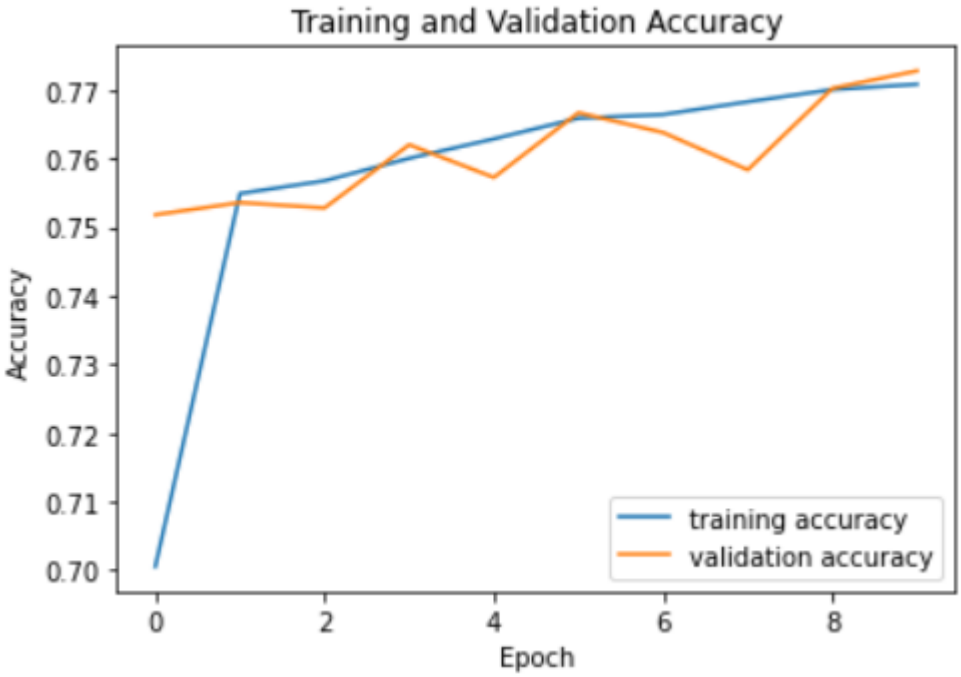
Metrics:

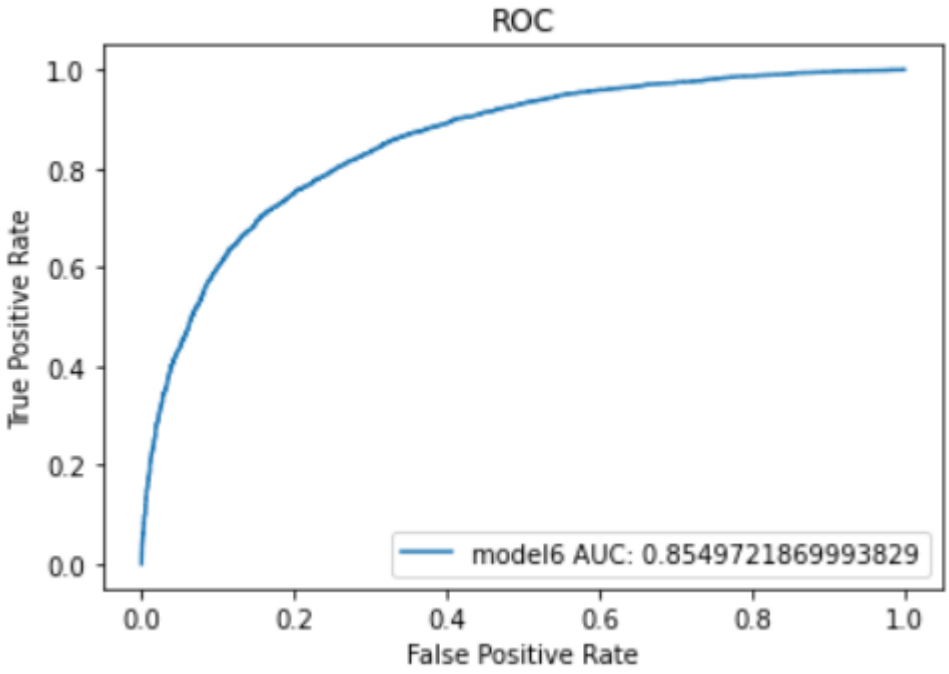
- Loss: 0.48
- Accuracy: 0.768
- Precision: 0.762
- Recall: 0.767
- F1 score: 0.765

Μοντέλο 2

- H1 = 64
- number of tacked RNN's = 3
- learning rate: 0.001


Loss
training loss
validation loss
Loss
Epochs
0.56
0.55
0.54
0.53
0.52
0.51
0.50
0.49
0.48
0
2
4
6
8


Training and Validation Accuracy
training accuracy
validation accuracy
Accuracy
Epoch
0.77
0.76
0.75
0.74
0.73
0.72
0.71
0.70
0
2
4
6
8

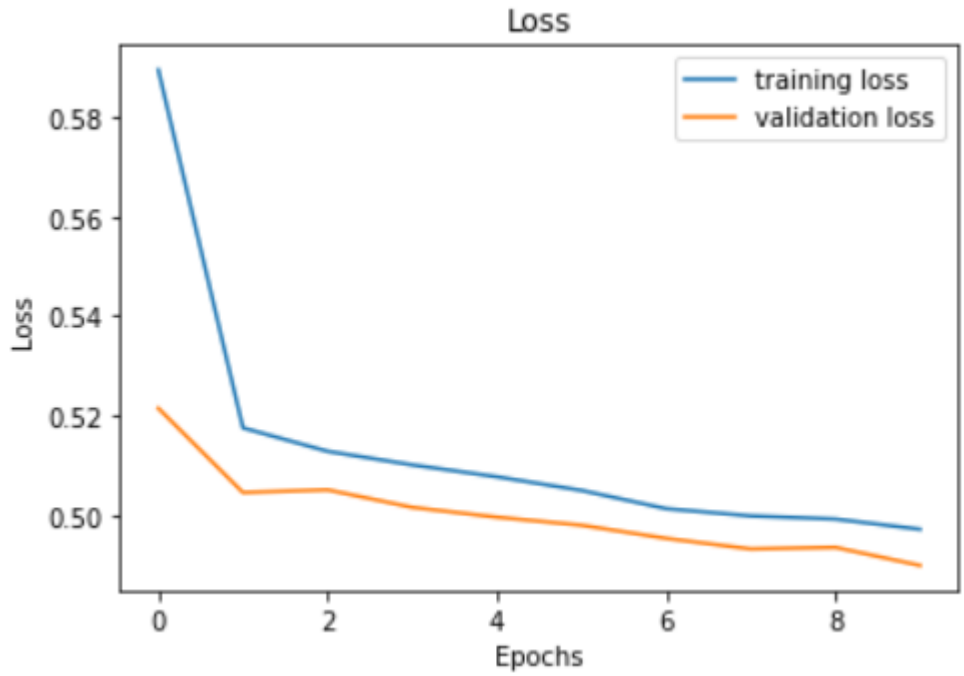


Metrics:

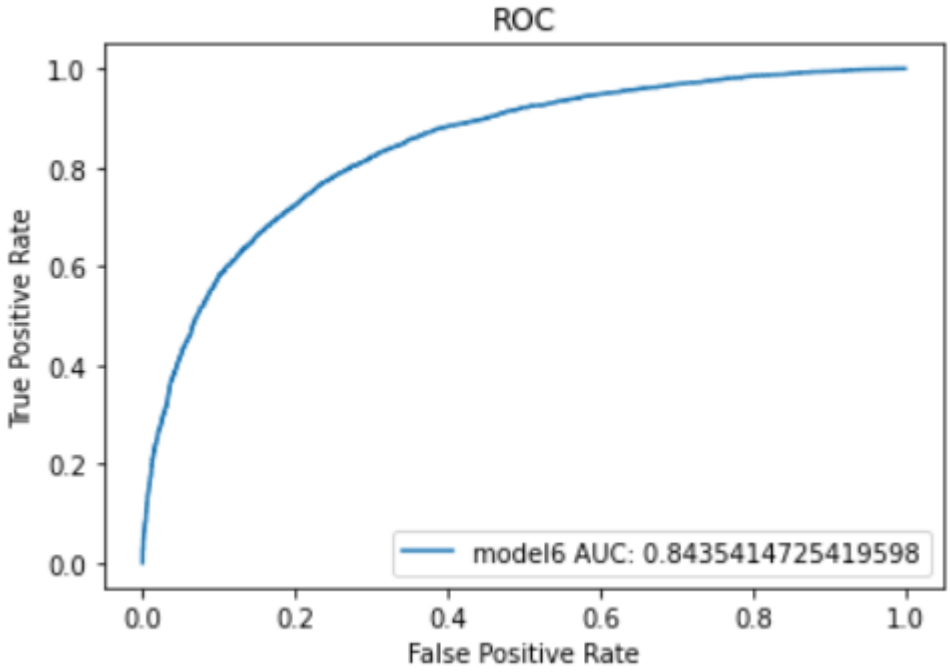
- Loss: 0.479
- Accuracy: 0.0.772
- Precision: 0.0.777
- Recall: 0.760
- F1 score: 0.768

Μοντέλο 3

- H1 = 32
- number of tacked RNN's = 2
- learning rate: 0.001
- Dropout probability: 0.5


Loss
training loss
validation loss
0.58
0.56
0.54
0.52
0.50
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.76
0.74
0.72
0.70
0.68
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch



Metrics:

- Loss: 0.497
- Accuracy: 0.767
- Precision: 0.773
- Recall: 0.73
- F1 score: 0.75

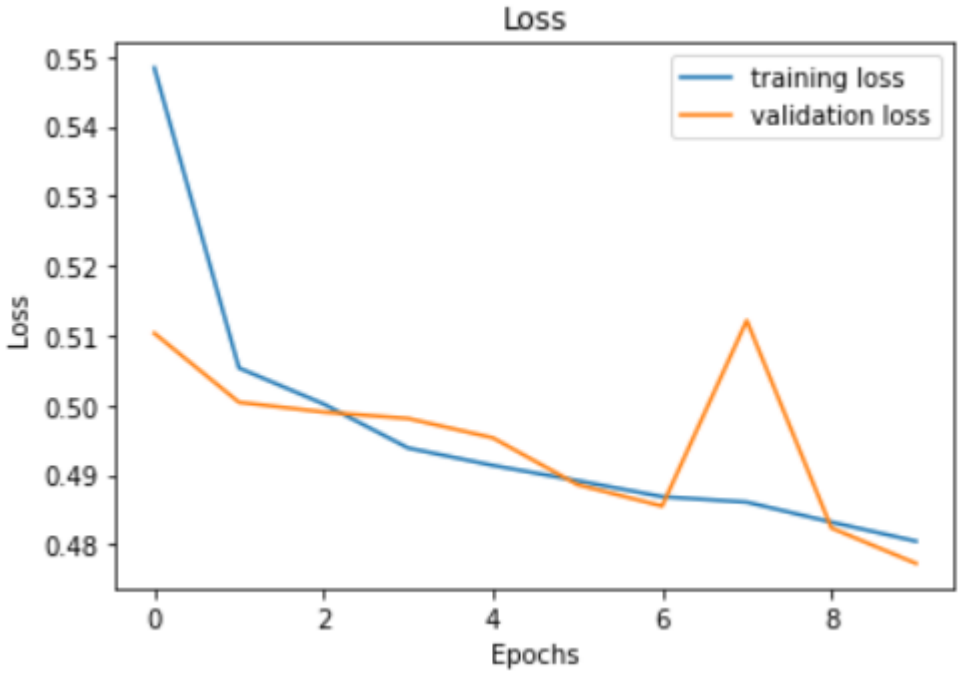
Παρατήρηση:

Τα μοντέλα που έχουν ένα ενδιάμεσο hidden layer κάνουν overfit και έχουν χαμηλό σκορ στην ακρίβεια.

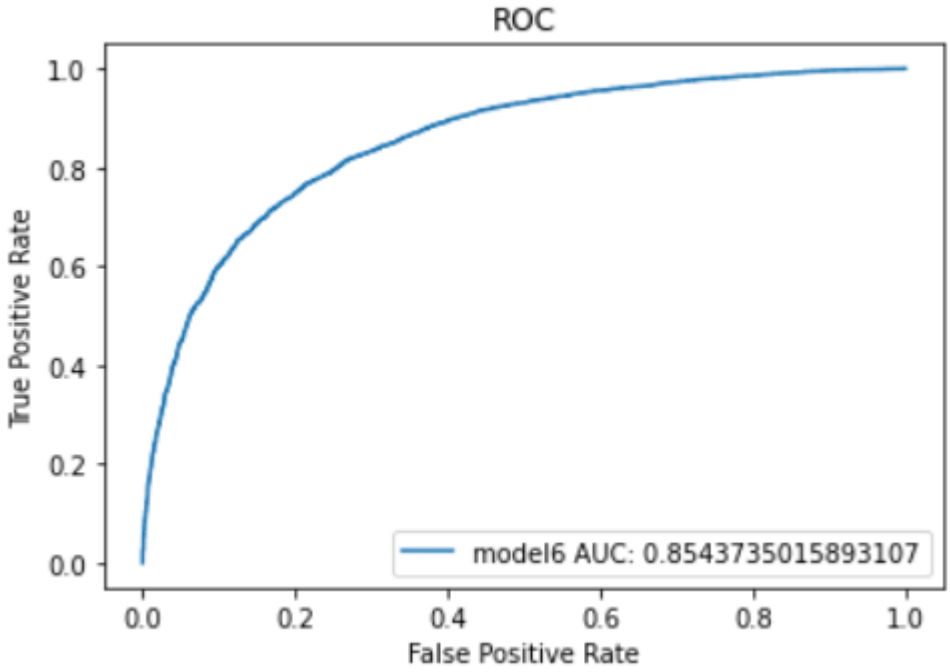
Μοντέλο 4

- H1 = 126

- H2 = 64
- number of tacked RNN's = 2
- learning rate: 0.001
- Dropout probability: 0.5




Training and Validation Accuracy
Accuracy
Epoch
training accuracy
validation accuracy
0.77
0.76
0.75
0.74
0.73
0.72
0.71
0
2
4
6
8

