report

测试三种lstm结构

纯卷积层

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Layer (type) Output Shape Param #

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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dropout\_1 (Dropout) (None, 50, 50) 0

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conv1d\_1 (Conv1D) (None, 47, 80) 16080

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global\_max\_pooling1d\_1 (Glob (None, 80) 0

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dense\_1 (Dense) (None, 3) 243

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activation\_1 (Activation) (None, 3) 0

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Total params: 32,922,673

Trainable params: 16,323

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 38s 849us/step - loss: 1.3301 - acc: 0.4959 - val\_loss: 0.8615 - val\_acc: 0.5992

Epoch 2/10

44613/44613 [==============================] - 40s 907us/step - loss: 1.2247 - acc: 0.5418 - val\_loss: 0.8690 - val\_acc: 0.5961

Epoch 3/10

44613/44613 [==============================] - 40s 889us/step - loss: 1.2016 - acc: 0.5554 - val\_loss: 0.8138 - val\_acc: 0.6322

Epoch 4/10

44613/44613 [==============================] - 41s 923us/step - loss: 1.1849 - acc: 0.5602 - val\_loss: 0.8137 - val\_acc: 0.6266

Epoch 5/10

44613/44613 [==============================] - 38s 863us/step - loss: 1.1638 - acc: 0.5723 - val\_loss: 0.8745 - val\_acc: 0.5959

Epoch 6/10

44613/44613 [==============================] - 40s 896us/step - loss: 1.1575 - acc: 0.5728 - val\_loss: 0.8117 - val\_acc: 0.6264

Epoch 7/10

44613/44613 [==============================] - 41s 924us/step - loss: 1.1572 - acc: 0.5750 - val\_loss: 0.8384 - val\_acc: 0.6084

Epoch 8/10

44613/44613 [==============================] - 41s 916us/step - loss: 1.1514 - acc: 0.5741 - val\_loss: 0.8163 - val\_acc: 0.6242

Epoch 9/10

44613/44613 [==============================] - 39s 867us/step - loss: 1.1450 - acc: 0.5810 - val\_loss: 0.7874 - val\_acc: 0.6468

Epoch 10/10

44613/44613 [==============================] - 41s 927us/step - loss: 1.1417 - acc: 0.5834 - val\_loss: 0.7535 - val\_acc: 0.6633

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 28s 637us/step - loss: 1.3334 - acc: 0.4942 - val\_loss: 0.8850 - val\_acc: 0.5790

Epoch 2/20

44613/44613 [==============================] - 32s 716us/step - loss: 1.2381 - acc: 0.5368 - val\_loss: 0.9172 - val\_acc: 0.5570

Epoch 3/20

44613/44613 [==============================] - 34s 756us/step - loss: 1.2021 - acc: 0.5533 - val\_loss: 0.8651 - val\_acc: 0.5983

Epoch 4/20

44613/44613 [==============================] - 31s 696us/step - loss: 1.1879 - acc: 0.5597 - val\_loss: 0.8325 - val\_acc: 0.6201

Epoch 5/20

44613/44613 [==============================] - 30s 680us/step - loss: 1.1772 - acc: 0.5690 - val\_loss: 0.8419 - val\_acc: 0.6139

Epoch 6/20

44613/44613 [==============================] - 31s 687us/step - loss: 1.1708 - acc: 0.5698 - val\_loss: 0.8651 - val\_acc: 0.5961

Epoch 7/20

44613/44613 [==============================] - 33s 749us/step - loss: 1.1631 - acc: 0.5760 - val\_loss: 0.8432 - val\_acc: 0.6102

Epoch 8/20

44613/44613 [==============================] - 50s 1ms/step - loss: 1.1654 - acc: 0.5757 - val\_loss: 0.8172 - val\_acc: 0.6139

Epoch 9/20

44613/44613 [==============================] - 69s 2ms/step - loss: 1.1583 - acc: 0.5776 - val\_loss: 0.8047 - val\_acc: 0.6371

Epoch 10/20

44613/44613 [==============================] - 81s 2ms/step - loss: 1.1530 - acc: 0.5806 - val\_loss: 0.8027 - val\_acc: 0.6405

Epoch 11/20

44613/44613 [==============================] - 82s 2ms/step - loss: 1.1451 - acc: 0.5837 - val\_loss: 0.7662 - val\_acc: 0.6520

Epoch 12/20

44613/44613 [==============================] - 83s 2ms/step - loss: 1.1460 - acc: 0.5820 - val\_loss: 0.7899 - val\_acc: 0.6411

Epoch 13/20

44613/44613 [==============================] - 81s 2ms/step - loss: 1.1491 - acc: 0.5853 - val\_loss: 0.8322 - val\_acc: 0.6117

Epoch 14/20

44613/44613 [==============================] - 80s 2ms/step - loss: 1.1463 - acc: 0.5857 - val\_loss: 0.8265 - val\_acc: 0.6207

Epoch 15/20

44613/44613 [==============================] - 80s 2ms/step - loss: 1.1459 - acc: 0.5831 - val\_loss: 0.7935 - val\_acc: 0.6371

Epoch 16/20

44613/44613 [==============================] - 80s 2ms/step - loss: 1.1419 - acc: 0.5863 - val\_loss: 0.7924 - val\_acc: 0.6439

Epoch 17/20

44613/44613 [==============================] - 80s 2ms/step - loss: 1.1372 - acc: 0.5896 - val\_loss: 0.8142 - val\_acc: 0.6280

Epoch 18/20

44613/44613 [==============================] - 82s 2ms/step - loss: 1.1430 - acc: 0.5813 - val\_loss: 0.7845 - val\_acc: 0.6470

Epoch 19/20

44613/44613 [==============================] - 81s 2ms/step - loss: 1.1306 - acc: 0.5910 - val\_loss: 0.7613 - val\_acc: 0.6595

Epoch 20/20

44613/44613 [==============================] - 81s 2ms/step - loss: 1.1317 - acc: 0.5905 - val\_loss: 0.7885 - val\_acc: 0.6437

纯单lstm

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param #

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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gaussian\_noise\_1 (GaussianNo (None, 50, 50) 0

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dropout\_1 (Dropout) (None, 50, 50) 0

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lstm\_1 (LSTM) (None, 32) 10624

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dropout\_2 (Dropout) (None, 32) 0

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dense\_1 (Dense) (None, 3) 99

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Total params: 32,917,073

Trainable params: 10,723

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 96s 2ms/step - loss: 1.4527 - acc: 0.3916 - val\_loss: 0.9946 - val\_acc: 0.4965

Epoch 2/10

44613/44613 [==============================] - 88s 2ms/step - loss: 1.3877 - acc: 0.4438 - val\_loss: 0.9848 - val\_acc: 0.5187

Epoch 3/10

44613/44613 [==============================] - 91s 2ms/step - loss: 1.3661 - acc: 0.4581 - val\_loss: 0.9432 - val\_acc: 0.5330

Epoch 4/10

44613/44613 [==============================] - 100s 2ms/step - loss: 1.3450 - acc: 0.4706 - val\_loss: 0.9485 - val\_acc: 0.5213

Epoch 5/10

44613/44613 [==============================] - 101s 2ms/step - loss: 1.3336 - acc: 0.4746 - val\_loss: 0.9219 - val\_acc: 0.5338

Epoch 6/10

44613/44613 [==============================] - 98s 2ms/step - loss: 1.3213 - acc: 0.4736 - val\_loss: 0.8927 - val\_acc: 0.5489

Epoch 7/10

44613/44613 [==============================] - 133s 3ms/step - loss: 1.3104 - acc: 0.4873 - val\_loss: 0.9144 - val\_acc: 0.5429

Epoch 8/10

44613/44613 [==============================] - 92s 2ms/step - loss: 1.3100 - acc: 0.4890 - val\_loss: 0.9068 - val\_acc: 0.5485

Epoch 9/10

44613/44613 [==============================] - 92s 2ms/step - loss: 1.3000 - acc: 0.4916 - val\_loss: 0.8716 - val\_acc: 0.5697

Epoch 10/10

44613/44613 [==============================] - 94s 2ms/step - loss: 1.2990 - acc: 0.4921 - val\_loss: 0.8969 - val\_acc: 0.5433

纯双向lstm

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param #

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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gaussian\_noise\_1 (GaussianNo (None, 50, 50) 0

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dropout\_1 (Dropout) (None, 50, 50) 0

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bidirectional\_1 (Bidirection (None, 64) 21248

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dropout\_2 (Dropout) (None, 64) 0

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dense\_1 (Dense) (None, 3) 195

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Total params: 32,927,793

Trainable params: 21,443

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 136s 3ms/step - loss: 1.4426 - acc: 0.4040 - val\_loss: 0.9448 - val\_acc: 0.5326

Epoch 2/10

44613/44613 [==============================] - 121s 3ms/step - loss: 1.3588 - acc: 0.4634 - val\_loss: 0.9522 - val\_acc: 0.5372

Epoch 3/10

44613/44613 [==============================] - 152s 3ms/step - loss: 1.3267 - acc: 0.4829 - val\_loss: 0.8819 - val\_acc: 0.5701

Epoch 4/10

44613/44613 [==============================] - 147s 3ms/step - loss: 1.3092 - acc: 0.4896 - val\_loss: 0.8857 - val\_acc: 0.5651

Epoch 5/10

44613/44613 [==============================] - 188s 4ms/step - loss: 1.2942 - acc: 0.5009 - val\_loss: 0.8844 - val\_acc: 0.5584

Epoch 6/10

44613/44613 [==============================] - 132s 3ms/step - loss: 1.2883 - acc: 0.5020 - val\_loss: 0.8851 - val\_acc: 0.5614

Epoch 7/10

44613/44613 [==============================] - 132s 3ms/step - loss: 1.2757 - acc: 0.5062 - val\_loss: 0.8582 - val\_acc: 0.5762

