Assignment 7

Link to questions - here (https://docs.google.com/document/d/1o7tMfmpS5XhLc9YpQHV92ZJs1YgyZ40-G98zOVH_0_8/edit?usp=sharing)

Student Details:

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Connect to Drive

```
Drive already mounted at /content/drive; to attempt to forcibly re
mount, call drive.mount("/content/drive", force_remount=True).
```

Imports ¶

```
2.3.0
```

Explore and preprocess

Read CSV

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	H
0	149687	B001EPQRGG	A14OQ67LM79KW3	Candace Mike N Elmo "candacemikenelmo"	0	
1	393601	B001ET5XVW	A39CC8SWYBILWO	LHK	1	
2	393464	B001SATUF2	A8WIS8WGO3B30	stonrdude "dude"	0	
3	479900	B0037QTMD0	A804FIHJ3P9UI	W. J. Costlow	1	
4	175089	B002TXT502	A23X9QV9XPU9MG	BekahKnits	1	

Assign sentiment and create list for labels & reviews

Convert reviews into sequences of word indices

- A "word index" would be an ID for the word
- Sequences are truncated to a maximum length of 100 words

```
Length of sequences:  393579
Found 133039 unique tokens.
Shape of data tensor: (393579, 100)
Shape of label tensor: (393579, 2)
```

Make separate lists for positive and negative reviews

```
Positive reviews # 86823
Negative reviews # 306756
```

Build train, validation, test data

- 10000 reviews are considered for training
- 2000 reviews are considered for each test and validation sets
- For each of the three segments, equal number of pos. and neg. reviews are taken

```
Training  10000
Validation  2000
Test  2000
```

Storing and retrieving the data variables

Preparing the embedding matrix

- Using the pre-trained GloVe embedding which will contain at index `i` the embedding vector for the word of index `i` in our word index.

```
Found 400000 word vectors.
```

Storing and retrieving the data variables

Building Model

Utility function to plot accuracy and loss

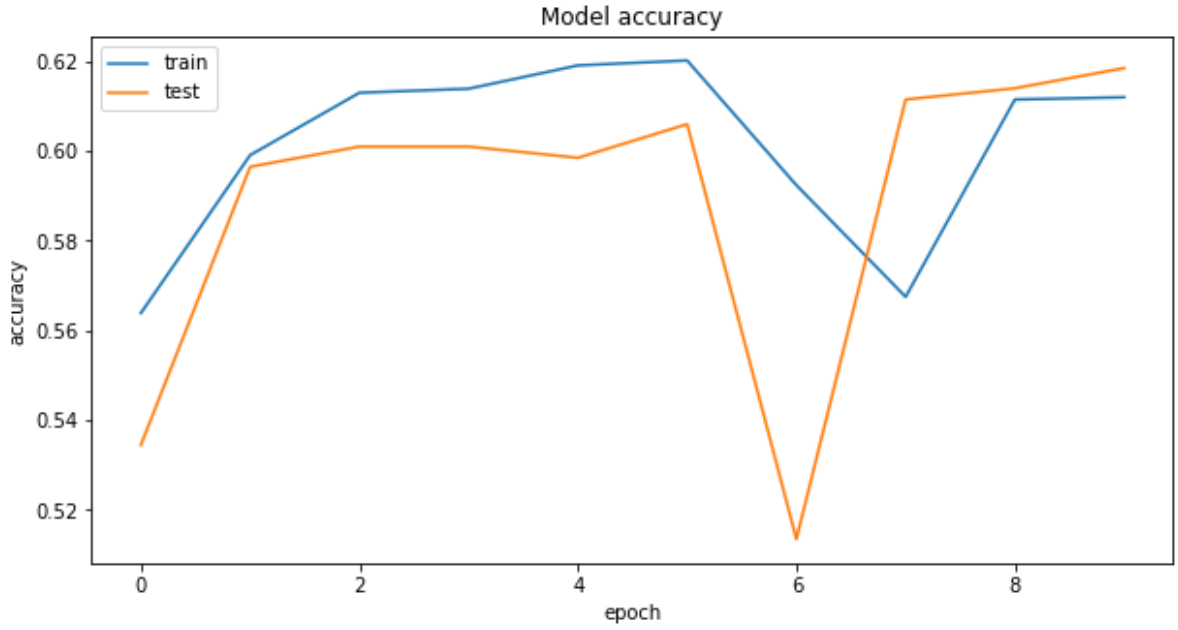
Importing keras

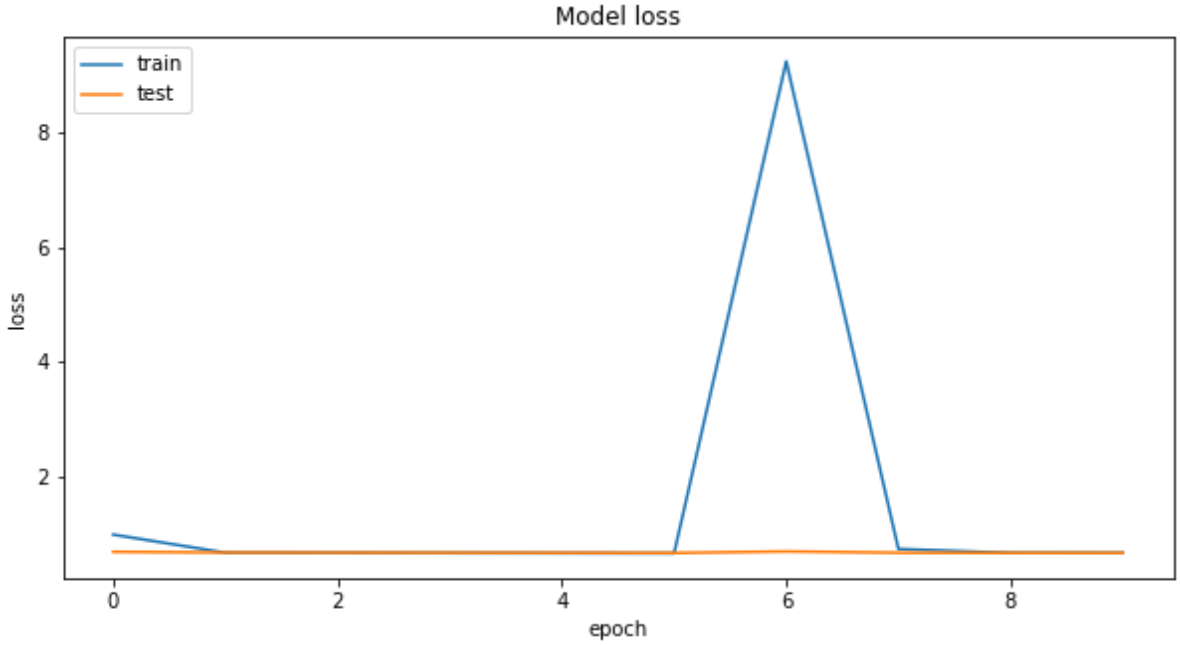
GloVe Embedding layer

Model 1 (1 LSTM-64)

```
WARNING:tensorflow:Layer lstm will not use cuDNN kernel since it d
oesn't meet the cuDNN kernel criteria. It will use generic GPU ker
nel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 18s 226ms/step - loss: 0.
9867 - accuracy: 0.5639 - val_loss: 0.6866 - val_accuracy: 0.5345
Epoch 2/10
79/79 [==============================] - 18s 222ms/step - loss: 0.
6711 - accuracy: 0.5991 - val_loss: 0.6743 - val_accuracy: 0.5965
Epoch 3/10
79/79 [==============================] - 17s 218ms/step - loss: 0.
6672 - accuracy: 0.6130 - val_loss: 0.6726 - val_accuracy: 0.6010
Epoch 4/10
79/79 [==============================] - 18s 227ms/step - loss: 0.
6650 - accuracy: 0.6139 - val_loss: 0.6710 - val_accuracy: 0.6010
Epoch 5/10
79/79 [==============================] - 17s 221ms/step - loss: 0.
6627 - accuracy: 0.6191 - val_loss: 0.6697 - val_accuracy: 0.5985
Epoch 6/10
79/79 [==============================] - 18s 227ms/step - loss: 0.
6603 - accuracy: 0.6202 - val_loss: 0.6672 - val_accuracy: 0.6060
Epoch 7/10
79/79 [==============================] - 17s 214ms/step - loss: 9.
2332 - accuracy: 0.5924 - val_loss: 0.6931 - val_accuracy: 0.5135
Epoch 8/10
79/79 [==============================] - 18s 225ms/step - loss: 0.
7365 - accuracy: 0.5675 - val_loss: 0.6709 - val_accuracy: 0.6115
Epoch 9/10
79/79 [==============================] - 17s 221ms/step - loss: 0.
6673 - accuracy: 0.6115 - val_loss: 0.6694 - val_accuracy: 0.6140
Epoch 10/10
79/79 [==============================] - 17s 220ms/step - loss: 0.
6662 - accuracy: 0.6120 - val_loss: 0.6683 - val_accuracy: 0.6185
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
lstm (LSTM)                  (None, 64)                42240
_________________________________________________________________
dense (Dense)                (None, 2)                 130
=================================================================
Total params: 13,346,370
Trainable params: 42,370
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 1s 19ms/step - loss: 0.67
09 - accuracy: 0.5965
test loss, test acc: [0.6708700060844421, 0.5964999794960022]
```