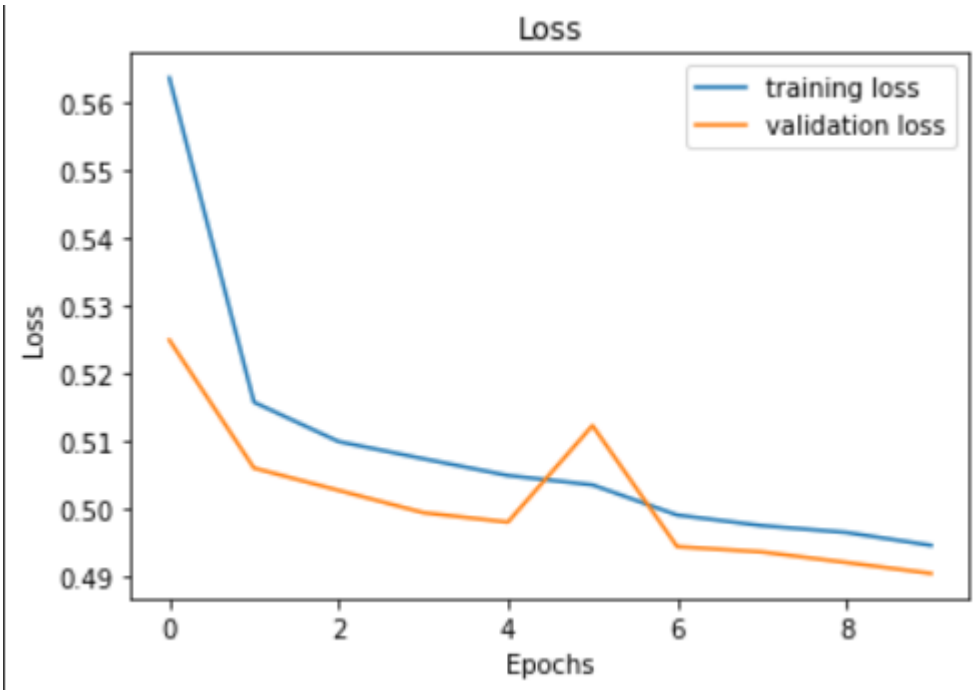

ROC
True Positive Rate
False Positive Rate
model6 AUC: 0.8543735015893107
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

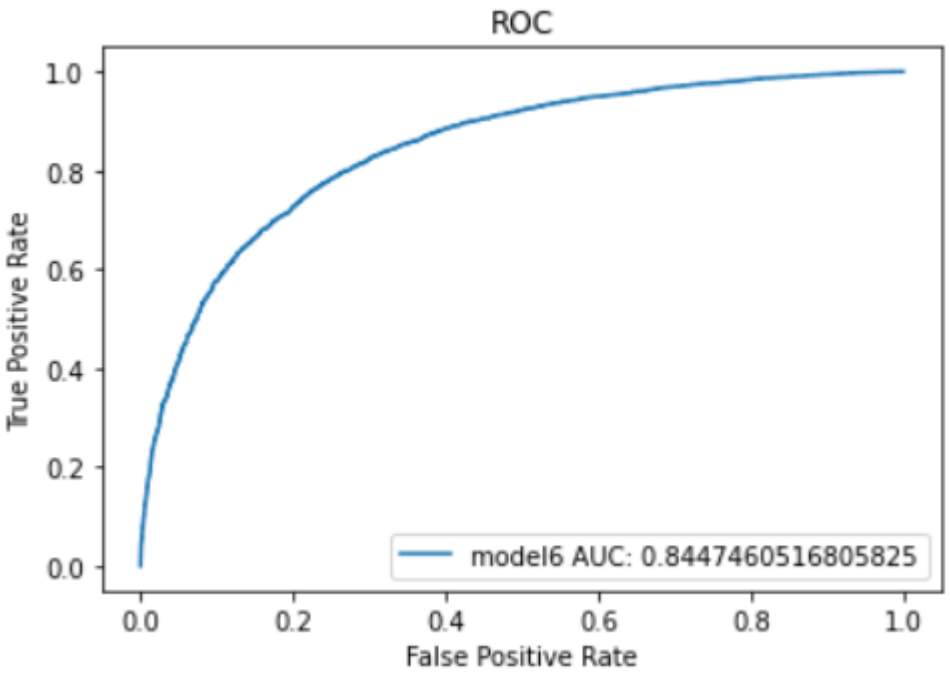
Metrics:

- Accuracy: 0.774
- Precision: 0.767
- Recall: 0.776
- F1 score: 0.772

Μοντέλο 5

- H1 = 64
- H2 = 32
- number of tacked RNN's = 2
- learning rate: 0.001
- Dropout probability: 0.5





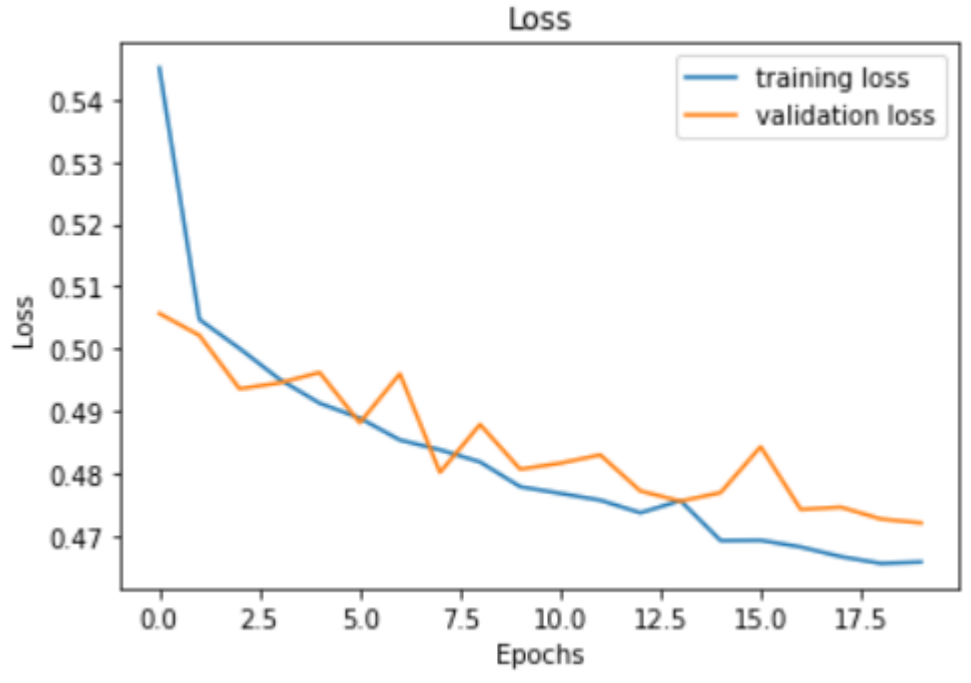
Metrics:

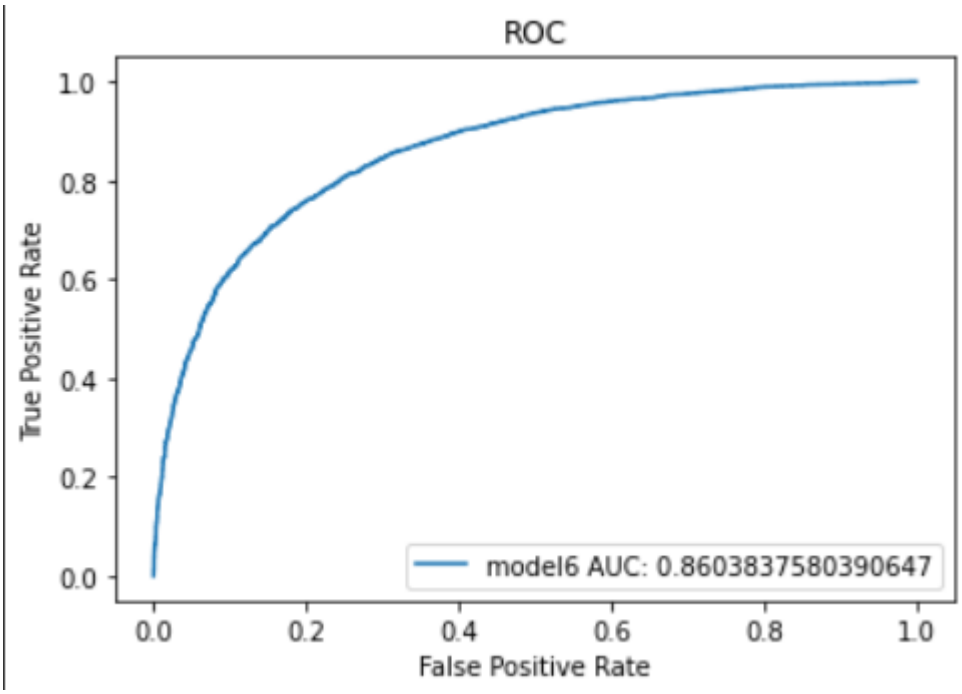
- Accuracy 0.764

- Precision 0.775
- Recall 0.733
- F1 score 0.754

Μοντέλο 6

- H1 = 124
- H2 = 64
- H3 = 32
- number of tacked RNN's = 2
- learning rate: 0.001





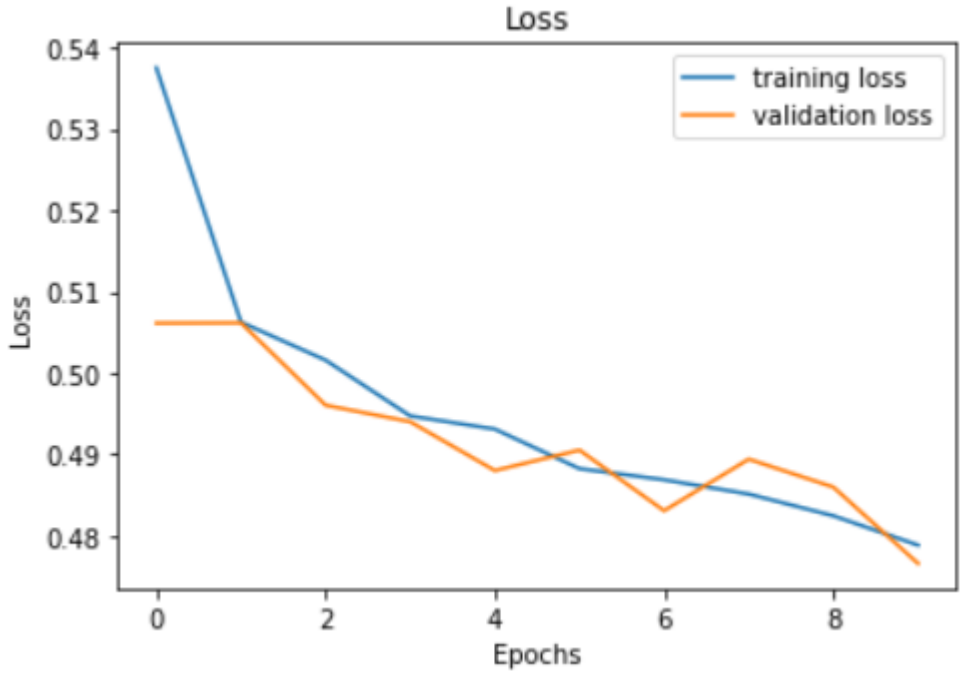
Metrics

- Loss: 0.47

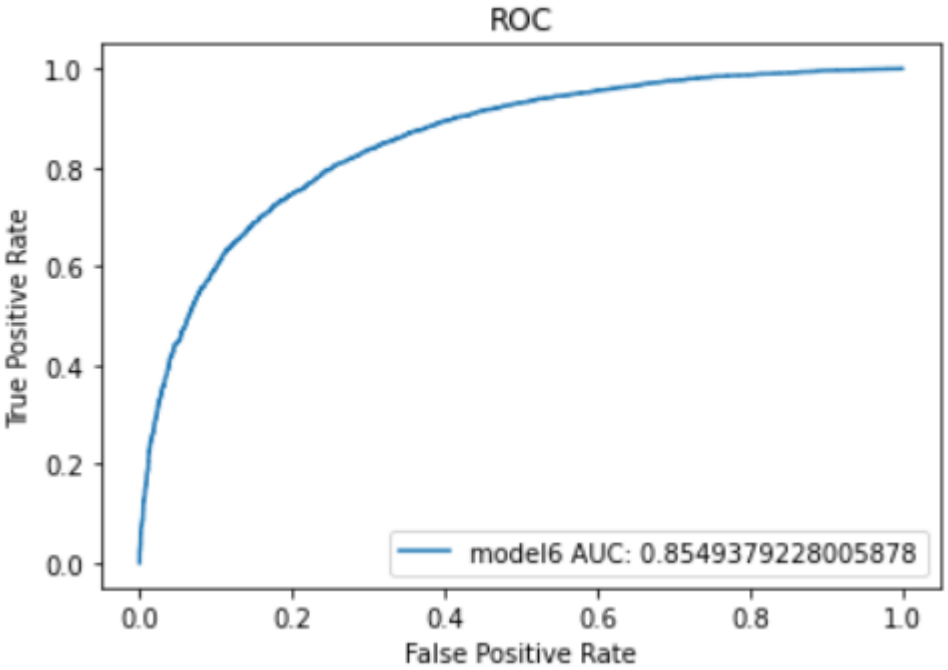
- Accuracy 0.775
- Precision 0.785
- Recall 0.743
- F1 score 0.763

Μοντέλο 7

- H1 = 124
- H2 = 64
- H3 = 32
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping




Training and Validation Accuracy
Accuracy
Epoch
training accuracy
validation accuracy
0.72
0.73
0.74
0.75
0.76
0.77
0
2
4
6
8