Epoch 8/10

44613/44613 [==============================] - 142s 3ms/step - loss: 1.2743 - acc: 0.5102 - val\_loss: 0.8600 - val\_acc: 0.5749

Epoch 9/10

44613/44613 [==============================] - 160s 4ms/step - loss: 1.2655 - acc: 0.5157 - val\_loss: 0.8945 - val\_acc: 0.5519

加入卷积层

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param #

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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gaussian\_noise\_1 (GaussianNo (None, 50, 50) 0

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dropout\_1 (Dropout) (None, 50, 50) 0

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conv1d\_1 (Conv1D) (None, 50, 64) 16064

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max\_pooling1d\_1 (MaxPooling1 (None, 12, 64) 0

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lstm\_1 (LSTM) (None, 32) 12416

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dropout\_2 (Dropout) (None, 32) 0

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dense\_1 (Dense) (None, 3) 99

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Total params: 32,934,929

Trainable params: 28,579

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 33s 729us/step - loss: 1.4580 - acc: 0.3710 - val\_loss: 0.9701 - val\_acc: 0.4934

Epoch 2/10

44613/44613 [==============================] - 33s 749us/step - loss: 1.3257 - acc: 0.4774 - val\_loss: 0.9000 - val\_acc: 0.5850

Epoch 3/10

44613/44613 [==============================] - 37s 829us/step - loss: 1.2826 - acc: 0.5089 - val\_loss: 0.9114 - val\_acc: 0.5568

Epoch 4/10

44613/44613 [==============================] - 35s 784us/step - loss: 1.2587 - acc: 0.5199 - val\_loss: 0.8365 - val\_acc: 0.6207

Epoch 5/10

44613/44613 [==============================] - 36s 800us/step - loss: 1.2463 - acc: 0.5277 - val\_loss: 0.8583 - val\_acc: 0.5996

Epoch 6/10

44613/44613 [==============================] - 32s 712us/step - loss: 1.2333 - acc: 0.5346 - val\_loss: 0.8310 - val\_acc: 0.6193

Epoch 7/10

44613/44613 [==============================] - 32s 716us/step - loss: 1.2318 - acc: 0.5345 - val\_loss: 0.8543 - val\_acc: 0.5947

Epoch 8/10

44613/44613 [==============================] - 39s 867us/step - loss: 1.2168 - acc: 0.5409 - val\_loss: 0.8203 - val\_acc: 0.6308

Epoch 9/10

44613/44613 [==============================] - 38s 854us/step - loss: 1.2139 - acc: 0.5457 - val\_loss: 0.8262 - val\_acc: 0.6306

Epoch 10/10

44613/44613 [==============================] - 40s 899us/step - loss: 1.2071 - acc: 0.5486 - val\_loss: 0.8210 - val\_acc: 0.6334

add dense after lstm

use everything

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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lstm\_2 (LSTM) (None, 32) 8320 attention\_mul[0][0]

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dense\_1 (Dense) (None, 3) 99 lstm\_2[0][0]

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Total params: 32,944,305

Trainable params: 37,955

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 83s 2ms/step - loss: 1.4097 - acc: 0.3774 - val\_loss: 0.9677 - val\_acc: 0.4535

Epoch 2/10

44613/44613 [==============================] - 66s 1ms/step - loss: 1.3244 - acc: 0.4301 - val\_loss: 0.9171 - val\_acc: 0.5181

Epoch 3/10

44613/44613 [==============================] - 69s 2ms/step - loss: 1.2975 - acc: 0.4550 - val\_loss: 0.9279 - val\_acc: 0.5427

Epoch 4/10

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2789 - acc: 0.4847 - val\_loss: 0.9057 - val\_acc: 0.5628

Epoch 5/10

44613/44613 [==============================] - 68s 2ms/step - loss: 1.2679 - acc: 0.5046 - val\_loss: 0.8672 - val\_acc: 0.5977

Epoch 6/10

44613/44613 [==============================] - 53s 1ms/step - loss: 1.2580 - acc: 0.5159 - val\_loss: 0.8598 - val\_acc: 0.6151

Epoch 7/10

44613/44613 [==============================] - 52s 1ms/step - loss: 1.2357 - acc: 0.5305 - val\_loss: 0.8778 - val\_acc: 0.5854

Epoch 8/10

44613/44613 [==============================] - 48s 1ms/step - loss: 1.2290 - acc: 0.5282 - val\_loss: 0.8546 - val\_acc: 0.5941

Epoch 9/10

44613/44613 [==============================] - 48s 1ms/step - loss: 1.2197 - acc: 0.5330 - val\_loss: 0.8313 - val\_acc: 0.6127

Epoch 10/10

44613/44613 [==============================] - 48s 1ms/step - loss: 1.2156 - acc: 0.5415 - val\_loss: 0.8175 - val\_acc: 0.6276

conv +lstm + concent +.. +lstm

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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lstm\_2 (LSTM) (None, 12, 32) 8320 attention\_mul[0][0]

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dropout\_3 (Dropout) (None, 12, 32) 0 lstm\_2[0][0]

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attention\_probs2 (Dense) (None, 12, 32) 1056 dropout\_3[0][0]

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attention\_mul2 (Merge) (None, 12, 32) 0 dropout\_3[0][0]

attention\_probs2[0][0]

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lstm\_3 (LSTM) (None, 32) 8320 attention\_mul2[0][0]

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dense\_1 (Dense) (None, 3) 99 lstm\_3[0][0]

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Total params: 32,953,681

Trainable params: 47,331

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 108s 2ms/step - loss: 1.4391 - acc: 0.3625 - val\_loss: 0.9600 - val\_acc: 0.4565

Epoch 2/10

44613/44613 [==============================] - 100s 2ms/step - loss: 1.3516 - acc: 0.4211 - val\_loss: 0.9257 - val\_acc: 0.4711

Epoch 3/10

44613/44613 [==============================] - 105s 2ms/step - loss: 1.3223 - acc: 0.4378 - val\_loss: 0.9326 - val\_acc: 0.4896

Epoch 4/10

44613/44613 [==============================] - 107s 2ms/step - loss: 1.3091 - acc: 0.4562 - val\_loss: 0.9082 - val\_acc: 0.5471

Epoch 5/10

44613/44613 [==============================] - 104s 2ms/step - loss: 1.2950 - acc: 0.4729 - val\_loss: 0.8952 - val\_acc: 0.5586

Epoch 6/10

44613/44613 [==============================] - 112s 3ms/step - loss: 1.2833 - acc: 0.4922 - val\_loss: 0.8891 - val\_acc: 0.5915

Epoch 7/10

44613/44613 [==============================] - 145s 3ms/step - loss: 1.2722 - acc: 0.5026 - val\_loss: 0.8989 - val\_acc: 0.5739

Epoch 8/10

44613/44613 [==============================] - 118s 3ms/step - loss: 1.2681 - acc: 0.5080 - val\_loss: 0.8778 - val\_acc: 0.5723

Epoch 9/10

44613/44613 [==============================] - 110s 2ms/step - loss: 1.2612 - acc: 0.5136 - val\_loss: 0.8868 - val\_acc: 0.5875

Epoch 10/10

44613/44613 [==============================] - 105s 2ms/step - loss: 1.2551 - acc: 0.5213 - val\_loss: 0.8750 - val\_acc: 0.5917

Epoch 1/20

44613/44613 [==============================] - 114s 3ms/step - loss: 1.4368 - acc: 0.3764 - val\_loss: 0.9910 - val\_acc: 0.4543

Epoch 2/20

44613/44613 [==============================] - 126s 3ms/step - loss: 1.3435 - acc: 0.4243 - val\_loss: 0.9231 - val\_acc: 0.4739

Epoch 3/20

44613/44613 [==============================] - 126s 3ms/step - loss: 1.3189 - acc: 0.4393 - val\_loss: 0.9341 - val\_acc: 0.5126

Epoch 4/20

44613/44613 [==============================] - 123s 3ms/step - loss: 1.3014 - acc: 0.4578 - val\_loss: 0.9135 - val\_acc: 0.5227

Epoch 5/20

44613/44613 [==============================] - 122s 3ms/step - loss: 1.2896 - acc: 0.4738 - val\_loss: 0.8987 - val\_acc: 0.5562

Epoch 6/20

44613/44613 [==============================] - 122s 3ms/step - loss: 1.2768 - acc: 0.4846 - val\_loss: 0.8805 - val\_acc: 0.5649

Epoch 7/20

44613/44613 [==============================] - 123s 3ms/step - loss: 1.2742 - acc: 0.4939 - val\_loss: 0.8802 - val\_acc: 0.5703

Epoch 8/20

44613/44613 [==============================] - 124s 3ms/step - loss: 1.2624 - acc: 0.5007 - val\_loss: 0.8698 - val\_acc: 0.6046

Epoch 9/20

44613/44613 [==============================] - 111s 2ms/step - loss: 1.2602 - acc: 0.5022 - val\_loss: 0.8634 - val\_acc: 0.5979

Epoch 10/20

44613/44613 [==============================] - 94s 2ms/step - loss: 1.2532 - acc: 0.5171 - val\_loss: 0.8601 - val\_acc: 0.5973

Epoch 11/20

44613/44613 [==============================] - 93s 2ms/step - loss: 1.2413 - acc: 0.5231 - val\_loss: 0.8497 - val\_acc: 0.6209

Epoch 12/20

44613/44613 [==============================] - 93s 2ms/step - loss: 1.2426 - acc: 0.5258 - val\_loss: 0.8730 - val\_acc: 0.6004

Epoch 13/20

44613/44613 [==============================] - 92s 2ms/step - loss: 1.2406 - acc: 0.5243 - val\_loss: 0.8669 - val\_acc: 0.5935