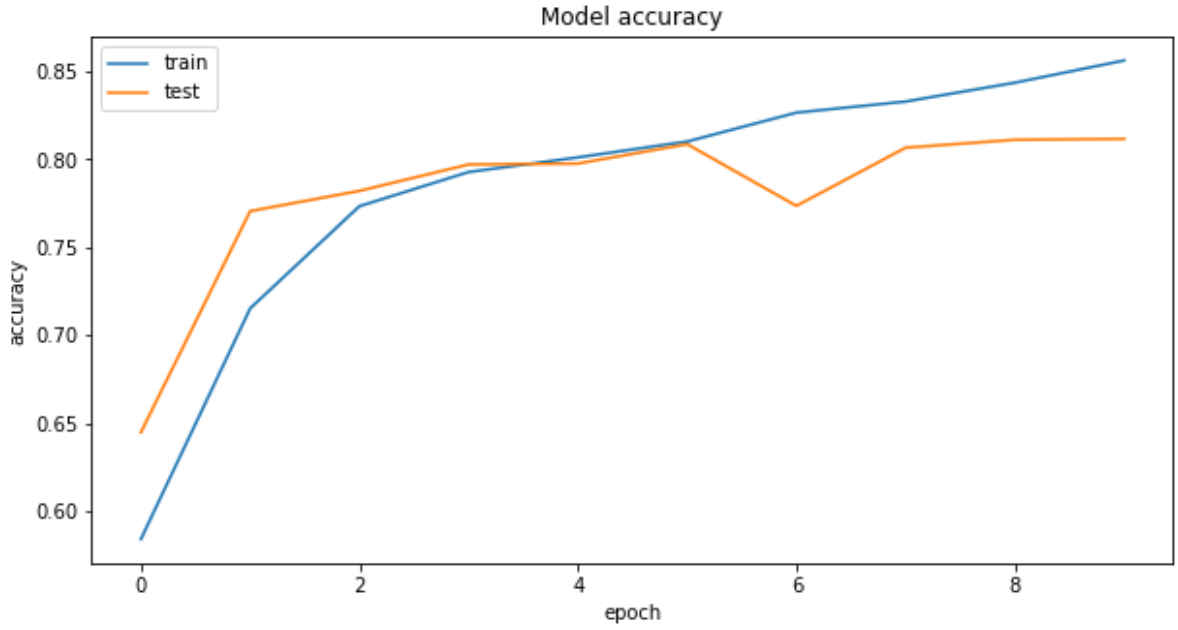


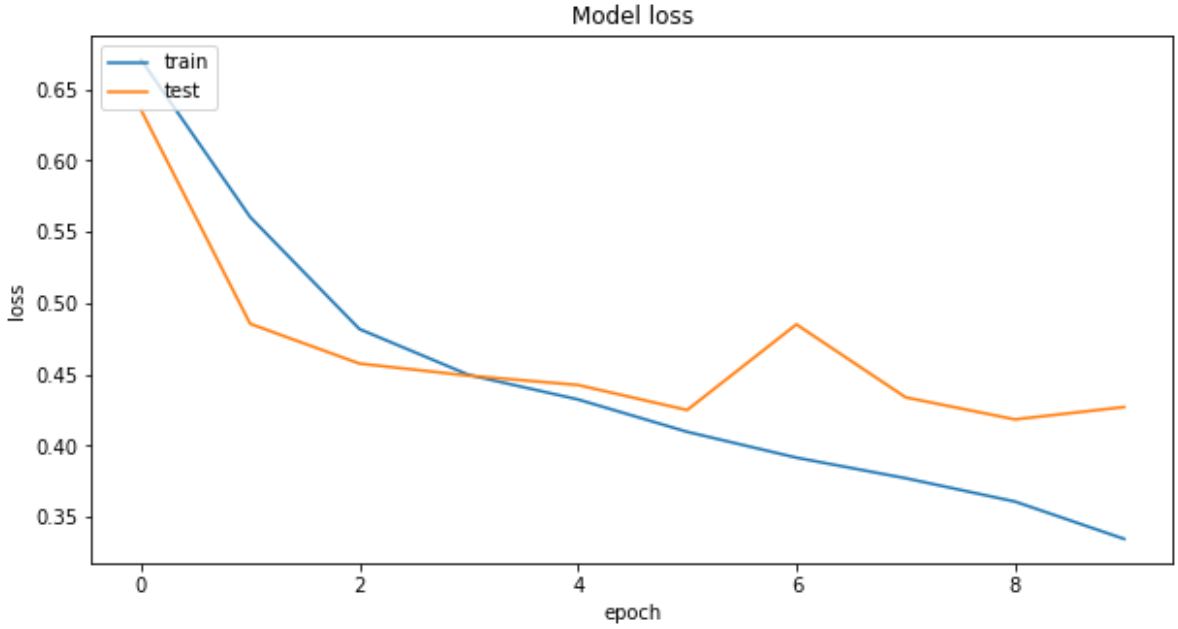


Model 2 (1 GRU-64)

```
WARNING:tensorflow:Layer gru will not use cuDNN kernel since it do
esn't meet the cuDNN kernel criteria. It will use generic GPU kern
el as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 21s 267ms/step - loss: 0.
6709 - accuracy: 0.5844 - val_loss: 0.6357 - val_accuracy: 0.6450
Epoch 2/10
79/79 [==============================] - 23s 290ms/step - loss: 0.
5604 - accuracy: 0.7153 - val_loss: 0.4856 - val_accuracy: 0.7705
Epoch 3/10
79/79 [==============================] - 22s 284ms/step - loss: 0.
4819 - accuracy: 0.7733 - val_loss: 0.4577 - val_accuracy: 0.7820
Epoch 4/10
79/79 [==============================] - 23s 285ms/step - loss: 0.
4497 - accuracy: 0.7927 - val_loss: 0.4492 - val_accuracy: 0.7970
Epoch 5/10
79/79 [==============================] - 22s 280ms/step - loss: 0.
4325 - accuracy: 0.8010 - val_loss: 0.4427 - val_accuracy: 0.7975
Epoch 6/10
79/79 [==============================] - 21s 266ms/step - loss: 0.
4098 - accuracy: 0.8100 - val_loss: 0.4251 - val_accuracy: 0.8085
Epoch 7/10
79/79 [==============================] - 22s 278ms/step - loss: 0.
3917 - accuracy: 0.8264 - val_loss: 0.4852 - val_accuracy: 0.7735
Epoch 8/10
79/79 [==============================] - 22s 274ms/step - loss: 0.
3773 - accuracy: 0.8327 - val_loss: 0.4340 - val_accuracy: 0.8065
Epoch 9/10
79/79 [==============================] - 21s 268ms/step - loss: 0.
3609 - accuracy: 0.8434 - val_loss: 0.4185 - val_accuracy: 0.8110
Epoch 10/10
79/79 [==============================] - 21s 264ms/step - loss: 0.
3347 - accuracy: 0.8560 - val_loss: 0.4272 - val_accuracy: 0.8115
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru (GRU)                    (None, 64)                31872
_________________________________________________________________
dense_1 (Dense)              (None, 2)                 130
=================================================================
Total params: 13,336,002
Trainable params: 32,002
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 1s 21ms/step - loss: 0.39
24 - accuracy: 0.8235
test loss, test acc: [0.39243075251579285, 0.8234999775886536]
```



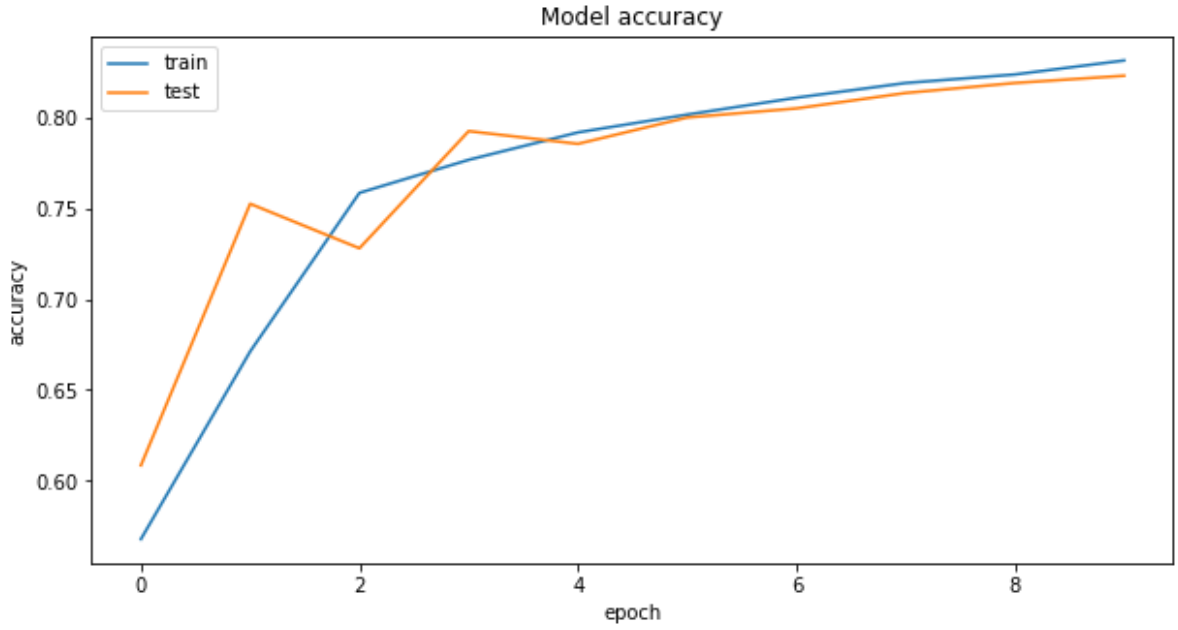


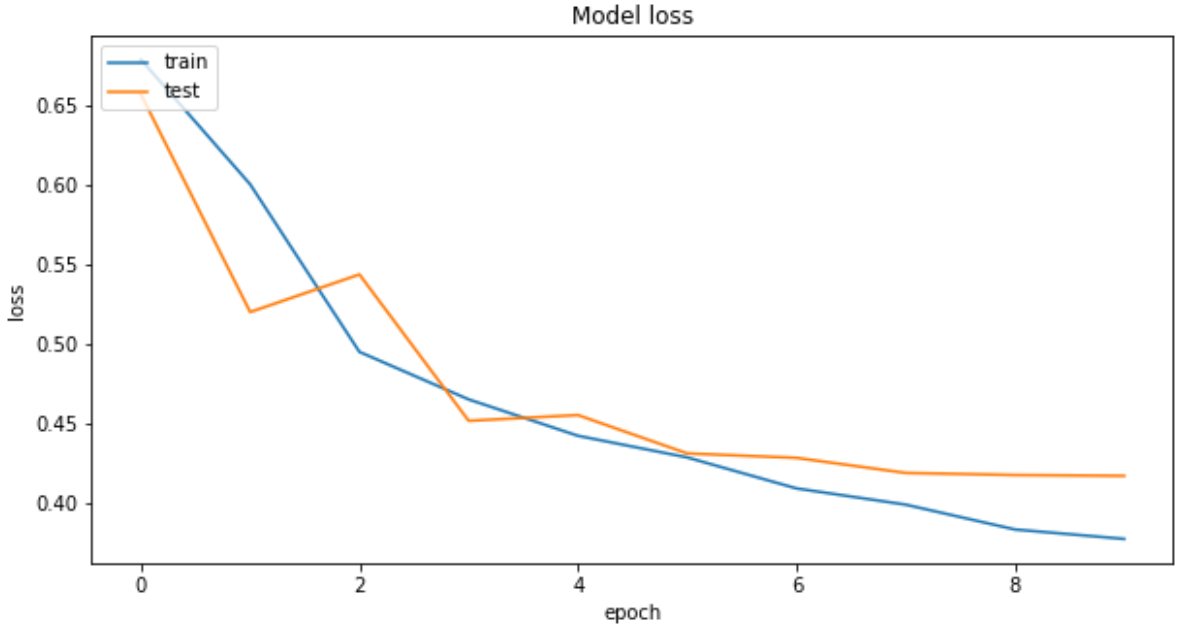
Best model so far is model 2 (using GRU)

Model 3 (1 GRU-32)

```
WARNING:tensorflow:Layer gru_1 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 23s 288ms/step - loss: 0.
6789 - accuracy: 0.5679 - val_loss: 0.6570 - val_accuracy: 0.6085
Epoch 2/10
79/79 [==============================] - 21s 264ms/step - loss: 0.
6003 - accuracy: 0.6712 - val_loss: 0.5199 - val_accuracy: 0.7525
Epoch 3/10
79/79 [==============================] - 22s 278ms/step - loss: 0.
4948 - accuracy: 0.7585 - val_loss: 0.5435 - val_accuracy: 0.7280
Epoch 4/10
79/79 [==============================] - 24s 309ms/step - loss: 0.
4648 - accuracy: 0.7767 - val_loss: 0.4513 - val_accuracy: 0.7925
Epoch 5/10
79/79 [==============================] - 22s 284ms/step - loss: 0.
4419 - accuracy: 0.7918 - val_loss: 0.4550 - val_accuracy: 0.7855
Epoch 6/10
79/79 [==============================] - 23s 288ms/step - loss: 0.
4283 - accuracy: 0.8016 - val_loss: 0.4308 - val_accuracy: 0.8000
Epoch 7/10
79/79 [==============================] - 23s 292ms/step - loss: 0.
4088 - accuracy: 0.8109 - val_loss: 0.4280 - val_accuracy: 0.8050
Epoch 8/10
79/79 [==============================] - 23s 285ms/step - loss: 0.
3985 - accuracy: 0.8190 - val_loss: 0.4185 - val_accuracy: 0.8135
Epoch 9/10
79/79 [==============================] - 22s 281ms/step - loss: 0.
3829 - accuracy: 0.8237 - val_loss: 0.4172 - val_accuracy: 0.8190
Epoch 10/10
79/79 [==============================] - 22s 280ms/step - loss: 0.
3769 - accuracy: 0.8314 - val_loss: 0.4167 - val_accuracy: 0.8230
```

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_1 (GRU)                  (None, 32)                12864
_________________________________________________________________
dense_2 (Dense)              (None, 2)                 66
=================================================================
Total params: 13,316,930
Trainable params: 12,930
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 2s 24ms/step - loss: 0.40
07 - accuracy: 0.8210
test loss, test acc: [0.40069156885147095, 0.8209999799728394]
```

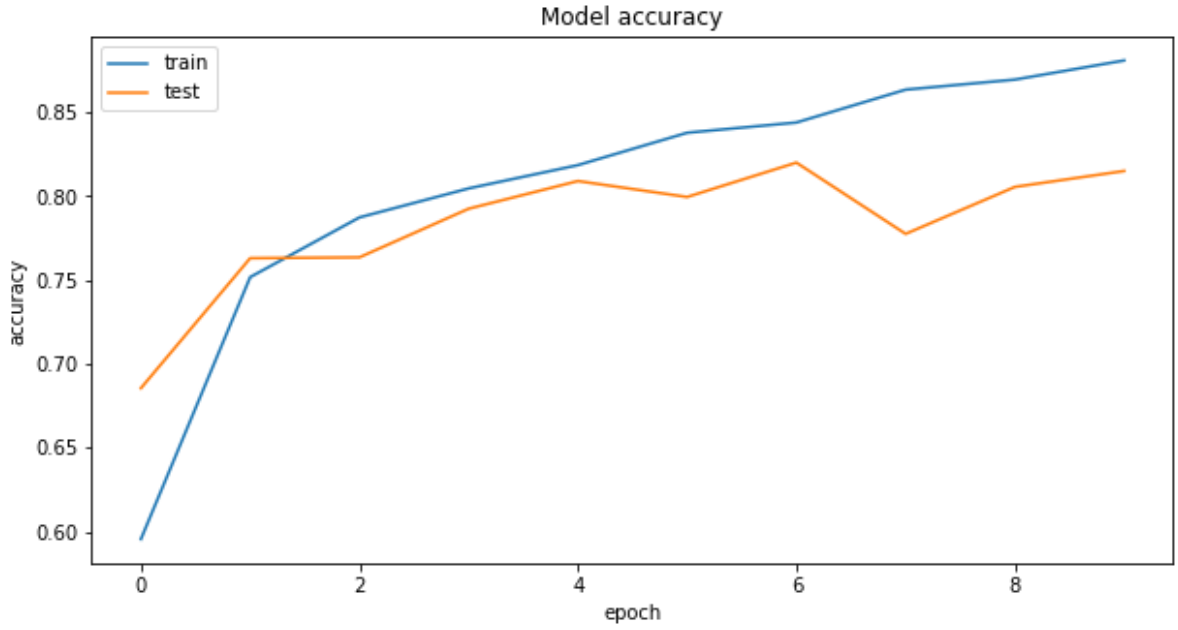


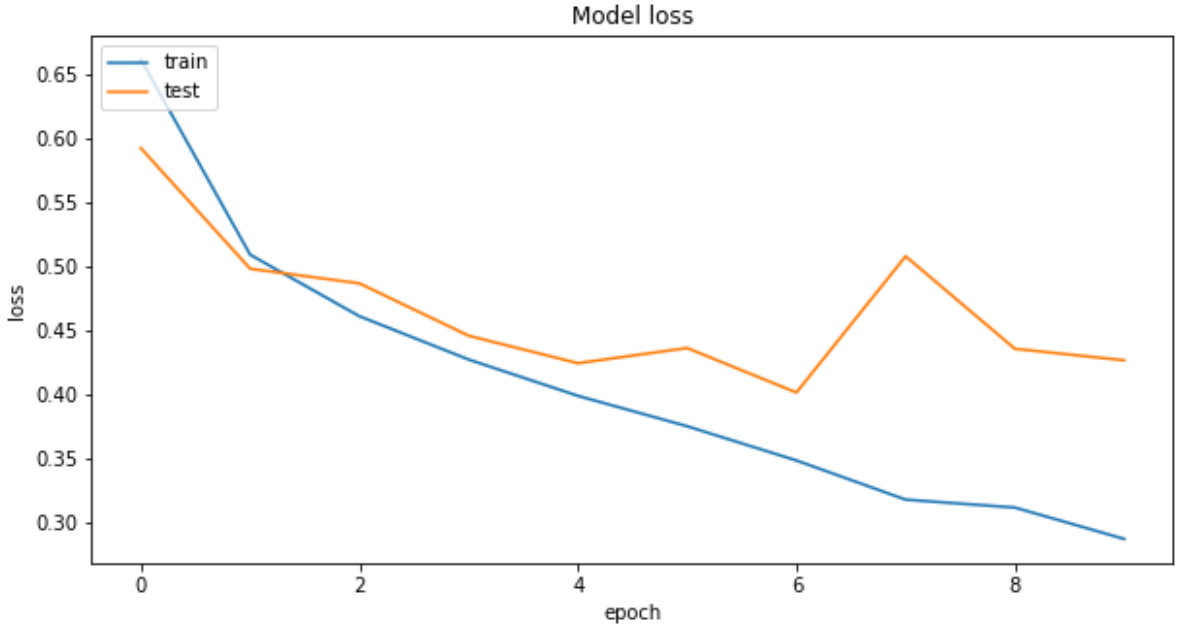


Model 4 (1 GRU-128)