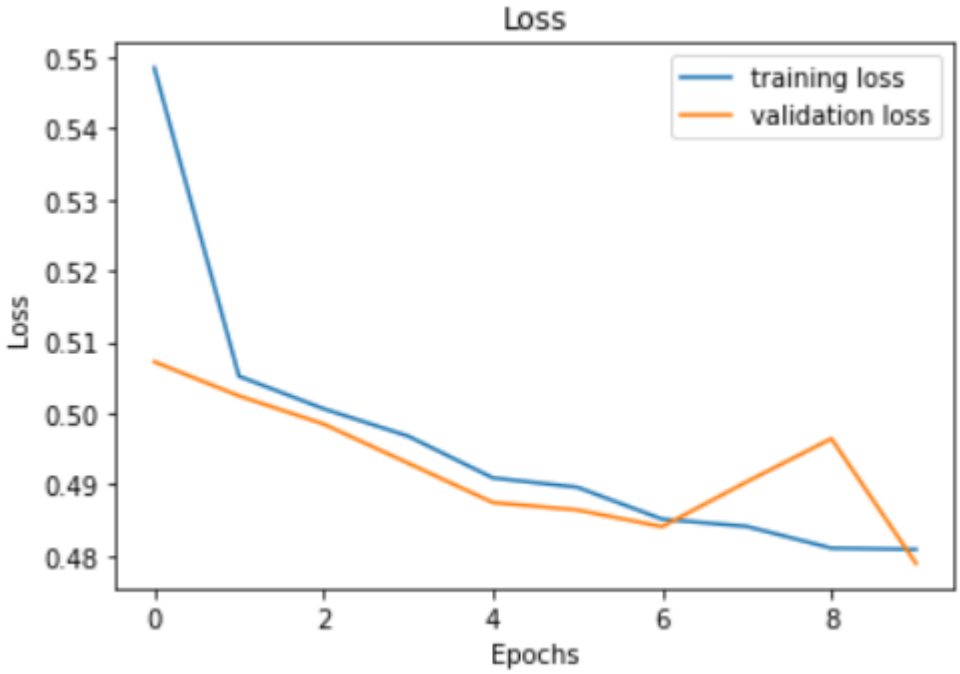

ROC
True Positive Rate
False Positive Rate
model6 AUC: 0.8549379228005878
0.0
0.2
0.4
0.6
0.8
1.0

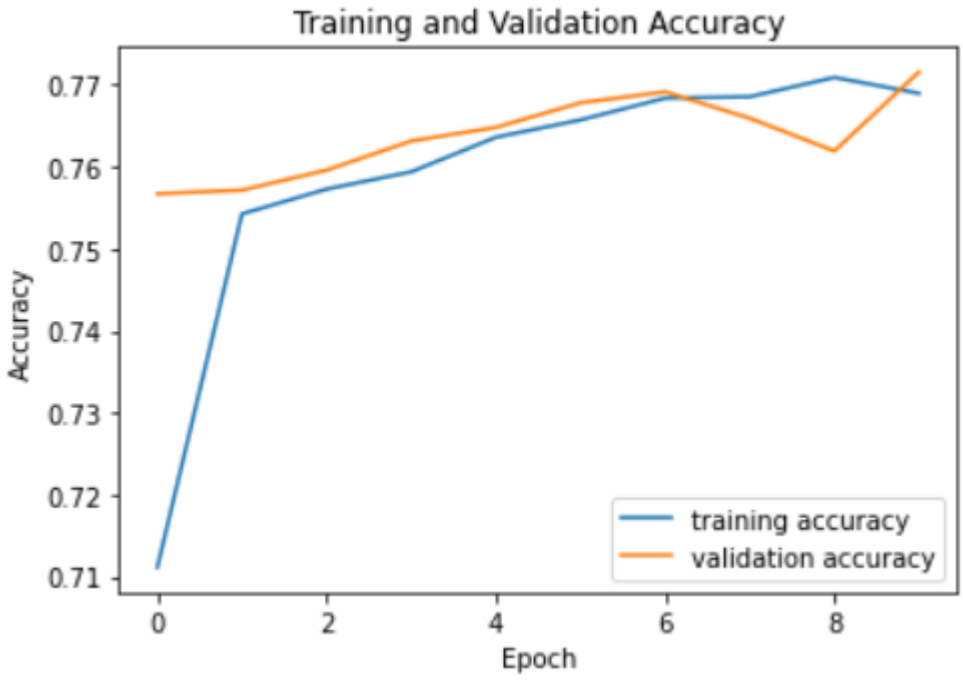
Metrics

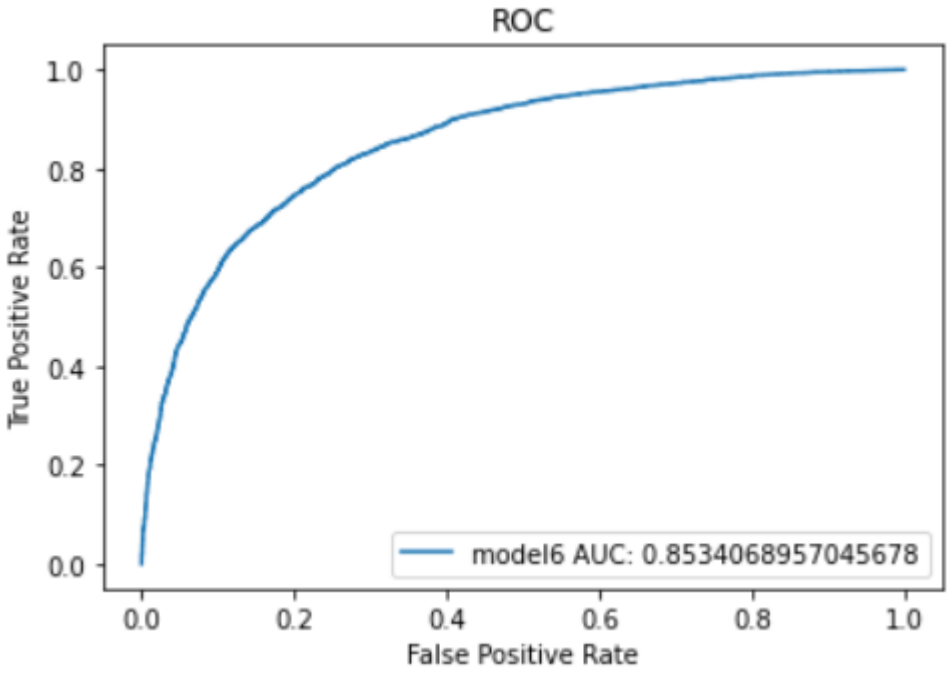
- Loss: 0.47
- Accuracy 0.775
- Precision 0.785
- Recall 0.743
- F1 score 0.763

Μοντέλο 8

- H1 = 64
- H2 = 32
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping




Training and Validation Accuracy
Accuracy
Epoch
training accuracy
validation accuracy
0.77
0.76
0.75
0.74
0.73
0.72
0.71
0
2
4
6
8

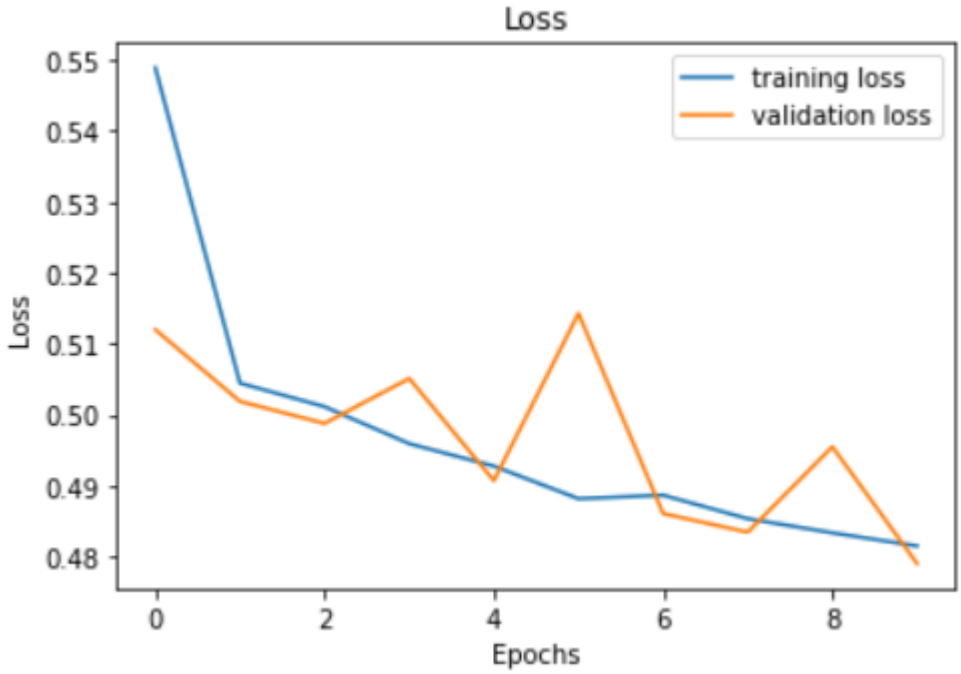

ROC
True Positive Rate
False Positive Rate
model6 AUC: 0.8534068957045678
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

Metrics

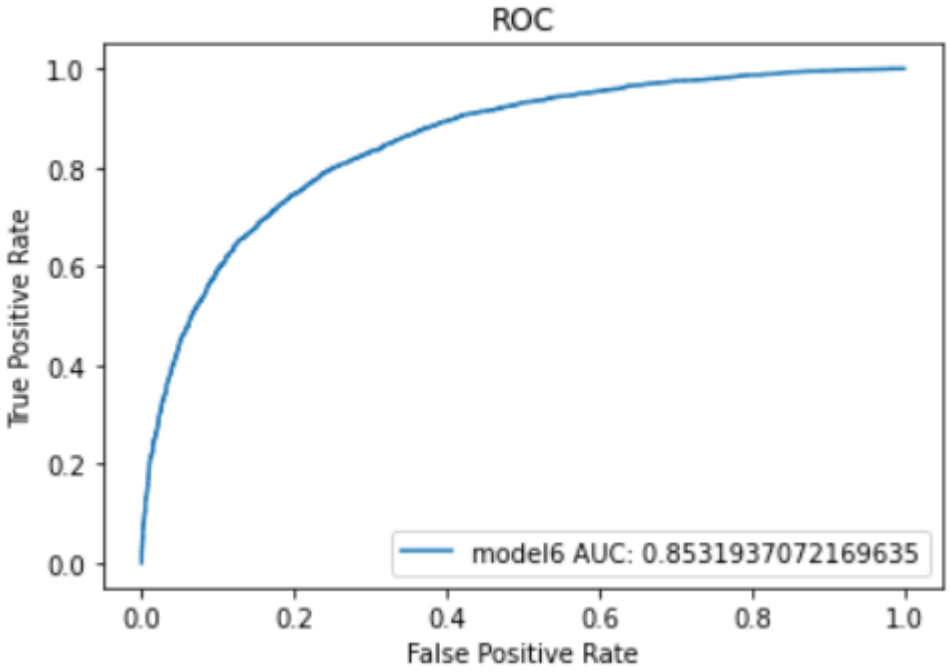
- Loss: 0.48
- Accuracy 0.771
- Precision 0.769
- Recall 0.767
- F1 score 0.768

Μοντέλο 9

- H1 = 64
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping




Training and Validation Accuracy
Accuracy
Epoch
training accuracy
validation accuracy
0.77
0.76
0.75
0.74
0.73
0.72
0.71
0
2
4
6
8


ROC
True Positive Rate
False Positive Rate
model6 AUC: 0.8531937072169635
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

Metrics

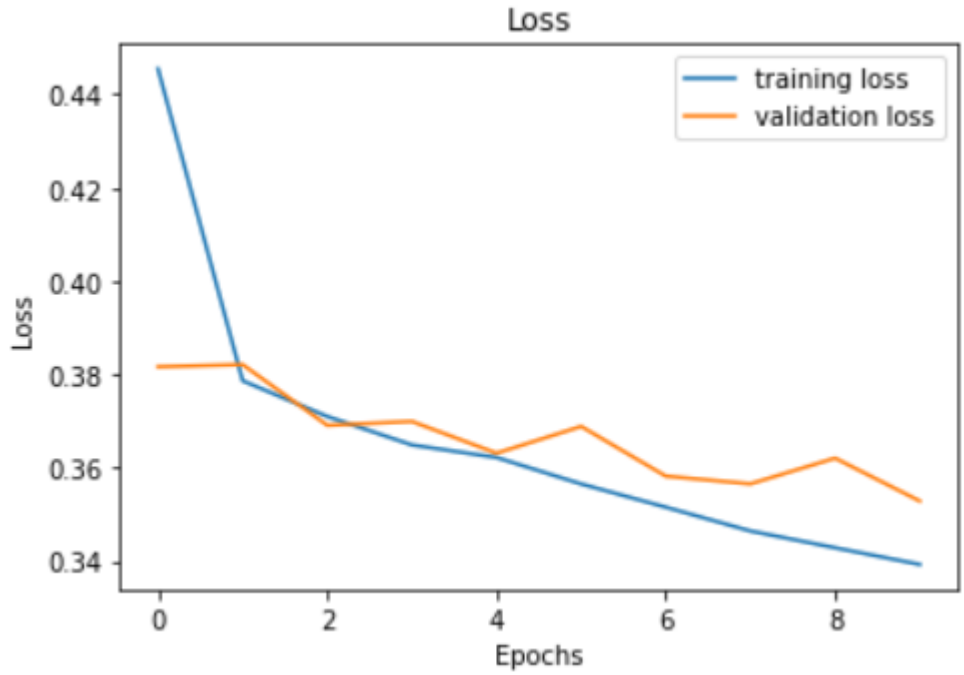
- Loss: 0.481
- Accuracy 0.771
- Precision 0.787
- Recall 0.737
- F1 score 0.761

Παρατήρηση:

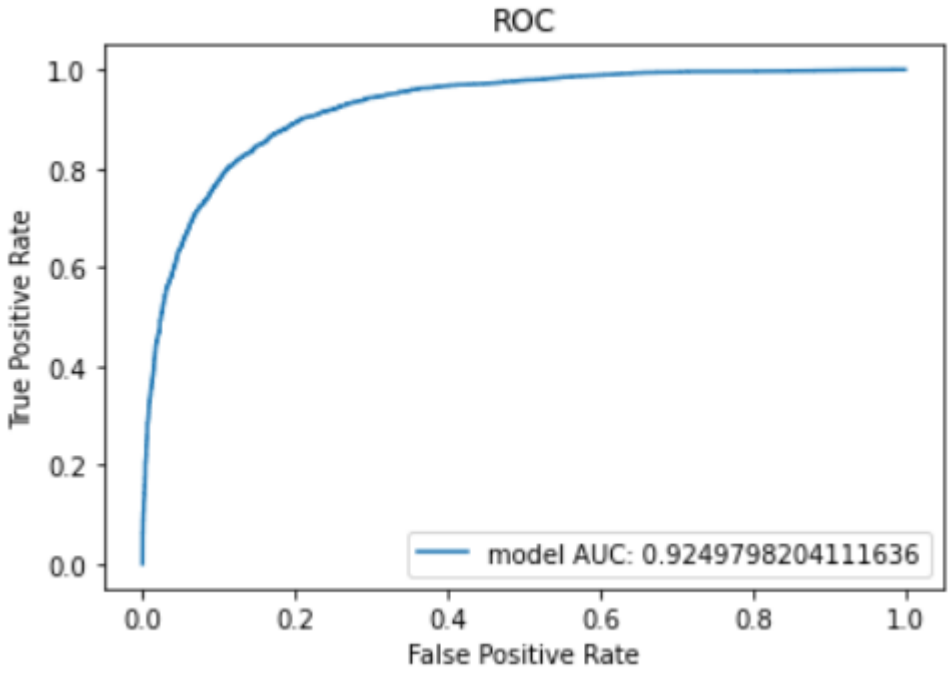
Τα παραπάνω μοντέλα δεν μπορούν να εκπαιδευτούν καλά και στα παρακάτω χρησιμοποιήθηκαν τα 300 sized word embeddings.