Epoch 14/20

44613/44613 [==============================] - 92s 2ms/step - loss: 1.2387 - acc: 0.5266 - val\_loss: 0.8473 - val\_acc: 0.6153

Epoch 15/20

44613/44613 [==============================] - 86s 2ms/step - loss: 1.2405 - acc: 0.5257 - val\_loss: 0.8562 - val\_acc: 0.6014

Epoch 16/20

44613/44613 [==============================] - 68s 2ms/step - loss: 1.2311 - acc: 0.5363 - val\_loss: 0.8439 - val\_acc: 0.6252

Epoch 17/20

44613/44613 [==============================] - 66s 1ms/step - loss: 1.2279 - acc: 0.5389 - val\_loss: 0.8402 - val\_acc: 0.6228

Epoch 18/20

44613/44613 [==============================] - 67s 1ms/step - loss: 1.2247 - acc: 0.5386 - val\_loss: 0.8366 - val\_acc: 0.6272

Epoch 19/20

44613/44613 [==============================] - 66s 1ms/step - loss: 1.2210 - acc: 0.5458 - val\_loss: 0.8526 - val\_acc: 0.6205

Epoch 20/20

44613/44613 [==============================] - 284s 6ms/step - loss: 1.2215 - acc: 0.5415 - val\_loss: 0.8522 - val\_acc: 0.6107

cov+lstm+cont+conv+lstm+cont+lstm

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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conv1d\_2 (Conv1D) (None, 12, 64) 10304 attention\_mul[0][0]

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max\_pooling1d\_2 (MaxPooling1D) (None, 3, 64) 0 conv1d\_2[0][0]

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lstm\_2 (LSTM) (None, 3, 32) 12416 max\_pooling1d\_2[0][0]

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dropout\_3 (Dropout) (None, 3, 32) 0 lstm\_2[0][0]

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attention\_probs2 (Dense) (None, 3, 32) 1056 dropout\_3[0][0]

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attention\_mul2 (Merge) (None, 3, 32) 0 dropout\_3[0][0]

attention\_probs2[0][0]

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lstm\_3 (LSTM) (None, 32) 8320 attention\_mul2[0][0]

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dense\_1 (Dense) (None, 3) 99 lstm\_3[0][0]

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Total params: 32,968,081

Trainable params: 61,731

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 85s 2ms/step - loss: 1.4082 - acc: 0.3511 - val\_loss: 0.9516 - val\_acc: 0.4755

Epoch 2/10

44613/44613 [==============================] - 71s 2ms/step - loss: 1.3279 - acc: 0.4433 - val\_loss: 0.9406 - val\_acc: 0.5021

Epoch 3/10

44613/44613 [==============================] - 67s 2ms/step - loss: 1.3011 - acc: 0.4607 - val\_loss: 0.8996 - val\_acc: 0.5467

Epoch 4/10

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2914 - acc: 0.4779 - val\_loss: 0.9486 - val\_acc: 0.5344

Epoch 5/10

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2775 - acc: 0.4903 - val\_loss: 0.9204 - val\_acc: 0.5588

Epoch 6/10

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2661 - acc: 0.4962 - val\_loss: 0.8964 - val\_acc: 0.5840

Epoch 7/10

44613/44613 [==============================] - 73s 2ms/step - loss: 1.2612 - acc: 0.5023 - val\_loss: 0.8904 - val\_acc: 0.5881

Epoch 8/10

44613/44613 [==============================] - 76s 2ms/step - loss: 1.2548 - acc: 0.5115 - val\_loss: 0.8797 - val\_acc: 0.5953

Epoch 9/10

44613/44613 [==============================] - 97s 2ms/step - loss: 1.2489 - acc: 0.5154 - val\_loss: 0.8693 - val\_acc: 0.6002

Epoch 10/10

44613/44613 [==============================] - 101s 2ms/step - loss: 1.2409 - acc: 0.5241 - val\_loss: 0.8530 - val\_acc: 0.6014

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 119s 3ms/step - loss: 1.4309 - acc: 0.3875 - val\_loss: 1.0497 - val\_acc: 0.3956

Epoch 2/20

44613/44613 [==============================] - 87s 2ms/step - loss: 1.3423 - acc: 0.4182 - val\_loss: 0.9461 - val\_acc: 0.4880

Epoch 3/20

44613/44613 [==============================] - 87s 2ms/step - loss: 1.3121 - acc: 0.4372 - val\_loss: 0.9674 - val\_acc: 0.4858

Epoch 4/20

44613/44613 [==============================] - 85s 2ms/step - loss: 1.2934 - acc: 0.4582 - val\_loss: 0.9436 - val\_acc: 0.5469

Epoch 5/20

44613/44613 [==============================] - 85s 2ms/step - loss: 1.2797 - acc: 0.4817 - val\_loss: 0.9159 - val\_acc: 0.5485

Epoch 6/20

44613/44613 [==============================] - 84s 2ms/step - loss: 1.2735 - acc: 0.4888 - val\_loss: 0.8913 - val\_acc: 0.5715

Epoch 7/20

44613/44613 [==============================] - 84s 2ms/step - loss: 1.2640 - acc: 0.4932 - val\_loss: 0.9058 - val\_acc: 0.5461

Epoch 8/20

44613/44613 [==============================] - 84s 2ms/step - loss: 1.2542 - acc: 0.5023 - val\_loss: 0.8849 - val\_acc: 0.6060

Epoch 9/20

44613/44613 [==============================] - 86s 2ms/step - loss: 1.2550 - acc: 0.5098 - val\_loss: 0.8807 - val\_acc: 0.5925

Epoch 10/20

44613/44613 [==============================] - 86s 2ms/step - loss: 1.2445 - acc: 0.5171 - val\_loss: 0.8842 - val\_acc: 0.5953

Epoch 11/20

44613/44613 [==============================] - 85s 2ms/step - loss: 1.2391 - acc: 0.5257 - val\_loss: 0.8775 - val\_acc: 0.6046

Epoch 12/20

44613/44613 [==============================] - 68s 2ms/step - loss: 1.2372 - acc: 0.5246 - val\_loss: 0.8850 - val\_acc: 0.5873

Epoch 13/20

44613/44613 [==============================] - 66s 1ms/step - loss: 1.2335 - acc: 0.5305 - val\_loss: 0.8501 - val\_acc: 0.6248

Epoch 14/20

44613/44613 [==============================] - 65s 1ms/step - loss: 1.2272 - acc: 0.5388 - val\_loss: 0.8437 - val\_acc: 0.6290

Epoch 15/20

44613/44613 [==============================] - 66s 1ms/step - loss: 1.2248 - acc: 0.5396 - val\_loss: 0.9129 - val\_acc: 0.5638

Epoch 16/20

44613/44613 [==============================] - 65s 1ms/step - loss: 1.2205 - acc: 0.5417 - val\_loss: 0.8409 - val\_acc: 0.6375

Epoch 17/20

44613/44613 [==============================] - 64s 1ms/step - loss: 1.2108 - acc: 0.5429 - val\_loss: 0.8437 - val\_acc: 0.6215

Epoch 18/20

44613/44613 [==============================] - 65s 1ms/step - loss: 1.2051 - acc: 0.5529 - val\_loss: 0.8363 - val\_acc: 0.6286

Epoch 19/20

44613/44613 [==============================] - 65s 1ms/step - loss: 1.2026 - acc: 0.5553 - val\_loss: 0.8337 - val\_acc: 0.6421

Epoch 20/20

44613/44613 [==============================] - 65s 1ms/step - loss: 1.2014 - acc: 0.5531 - val\_loss: 0.8055 - val\_acc: 0.6522

Train on 44613 samples, validate on 4957 samples

Epoch 1/30

44613/44613 [==============================] - 59s 1ms/step - loss: 1.4325 - acc: 0.3832 - val\_loss: 1.0198 - val\_acc: 0.4420

Epoch 2/30

44613/44613 [==============================] - 50s 1ms/step - loss: 1.3692 - acc: 0.4262 - val\_loss: 0.9661 - val\_acc: 0.4823

Epoch 3/30

44613/44613 [==============================] - 49s 1ms/step - loss: 1.3341 - acc: 0.4396 - val\_loss: 0.9988 - val\_acc: 0.5221

Epoch 4/30

44613/44613 [==============================] - 54s 1ms/step - loss: 1.3069 - acc: 0.4553 - val\_loss: 0.9384 - val\_acc: 0.5586

Epoch 5/30

44613/44613 [==============================] - 60s 1ms/step - loss: 1.2964 - acc: 0.4709 - val\_loss: 0.9316 - val\_acc: 0.5653

Epoch 6/30

44613/44613 [==============================] - 74s 2ms/step - loss: 1.2768 - acc: 0.4908 - val\_loss: 0.9075 - val\_acc: 0.5838

Epoch 7/30

44613/44613 [==============================] - 73s 2ms/step - loss: 1.2673 - acc: 0.4994 - val\_loss: 0.8985 - val\_acc: 0.5925

Epoch 8/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2639 - acc: 0.5029 - val\_loss: 0.8980 - val\_acc: 0.5772

Epoch 9/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2607 - acc: 0.5032 - val\_loss: 0.8786 - val\_acc: 0.6090

Epoch 10/30

44613/44613 [==============================] - 70s 2ms/step - loss: 1.2544 - acc: 0.5090 - val\_loss: 0.8768 - val\_acc: 0.6139

Epoch 11/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2483 - acc: 0.5174 - val\_loss: 0.8882 - val\_acc: 0.5921

Epoch 12/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2454 - acc: 0.5212 - val\_loss: 0.8807 - val\_acc: 0.6024

Epoch 13/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2344 - acc: 0.5341 - val\_loss: 0.8715 - val\_acc: 0.6040

Epoch 14/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2374 - acc: 0.5311 - val\_loss: 0.8825 - val\_acc: 0.5901