```
WARNING:tensorflow:Layer gru_2 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 22s 280ms/step - loss: 0.
6614 - accuracy: 0.5955 - val_loss: 0.5921 - val_accuracy: 0.6855
Epoch 2/10
79/79 [==============================] - 22s 279ms/step - loss: 0.
5088 - accuracy: 0.7517 - val_loss: 0.4978 - val_accuracy: 0.7630
Epoch 3/10
79/79 [==============================] - 23s 287ms/step - loss: 0.
4607 - accuracy: 0.7873 - val_loss: 0.4864 - val_accuracy: 0.7635
Epoch 4/10
79/79 [==============================] - 23s 288ms/step - loss: 0.
4268 - accuracy: 0.8046 - val_loss: 0.4454 - val_accuracy: 0.7925
Epoch 5/10
79/79 [==============================] - 22s 272ms/step - loss: 0.
3984 - accuracy: 0.8185 - val_loss: 0.4240 - val_accuracy: 0.8090
Epoch 6/10
79/79 [==============================] - 22s 284ms/step - loss: 0.
3747 - accuracy: 0.8378 - val_loss: 0.4358 - val_accuracy: 0.7995
Epoch 7/10
79/79 [==============================] - 22s 282ms/step - loss: 0.
3479 - accuracy: 0.8439 - val_loss: 0.4010 - val_accuracy: 0.8200
Epoch 8/10
79/79 [==============================] - 22s 273ms/step - loss: 0.
3173 - accuracy: 0.8635 - val_loss: 0.5076 - val_accuracy: 0.7775
Epoch 9/10
79/79 [==============================] - 23s 288ms/step - loss: 0.
3111 - accuracy: 0.8695 - val_loss: 0.4352 - val_accuracy: 0.8055
Epoch 10/10
79/79 [==============================] - 22s 284ms/step - loss: 0.
2866 - accuracy: 0.8809 - val_loss: 0.4263 - val_accuracy: 0.8150
```

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_2 (GRU)                  (None, 128)               88320
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,392,578
Trainable params: 88,578
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 2s 25ms/step - loss: 0.38
92 - accuracy: 0.8385
test loss, test acc: [0.389176607131958, 0.8385000228881836]
```





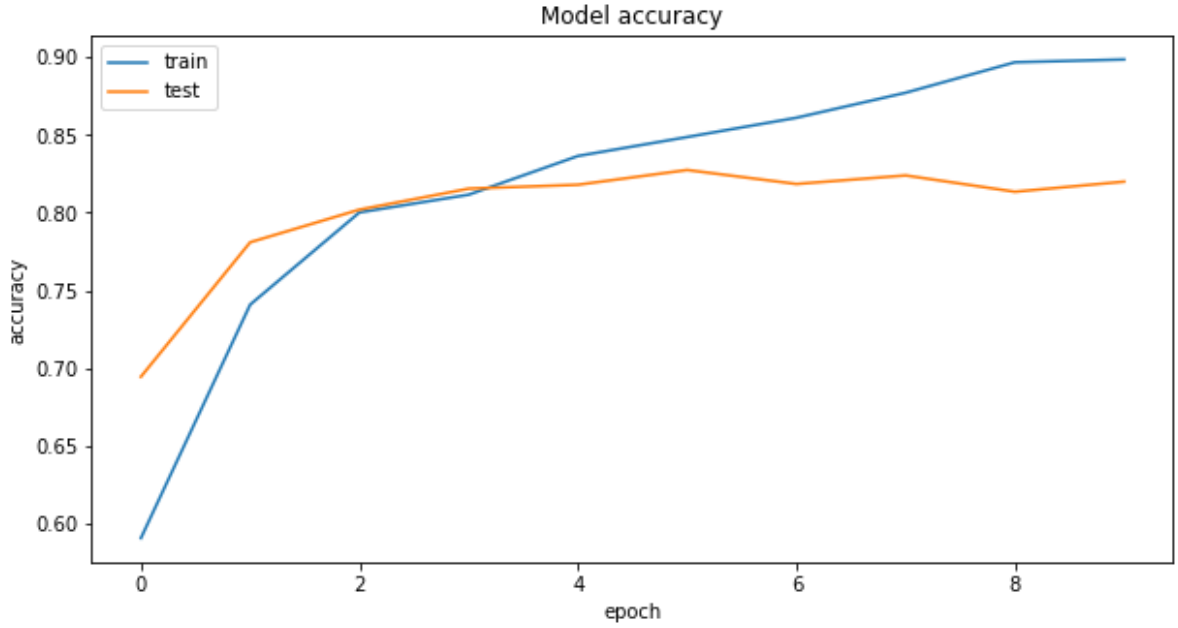
Now, Model 4 is the best performing

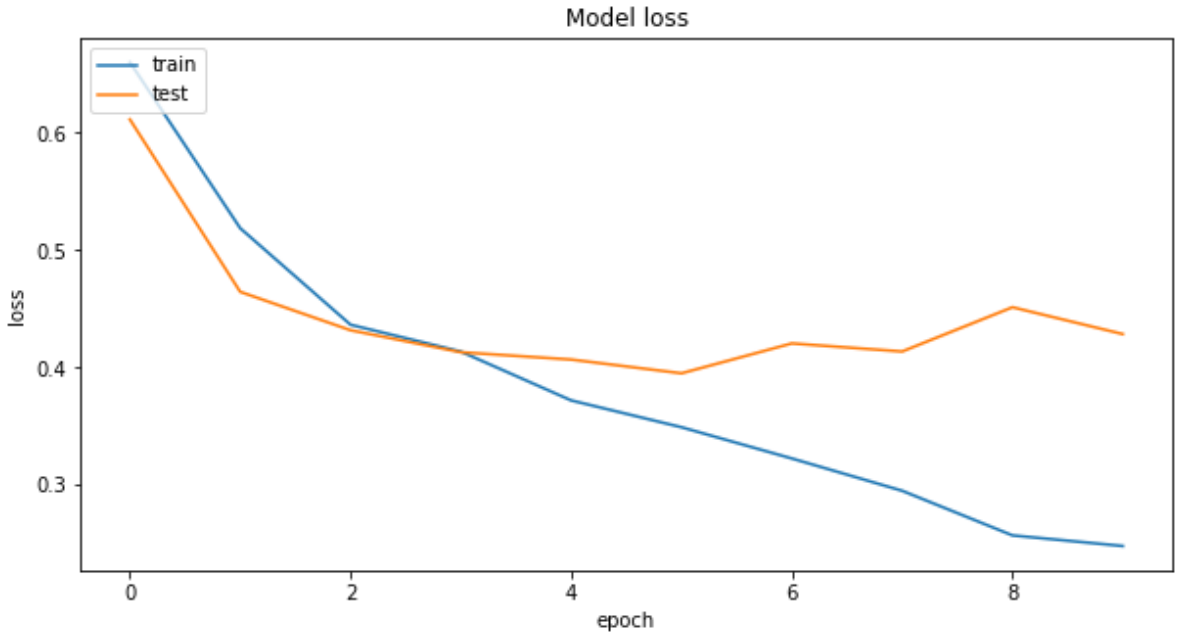
For stacked LSTMs/GRUs, add `return_sequences=True` for all but the last of those layers

Model 5 (2 GRU-128)

```
WARNING:tensorflow:Layer gru_3 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_4 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 46s 576ms/step - loss: 0.
6601 - accuracy: 0.5907 - val_loss: 0.6114 - val_accuracy: 0.6945
Epoch 2/10
79/79 [==============================] - 45s 565ms/step - loss: 0.
5187 - accuracy: 0.7409 - val_loss: 0.4645 - val_accuracy: 0.7810
Epoch 3/10
79/79 [==============================] - 43s 545ms/step - loss: 0.
4365 - accuracy: 0.8002 - val_loss: 0.4318 - val_accuracy: 0.8020
Epoch 4/10
79/79 [==============================] - 44s 557ms/step - loss: 0.
4137 - accuracy: 0.8116 - val_loss: 0.4131 - val_accuracy: 0.8155
Epoch 5/10
79/79 [==============================] - 45s 567ms/step - loss: 0.
3721 - accuracy: 0.8365 - val_loss: 0.4069 - val_accuracy: 0.8180
Epoch 6/10
79/79 [==============================] - 44s 556ms/step - loss: 0.
3492 - accuracy: 0.8487 - val_loss: 0.3951 - val_accuracy: 0.8275
Epoch 7/10
79/79 [==============================] - 45s 571ms/step - loss: 0.
3226 - accuracy: 0.8611 - val_loss: 0.4206 - val_accuracy: 0.8185
Epoch 8/10
79/79 [==============================] - 45s 564ms/step - loss: 0.
2951 - accuracy: 0.8772 - val_loss: 0.4137 - val_accuracy: 0.8240
Epoch 9/10
79/79 [==============================] - 45s 573ms/step - loss: 0.
2571 - accuracy: 0.8968 - val_loss: 0.4514 - val_accuracy: 0.8135
Epoch 10/10
79/79 [==============================] - 44s 562ms/step - loss: 0.
2481 - accuracy: 0.8986 - val_loss: 0.4286 - val_accuracy: 0.8200
```

```
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_3 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_4 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense_4 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,491,650
Trainable params: 187,650
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 2s 40ms/step - loss: 0.40
28 - accuracy: 0.8375
test loss, test acc: [0.4027763307094574, 0.8374999761581421]
```