Μοντέλο 10

- H1 = 64
- H2 = 64
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.44
0.42
0.40
0.38
0.36
0.34
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.85
0.84
0.83
0.82
0.81
0.80
0.79
0.78
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

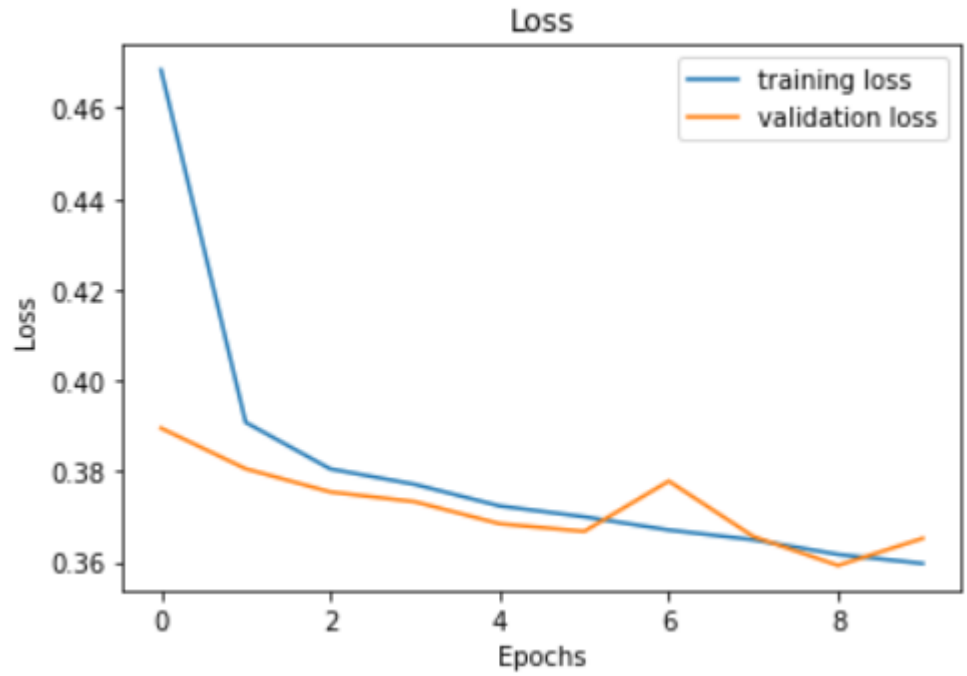

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9249798204111636

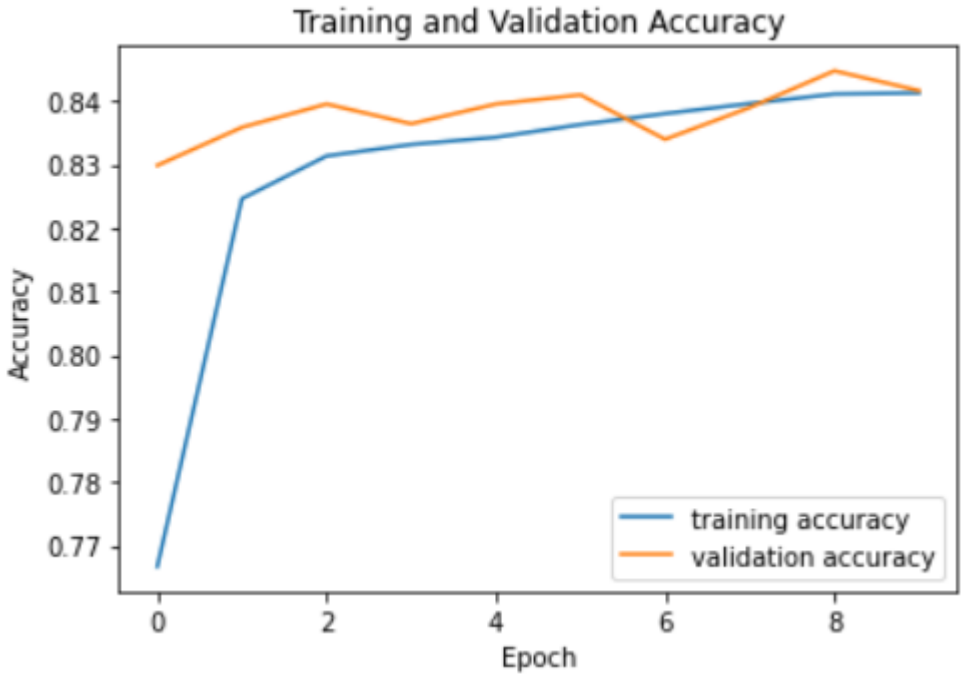
Metrics

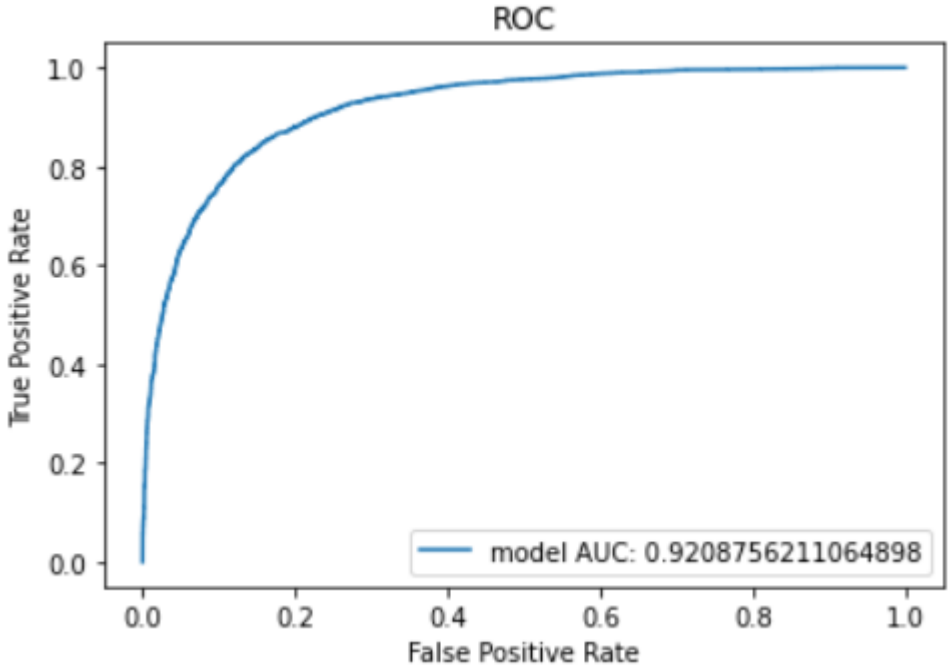
- Loss: 0.339
- Accuracy 0.848
- Precision 0.837
- Recall 0.854
- F1 score 0.845

Μοντέλο 11

- H1 = 64
- H2 = 64
- Dropout chance = 0.5 at H2
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.46
0.44
0.42
0.40
0.38
0.36
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.83
0.82
0.81
0.80
0.79
0.78
0.77
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

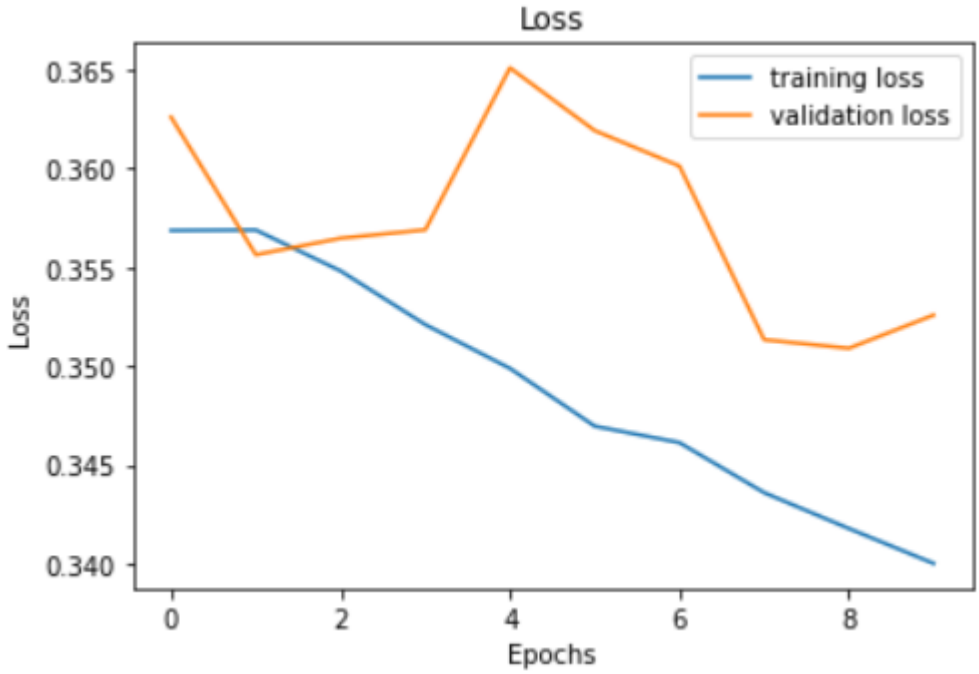

ROC
True Positive Rate
False Positive Rate
model AUC: 0.9208756211064898
0.0
0.2
0.4
0.6
0.8
1.0

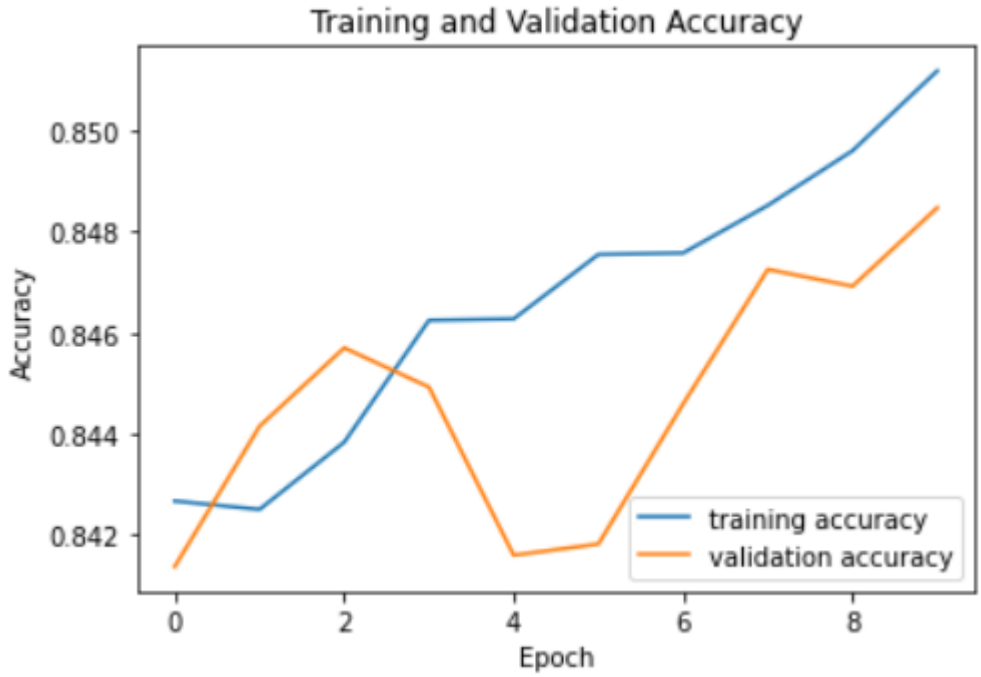
Metrics

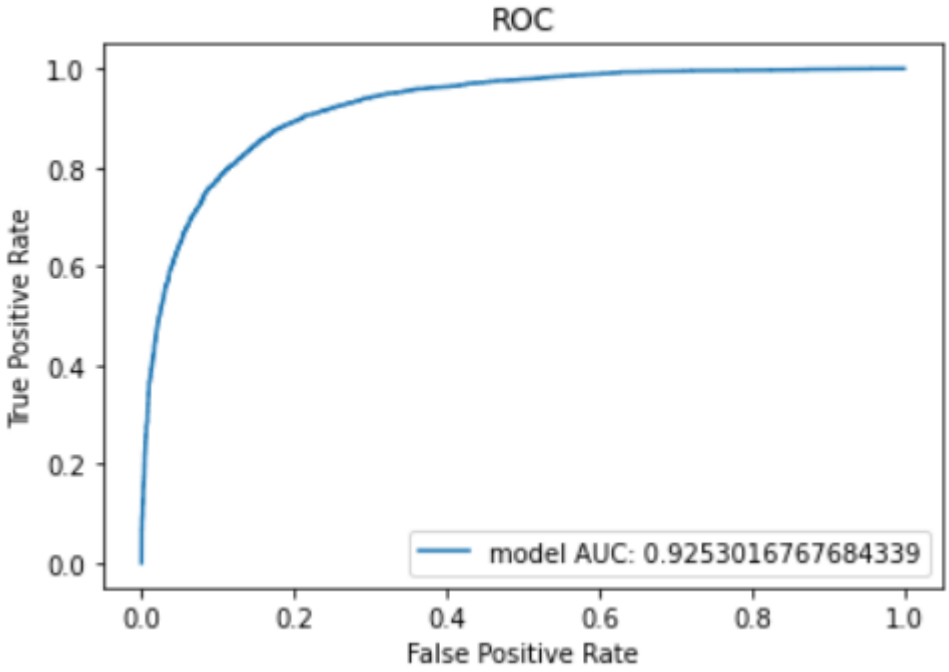
- Loss: 0.359
- Accuracy 0.839
- Precision 0.813
- Recall 0.876
- F1 score 0.843