Epoch 15/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2353 - acc: 0.5308 - val\_loss: 0.8448 - val\_acc: 0.6326

Epoch 16/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2245 - acc: 0.5400 - val\_loss: 0.8447 - val\_acc: 0.6177

Epoch 17/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2180 - acc: 0.5397 - val\_loss: 0.8347 - val\_acc: 0.6185

Epoch 18/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2154 - acc: 0.5368 - val\_loss: 0.8339 - val\_acc: 0.6276

Epoch 19/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2097 - acc: 0.5435 - val\_loss: 0.8341 - val\_acc: 0.6359

Epoch 20/30

44613/44613 [==============================] - 70s 2ms/step - loss: 1.2044 - acc: 0.5474 - val\_loss: 0.8504 - val\_acc: 0.6193

Epoch 21/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.2012 - acc: 0.5515 - val\_loss: 0.8168 - val\_acc: 0.6445

Epoch 22/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.1919 - acc: 0.5578 - val\_loss: 0.8169 - val\_acc: 0.6500

Epoch 23/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.1912 - acc: 0.5591 - val\_loss: 0.8301 - val\_acc: 0.6324

Epoch 24/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.1937 - acc: 0.5550 - val\_loss: 0.8293 - val\_acc: 0.6429

Epoch 25/30

44613/44613 [==============================] - 71s 2ms/step - loss: 1.1917 - acc: 0.5559 - val\_loss: 0.8071 - val\_acc: 0.6458

Epoch 26/30

44613/44613 [==============================] - 70s 2ms/step - loss: 1.1888 - acc: 0.5610 - val\_loss: 0.8177 - val\_acc: 0.6451

Epoch 27/30

44613/44613 [==============================] - 49s 1ms/step - loss: 1.1865 - acc: 0.5575 - val\_loss: 0.8008 - val\_acc: 0.6443

Epoch 28/30

44613/44613 [==============================] - 48s 1ms/step - loss: 1.1828 - acc: 0.5642 - val\_loss: 0.8008 - val\_acc: 0.6528

Epoch 29/30

44613/44613 [==============================] - 47s 1ms/step - loss: 1.1881 - acc: 0.5595 - val\_loss: 0.8152 - val\_acc: 0.6512

Epoch 30/30

44613/44613 [==============================] - 48s 1ms/step - loss: 1.1799 - acc: 0.5642 - val\_loss: 0.8215 - val\_acc: 0.6308

conv +lstm + concent +conv

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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conv1d\_2 (Conv1D) (None, 9, 80) 10320 attention\_mul[0][0]

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global\_max\_pooling1d\_1 (GlobalM (None, 80) 0 conv1d\_2[0][0]

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dense\_1 (Dense) (None, 3) 243 global\_max\_pooling1d\_1[0][0]

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Total params: 32,946,449

Trainable params: 40,099

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 95s 2ms/step - loss: 1.3626 - acc: 0.4394 - val\_loss: 0.9423 - val\_acc: 0.5782

Epoch 2/10

44613/44613 [==============================] - 86s 2ms/step - loss: 1.2640 - acc: 0.5060 - val\_loss: 0.8990 - val\_acc: 0.5709

Epoch 3/10

44613/44613 [==============================] - 69s 2ms/step - loss: 1.2414 - acc: 0.5233 - val\_loss: 0.8586 - val\_acc: 0.6302

Epoch 4/10

44613/44613 [==============================] - 63s 1ms/step - loss: 1.2219 - acc: 0.5337 - val\_loss: 0.8665 - val\_acc: 0.6125

Epoch 5/10

44613/44613 [==============================] - 61s 1ms/step - loss: 1.2073 - acc: 0.5397 - val\_loss: 0.8636 - val\_acc: 0.6252

Epoch 6/10

44613/44613 [==============================] - 62s 1ms/step - loss: 1.1988 - acc: 0.5462 - val\_loss: 0.8460 - val\_acc: 0.6256

Epoch 7/10

44613/44613 [==============================] - 61s 1ms/step - loss: 1.1947 - acc: 0.5471 - val\_loss: 0.8629 - val\_acc: 0.6094

Epoch 8/10

44613/44613 [==============================] - 50s 1ms/step - loss: 1.1846 - acc: 0.5504 - val\_loss: 0.8201 - val\_acc: 0.6468

Epoch 9/10

44613/44613 [==============================] - 38s 862us/step - loss: 1.1790 - acc: 0.5573 - val\_loss: 0.8410 - val\_acc: 0.6280

Epoch 10/10

44613/44613 [==============================] - 36s 811us/step - loss: 1.1814 - acc: 0.5543 - val\_loss: 0.8224 - val\_acc: 0.6332

lstm + conv + lstm

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param #

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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gaussian\_noise\_1 (GaussianNo (None, 50, 50) 0

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dropout\_1 (Dropout) (None, 50, 50) 0

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lstm\_1 (LSTM) (None, 50, 32) 10624

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dropout\_2 (Dropout) (None, 50, 32) 0

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conv1d\_1 (Conv1D) (None, 50, 64) 10304

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max\_pooling1d\_1 (MaxPooling1 (None, 12, 64) 0

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lstm\_2 (LSTM) (None, 32) 12416

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dropout\_3 (Dropout) (None, 32) 0

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dense\_1 (Dense) (None, 3) 99

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Total params: 32,939,793

Trainable params: 33,443

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 92s 2ms/step - loss: 1.4382 - acc: 0.3779 - val\_loss: 0.9965 - val\_acc: 0.4573

Epoch 2/10

44613/44613 [==============================] - 111s 2ms/step - loss: 1.3626 - acc: 0.4536 - val\_loss: 0.9574 - val\_acc: 0.5467

Epoch 3/10

44613/44613 [==============================] - 117s 3ms/step - loss: 1.3307 - acc: 0.4805 - val\_loss: 0.9142 - val\_acc: 0.5586

Epoch 4/10

44613/44613 [==============================] - 108s 2ms/step - loss: 1.3123 - acc: 0.4897 - val\_loss: 0.8931 - val\_acc: 0.5778

Epoch 5/10

44613/44613 [==============================] - 113s 3ms/step - loss: 1.2971 - acc: 0.4983 - val\_loss: 0.8718 - val\_acc: 0.5905

Epoch 6/10

44613/44613 [==============================] - 122s 3ms/step - loss: 1.2907 - acc: 0.5013 - val\_loss: 0.8788 - val\_acc: 0.5866

Epoch 7/10

44613/44613 [==============================] - 125s 3ms/step - loss: 1.2827 - acc: 0.5050 - val\_loss: 0.8725 - val\_acc: 0.5939

Epoch 8/10

44613/44613 [==============================] - 108s 2ms/step - loss: 1.2767 - acc: 0.5077 - val\_loss: 0.8556 - val\_acc: 0.6111

Epoch 9/10

44613/44613 [==============================] - 115s 3ms/step - loss: 1.2730 - acc: 0.5096 - val\_loss: 0.8513 - val\_acc: 0.6060

Epoch 10/10

44613/44613 [==============================] - 115s 3ms/step - loss: 1.2730 - acc: 0.5106 - val\_loss: 0.8388 - val\_acc: 0.6155

lstm merge conv+lstm

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 32) 12416 max\_pooling1d\_1[0][0]

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lstm\_2 (LSTM) (None, 32) 10624 dropout\_1[0][0]

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dropout\_2 (Dropout) (None, 32) 0 lstm\_1[0][0]

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dropout\_3 (Dropout) (None, 32) 0 lstm\_2[0][0]

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merge\_1 (Merge) (None, 32) 0 dropout\_2[0][0]

dropout\_3[0][0]

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dense\_1 (Dense) (None, 3) 99 merge\_1[0][0]

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Total params: 32,945,553

Trainable params: 39,203

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 108s 2ms/step - loss: 1.4454 - acc: 0.3735 - val\_loss: 0.9890 - val\_acc: 0.4587

Epoch 2/10

44613/44613 [==============================] - 101s 2ms/step - loss: 1.3359 - acc: 0.4586 - val\_loss: 0.8999 - val\_acc: 0.5891

Epoch 3/10

44613/44613 [==============================] - 96s 2ms/step - loss: 1.2754 - acc: 0.5109 - val\_loss: 0.8809 - val\_acc: 0.6161

Epoch 4/10

44613/44613 [==============================] - 97s 2ms/step - loss: 1.2524 - acc: 0.5211 - val\_loss: 0.8821 - val\_acc: 0.6222

Epoch 5/10

44613/44613 [==============================] - 110s 2ms/step - loss: 1.2467 - acc: 0.5220 - val\_loss: 0.8432 - val\_acc: 0.6228

Epoch 6/10

44613/44613 [==============================] - 106s 2ms/step - loss: 1.2388 - acc: 0.5301 - val\_loss: 0.8401 - val\_acc: 0.6304

Epoch 7/10

44613/44613 [==============================] - 106s 2ms/step - loss: 1.2291 - acc: 0.5352 - val\_loss: 0.8375 - val\_acc: 0.6205

Epoch 8/10

44613/44613 [==============================] - 99s 2ms/step - loss: 1.2251 - acc: 0.5345 - val\_loss: 0.8347 - val\_acc: 0.6349

Epoch 9/10

44613/44613 [==============================] - 98s 2ms/step - loss: 1.2226 - acc: 0.5397 - val\_loss: 0.8159 - val\_acc: 0.6330

Epoch 10/10

44613/44613 [==============================] - 99s 2ms/step - loss: 1.2200 - acc: 0.5429 - val\_loss: 0.8395 - val\_acc: 0.6286

cov+lstm+cont+conv+lstm+cont+conv

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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conv1d\_2 (Conv1D) (None, 12, 64) 10304 attention\_mul[0][0]

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max\_pooling1d\_2 (MaxPooling1D) (None, 3, 64) 0 conv1d\_2[0][0]