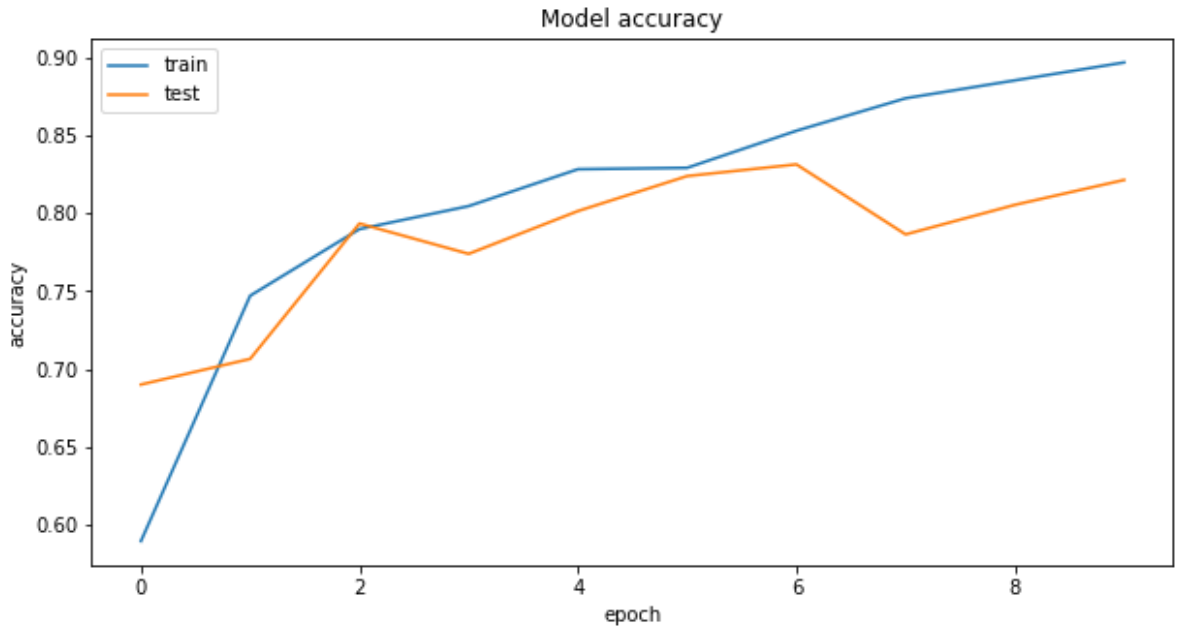


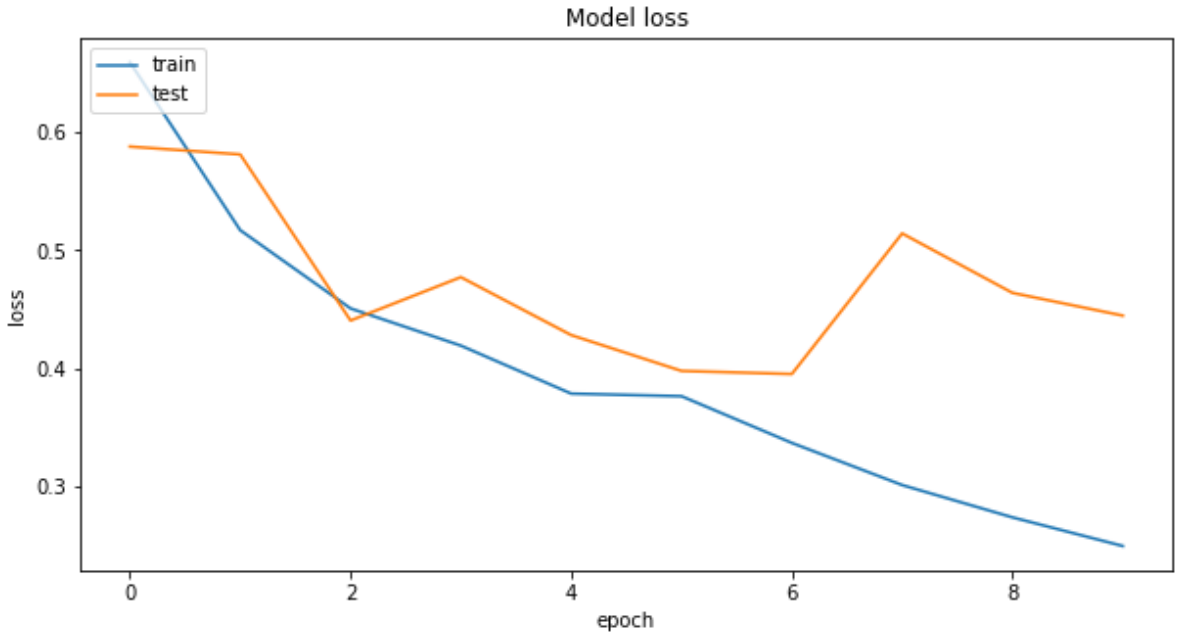

```
WARNING:tensorflow:Layer gru_3 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_4 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
63/63 [==============================] - 3s 47ms/step - loss: 0.40
28 - accuracy: 0.8375
```

Model 6 (3 GRU-128)

```
WARNING:tensorflow:Layer gru_5 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_6 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_7 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 68s 856ms/step - loss: 0.
6592 - accuracy: 0.5894 - val_loss: 0.5878 - val_accuracy: 0.6900
Epoch 2/10
79/79 [==============================] - 66s 830ms/step - loss: 0.
5170 - accuracy: 0.7471 - val_loss: 0.5811 - val_accuracy: 0.7065
Epoch 3/10
79/79 [==============================] - 65s 818ms/step - loss: 0.
4507 - accuracy: 0.7899 - val_loss: 0.4405 - val_accuracy: 0.7935
Epoch 4/10
79/79 [==============================] - 65s 822ms/step - loss: 0.
4192 - accuracy: 0.8047 - val_loss: 0.4772 - val_accuracy: 0.7740
Epoch 5/10
79/79 [==============================] - 65s 829ms/step - loss: 0.
3786 - accuracy: 0.8284 - val_loss: 0.4281 - val_accuracy: 0.8015
Epoch 6/10
79/79 [==============================] - 65s 826ms/step - loss: 0.
3764 - accuracy: 0.8293 - val_loss: 0.3978 - val_accuracy: 0.8240
Epoch 7/10
79/79 [==============================] - 65s 825ms/step - loss: 0.
3368 - accuracy: 0.8531 - val_loss: 0.3952 - val_accuracy: 0.8315
Epoch 8/10
79/79 [==============================] - 64s 813ms/step - loss: 0.
3011 - accuracy: 0.8740 - val_loss: 0.5142 - val_accuracy: 0.7865
Epoch 9/10
79/79 [==============================] - 66s 835ms/step - loss: 0.
2738 - accuracy: 0.8855 - val_loss: 0.4639 - val_accuracy: 0.8055
Epoch 10/10
79/79 [==============================] - 65s 819ms/step - loss: 0.
2495 - accuracy: 0.8970 - val_loss: 0.4446 - val_accuracy: 0.8215
```

```
Model: "sequential_5"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_5 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_6 (GRU)                  (None, 100, 128)          99072
_________________________________________________________________
gru_7 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense_5 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,590,722
Trainable params: 286,722
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 4s 60ms/step - loss: 0.40
78 - accuracy: 0.8320
test loss, test acc: [0.40783989429473877, 0.8320000171661377]
```

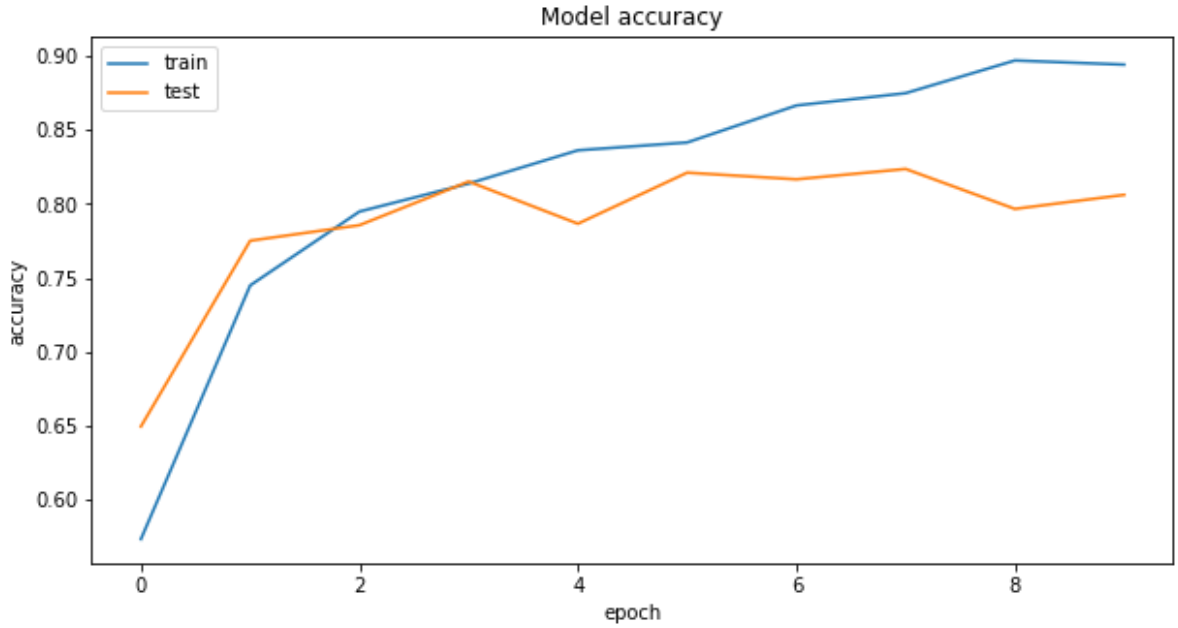


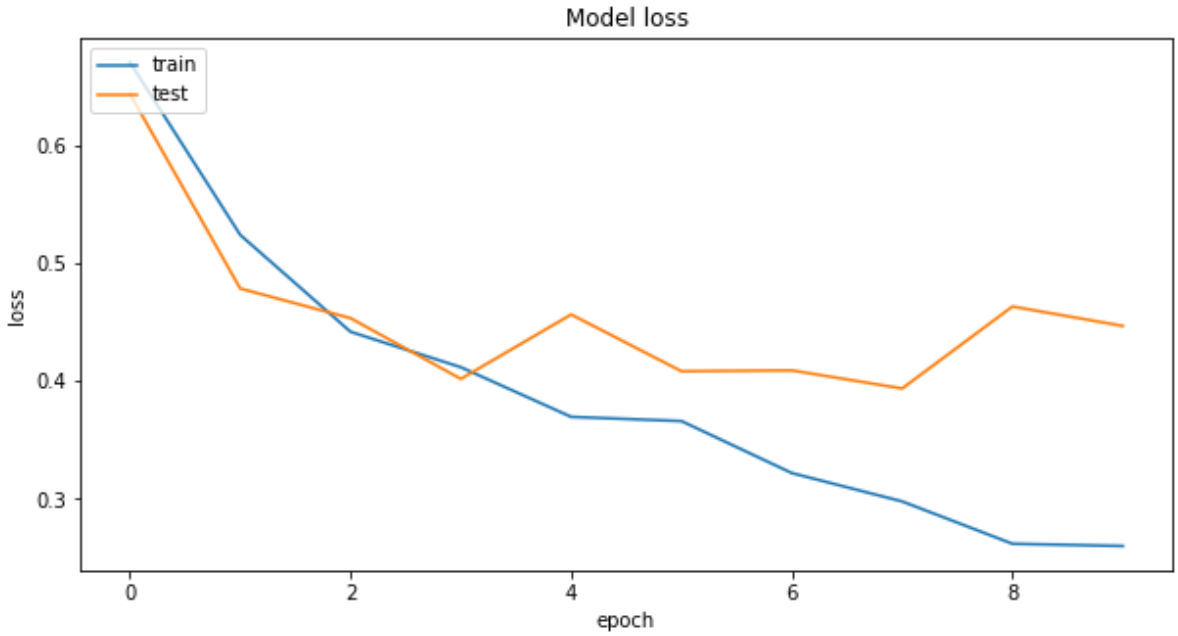


Model 7 (4 GRU-128)

```
WARNING:tensorflow:Layer gru_8 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_9 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_10 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_11 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 85s 1s/step - loss: 0.670
6 - accuracy: 0.5734 - val_loss: 0.6438 - val_accuracy: 0.6495
Epoch 2/10
79/79 [==============================] - 84s 1s/step - loss: 0.524
0 - accuracy: 0.7448 - val_loss: 0.4785 - val_accuracy: 0.7750
Epoch 3/10
79/79 [==============================] - 84s 1s/step - loss: 0.441
8 - accuracy: 0.7947 - val_loss: 0.4533 - val_accuracy: 0.7855
Epoch 4/10
79/79 [==============================] - 85s 1s/step - loss: 0.411
7 - accuracy: 0.8136 - val_loss: 0.4018 - val_accuracy: 0.8150
Epoch 5/10
79/79 [==============================] - 85s 1s/step - loss: 0.369
6 - accuracy: 0.8361 - val_loss: 0.4564 - val_accuracy: 0.7865
Epoch 6/10
79/79 [==============================] - 84s 1s/step - loss: 0.366
0 - accuracy: 0.8414 - val_loss: 0.4083 - val_accuracy: 0.8210
Epoch 7/10
79/79 [==============================] - 84s 1s/step - loss: 0.321
8 - accuracy: 0.8664 - val_loss: 0.4090 - val_accuracy: 0.8165
Epoch 8/10
79/79 [==============================] - 86s 1s/step - loss: 0.297
8 - accuracy: 0.8747 - val_loss: 0.3936 - val_accuracy: 0.8235
Epoch 9/10
79/79 [==============================] - 83s 1s/step - loss: 0.261
8 - accuracy: 0.8968 - val_loss: 0.4632 - val_accuracy: 0.7965
Epoch 10/10
79/79 [==============================] - 84s 1s/step - loss: 0.259
9 - accuracy: 0.8940 - val_loss: 0.4468 - val_accuracy: 0.8060
```

```
Model: "sequential_6"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_8 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_9 (GRU)                  (None, 100, 128)          99072
_________________________________________________________________
gru_10 (GRU)                 (None, 100, 128)          99072
_________________________________________________________________
gru_11 (GRU)                 (None, 128)               99072
_________________________________________________________________
dense_6 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,689,794
Trainable params: 385,794
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 4s 70ms/step - loss: 0.40
19 - accuracy: 0.8260
test loss, test acc: [0.4018857479095459, 0.8259999752044678]
```