Μοντέλο 12

- H1 = 64
- H2 = 64
- H3 = 32
- Dropout chance = 0.5 at H2 and H3
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.365
0.360
0.355
0.350
0.345
0.340
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.850
0.848
0.846
0.844
0.842
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

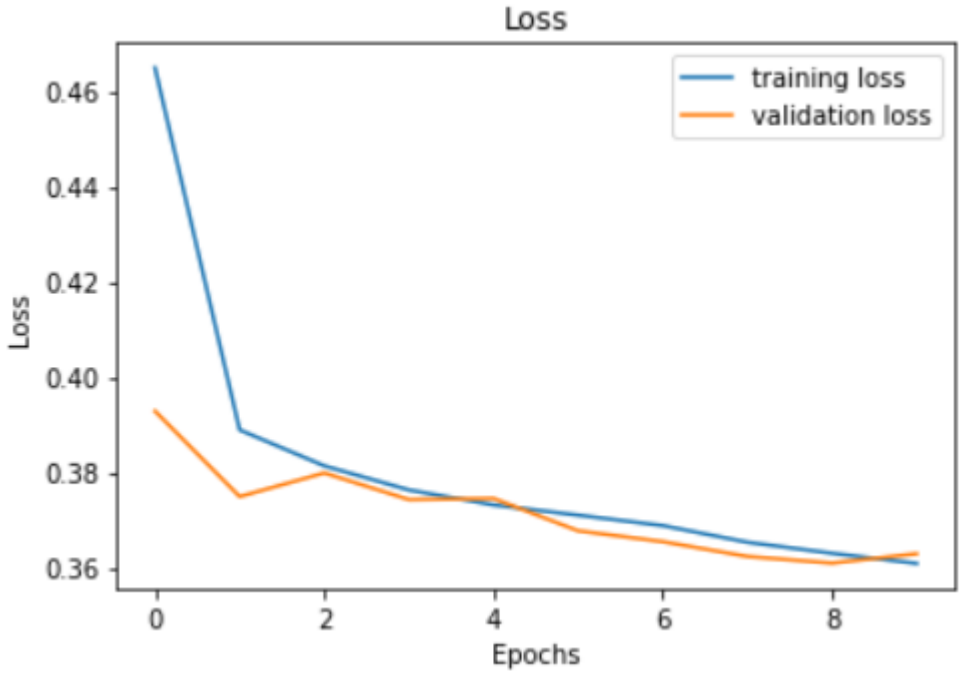

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9253016767684339

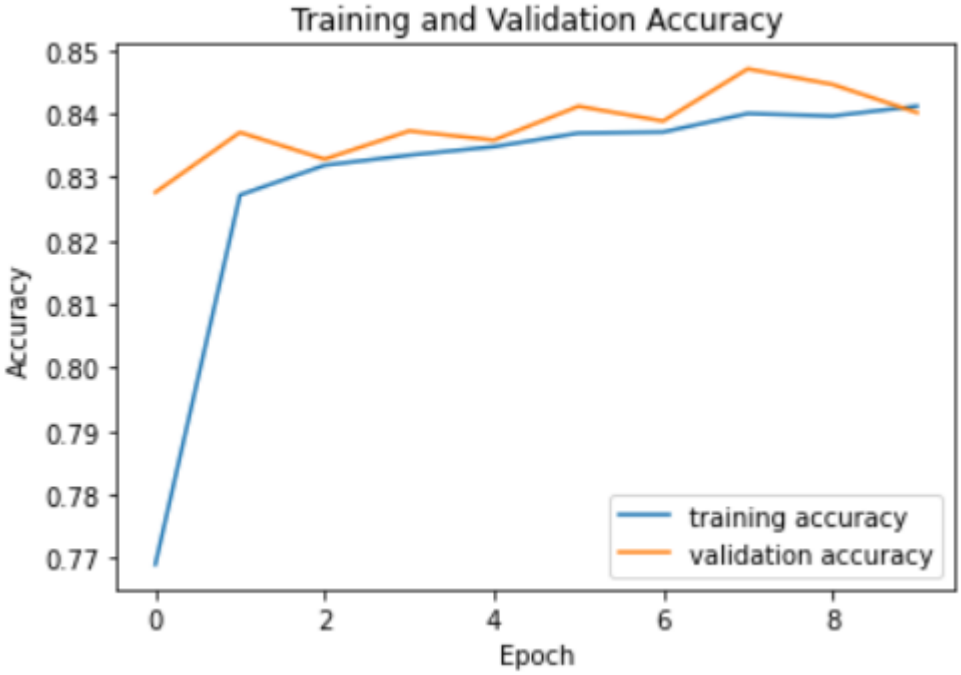
Metrics

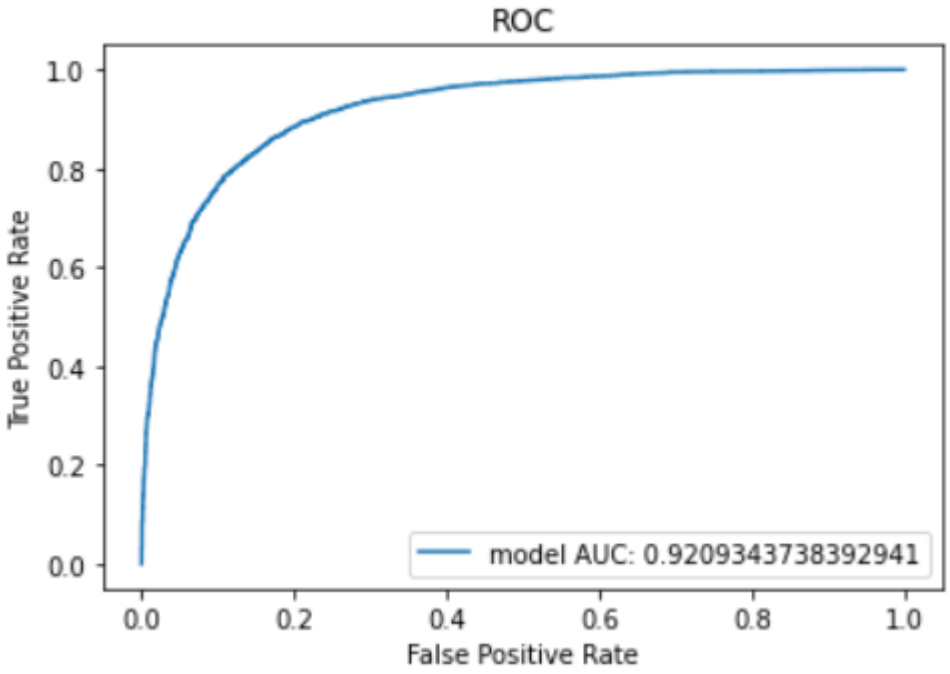
- Loss: 0.360
- Accuracy 0.840
- Precision 0.859
- Recall 0.808
- F1 score 0.832

Μοντέλο 13

- H1 = 64
- H2 = 64
- H3 = 64
- number of tacked RNN's = 2
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.46
0.44
0.42
0.40
0.38
0.36
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.85
0.84
0.83
0.82
0.81
0.80
0.79
0.78
0.77
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch


ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9209343738392941

Metrics

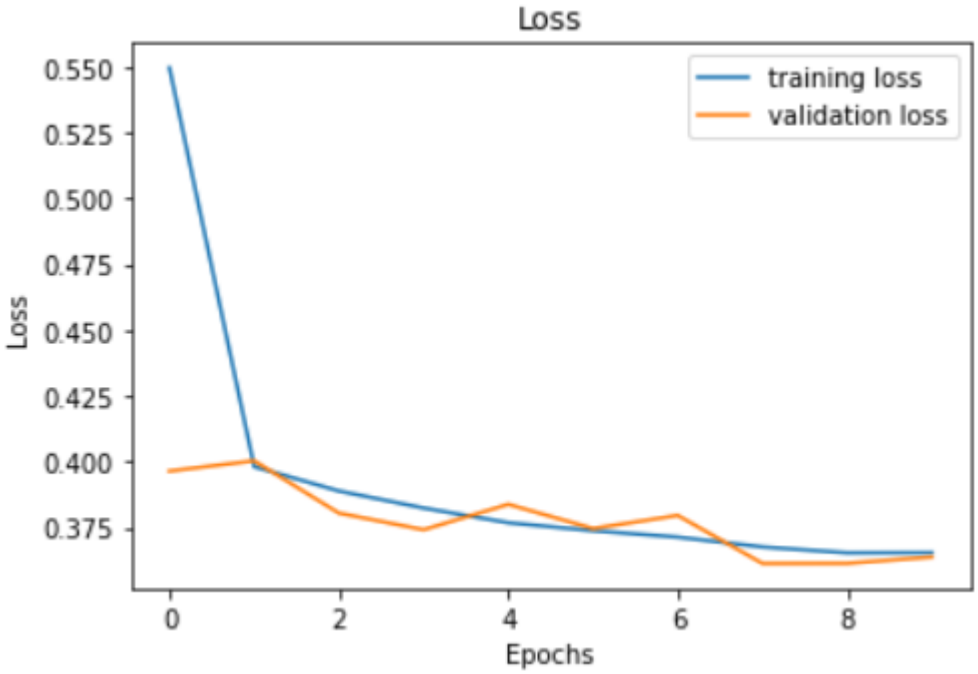
- Loss: 0.360
- Accuracy 0.840
- Precision 0.859
- Recall 0.808
- F1 score 0.832

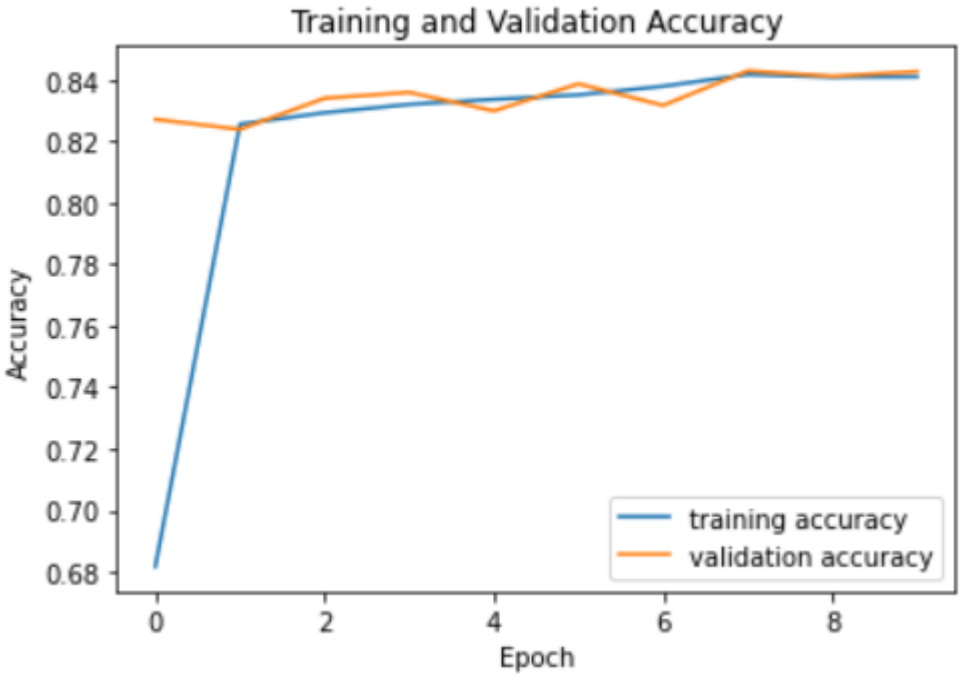
Παρατήρηση:

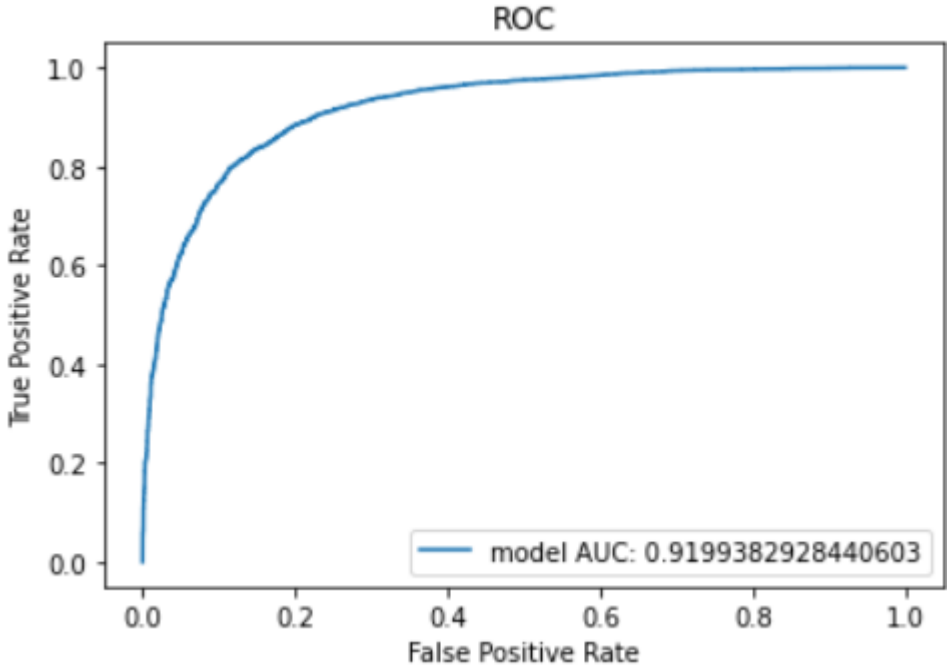
Με 3 hidden layers και χωρίς Dropout και τις υπόλοιπες παραμέτρους ίδιες το μοντέλο 13 αποδίδει πολύ καλύτερα από το 12. Τώρα θα δοκιμάσουμε να χρησιμοποιήσουμε περισσότερα απο 2Stacked RNN's.