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lstm\_2 (LSTM) (None, 3, 32) 12416 max\_pooling1d\_2[0][0]

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dropout\_3 (Dropout) (None, 3, 32) 0 lstm\_2[0][0]

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attention\_probs2 (Dense) (None, 3, 32) 1056 dropout\_3[0][0]

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attention\_mul2 (Merge) (None, 3, 32) 0 dropout\_3[0][0]

attention\_probs2[0][0]

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conv1d\_3 (Conv1D) (None, 3, 64) 10304 attention\_mul2[0][0]

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global\_max\_pooling1d\_1 (GlobalM (None, 64) 0 conv1d\_3[0][0]

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dense\_1 (Dense) (None, 3) 195 global\_max\_pooling1d\_1[0][0]

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Total params: 32,970,161

Trainable params: 63,811

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 47s 1ms/step - loss: 1.4046 - acc: 0.3552 - val\_loss: 0.9519 - val\_acc: 0.4781

Epoch 2/10

44613/44613 [==============================] - 44s 978us/step - loss: 1.3170 - acc: 0.4403 - val\_loss: 0.9283 - val\_acc: 0.5144

Epoch 3/10

44613/44613 [==============================] - 46s 1ms/step - loss: 1.2878 - acc: 0.4721 - val\_loss: 0.9144 - val\_acc: 0.5638

Epoch 4/10

44613/44613 [==============================] - 53s 1ms/step - loss: 1.2721 - acc: 0.4978 - val\_loss: 0.8822 - val\_acc: 0.6070

Epoch 5/10

44613/44613 [==============================] - 60s 1ms/step - loss: 1.2568 - acc: 0.5135 - val\_loss: 0.8741 - val\_acc: 0.6197

Epoch 6/10

44613/44613 [==============================] - 66s 1ms/step - loss: 1.2482 - acc: 0.5213 - val\_loss: 0.8670 - val\_acc: 0.6111

Epoch 7/10

44613/44613 [==============================] - 72s 2ms/step - loss: 1.2352 - acc: 0.5327 - val\_loss: 0.8668 - val\_acc: 0.6086

Epoch 8/10

44613/44613 [==============================] - 80s 2ms/step - loss: 1.2363 - acc: 0.5321 - val\_loss: 0.8457 - val\_acc: 0.6326

Epoch 9/10

44613/44613 [==============================] - 89s 2ms/step - loss: 1.2244 - acc: 0.5327 - val\_loss: 0.8396 - val\_acc: 0.6262

Epoch 10/10

44613/44613 [==============================] - 89s 2ms/step - loss: 1.2138 - acc: 0.5404 - val\_loss: 0.8383 - val\_acc: 0.6298

cov+lstm+cont+conv+lstm+cont+conv merge cov+lstm+cont+conv merge cov

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_2 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_2[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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conv1d\_3 (Conv1D) (None, 12, 64) 10304 attention\_mul[0][0]

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global\_max\_pooling1d\_1 (GlobalM (None, 64) 0 conv1d\_1[0][0]

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global\_max\_pooling1d\_2 (GlobalM (None, 64) 0 conv1d\_3[0][0]

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merge\_1 (Merge) (None, 64) 0 global\_max\_pooling1d\_1[0][0]

global\_max\_pooling1d\_2[0][0]

global\_max\_pooling1d\_1[0][0]

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dense\_1 (Dense) (None, 3) 195 merge\_1[0][0]

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Total params: 32,962,449

Trainable params: 56,099

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 118s 3ms/step - loss: 1.5074 - acc: 0.4748 - val\_loss: 0.8528 - val\_acc: 0.5949

Epoch 2/10

44613/44613 [==============================] - 136s 3ms/step - loss: 1.2818 - acc: 0.5266 - val\_loss: 0.8543 - val\_acc: 0.6000

Epoch 3/10

44613/44613 [==============================] - 133s 3ms/step - loss: 1.2173 - acc: 0.5490 - val\_loss: 0.8679 - val\_acc: 0.5889

Epoch 4/10

44613/44613 [==============================] - 94s 2ms/step - loss: 1.1946 - acc: 0.5592 - val\_loss: 0.8477 - val\_acc: 0.6115

Epoch 5/10

44613/44613 [==============================] - 97s 2ms/step - loss: 1.1884 - acc: 0.5621 - val\_loss: 0.8565 - val\_acc: 0.6024

Epoch 6/10

44613/44613 [==============================] - 96s 2ms/step - loss: 1.1706 - acc: 0.5671 - val\_loss: 0.7971 - val\_acc: 0.6373

Epoch 7/10

44613/44613 [==============================] - 103s 2ms/step - loss: 1.1697 - acc: 0.5728 - val\_loss: 0.7865 - val\_acc: 0.6490

Epoch 8/10

44613/44613 [==============================] - 88s 2ms/step - loss: 1.1659 - acc: 0.5704 - val\_loss: 0.7975 - val\_acc: 0.6381

Epoch 9/10

44613/44613 [==============================] - 86s 2ms/step - loss: 1.1646 - acc: 0.5743 - val\_loss: 0.7765 - val\_acc: 0.6544

Epoch 10/10

44613/44613 [==============================] - 88s 2ms/step - loss: 1.1653 - acc: 0.5731 - val\_loss: 0.8621 - val\_acc: 0.5998

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 83s 2ms/step - loss: 1.4942 - acc: 0.4773 - val\_loss: 0.8751 - val\_acc: 0.5774

Epoch 2/20

44613/44613 [==============================] - 78s 2ms/step - loss: 1.2792 - acc: 0.5271 - val\_loss: 1.0379 - val\_acc: 0.4745

Epoch 3/20

44613/44613 [==============================] - 78s 2ms/step - loss: 1.2225 - acc: 0.5473 - val\_loss: 0.8868 - val\_acc: 0.5804

Epoch 4/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.1916 - acc: 0.5603 - val\_loss: 0.9012 - val\_acc: 0.5745

Epoch 5/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1865 - acc: 0.5642 - val\_loss: 0.8885 - val\_acc: 0.5856

Epoch 6/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1772 - acc: 0.5673 - val\_loss: 0.8953 - val\_acc: 0.5784

Epoch 7/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1760 - acc: 0.5689 - val\_loss: 0.8272 - val\_acc: 0.6232

Epoch 8/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1670 - acc: 0.5714 - val\_loss: 0.9429 - val\_acc: 0.5475

Epoch 9/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1663 - acc: 0.5721 - val\_loss: 0.8011 - val\_acc: 0.6379

Epoch 10/20

44613/44613 [==============================] - 74s 2ms/step - loss: 1.1655 - acc: 0.5739 - val\_loss: 0.8582 - val\_acc: 0.6086

Epoch 11/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1620 - acc: 0.5745 - val\_loss: 0.8172 - val\_acc: 0.6258

Epoch 12/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1581 - acc: 0.5784 - val\_loss: 0.8084 - val\_acc: 0.6324

Epoch 13/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1546 - acc: 0.5778 - val\_loss: 0.7990 - val\_acc: 0.6347

Epoch 14/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.1508 - acc: 0.5825 - val\_loss: 0.8329 - val\_acc: 0.6117

Epoch 15/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.1554 - acc: 0.5797 - val\_loss: 0.7823 - val\_acc: 0.6474

Epoch 16/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1553 - acc: 0.5801 - val\_loss: 0.7789 - val\_acc: 0.6508

Epoch 17/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1488 - acc: 0.5851 - val\_loss: 0.8664 - val\_acc: 0.5911

Epoch 18/20

44613/44613 [==============================] - 74s 2ms/step - loss: 1.1501 - acc: 0.5803 - val\_loss: 0.8469 - val\_acc: 0.6096

Epoch 19/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1440 - acc: 0.5837 - val\_loss: 0.8531 - val\_acc: 0.6046

Epoch 20/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.1430 - acc: 0.5836 - val\_loss: 0.8069 - val\_acc: 0.6292

multi filter

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 48, 100) 15100 dropout\_1[0][0]

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conv1d\_2 (Conv1D) (None, 47, 100) 20100 dropout\_1[0][0]

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conv1d\_3 (Conv1D) (None, 46, 100) 25100 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 24, 100) 0 conv1d\_1[0][0]

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max\_pooling1d\_2 (MaxPooling1D) (None, 23, 100) 0 conv1d\_2[0][0]

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max\_pooling1d\_3 (MaxPooling1D) (None, 23, 100) 0 conv1d\_3[0][0]

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flatten\_1 (Flatten) (None, 2400) 0 max\_pooling1d\_1[0][0]

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flatten\_2 (Flatten) (None, 2300) 0 max\_pooling1d\_2[0][0]

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flatten\_3 (Flatten) (None, 2300) 0 max\_pooling1d\_3[0][0]

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merge\_1 (Merge) (None, 7000) 0 flatten\_1[0][0]

flatten\_2[0][0]

flatten\_3[0][0]

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dropout\_2 (Dropout) (None, 7000) 0 merge\_1[0][0]

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dense\_1 (Dense) (None, 3) 21003 dropout\_2[0][0]

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Total params: 32,987,653

Trainable params: 81,303

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 134s 3ms/step - loss: 1.2920 - mean\_squared\_error: 0.1993 - acc: 0.5131 - val\_loss: 0.9484 - val\_mean\_squared\_error: 0.1910 - val\_acc: 0.5146

Epoch 2/10

44613/44613 [==============================] - 119s 3ms/step - loss: 1.1704 - mean\_squared\_error: 0.1808 - acc: 0.5705 - val\_loss: 0.8821 - val\_mean\_squared\_error: 0.1767 - val\_acc: 0.5862

Epoch 3/10

44613/44613 [==============================] - 81s 2ms/step - loss: 1.1483 - mean\_squared\_error: 0.1775 - acc: 0.5795 - val\_loss: 0.8844 - val\_mean\_squared\_error: 0.1763 - val\_acc: 0.5852