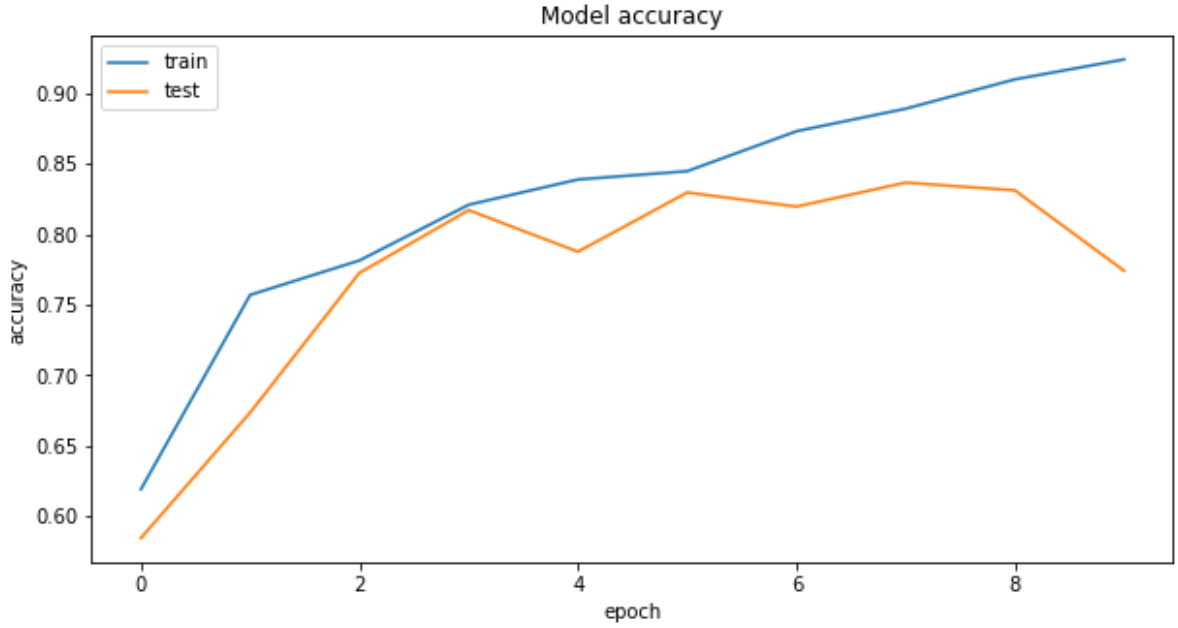


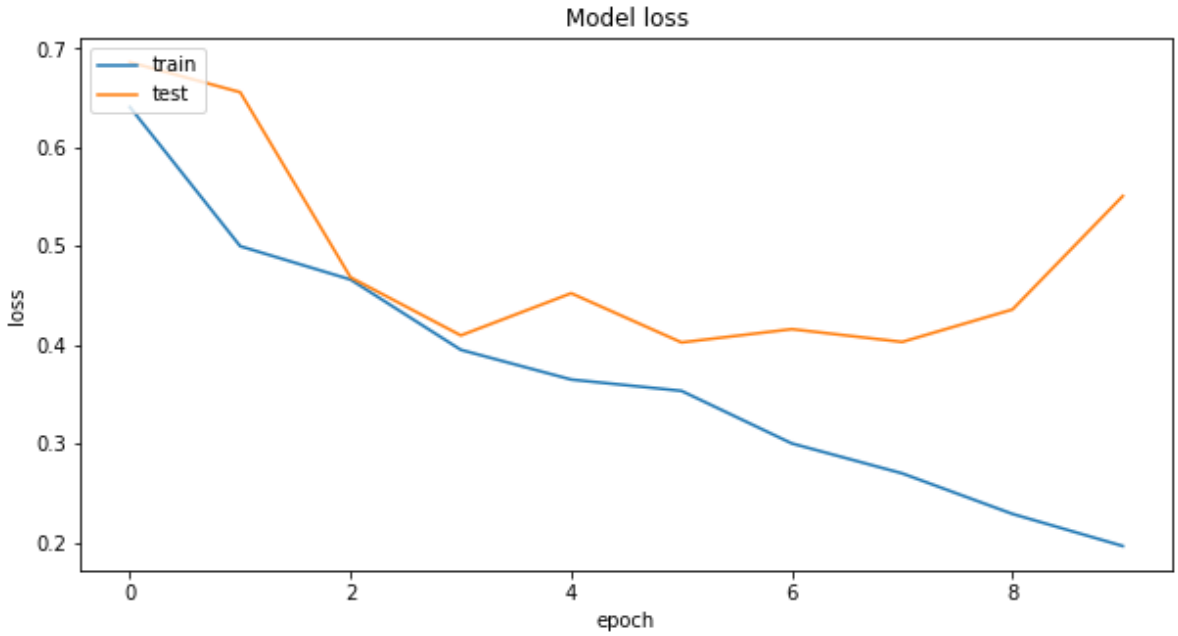
Model 5 is the best performing so far

Model 8 (2 Bidirectional GRU-128)

```
WARNING:tensorflow:Layer gru_12 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_12 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_12 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_13 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_13 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_13 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 83s 1s/step - loss: 0.640
7 - accuracy: 0.6191 - val_loss: 0.6861 - val_accuracy: 0.5845
Epoch 2/10
79/79 [==============================] - 85s 1s/step - loss: 0.499
8 - accuracy: 0.7569 - val_loss: 0.6557 - val_accuracy: 0.6735
Epoch 3/10
79/79 [==============================] - 83s 1s/step - loss: 0.466
0 - accuracy: 0.7813 - val_loss: 0.4682 - val_accuracy: 0.7725
Epoch 4/10
79/79 [==============================] - 83s 1s/step - loss: 0.394
9 - accuracy: 0.8208 - val_loss: 0.4095 - val_accuracy: 0.8170
Epoch 5/10
79/79 [==============================] - 82s 1s/step - loss: 0.364
8 - accuracy: 0.8387 - val_loss: 0.4522 - val_accuracy: 0.7875
Epoch 6/10
79/79 [==============================] - 80s 1s/step - loss: 0.353
4 - accuracy: 0.8446 - val_loss: 0.4024 - val_accuracy: 0.8295
Epoch 7/10
79/79 [==============================] - 82s 1s/step - loss: 0.300
1 - accuracy: 0.8729 - val_loss: 0.4158 - val_accuracy: 0.8195
Epoch 8/10
79/79 [==============================] - 81s 1s/step - loss: 0.269
9 - accuracy: 0.8889 - val_loss: 0.4029 - val_accuracy: 0.8365
Epoch 9/10
79/79 [==============================] - 82s 1s/step - loss: 0.228
8 - accuracy: 0.9097 - val_loss: 0.4358 - val_accuracy: 0.8310
Epoch 10/10
79/79 [==============================] - 82s 1s/step - loss: 0.196
3 - accuracy: 0.9238 - val_loss: 0.5506 - val_accuracy: 0.7740
```

```
Model: "sequential_7"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
bidirectional (Bidirectional (None, 100, 256)          176640
_________________________________________________________________
bidirectional_1 (Bidirection (None, 256)               296448
_________________________________________________________________
dense_7 (Dense)              (None, 2)                 514
=================================================================
Total params: 13,777,602
Trainable params: 473,602
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 5s 72ms/step - loss: 0.54
24 - accuracy: 0.7910
test loss, test acc: [0.5423805117607117, 0.7910000085830688]
```



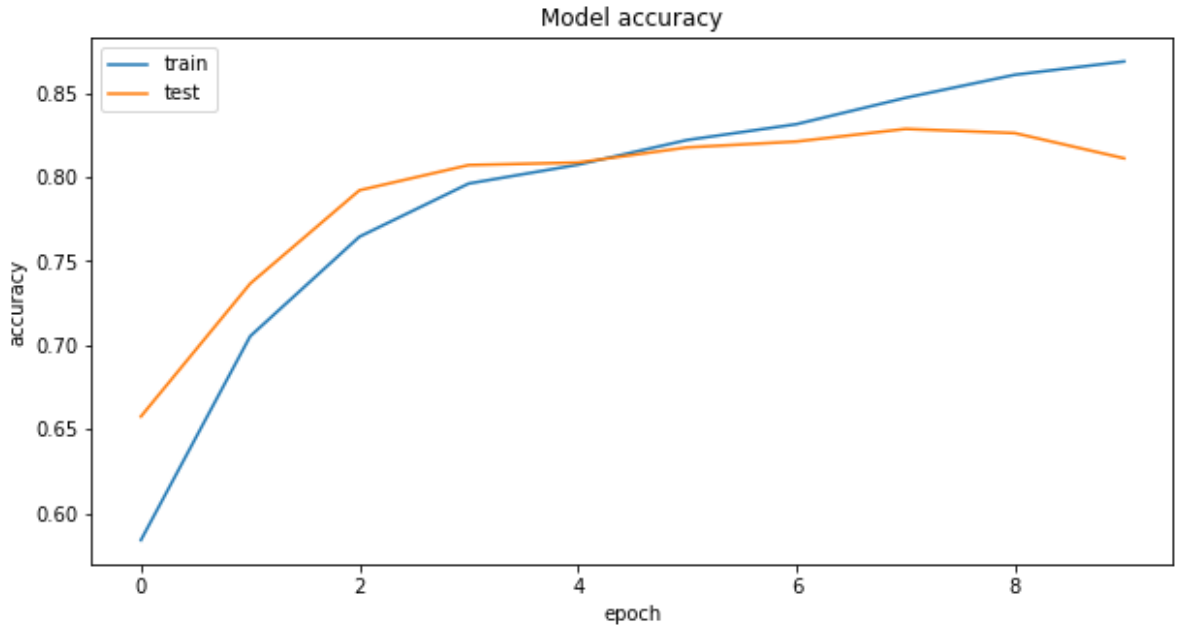


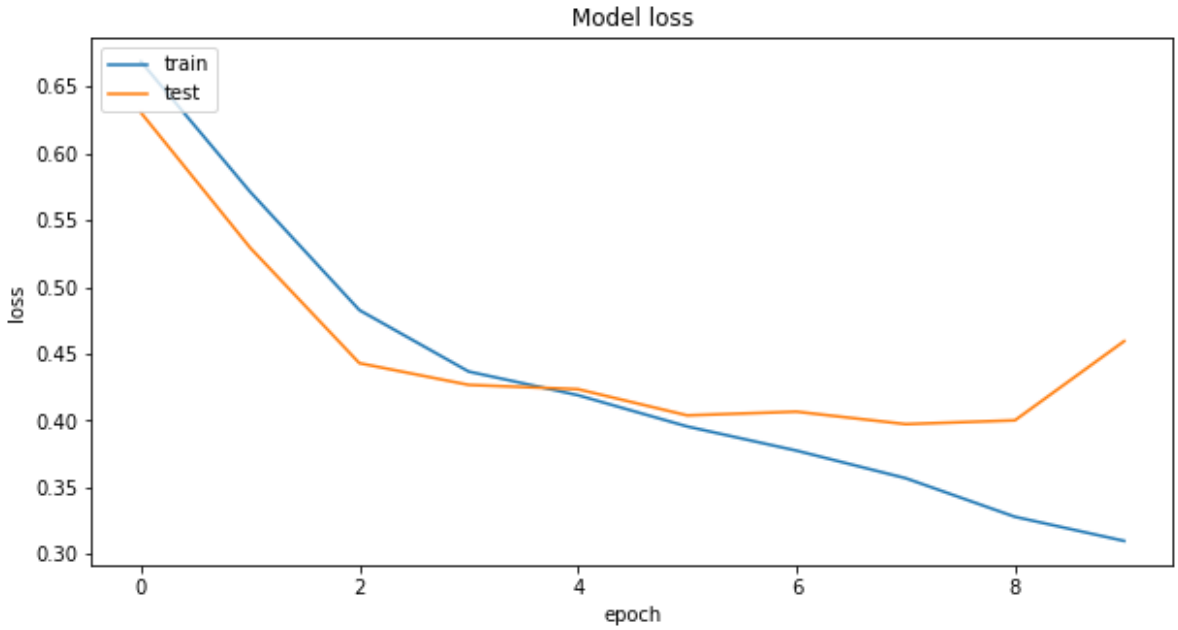
Still, Model 5 is the best performing

Model 9 (2 GRU-128 dropout=0.1)

```
WARNING:tensorflow:Layer gru_14 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_15 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 48s 604ms/step - loss: 0.
6687 - accuracy: 0.5840 - val_loss: 0.6305 - val_accuracy: 0.6575
Epoch 2/10
79/79 [==============================] - 47s 599ms/step - loss: 0.
5712 - accuracy: 0.7052 - val_loss: 0.5294 - val_accuracy: 0.7365
Epoch 3/10
79/79 [==============================] - 49s 622ms/step - loss: 0.
4826 - accuracy: 0.7644 - val_loss: 0.4429 - val_accuracy: 0.7920
Epoch 4/10
79/79 [==============================] - 48s 609ms/step - loss: 0.
4367 - accuracy: 0.7960 - val_loss: 0.4267 - val_accuracy: 0.8070
Epoch 5/10
79/79 [==============================] - 49s 619ms/step - loss: 0.
4190 - accuracy: 0.8072 - val_loss: 0.4235 - val_accuracy: 0.8085
Epoch 6/10
79/79 [==============================] - 49s 614ms/step - loss: 0.
3955 - accuracy: 0.8219 - val_loss: 0.4039 - val_accuracy: 0.8175
Epoch 7/10
79/79 [==============================] - 45s 574ms/step - loss: 0.
3775 - accuracy: 0.8313 - val_loss: 0.4066 - val_accuracy: 0.8210
Epoch 8/10
79/79 [==============================] - 47s 595ms/step - loss: 0.
3568 - accuracy: 0.8470 - val_loss: 0.3973 - val_accuracy: 0.8285
Epoch 9/10
79/79 [==============================] - 47s 595ms/step - loss: 0.
3279 - accuracy: 0.8607 - val_loss: 0.4001 - val_accuracy: 0.8260
Epoch 10/10
79/79 [==============================] - 48s 604ms/step - loss: 0.
3099 - accuracy: 0.8686 - val_loss: 0.4594 - val_accuracy: 0.8110
```

```
Model: "sequential_8"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_14 (GRU)                 (None, 100, 128)          88320
_________________________________________________________________
gru_15 (GRU)                 (None, 128)               99072
_________________________________________________________________
dense_8 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,491,650
Trainable params: 187,650
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 2s 37ms/step - loss: 0.42
05 - accuracy: 0.8200
test loss, test acc: [0.4205341935157776, 0.8199999928474426]
```