Μοντέλο 14

- H1 = 64
- H2 = 64
- H3 = 64
- number of tacked RNN's = 4
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.82
0.80
0.78
0.76
0.74
0.72
0.70
0.68
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

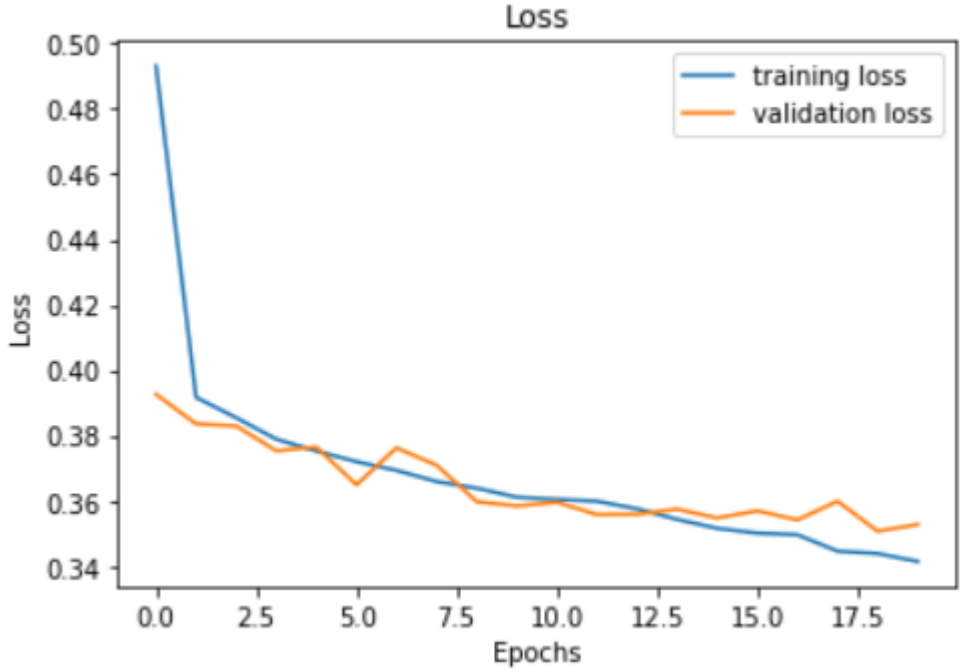

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9199382928440603

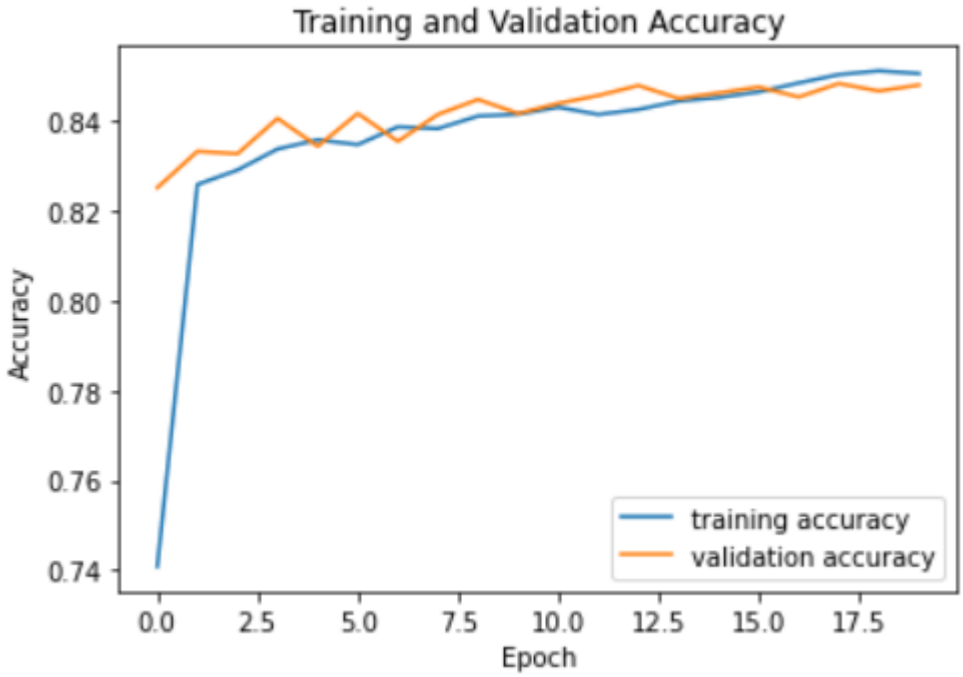
Metrics

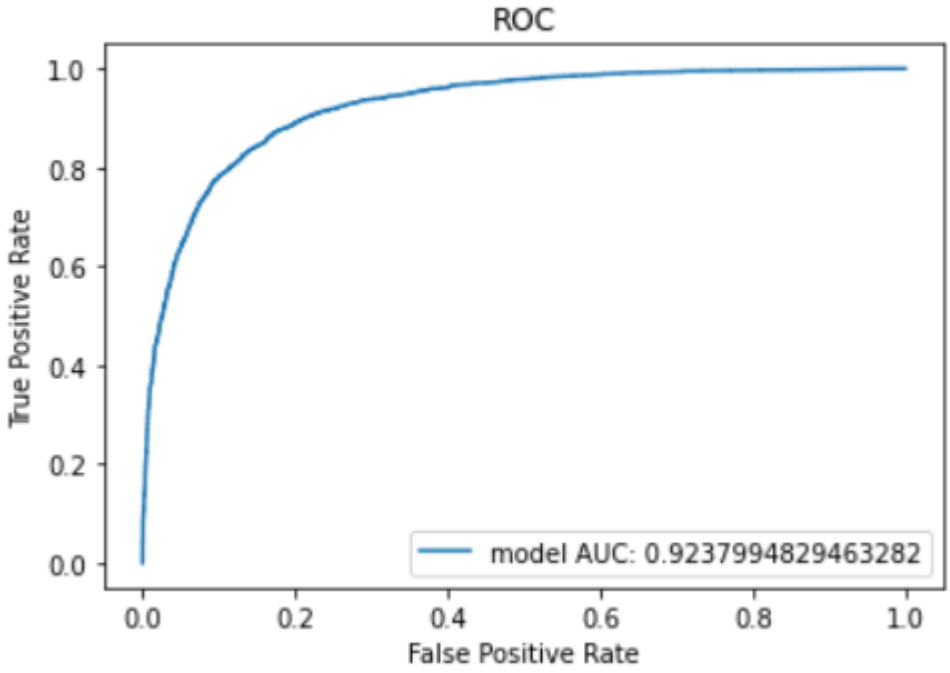
- Loss: 0.365
- Accuracy 0.842
- Precision 0.842
- Recall 0.836
- F1 score 0.839

Μοντέλο 15

- H1 = 64
- H2 = 64
- H3 = 64
- number of tacked RNN's = 3
- Dropout probability = 0.5 at H2
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
Loss
Epochs
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


Training and Validation Accuracy
training accuracy
validation accuracy
Accuracy
Epoch
0.84
0.82
0.80
0.78
0.76
0.74
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9237994829463282

Metrics

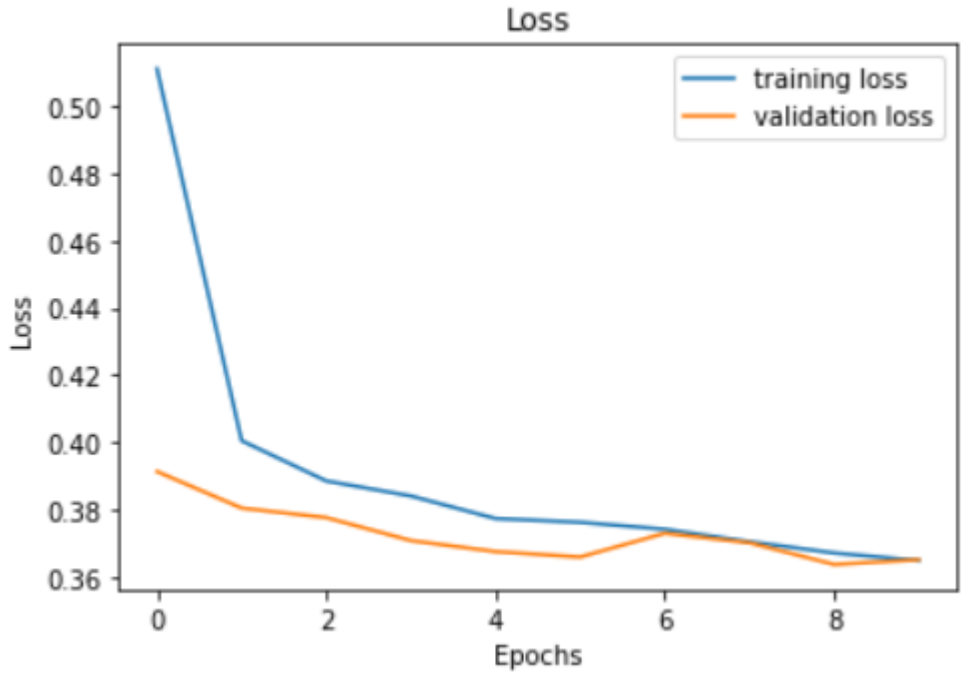
- Loss: 0.345
- Accuracy 0.847
- Precision 0.835
- Recall 0.858
- F1 score 0.846

Παρατήρηση:

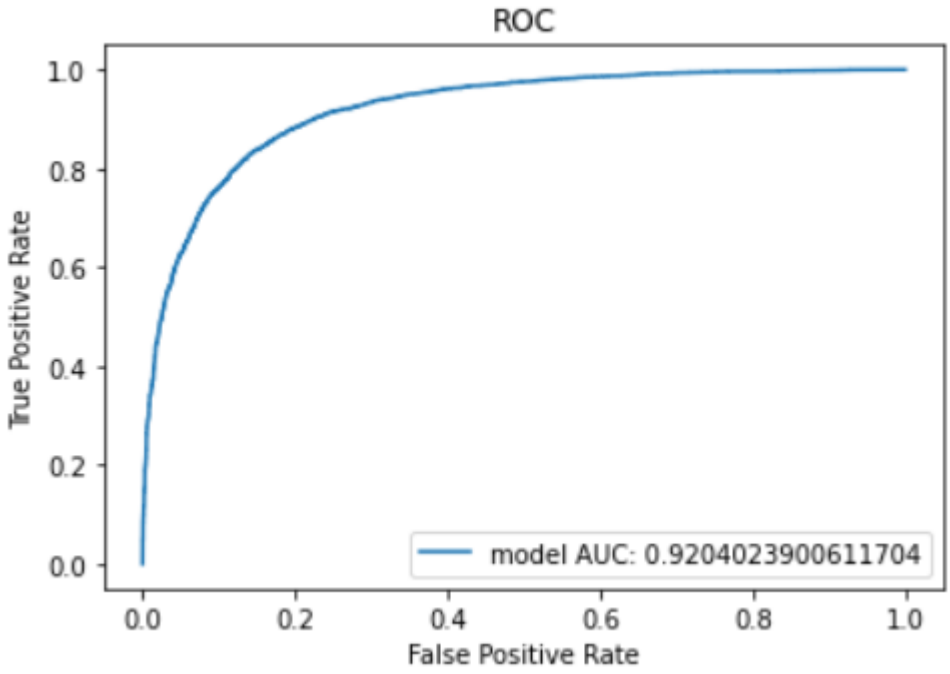
Υπάρχει βελτίωση στις γραφικές όταν χρησιμοποιούμε πάνω από 2 stacked RNN's.

Μοντέλο 16

- H1 = 32
- H2 = 32
- H3 = 32
- number of tacked RNN's = 3
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.82
0.80
0.78
0.76
0.74
0.72
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