Epoch 4/10

44613/44613 [==============================] - 82s 2ms/step - loss: 1.1307 - mean\_squared\_error: 0.1749 - acc: 0.5883 - val\_loss: 0.8531 - val\_mean\_squared\_error: 0.1704 - val\_acc: 0.6012

Epoch 5/10

44613/44613 [==============================] - 84s 2ms/step - loss: 1.1122 - mean\_squared\_error: 0.1726 - acc: 0.5978 - val\_loss: 0.8831 - val\_mean\_squared\_error: 0.1765 - val\_acc: 0.5911

Epoch 6/10

44613/44613 [==============================] - 88s 2ms/step - loss: 1.1042 - mean\_squared\_error: 0.1716 - acc: 0.6001 - val\_loss: 0.8277 - val\_mean\_squared\_error: 0.1650 - val\_acc: 0.6248

Epoch 7/10

44613/44613 [==============================] - 83s 2ms/step - loss: 1.0953 - mean\_squared\_error: 0.1696 - acc: 0.6058 - val\_loss: 0.8462 - val\_mean\_squared\_error: 0.1690 - val\_acc: 0.6147

Epoch 8/10

44613/44613 [==============================] - 74s 2ms/step - loss: 1.0830 - mean\_squared\_error: 0.1681 - acc: 0.6104 - val\_loss: 0.8025 - val\_mean\_squared\_error: 0.1602 - val\_acc: 0.6470

Epoch 9/10

44613/44613 [==============================] - 76s 2ms/step - loss: 1.0758 - mean\_squared\_error: 0.1671 - acc: 0.6119 - val\_loss: 0.8218 - val\_mean\_squared\_error: 0.1640 - val\_acc: 0.6314

Epoch 10/10

44613/44613 [==============================] - 78s 2ms/step - loss: 1.0669 - mean\_squared\_error: 0.1659 - acc: 0.6178 - val\_loss: 0.8208 - val\_mean\_squared\_error: 0.1633 - val\_acc: 0.6290

lstm merge conv+lstm merge conv+lstm+cond

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_2 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_3 (Dropout) (None, 12, 32) 0 lstm\_2[0][0]

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conv1d\_2 (Conv1D) (None, 12, 64) 10304 dropout\_3[0][0]

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max\_pooling1d\_2 (MaxPooling1D) (None, 3, 64) 0 conv1d\_2[0][0]

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lstm\_1 (LSTM) (None, 32) 12416 max\_pooling1d\_1[0][0]

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lstm\_4 (LSTM) (None, 32) 10624 dropout\_1[0][0]

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lstm\_3 (LSTM) (None, 32) 12416 max\_pooling1d\_2[0][0]

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dropout\_2 (Dropout) (None, 32) 0 lstm\_1[0][0]

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dropout\_5 (Dropout) (None, 32) 0 lstm\_4[0][0]

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dropout\_4 (Dropout) (None, 32) 0 lstm\_3[0][0]

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merge\_1 (Merge) (None, 32) 0 dropout\_2[0][0]

dropout\_5[0][0]

dropout\_4[0][0]

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dense\_1 (Dense) (None, 3) 99 merge\_1[0][0]

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Total params: 32,980,689

Trainable params: 74,339

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 87s 2ms/step - loss: 1.4202 - acc: 0.3835 - val\_loss: 0.9658 - val\_acc: 0.4832

Epoch 2/10

44613/44613 [==============================] - 79s 2ms/step - loss: 1.2932 - acc: 0.4919 - val\_loss: 0.9118 - val\_acc: 0.5822

Epoch 3/10

44613/44613 [==============================] - 89s 2ms/step - loss: 1.2595 - acc: 0.5210 - val\_loss: 0.8675 - val\_acc: 0.6123

Epoch 4/10

44613/44613 [==============================] - 91s 2ms/step - loss: 1.2340 - acc: 0.5332 - val\_loss: 0.8515 - val\_acc: 0.6343

Epoch 5/10

44613/44613 [==============================] - 78s 2ms/step - loss: 1.2217 - acc: 0.5386 - val\_loss: 0.8395 - val\_acc: 0.6363

Epoch 6/10

44613/44613 [==============================] - 78s 2ms/step - loss: 1.2129 - acc: 0.5471 - val\_loss: 0.8234 - val\_acc: 0.6401

Epoch 7/10

44613/44613 [==============================] - 82s 2ms/step - loss: 1.2038 - acc: 0.5459 - val\_loss: 0.8252 - val\_acc: 0.6268

Epoch 8/10

44613/44613 [==============================] - 84s 2ms/step - loss: 1.2034 - acc: 0.5502 - val\_loss: 0.8389 - val\_acc: 0.6439

Epoch 9/10

44613/44613 [==============================] - 78s 2ms/step - loss: 1.1937 - acc: 0.5558 - val\_loss: 0.8270 - val\_acc: 0.6407

Epoch 10/10

44613/44613 [==============================] - 79s 2ms/step - loss: 1.1883 - acc: 0.5574 - val\_loss: 0.8290 - val\_acc: 0.6320

#cnn+lstm+dense+lstm+dense+conv

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 16064 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 64) 0 conv1d\_1[0][0]

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lstm\_1 (LSTM) (None, 12, 32) 12416 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 12, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 12, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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lstm\_2 (LSTM) (None, 12, 32) 8320 attention\_mul[0][0]

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dropout\_3 (Dropout) (None, 12, 32) 0 lstm\_2[0][0]

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attention\_probs2 (Dense) (None, 12, 32) 1056 dropout\_3[0][0]

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attention\_mul2 (Merge) (None, 12, 32) 0 dropout\_3[0][0]

attention\_probs2[0][0]

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conv1d\_2 (Conv1D) (None, 12, 64) 10304 attention\_mul2[0][0]

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global\_max\_pooling1d\_1 (GlobalM (None, 64) 0 conv1d\_2[0][0]

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dense\_1 (Dense) (None, 3) 195 global\_max\_pooling1d\_1[0][0]

==================================================================================================

Total params: 32,955,761

Trainable params: 49,411

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 61s 1ms/step - loss: 1.4775 - acc: 0.3232 - val\_loss: 1.1014 - val\_acc: 0.3964

Epoch 2/10

44613/44613 [==============================] - 60s 1ms/step - loss: 1.4106 - acc: 0.3850 - val\_loss: 0.9906 - val\_acc: 0.4434

Epoch 3/10

44613/44613 [==============================] - 65s 1ms/step - loss: 1.3287 - acc: 0.4320 - val\_loss: 0.9527 - val\_acc: 0.4753

Epoch 4/10

44613/44613 [==============================] - 75s 2ms/step - loss: 1.3021 - acc: 0.4539 - val\_loss: 0.9586 - val\_acc: 0.4894

Epoch 5/10

44613/44613 [==============================] - 74s 2ms/step - loss: 1.2914 - acc: 0.4733 - val\_loss: 0.9457 - val\_acc: 0.5556

Epoch 6/10

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2763 - acc: 0.4863 - val\_loss: 0.9380 - val\_acc: 0.5457

Epoch 7/10

44613/44613 [==============================] - 74s 2ms/step - loss: 1.2631 - acc: 0.5047 - val\_loss: 0.8970 - val\_acc: 0.5917

Epoch 8/10

44613/44613 [==============================] - 73s 2ms/step - loss: 1.2584 - acc: 0.5070 - val\_loss: 0.9165 - val\_acc: 0.5737

Epoch 9/10

44613/44613 [==============================] - 73s 2ms/step - loss: 1.2496 - acc: 0.5166 - val\_loss: 0.8904 - val\_acc: 0.5947

Epoch 10/10

44613/44613 [==============================] - 533s 12ms/step - loss: 1.2427 - acc: 0.5285 - val\_loss: 0.8723 - val\_acc: 0.6151

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 83s 2ms/step - loss: 1.4369 - acc: 0.3828 - val\_loss: 1.0042 - val\_acc: 0.4242

Epoch 2/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.3345 - acc: 0.4184 - val\_loss: 0.9259 - val\_acc: 0.4702

Epoch 3/20

44613/44613 [==============================] - 80s 2ms/step - loss: 1.3112 - acc: 0.4365 - val\_loss: 0.9181 - val\_acc: 0.5225

Epoch 4/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2903 - acc: 0.4621 - val\_loss: 0.9280 - val\_acc: 0.5624

Epoch 5/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2770 - acc: 0.4860 - val\_loss: 0.9122 - val\_acc: 0.5772

Epoch 6/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2717 - acc: 0.4943 - val\_loss: 0.9218 - val\_acc: 0.5826

Epoch 7/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2574 - acc: 0.5071 - val\_loss: 0.8853 - val\_acc: 0.6018

Epoch 8/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2473 - acc: 0.5215 - val\_loss: 0.8662 - val\_acc: 0.6092

Epoch 9/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2420 - acc: 0.5219 - val\_loss: 0.8936 - val\_acc: 0.5992

Epoch 10/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2336 - acc: 0.5318 - val\_loss: 0.8648 - val\_acc: 0.6040

Epoch 11/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2282 - acc: 0.5335 - val\_loss: 0.8531 - val\_acc: 0.6078

Epoch 12/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2261 - acc: 0.5371 - val\_loss: 0.8663 - val\_acc: 0.6155

Epoch 13/20

44613/44613 [==============================] - 64s 1ms/step - loss: 1.2219 - acc: 0.5420 - val\_loss: 0.8760 - val\_acc: 0.5971

Epoch 14/20

44613/44613 [==============================] - 60s 1ms/step - loss: 1.2269 - acc: 0.5380 - val\_loss: 0.8605 - val\_acc: 0.6018