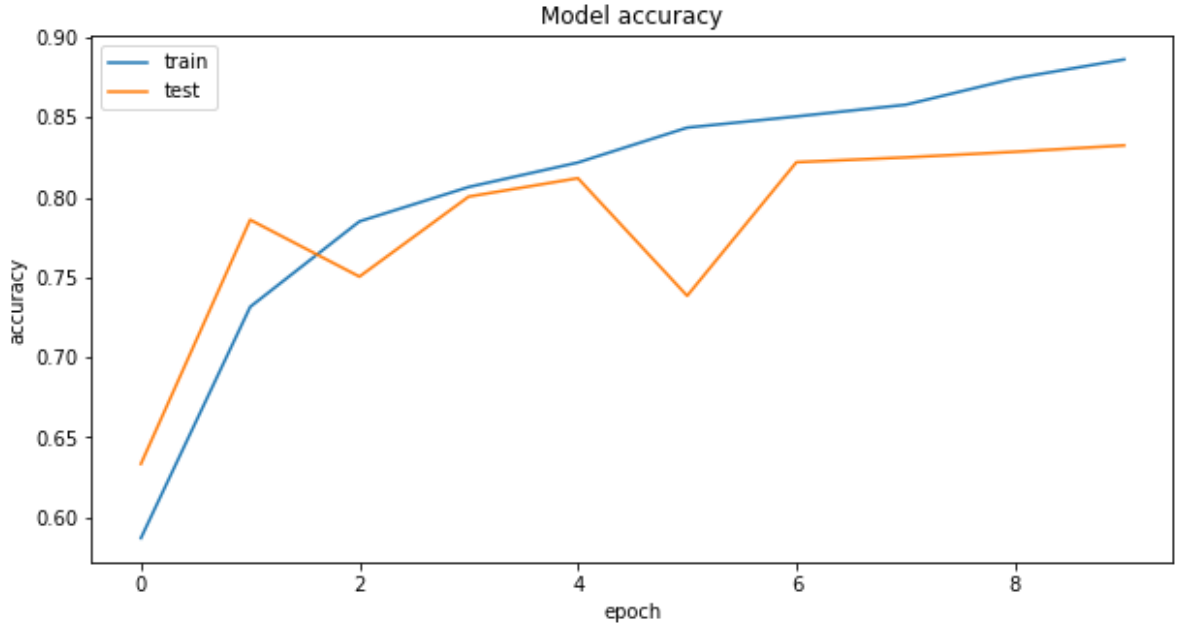


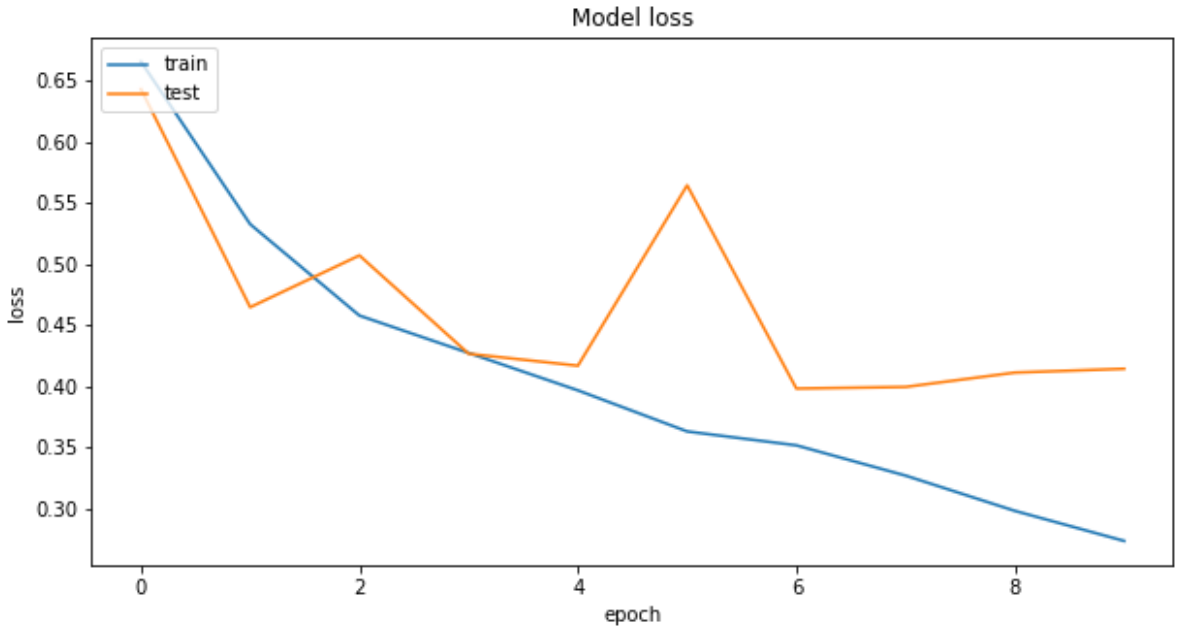


Model 10 (2 GRU-128 recurrent dropout=0.2)

```
WARNING:tensorflow:Layer gru will not use cuDNN kernel since it do
esn't meet the cuDNN kernel criteria. It will use generic GPU kern
el as fallback when running on GPU
WARNING:tensorflow:Layer gru_1 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 43s 540ms/step - loss: 0.
6658 - accuracy: 0.5871 - val_loss: 0.6432 - val_accuracy: 0.6335
Epoch 2/10
79/79 [==============================] - 42s 531ms/step - loss: 0.
5327 - accuracy: 0.7316 - val_loss: 0.4648 - val_accuracy: 0.7860
Epoch 3/10
79/79 [==============================] - 42s 532ms/step - loss: 0.
4579 - accuracy: 0.7850 - val_loss: 0.5071 - val_accuracy: 0.7505
Epoch 4/10
79/79 [==============================] - 42s 533ms/step - loss: 0.
4273 - accuracy: 0.8065 - val_loss: 0.4267 - val_accuracy: 0.8005
Epoch 5/10
79/79 [==============================] - 42s 532ms/step - loss: 0.
3967 - accuracy: 0.8218 - val_loss: 0.4169 - val_accuracy: 0.8120
Epoch 6/10
79/79 [==============================] - 42s 527ms/step - loss: 0.
3631 - accuracy: 0.8436 - val_loss: 0.5645 - val_accuracy: 0.7385
Epoch 7/10
79/79 [==============================] - 42s 527ms/step - loss: 0.
3517 - accuracy: 0.8506 - val_loss: 0.3982 - val_accuracy: 0.8220
Epoch 8/10
79/79 [==============================] - 42s 529ms/step - loss: 0.
3270 - accuracy: 0.8579 - val_loss: 0.3995 - val_accuracy: 0.8250
Epoch 9/10
79/79 [==============================] - 42s 530ms/step - loss: 0.
2981 - accuracy: 0.8744 - val_loss: 0.4113 - val_accuracy: 0.8285
Epoch 10/10
79/79 [==============================] - 42s 526ms/step - loss: 0.
2735 - accuracy: 0.8862 - val_loss: 0.4144 - val_accuracy: 0.8325
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru (GRU)                    (None, 100, 128)          88320
_________________________________________________________________
gru_1 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense (Dense)                (None, 2)                 258
=================================================================
Total params: 13,491,650
Trainable params: 187,650
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 3s 48ms/step - loss: 0.38
61 - accuracy: 0.8365
test loss, test acc: [0.38611656427383423, 0.8364999890327454]
```

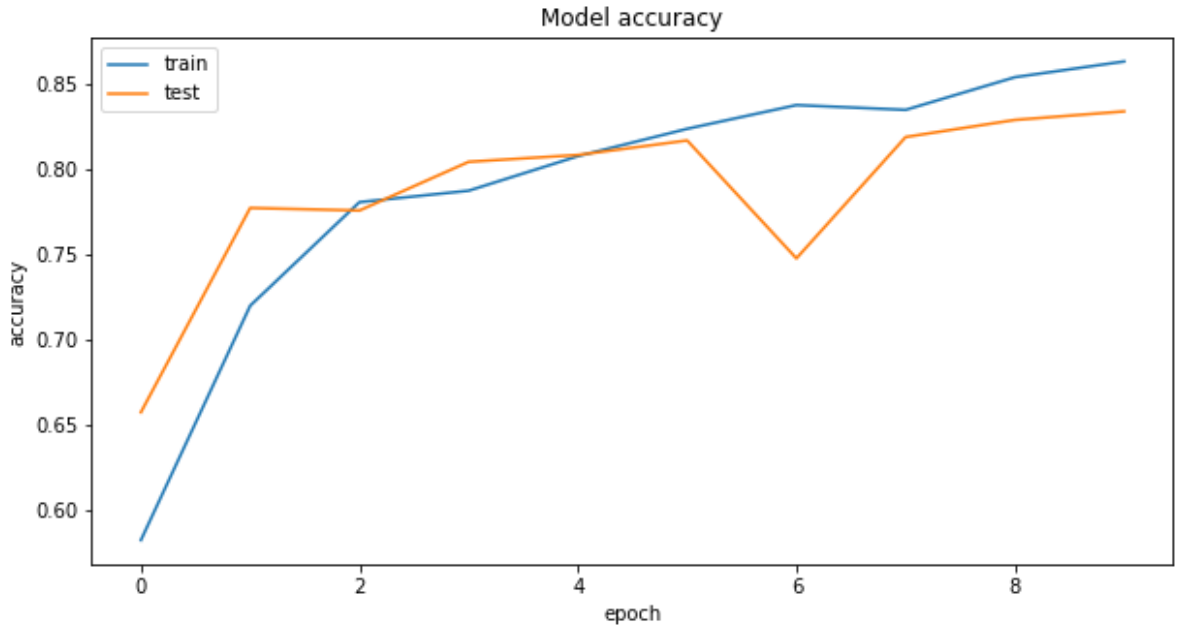


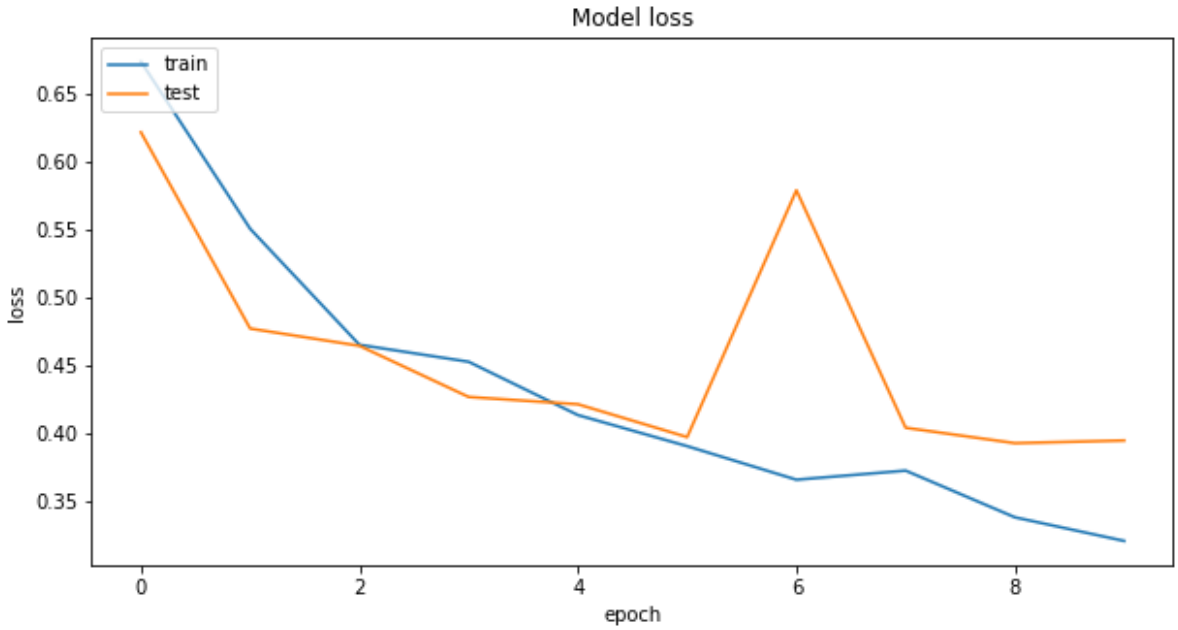


Model 11 (2 GRU-128 dropout=0.1 + recurrent dropout=0.2)

```
WARNING:tensorflow:Layer gru_2 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_3 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 49s 617ms/step - loss: 0.
6742 - accuracy: 0.5827 - val_loss: 0.6221 - val_accuracy: 0.6575
Epoch 2/10
79/79 [==============================] - 48s 605ms/step - loss: 0.
5510 - accuracy: 0.7198 - val_loss: 0.4776 - val_accuracy: 0.7770
Epoch 3/10
79/79 [==============================] - 48s 612ms/step - loss: 0.
4656 - accuracy: 0.7804 - val_loss: 0.4649 - val_accuracy: 0.7755
Epoch 4/10
79/79 [==============================] - 47s 599ms/step - loss: 0.
4531 - accuracy: 0.7871 - val_loss: 0.4272 - val_accuracy: 0.8040
Epoch 5/10
79/79 [==============================] - 47s 595ms/step - loss: 0.
4138 - accuracy: 0.8073 - val_loss: 0.4218 - val_accuracy: 0.8080
Epoch 6/10
79/79 [==============================] - 47s 596ms/step - loss: 0.
3910 - accuracy: 0.8233 - val_loss: 0.3976 - val_accuracy: 0.8165
Epoch 7/10
79/79 [==============================] - 47s 592ms/step - loss: 0.
3662 - accuracy: 0.8372 - val_loss: 0.5794 - val_accuracy: 0.7475
Epoch 8/10
79/79 [==============================] - 47s 593ms/step - loss: 0.
3729 - accuracy: 0.8344 - val_loss: 0.4045 - val_accuracy: 0.8185
Epoch 9/10
79/79 [==============================] - 47s 594ms/step - loss: 0.
3385 - accuracy: 0.8535 - val_loss: 0.3932 - val_accuracy: 0.8285
Epoch 10/10
79/79 [==============================] - 47s 599ms/step - loss: 0.
3212 - accuracy: 0.8627 - val_loss: 0.3951 - val_accuracy: 0.8335
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_2 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_3 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense_1 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,491,650
Trainable params: 187,650
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 3s 46ms/step - loss: 0.36
01 - accuracy: 0.8440
test loss, test acc: [0.3601447641849518, 0.843999981880188]
```