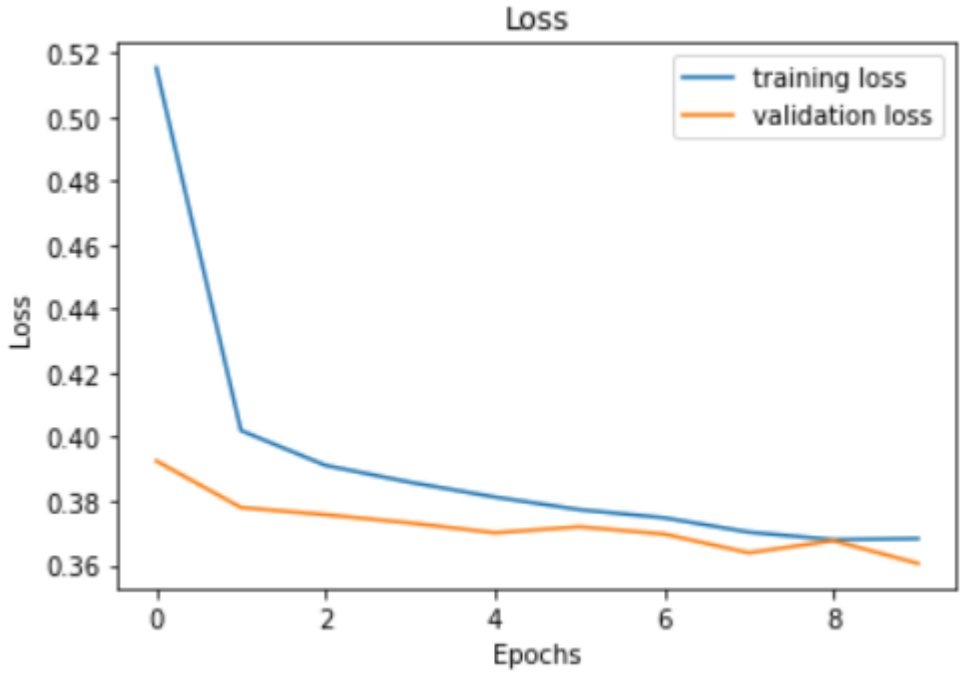

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9204023900611704

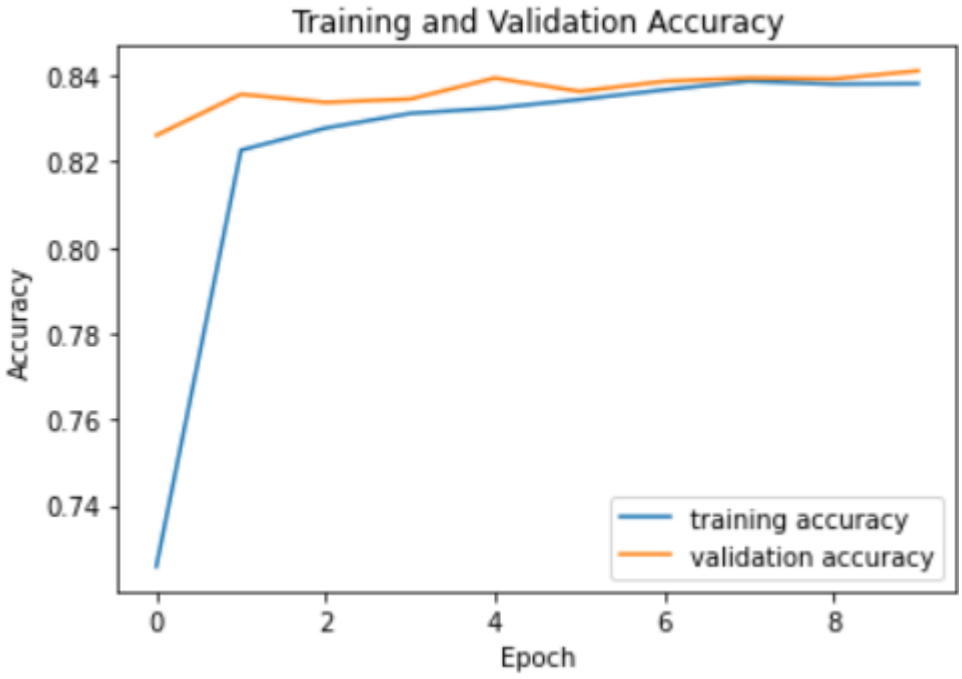
Metrics

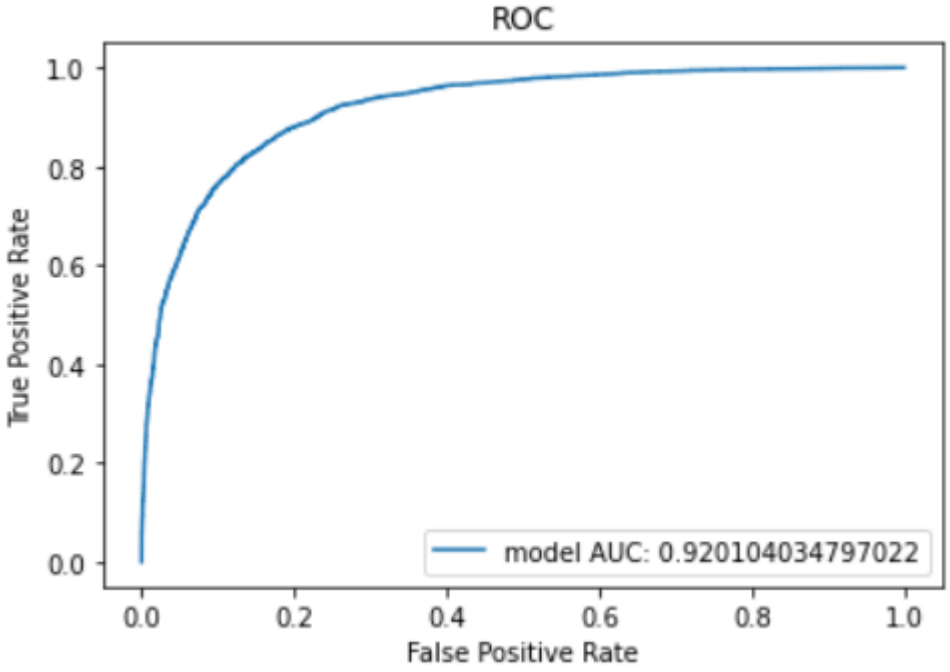
- Loss: 0.364
- Accuracy 0.841
- Precision 0.815
- Recall 0.877
- F1 score 0.845

Μοντέλο 17

- H1 = 32
- H2 = 32
- H3 = 32
- number of tacked RNN's = 3
- learning rate: 0.001
- with gradient clipping
- with ReLU activation function


Loss
training loss
validation loss
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.82
0.80
0.78
0.76
0.74
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch


ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.920104034797022

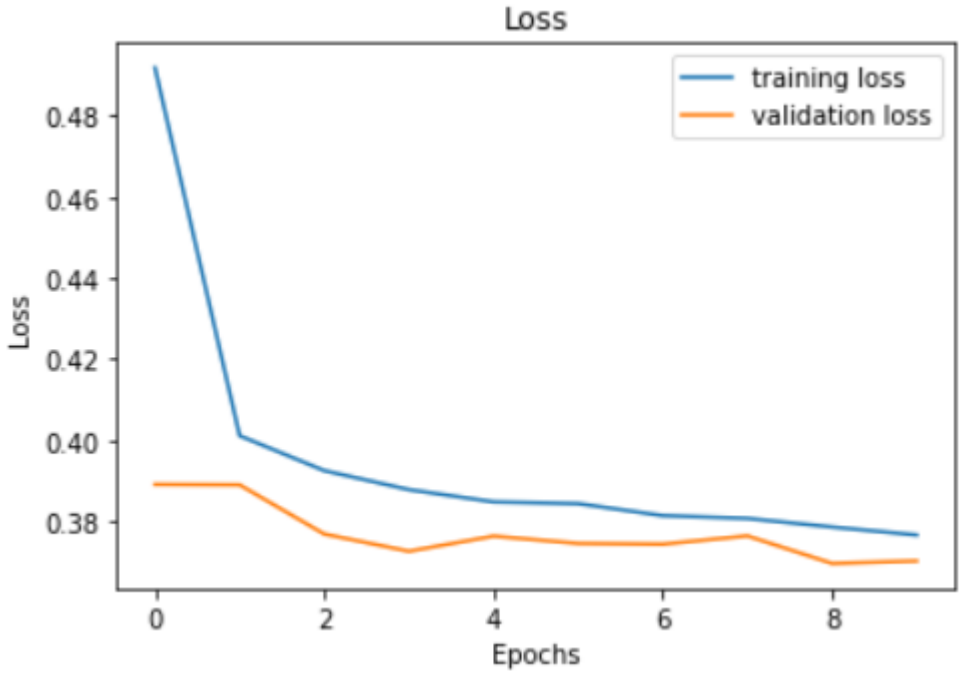
Metrics

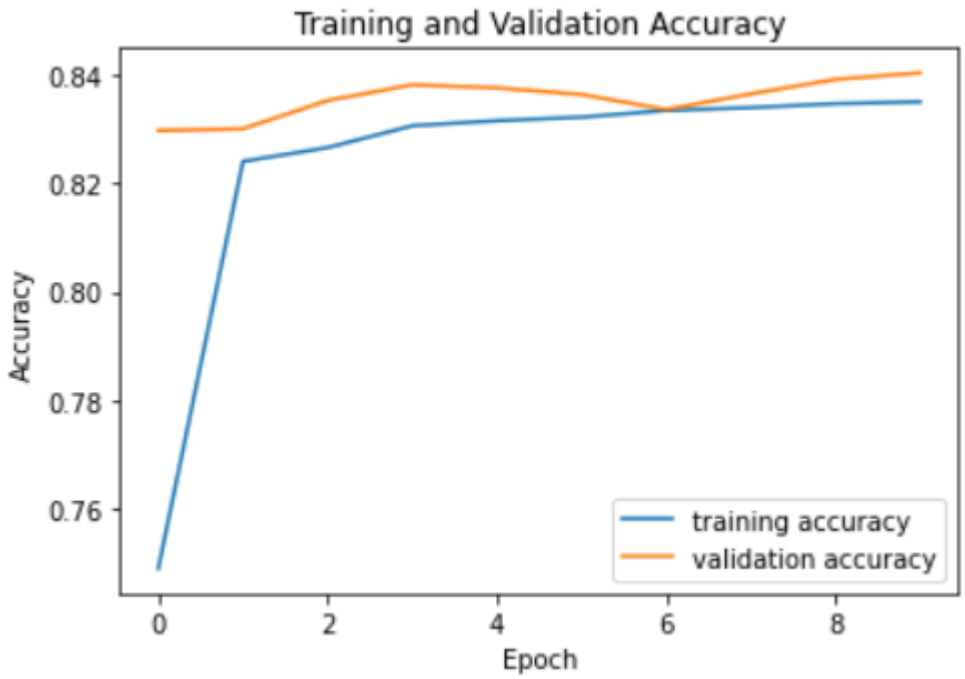
- Loss: 0.368
- Accuracy 0.841
- Precision 0.837
- Recall 0.840
- F1 score 0.839

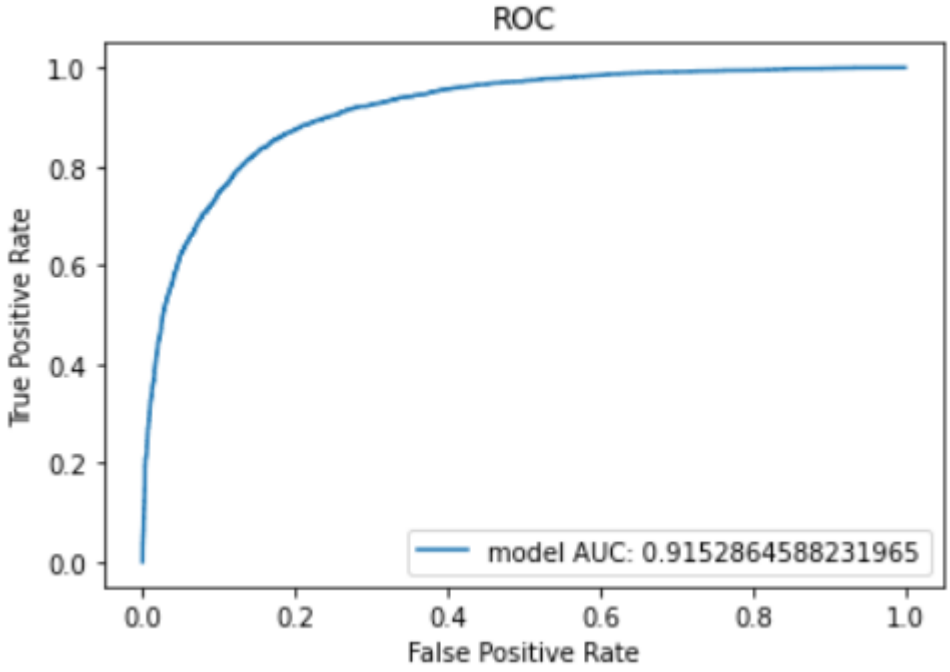
ΓΡΥ ςελλ τψπε:

Μοντέλο 18

- H1 = 32
- H2 = 32
- H3 = 32
- number of tacked RNN's = 3
- learning rate: 0.001
- with gradient clipping


Loss
training loss
validation loss
0.48
0.46
0.44
0.42
0.40
0.38
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.82
0.80
0.78
0.76
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