Epoch 15/20

44613/44613 [==============================] - 64s 1ms/step - loss: 1.2181 - acc: 0.5445 - val\_loss: 0.8580 - val\_acc: 0.6254

Epoch 16/20

44613/44613 [==============================] - 78s 2ms/step - loss: 1.2186 - acc: 0.5440 - val\_loss: 0.8511 - val\_acc: 0.6133

Epoch 17/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.2078 - acc: 0.5495 - val\_loss: 0.8290 - val\_acc: 0.6322

Epoch 18/20

44613/44613 [==============================] - 75s 2ms/step - loss: 1.2049 - acc: 0.5482 - val\_loss: 0.8507 - val\_acc: 0.6171

Epoch 19/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.2013 - acc: 0.5506 - val\_loss: 0.8521 - val\_acc: 0.6219

Epoch 20/20

44613/44613 [==============================] - 76s 2ms/step - loss: 1.2001 - acc: 0.5492 - val\_loss: 0.8548 - val\_acc: 0.6129

#lstm+dense+lstm+dense+conv

vocab\_size 658127 (658127, 50)

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 50) 32906350 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 50) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 50) 0 gaussian\_noise\_1[0][0]

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lstm\_1 (LSTM) (None, 50, 32) 10624 dropout\_1[0][0]

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dropout\_2 (Dropout) (None, 50, 32) 0 lstm\_1[0][0]

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attention\_probs (Dense) (None, 50, 32) 1056 dropout\_2[0][0]

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attention\_mul (Merge) (None, 50, 32) 0 dropout\_2[0][0]

attention\_probs[0][0]

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lstm\_2 (LSTM) (None, 50, 32) 8320 attention\_mul[0][0]

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dropout\_3 (Dropout) (None, 50, 32) 0 lstm\_2[0][0]

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attention\_probs2 (Dense) (None, 50, 32) 1056 dropout\_3[0][0]

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attention\_mul2 (Merge) (None, 50, 32) 0 dropout\_3[0][0]

attention\_probs2[0][0]

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conv1d\_1 (Conv1D) (None, 50, 64) 10304 attention\_mul2[0][0]

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global\_max\_pooling1d\_1 (GlobalM (None, 64) 0 conv1d\_1[0][0]

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dense\_1 (Dense) (None, 3) 195 global\_max\_pooling1d\_1[0][0]

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Total params: 32,937,905

Trainable params: 31,555

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/10

44613/44613 [==============================] - 224s 5ms/step - loss: 1.4679 - acc: 0.3072 - val\_loss: 1.0401 - val\_acc: 0.4430

Epoch 2/10

44613/44613 [==============================] - 214s 5ms/step - loss: 1.4049 - acc: 0.4020 - val\_loss: 0.9947 - val\_acc: 0.4400

Epoch 3/10

44613/44613 [==============================] - 647s 15ms/step - loss: 1.3681 - acc: 0.4206 - val\_loss: 0.9505 - val\_acc: 0.4854

Epoch 4/10

44613/44613 [==============================] - 205s 5ms/step - loss: 1.3503 - acc: 0.4379 - val\_loss: 0.9386 - val\_acc: 0.4969

Epoch 5/10

44613/44613 [==============================] - 211s 5ms/step - loss: 1.3335 - acc: 0.4513 - val\_loss: 0.9146 - val\_acc: 0.5245

Epoch 6/10

44613/44613 [==============================] - 180s 4ms/step - loss: 1.3299 - acc: 0.4633 - val\_loss: 0.9066 - val\_acc: 0.5687

Epoch 7/10

44613/44613 [==============================] - 224s 5ms/step - loss: 1.3203 - acc: 0.4719 - val\_loss: 0.9350 - val\_acc: 0.5360

Epoch 8/10

44613/44613 [==============================] - 219s 5ms/step - loss: 1.3202 - acc: 0.4745 - val\_loss: 0.8898 - val\_acc: 0.5877

Epoch 9/10

44613/44613 [==============================] - 220s 5ms/step - loss: 1.3095 - acc: 0.4841 - val\_loss: 0.8946 - val\_acc: 0.5877

Epoch 10/10

44613/44613 [==============================] - 220s 5ms/step - loss: 1.3055 - acc: 0.4911 - val\_loss: 0.8753 - val\_acc: 0.6072

Epoch 1/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.4633 - acc: 0.3701 - val\_loss: 1.0880 - val\_acc: 0.4051

Epoch 2/20

44613/44613 [==============================] - 207s 5ms/step - loss: 1.4211 - acc: 0.3848 - val\_loss: 1.0561 - val\_acc: 0.4396

Epoch 3/20

44613/44613 [==============================] - 162s 4ms/step - loss: 1.3918 - acc: 0.3978 - val\_loss: 1.0541 - val\_acc: 0.4230

Epoch 4/20

44613/44613 [==============================] - 163s 4ms/step - loss: 1.3678 - acc: 0.4086 - val\_loss: 0.9974 - val\_acc: 0.4656

Epoch 5/20

44613/44613 [==============================] - 164s 4ms/step - loss: 1.3558 - acc: 0.4273 - val\_loss: 1.0203 - val\_acc: 0.4454

Epoch 6/20

44613/44613 [==============================] - 173s 4ms/step - loss: 1.3488 - acc: 0.4252 - val\_loss: 0.9847 - val\_acc: 0.4706

Epoch 7/20

44613/44613 [==============================] - 174s 4ms/step - loss: 1.3330 - acc: 0.4411 - val\_loss: 0.9601 - val\_acc: 0.4953

Epoch 8/20

44613/44613 [==============================] - 207s 5ms/step - loss: 1.3289 - acc: 0.4584 - val\_loss: 0.9944 - val\_acc: 0.4817

Epoch 9/20

44613/44613 [==============================] - 223s 5ms/step - loss: 1.3214 - acc: 0.4634 - val\_loss: 0.9301 - val\_acc: 0.5572

Epoch 10/20

44613/44613 [==============================] - 226s 5ms/step - loss: 1.3142 - acc: 0.4742 - val\_loss: 0.9290 - val\_acc: 0.5608

Epoch 11/20

44613/44613 [==============================] - 228s 5ms/step - loss: 1.3090 - acc: 0.4784 - val\_loss: 0.9462 - val\_acc: 0.5513

Epoch 12/20

44613/44613 [==============================] - 225s 5ms/step - loss: 1.3047 - acc: 0.4831 - val\_loss: 0.9367 - val\_acc: 0.5542

Epoch 13/20

44613/44613 [==============================] - 459s 10ms/step - loss: 1.3022 - acc: 0.4848 - val\_loss: 0.9235 - val\_acc: 0.5925

Epoch 14/20

44613/44613 [==============================] - 223s 5ms/step - loss: 1.2964 - acc: 0.4948 - val\_loss: 0.9109 - val\_acc: 0.5983

Epoch 15/20

44613/44613 [==============================] - 227s 5ms/step - loss: 1.2925 - acc: 0.4973 - val\_loss: 0.9050 - val\_acc: 0.5903

Epoch 16/20

44613/44613 [==============================] - 218s 5ms/step - loss: 1.2890 - acc: 0.5011 - val\_loss: 0.9016 - val\_acc: 0.5842

Epoch 17/20

44613/44613 [==============================] - 216s 5ms/step - loss: 1.2811 - acc: 0.5032 - val\_loss: 0.8782 - val\_acc: 0.6032

Epoch 18/20

44613/44613 [==============================] - 216s 5ms/step - loss: 1.2801 - acc: 0.5036 - val\_loss: 0.8933 - val\_acc: 0.5985

Epoch 19/20

44613/44613 [==============================] - 167s 4ms/step - loss: 1.2707 - acc: 0.5080 - val\_loss: 0.8750 - val\_acc: 0.6197

Epoch 20/20

44613/44613 [==============================] - 180s 4ms/step - loss: 1.2669 - acc: 0.5076 - val\_loss: 0.8848 - val\_acc: 0.5975

origin

vocab\_size 658127 (658127, 50)

(None, 50, 300)

eee (None, 50, 300)

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Layer (type) Output Shape Param #

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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gaussian\_noise\_1 (GaussianNo (None, 50, 50) 0

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dropout\_1 (Dropout) (None, 50, 50) 0

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bidirectional\_1 (Bidirection (None, 50, 300) 241200

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dropout\_2 (Dropout) (None, 50, 300) 0

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bidirectional\_2 (Bidirection (None, 50, 300) 541200

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dropout\_3 (Dropout) (None, 50, 300) 0

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attention\_1 (Attention) (None, 300) 350

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dropout\_4 (Dropout) (None, 300) 0

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dense\_1 (Dense) (None, 3) 903

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activation\_1 (Activation) (None, 3) 0

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Total params: 33,690,003

Trainable params: 783,653

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 737s 17ms/step - loss: 1.2979 - acc: 0.4944 - val\_loss: 0.8232 - val\_acc: 0.6226

Epoch 2/20

44613/44613 [==============================] - 721s 16ms/step - loss: 1.2278 - acc: 0.5350 - val\_loss: 0.8621 - val\_acc: 0.5935

Epoch 3/20

44613/44613 [==============================] - 728s 16ms/step - loss: 1.1999 - acc: 0.5482 - val\_loss: 0.8174 - val\_acc: 0.6173

Epoch 4/20

44613/44613 [==============================] - 781s 18ms/step - loss: 1.1835 - acc: 0.5619 - val\_loss: 0.7842 - val\_acc: 0.6514

Epoch 5/20

44613/44613 [==============================] - 726s 16ms/step - loss: 1.1669 - acc: 0.5678 - val\_loss: 0.8160 - val\_acc: 0.6292

Epoch 6/20

44613/44613 [==============================] - 731s 16ms/step - loss: 1.1612 - acc: 0.5700 - val\_loss: 0.7945 - val\_acc: 0.6401