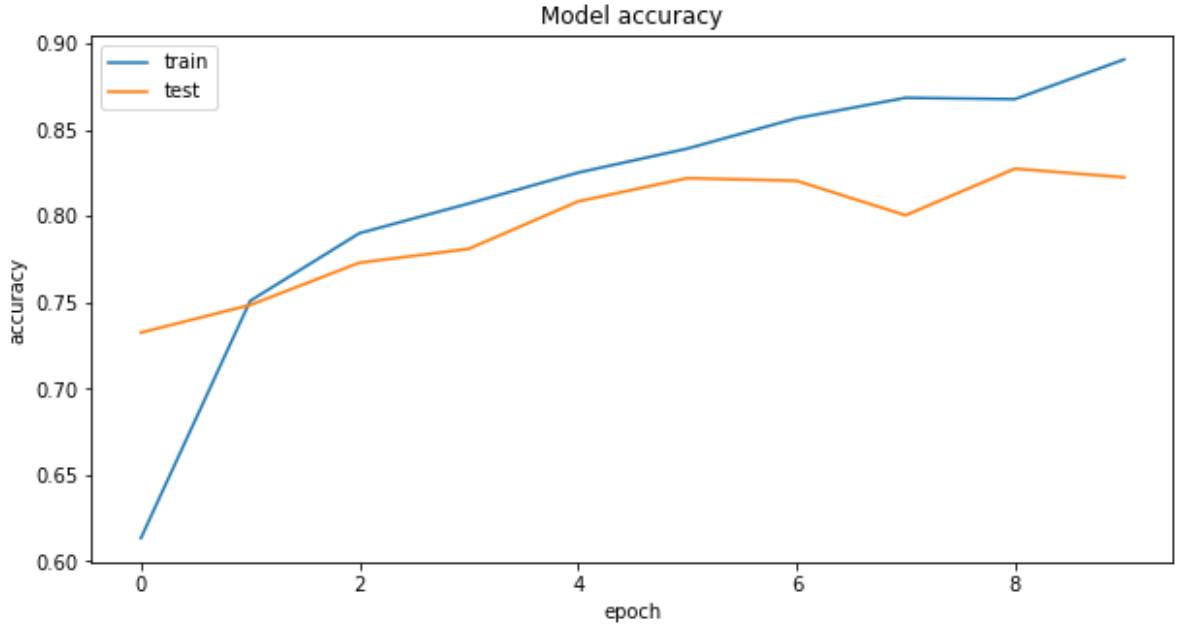


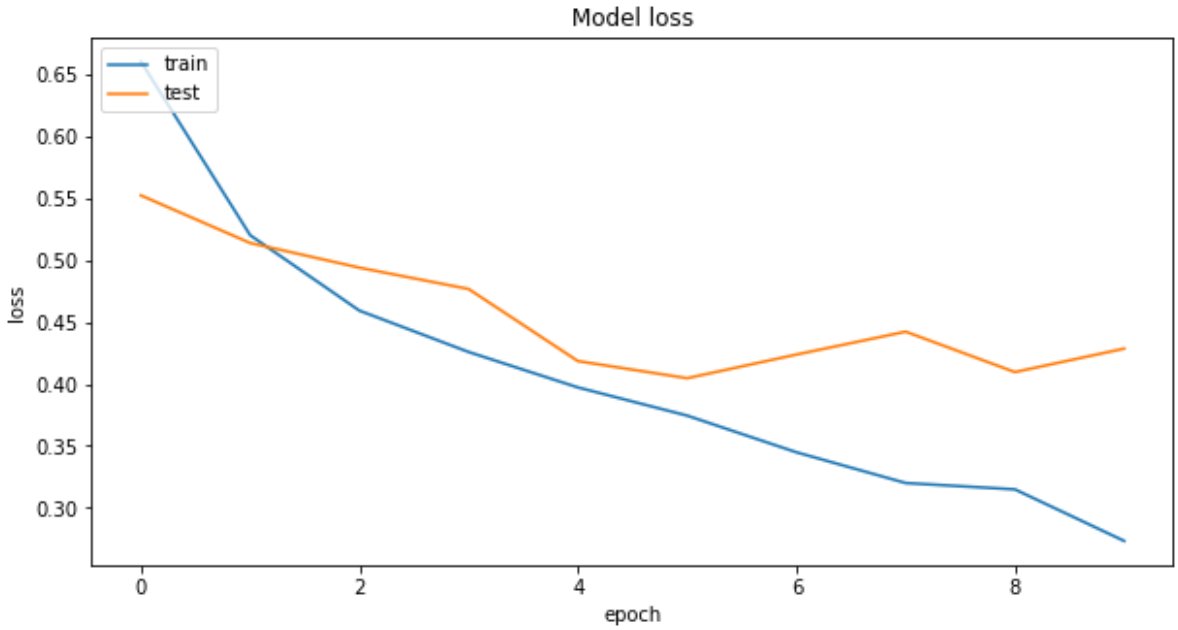


Model 12 (2 GRU-128 bias_regularizer=0.05)

```
WARNING:tensorflow:Layer gru_4 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_5 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 28s 353ms/step - loss: 0.
6606 - accuracy: 0.6134 - val_loss: 0.5524 - val_accuracy: 0.7325
Epoch 2/10
79/79 [==============================] - 27s 341ms/step - loss: 0.
5203 - accuracy: 0.7509 - val_loss: 0.5140 - val_accuracy: 0.7485
Epoch 3/10
79/79 [==============================] - 27s 343ms/step - loss: 0.
4593 - accuracy: 0.7901 - val_loss: 0.4940 - val_accuracy: 0.7730
Epoch 4/10
79/79 [==============================] - 27s 347ms/step - loss: 0.
4259 - accuracy: 0.8073 - val_loss: 0.4768 - val_accuracy: 0.7810
Epoch 5/10
79/79 [==============================] - 27s 343ms/step - loss: 0.
3972 - accuracy: 0.8252 - val_loss: 0.4185 - val_accuracy: 0.8085
Epoch 6/10
79/79 [==============================] - 27s 339ms/step - loss: 0.
3745 - accuracy: 0.8391 - val_loss: 0.4047 - val_accuracy: 0.8220
Epoch 7/10
79/79 [==============================] - 27s 346ms/step - loss: 0.
3448 - accuracy: 0.8567 - val_loss: 0.4238 - val_accuracy: 0.8205
Epoch 8/10
79/79 [==============================] - 27s 340ms/step - loss: 0.
3200 - accuracy: 0.8686 - val_loss: 0.4423 - val_accuracy: 0.8005
Epoch 9/10
79/79 [==============================] - 27s 344ms/step - loss: 0.
3149 - accuracy: 0.8678 - val_loss: 0.4097 - val_accuracy: 0.8275
Epoch 10/10
79/79 [==============================] - 28s 349ms/step - loss: 0.
2732 - accuracy: 0.8908 - val_loss: 0.4286 - val_accuracy: 0.8225
```

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 100, 100)          13304000
_________________________________________________________________
gru_4 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_5 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense_2 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,491,650
Trainable params: 187,650
Non-trainable params: 13,304,000
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 2s 32ms/step - loss: 0.41
38 - accuracy: 0.8295
test loss, test acc: [0.4138040244579315, 0.8295000195503235]
```





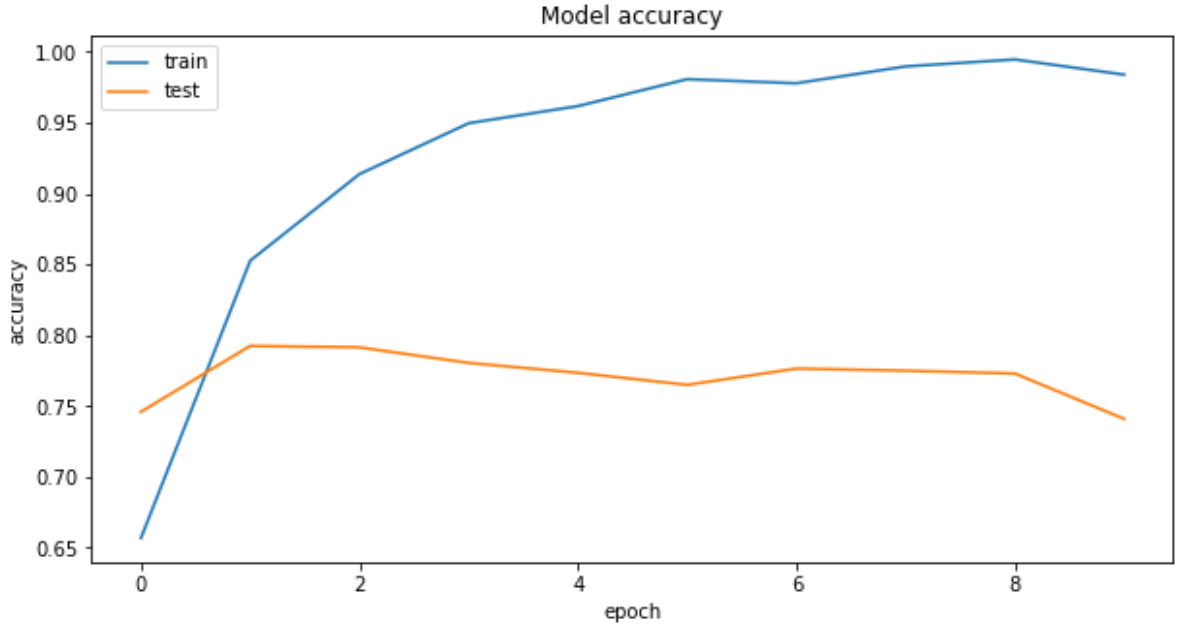

```
WARNING:tensorflow:Layer gru_4 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_5 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
63/63 [==============================] - 2s 32ms/step - loss: 0.41
38 - accuracy: 0.8295
```

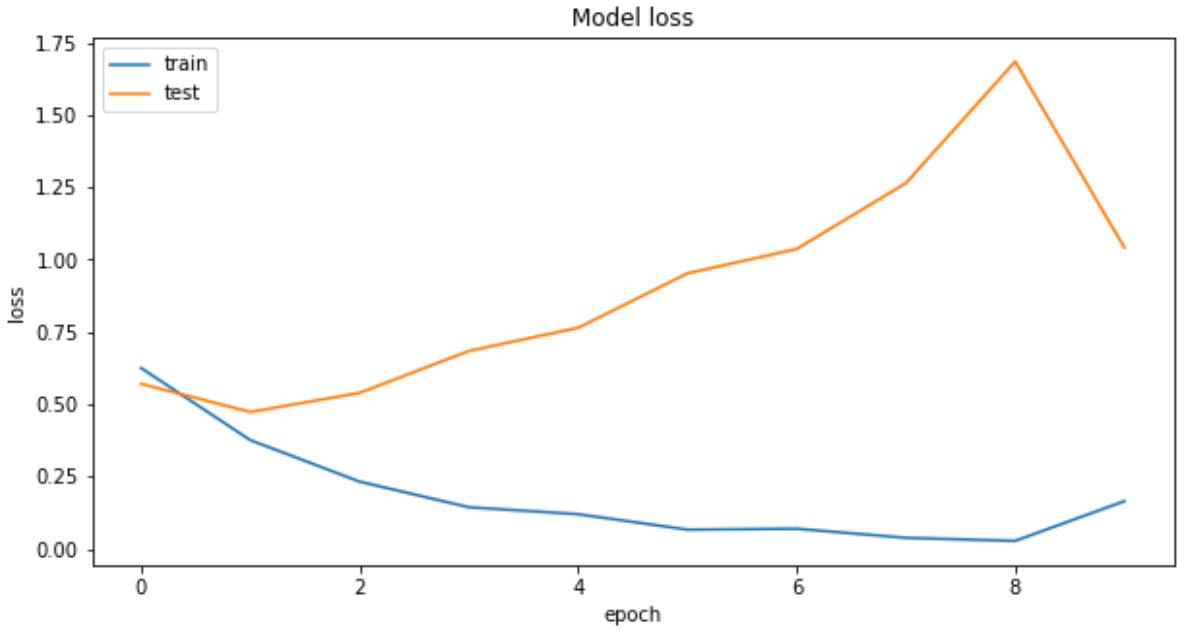
Now, Model 12 is the best performing

Model 13 (2 GRU-128 bias_regularizer=0.05 self-trainable embedding)