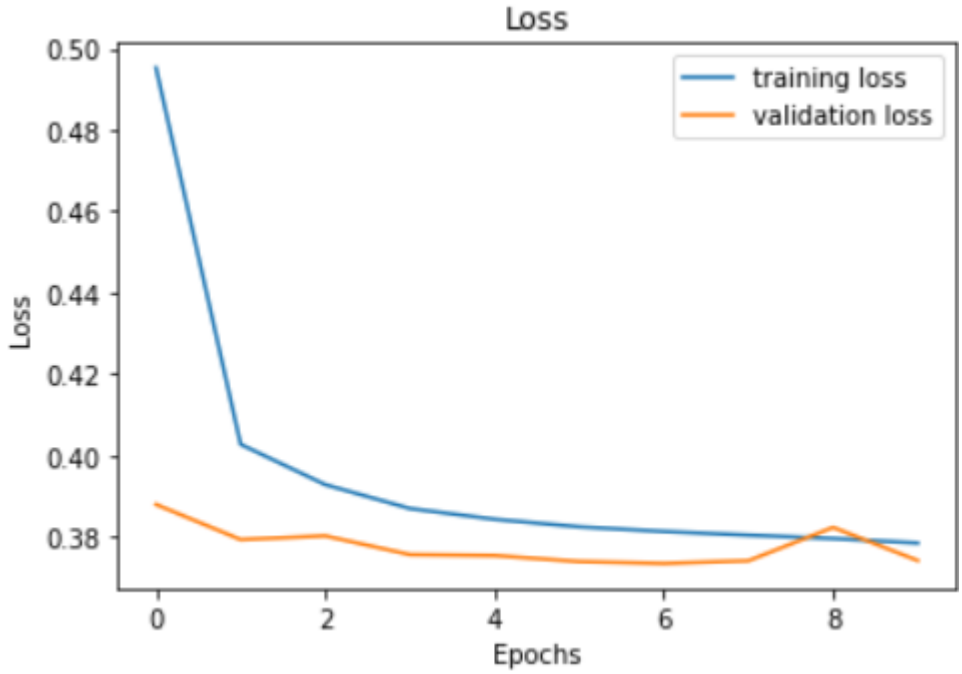

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9152864588231965

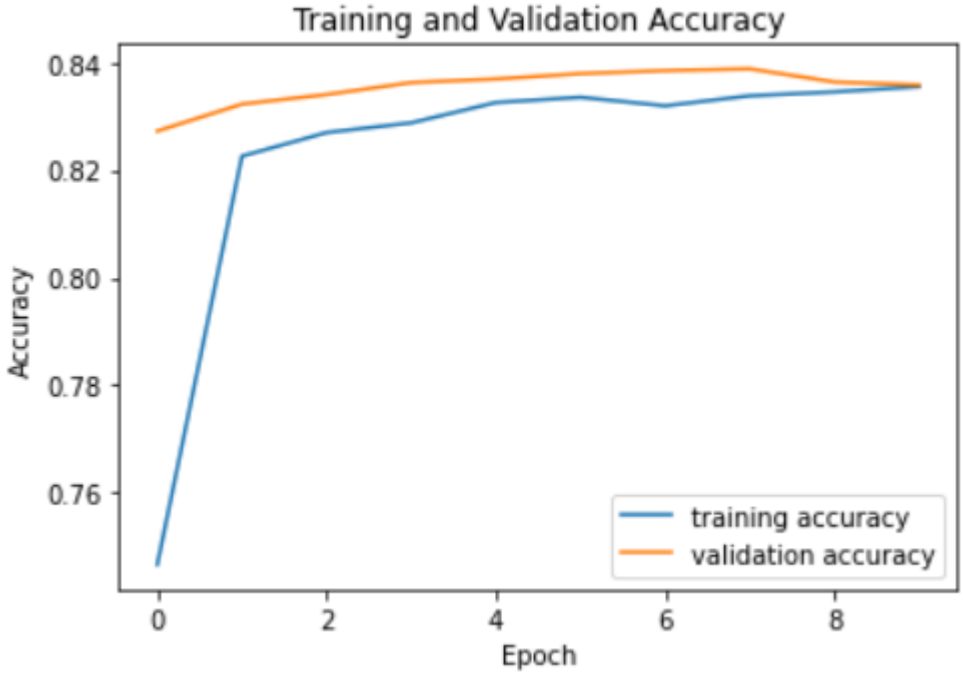
Metrics

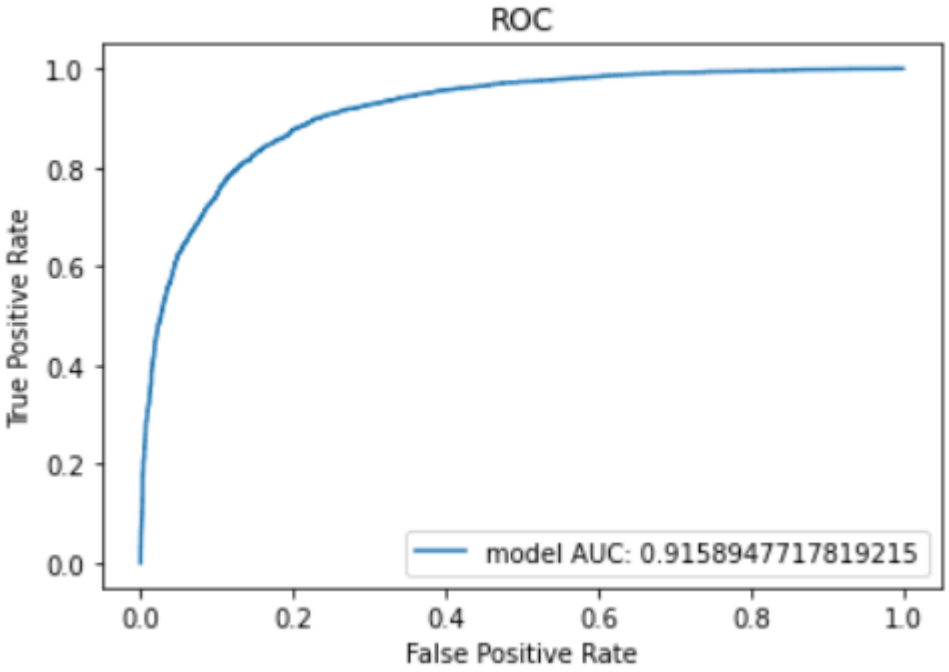
- Loss: 0.376
- Accuracy 0.838
- Precision 0.832
- Recall 0.842
- F1 score 0.835

Μοντέλο 19

- H1 = 32
- H2 = 32
- H3 = 32
- number of tacked RNN's = 3
- learning rate: 0.001
- with gradient clipping
- with ReLU activation


Loss
training loss
validation loss
0.50
0.48
0.46
0.44
0.42
0.40
0.38
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.82
0.80
0.78
0.76
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

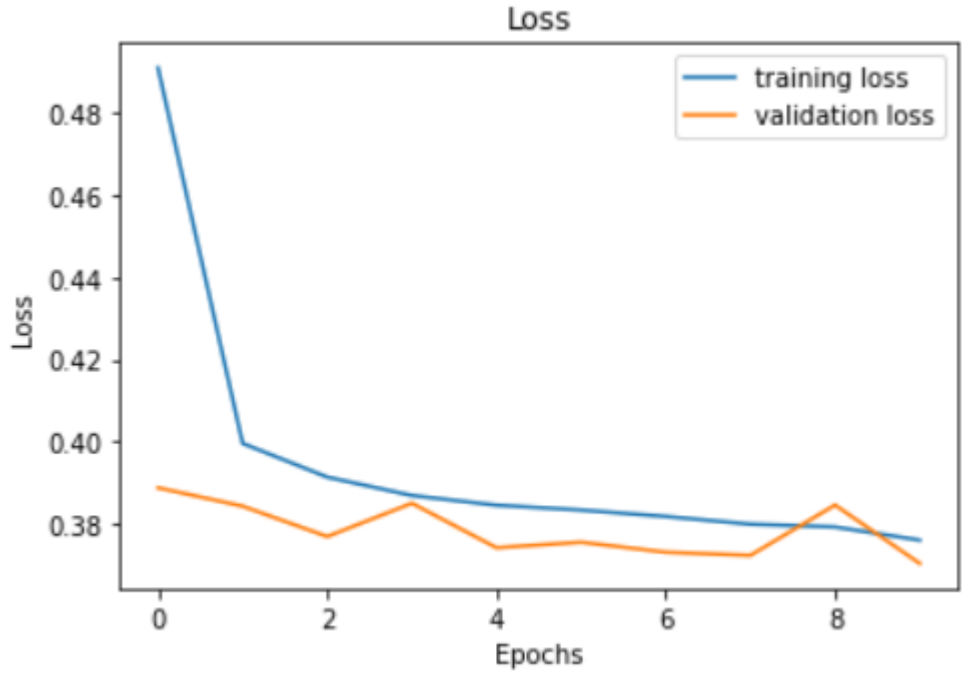

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.9158947717819215

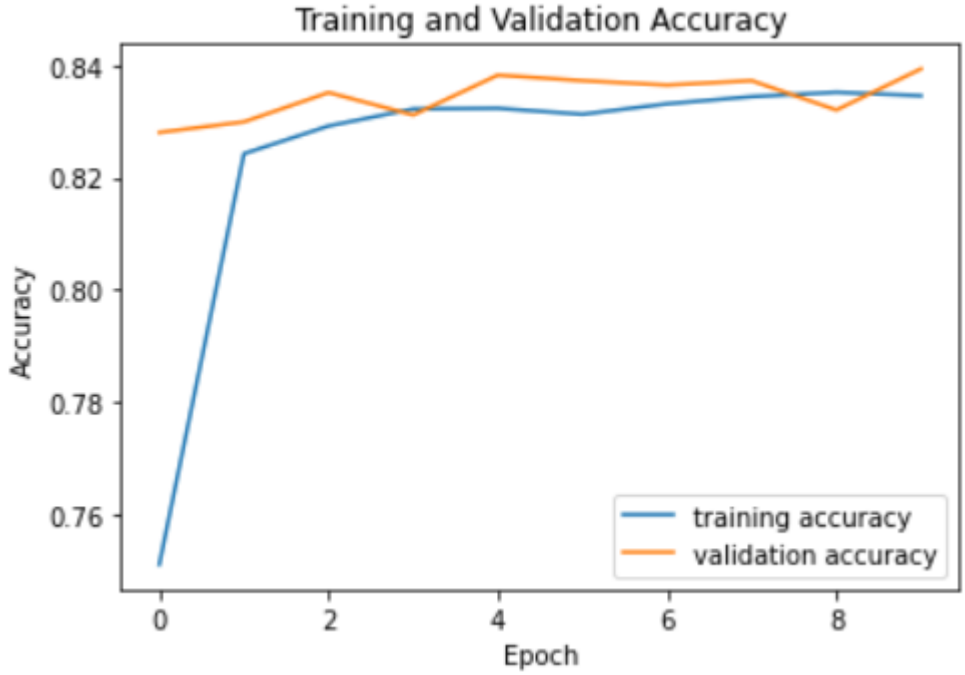
Metrics

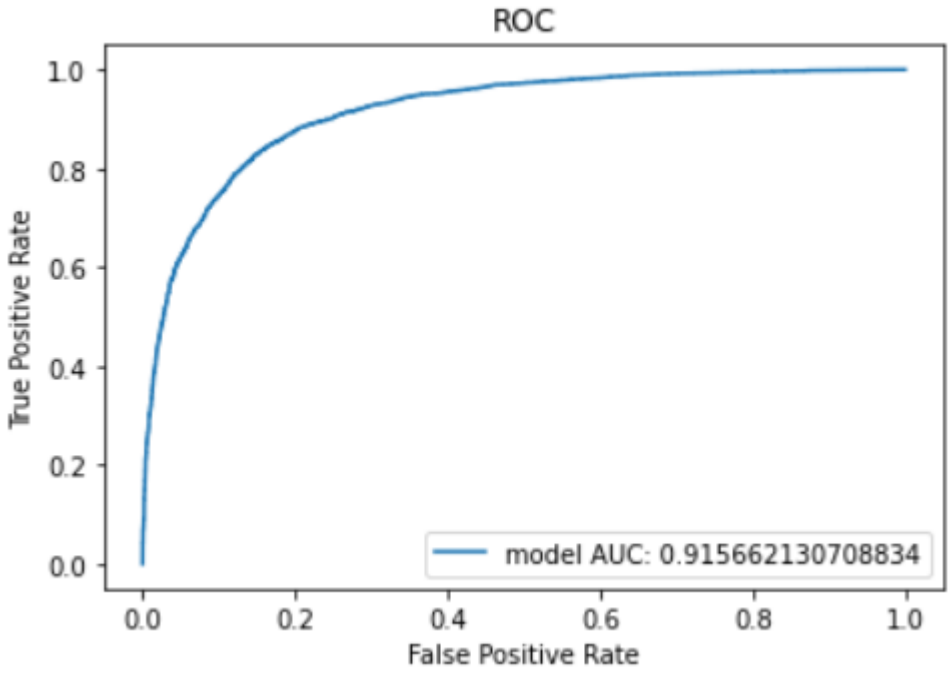
- Loss: 0.375
- Accuracy 0.835
- Precision 0.859
- Recall 0.795
- F1 score 0.826

Μοντέλο 20

- H1 = 32
- H2 = 32
- H3 = 32
- number of tacked RNN's = 3
- learning rate: 0.001
- with gradient clipping
- with Dropout probability = 0.5 at H2


Loss
training loss
validation loss
0.48
0.46
0.44
0.42
0.40
0.38
Loss
0
2
4
6
8
Epochs


Training and Validation Accuracy
0.84
0.82
0.80
0.78
0.76
Accuracy
training accuracy
validation accuracy
0
2
4
6
8
Epoch

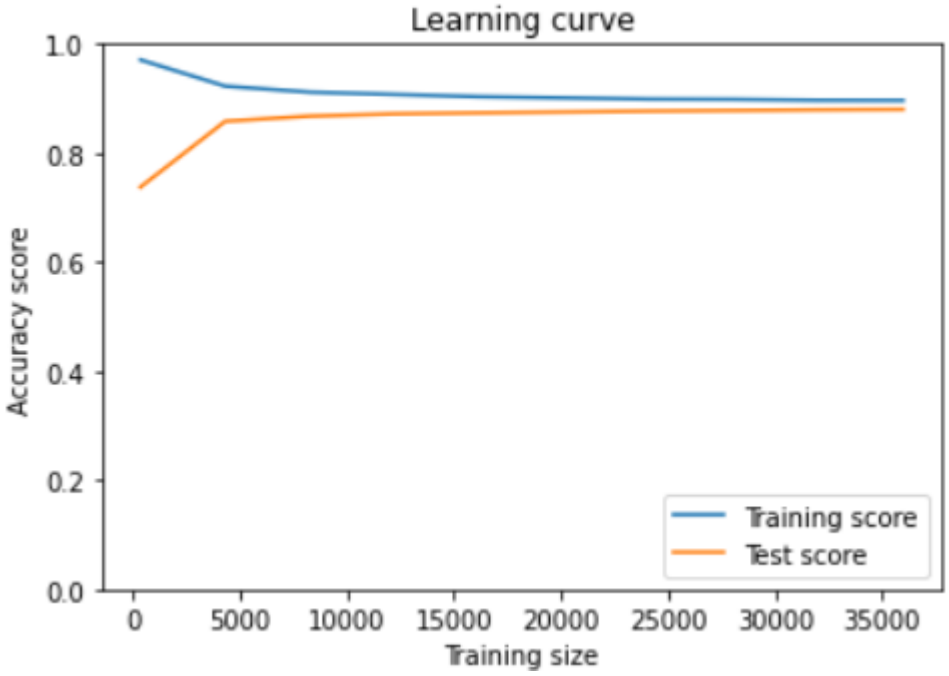

ROC
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
model AUC: 0.915662130708834

Metrics

- Loss: 0.376
- Accuracy 0.840
- Precision 0.838
- Recall 0.830
- F1 score 0.837

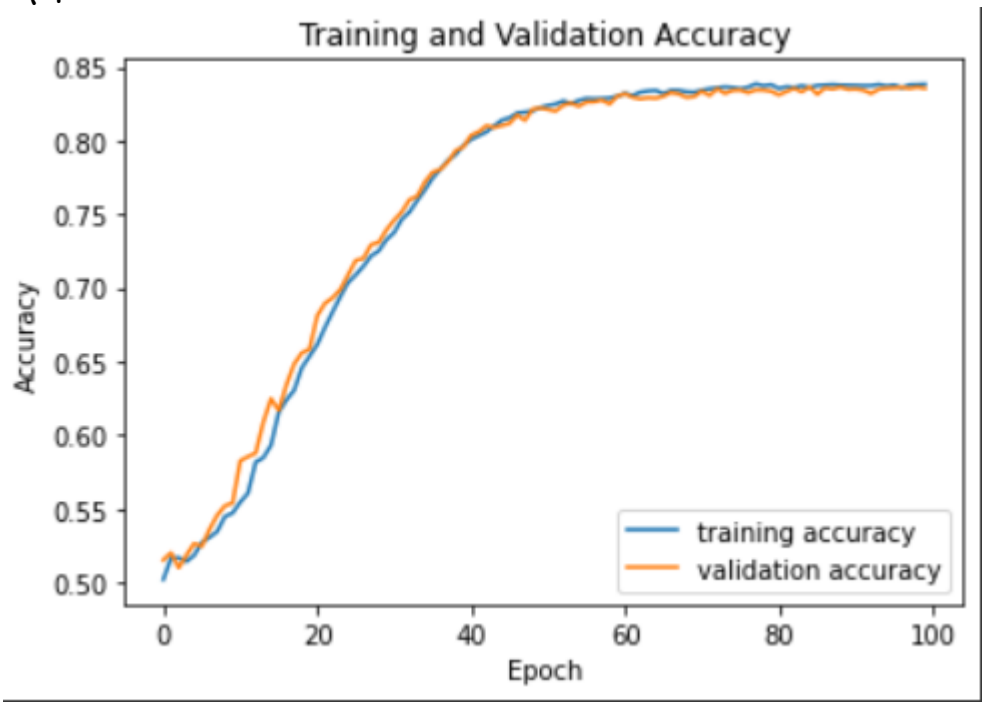
Σύγκριση με προηγούμενες εργασίες

Εργασία 1:



F1 score: 0.875 Accuracy: 0.83

Εργασία 2:



F1 score: 0.835 Accuracy: 0.835

Εργασία 3:

F1 score: 0.845 Accuracy: 0.841