```
WARNING:tensorflow:Layer gru_6 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_7 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/10
79/79 [==============================] - 39s 488ms/step - loss: 0.
6252 - accuracy: 0.6569 - val_loss: 0.5707 - val_accuracy: 0.7460
Epoch 2/10
79/79 [==============================] - 38s 477ms/step - loss: 0.
3760 - accuracy: 0.8526 - val_loss: 0.4734 - val_accuracy: 0.7925
Epoch 3/10
79/79 [==============================] - 37s 472ms/step - loss: 0.
2325 - accuracy: 0.9137 - val_loss: 0.5393 - val_accuracy: 0.7915
Epoch 4/10
79/79 [==============================] - 38s 475ms/step - loss: 0.
1441 - accuracy: 0.9496 - val_loss: 0.6843 - val_accuracy: 0.7805
Epoch 5/10
79/79 [==============================] - 37s 465ms/step - loss: 0.
1200 - accuracy: 0.9617 - val_loss: 0.7644 - val_accuracy: 0.7735
Epoch 6/10
79/79 [==============================] - 37s 465ms/step - loss: 0.
0667 - accuracy: 0.9807 - val_loss: 0.9525 - val_accuracy: 0.7650
Epoch 7/10
79/79 [==============================] - 37s 463ms/step - loss: 0.
0698 - accuracy: 0.9778 - val_loss: 1.0368 - val_accuracy: 0.7765
Epoch 8/10
79/79 [==============================] - 36s 462ms/step - loss: 0.
0384 - accuracy: 0.9897 - val_loss: 1.2644 - val_accuracy: 0.7750
Epoch 9/10
79/79 [==============================] - 36s 458ms/step - loss: 0.
0277 - accuracy: 0.9946 - val_loss: 1.6846 - val_accuracy: 0.7730
Epoch 10/10
79/79 [==============================] - 36s 459ms/step - loss: 0.
1651 - accuracy: 0.9839 - val_loss: 1.0419 - val_accuracy: 0.7410
```

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, 100, 100)          13304000
_________________________________________________________________
gru_6 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_7 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 258
=================================================================
Total params: 13,491,650
Trainable params: 13,491,650
Non-trainable params: 0
_________________________________________________________________
Evaluate on test data
63/63 [==============================] - 2s 31ms/step - loss: 0.99
08 - accuracy: 0.7665
test loss, test acc: [0.9908018708229065, 0.7664999961853027]
```





Model 14 (2 GRU-128 bias_regularizer=0.05 one hot encoded embedding)

- One hot encoding the labels crashes RAM. This is a problem I dont know how to fix. Hence currently not training this model.

Checking on my own review

```
Length of sequences:  2
Found 23 unique tokens.


array([[0.08688124, 0.9131187 ],
       [0.71508634, 0.2849137 ]], dtype=float32)
```

Hindi movie reviews dataset

Read CSV

	text	experience
0	\n\nबैनर :\nफॉक्स स्टार स्टुडियो, वाइड फ्रेम प...	2
1	Chandermohan.sharma@timesgroup.com बॉलिवुड मे...	0
2	\nडर @ द माल का सबसे बड़ा आकर्षण निर्देशक पवन ...	0
3	सुभाष नागरे या सरकार (अमिताभ बच्चन) महाराष्ट्र...	2
4	बैनर :\nपीवीआर पिक्चर्स\n\nनिर्माता :\nअजय बिज...	2

	text	experience
0	\n\nफिल्म के हीरो संजू (इमरान) और उसके दो साथि...	1
1	\nविक्रम सेठी (सिद्धार्थ मल्होत्रा) और माया (...	1
2	बैनर :\nयूटीवी मोशन पिक्चर्स, आमिर खान प्रोडक्...	2
3	बैनर :\nयूटीवी मोशन पिक्चर्स, भंडारकर एंटरटेनम...	1
4	\nनिर्माता-निर्देशक विशाल भारद्वाज को साहित्य ...	2

Assign sentiment and create list for labels & reviews

Convert reviews into sequences of word indices

- A "word index" would be an ID for the word
- Sequences are truncated to a maximum length of 100 words

```
Length of sequences:  898
Found 26030 unique tokens.
Shape of data tensor: (898, 100)
Shape of label tensor: (898, 3)
```

Build train, test data

- 80% for training, 10% for validation and 10% for test

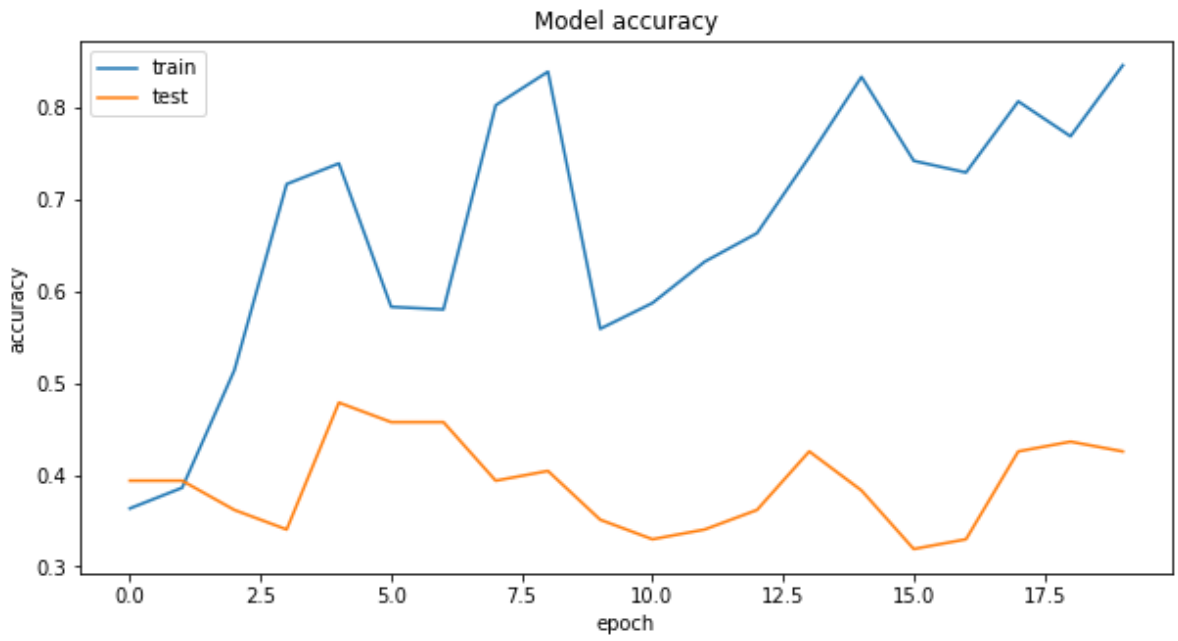
```
Training  710
Validation  94
Test  94
```

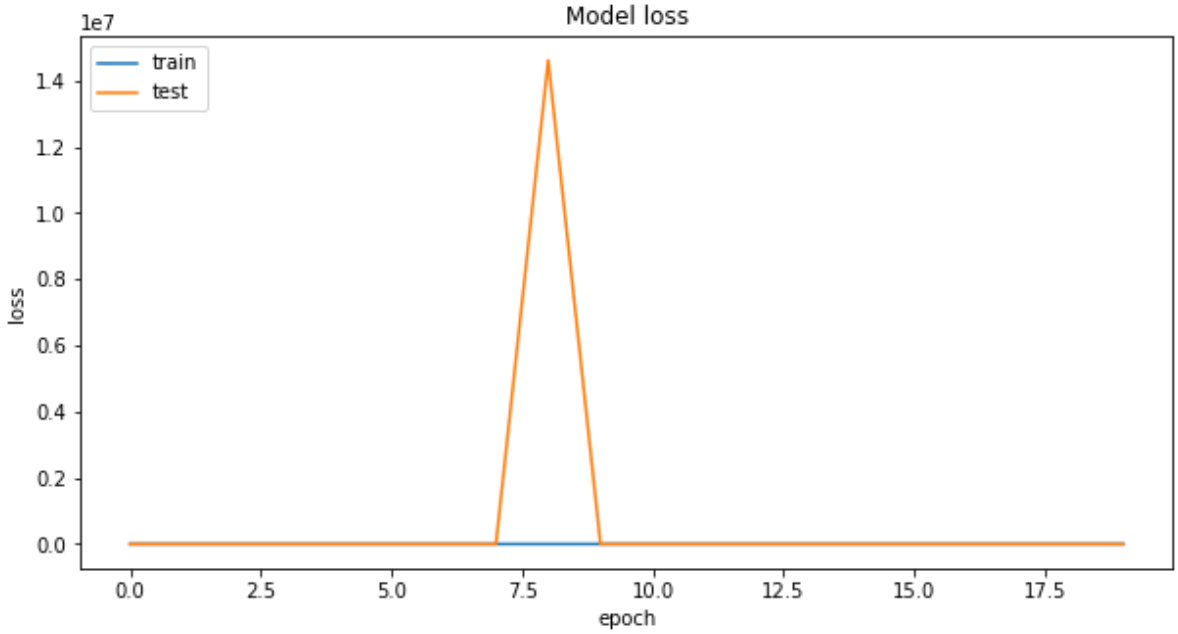
Model X (2 GRU-128 bias_regularizer=0.05 self-trainable embedding)

```
WARNING:tensorflow:Layer gru_8 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
WARNING:tensorflow:Layer gru_9 will not use cuDNN kernel since it
doesn't meet the cuDNN kernel criteria. It will use generic GPU ke
rnel as fallback when running on GPU
Epoch 1/20
23/23 [==============================] - 9s 386ms/step - loss: 1.1
199 - accuracy: 0.3634 - val_loss: 1.1104 - val_accuracy: 0.3936
Epoch 2/20
23/23 [==============================] - 8s 364ms/step - loss: 1.0
910 - accuracy: 0.3859 - val_loss: 1.1136 - val_accuracy: 0.3936
Epoch 3/20
23/23 [==============================] - 8s 369ms/step - loss: 22.
1958 - accuracy: 0.5141 - val_loss: 1.2796 - val_accuracy: 0.3617
Epoch 4/20
23/23 [==============================] - 8s 360ms/step - loss: 1.2
270 - accuracy: 0.7169 - val_loss: 1.3538 - val_accuracy: 0.3404
Epoch 5/20
23/23 [==============================] - 8s 368ms/step - loss: 1.2
641 - accuracy: 0.7394 - val_loss: 1.4439 - val_accuracy: 0.4787
Epoch 6/20
23/23 [==============================] - 8s 361ms/step - loss: 1.3
546 - accuracy: 0.5831 - val_loss: 1.4730 - val_accuracy: 0.4574
Epoch 7/20
23/23 [==============================] - 8s 369ms/step - loss: 1.2
465 - accuracy: 0.5803 - val_loss: 4.4566 - val_accuracy: 0.4574
Epoch 8/20
23/23 [==============================] - 8s 368ms/step - loss: 1.1
914 - accuracy: 0.8028 - val_loss: 1.4209 - val_accuracy: 0.3936
Epoch 9/20
23/23 [==============================] - 9s 378ms/step - loss: 0.9
720 - accuracy: 0.8394 - val_loss: 14612844.0000 - val_accuracy: 0
.4043
Epoch 10/20
23/23 [==============================] - 9s 374ms/step - loss: 6.9
395 - accuracy: 0.5592 - val_loss: 1.8813 - val_accuracy: 0.3511
Epoch 11/20
23/23 [==============================] - 9s 374ms/step - loss: 1.4
071 - accuracy: 0.5873 - val_loss: 1.8195 - val_accuracy: 0.3298
Epoch 12/20
23/23 [==============================] - 8s 367ms/step - loss: 1.3
365 - accuracy: 0.6324 - val_loss: 1.7965 - val_accuracy: 0.3404
Epoch 13/20
23/23 [==============================] - 8s 359ms/step - loss: 1.2
526 - accuracy: 0.6634 - val_loss: 1.7717 - val_accuracy: 0.3617
Epoch 14/20
23/23 [==============================] - 8s 362ms/step - loss: 1.1
332 - accuracy: 0.7465 - val_loss: 1.6641 - val_accuracy: 0.4255
Epoch 15/20
23/23 [==============================] - 8s 367ms/step - loss: 7.4
908 - accuracy: 0.8338 - val_loss: 1.7626 - val_accuracy: 0.3830
```

```
Epoch 16/20
23/23 [==============================] - 9s 386ms/step - loss: 1.2
299 - accuracy: 0.7423 - val_loss: 1.8922 - val_accuracy: 0.3191
Epoch 17/20
23/23 [==============================] - 8s 368ms/step - loss: 1.2
620 - accuracy: 0.7296 - val_loss: 1.8829 - val_accuracy: 0.3298
Epoch 18/20
23/23 [==============================] - 9s 371ms/step - loss: 1.4
068 - accuracy: 0.8070 - val_loss: 1.6987 - val_accuracy: 0.4255
Epoch 19/20
23/23 [==============================] - 9s 373ms/step - loss: 1.2
571 - accuracy: 0.7690 - val_loss: 1.6538 - val_accuracy: 0.4362
Epoch 20/20
23/23 [==============================] - 8s 367ms/step - loss: 1.3
676 - accuracy: 0.8465 - val_loss: 1.6537 - val_accuracy: 0.4255


Model: "sequential_5"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_2 (Embedding)      (None, 100, 100)          2603100
_________________________________________________________________
gru_8 (GRU)                  (None, 100, 128)          88320
_________________________________________________________________
gru_9 (GRU)                  (None, 128)               99072
_________________________________________________________________
dense_4 (Dense)              (None, 3)                 387
=================================================================
Total params: 2,790,879
Trainable params: 2,790,879
Non-trainable params: 0
_________________________________________________________________
Evaluate on test data
3/3 [==============================] - 0s 24ms/step - loss: 1.6553
- accuracy: 0.4149
test loss, test acc: [1.6553058624267578, 0.41489362716674805]
```




Model loss
1e7
train
test
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
loss
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
epoch