Epoch 7/20

44613/44613 [==============================] - 724s 16ms/step - loss: 1.1560 - acc: 0.5753 - val\_loss: 0.7937 - val\_acc: 0.6351

Epoch 8/20

44613/44613 [==============================] - 795s 18ms/step - loss: 1.1428 - acc: 0.5800 - val\_loss: 0.8069 - val\_acc: 0.6322

Epoch 9/20

44613/44613 [==============================] - 1402s 31ms/step - loss: 1.1378 - acc: 0.5829 - val\_loss: 0.7993 - val\_acc: 0.6330

Epoch 10/20

44613/44613 [==============================] - 1370s 31ms/step - loss: 1.1287 - acc: 0.5867 - val\_loss: 0.7777 - val\_acc: 0.6439

Epoch 11/20

44613/44613 [==============================] - 1354s 30ms/step - loss: 1.1251 - acc: 0.5906 - val\_loss: 0.7740 - val\_acc: 0.6472

Epoch 12/20

44613/44613 [==============================] - 1355s 30ms/step - loss: 1.1177 - acc: 0.5916 - val\_loss: 0.7619 - val\_acc: 0.6619

Epoch 13/20

44613/44613 [==============================] - 1360s 30ms/step - loss: 1.1089 - acc: 0.5963 - val\_loss: 0.7922 - val\_acc: 0.6447

Epoch 14/20

44613/44613 [==============================] - 783s 18ms/step - loss: 1.1118 - acc: 0.5974 - val\_loss: 0.8052 - val\_acc: 0.6292

Epoch 15/20

44613/44613 [==============================] - 746s 17ms/step - loss: 1.1023 - acc: 0.5991 - val\_loss: 0.7686 - val\_acc: 0.6510

Epoch 16/20

44613/44613 [==============================] - 1055s 24ms/step - loss: 1.0988 - acc: 0.5986 - val\_loss: 0.7601 - val\_acc: 0.6603

Epoch 17/20

44613/44613 [==============================] - 1339s 30ms/step - loss: 1.0952 - acc: 0.6016 - val\_loss: 0.7690 - val\_acc: 0.6538

Epoch 18/20

44613/44613 [==============================] - 1338s 30ms/step - loss: 1.0886 - acc: 0.6054 - val\_loss: 0.7801 - val\_acc: 0.6401

Epoch 19/20

44613/44613 [==============================] - 2560s 57ms/step - loss: 1.0914 - acc: 0.6056 - val\_loss: 0.7564 - val\_acc: 0.6643

Epoch 20/20

44613/44613 [==============================] - 1342s 30ms/step - loss: 1.0862 - acc: 0.6068 - val\_loss: 0.7609 - val\_acc: 0.6595

cnn+origin

vocab\_size 658127 (658127, 50)

(None, 12, 300)

eee (None, 12, 300)

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Layer (type) Output Shape Param #

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embedding\_1 (Embedding) (None, 50, 50) 32906350

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gaussian\_noise\_1 (GaussianNo (None, 50, 50) 0

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dropout\_1 (Dropout) (None, 50, 50) 0

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conv1d\_1 (Conv1D) (None, 50, 64) 16064

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max\_pooling1d\_1 (MaxPooling1 (None, 12, 64) 0

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bidirectional\_1 (Bidirection (None, 12, 300) 258000

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dropout\_2 (Dropout) (None, 12, 300) 0

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bidirectional\_2 (Bidirection (None, 12, 300) 541200

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dropout\_3 (Dropout) (None, 12, 300) 0

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attention\_1 (Attention) (None, 300) 312

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dropout\_4 (Dropout) (None, 300) 0

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dense\_1 (Dense) (None, 3) 903

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activation\_1 (Activation) (None, 3) 0

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Total params: 33,722,829

Trainable params: 816,479

Non-trainable params: 32,906,350

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 385s 9ms/step - loss: 1.3070 - acc: 0.4888 - val\_loss: 0.9018 - val\_acc: 0.5588

Epoch 2/20

44613/44613 [==============================] - 354s 8ms/step - loss: 1.2206 - acc: 0.5363 - val\_loss: 0.8625 - val\_acc: 0.5983

Epoch 3/20

44613/44613 [==============================] - 360s 8ms/step - loss: 1.1967 - acc: 0.5519 - val\_loss: 0.7918 - val\_acc: 0.6478

Epoch 4/20

44613/44613 [==============================] - 351s 8ms/step - loss: 1.1797 - acc: 0.5633 - val\_loss: 0.8163 - val\_acc: 0.6278

Epoch 5/20

44613/44613 [==============================] - 363s 8ms/step - loss: 1.1663 - acc: 0.5648 - val\_loss: 0.8644 - val\_acc: 0.5877

Epoch 6/20

44613/44613 [==============================] - 347s 8ms/step - loss: 1.1630 - acc: 0.5696 - val\_loss: 0.8071 - val\_acc: 0.6272

Epoch 7/20

44613/44613 [==============================] - 348s 8ms/step - loss: 1.1537 - acc: 0.5732 - val\_loss: 0.7968 - val\_acc: 0.6415

Epoch 8/20

44613/44613 [==============================] - 348s 8ms/step - loss: 1.1487 - acc: 0.5790 - val\_loss: 0.7913 - val\_acc: 0.6393

Epoch 9/20

44613/44613 [==============================] - 351s 8ms/step - loss: 1.1407 - acc: 0.5795 - val\_loss: 0.7987 - val\_acc: 0.6409

Epoch 10/20

44613/44613 [==============================] - 349s 8ms/step - loss: 1.1401 - acc: 0.5831 - val\_loss: 0.7696 - val\_acc: 0.6542

Epoch 11/20

44613/44613 [==============================] - 348s 8ms/step - loss: 1.1380 - acc: 0.5840 - val\_loss: 0.8059 - val\_acc: 0.6244

Epoch 12/20

44613/44613 [==============================] - 346s 8ms/step - loss: 1.1304 - acc: 0.5833 - val\_loss: 0.7829 - val\_acc: 0.6514

Epoch 13/20

44613/44613 [==============================] - 348s 8ms/step - loss: 1.1302 - acc: 0.5874 - val\_loss: 0.7979 - val\_acc: 0.6447

Epoch 14/20

44613/44613 [==============================] - 348s 8ms/step - loss: 1.1176 - acc: 0.5901 - val\_loss: 0.7677 - val\_acc: 0.6595

Epoch 15/20

44613/44613 [==============================] - 348s 8ms/step - loss: 1.1244 - acc: 0.5908 - val\_loss: 0.7869 - val\_acc: 0.6407

Epoch 16/20

44613/44613 [==============================] - 347s 8ms/step - loss: 1.1207 - acc: 0.5931 - val\_loss: 0.7733 - val\_acc: 0.6619

Epoch 17/20

44613/44613 [==============================] - 350s 8ms/step - loss: 1.1150 - acc: 0.5918 - val\_loss: 0.7752 - val\_acc: 0.6607

Epoch 18/20

44613/44613 [==============================] - 349s 8ms/step - loss: 1.1141 - acc: 0.5894 - val\_loss: 0.7824 - val\_acc: 0.6512

Epoch 19/20

44613/44613 [==============================] - 349s 8ms/step - loss: 1.1134 - acc: 0.5938 - val\_loss: 0.8001 - val\_acc: 0.6238

Epoch 20/20

44613/44613 [==============================] - 346s 8ms/step - loss: 1.1144 - acc: 0.5911 - val\_loss: 0.7960 - val\_acc: 0.6324

## 300dim

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 237s 5ms/step - loss: 1.3112 - acc: 0.4988 - val\_loss: 0.9037 - val\_acc: 0.5810

Epoch 2/20

44613/44613 [==============================] - 231s 5ms/step - loss: 1.1886 - acc: 0.5651 - val\_loss: 0.7863 - val\_acc: 0.6534

Epoch 3/20

44613/44613 [==============================] - 231s 5ms/step - loss: 1.1457 - acc: 0.5842 - val\_loss: 0.8009 - val\_acc: 0.6409

Epoch 4/20

44613/44613 [==============================] - 231s 5ms/step - loss: 1.1277 - acc: 0.5970 - val\_loss: 0.7638 - val\_acc: 0.6677

Epoch 5/20

44613/44613 [==============================] - 231s 5ms/step - loss: 1.1055 - acc: 0.6033 - val\_loss: 0.7721 - val\_acc: 0.6591

Epoch 6/20

44613/44613 [==============================] - 229s 5ms/step - loss: 1.0894 - acc: 0.6078 - val\_loss: 0.7808 - val\_acc: 0.6615

Epoch 7/20

44613/44613 [==============================] - 229s 5ms/step - loss: 1.0751 - acc: 0.6161 - val\_loss: 0.7591 - val\_acc: 0.6625

Epoch 8/20

44613/44613 [==============================] - 229s 5ms/step - loss: 1.0648 - acc: 0.6183 - val\_loss: 0.7581 - val\_acc: 0.6696

Epoch 9/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0567 - acc: 0.6232 - val\_loss: 0.7677 - val\_acc: 0.6544

Epoch 10/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0482 - acc: 0.6260 - val\_loss: 0.7588 - val\_acc: 0.6635

Epoch 11/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0370 - acc: 0.6331 - val\_loss: 0.7669 - val\_acc: 0.6585

Epoch 12/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0307 - acc: 0.6344 - val\_loss: 0.7563 - val\_acc: 0.6599

Epoch 13/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0252 - acc: 0.6346 - val\_loss: 0.7436 - val\_acc: 0.6730

Epoch 14/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0204 - acc: 0.6366 - val\_loss: 0.7578 - val\_acc: 0.6661

Epoch 15/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0152 - acc: 0.6407 - val\_loss: 0.7571 - val\_acc: 0.6647

Epoch 16/20

44613/44613 [==============================] - 229s 5ms/step - loss: 1.0098 - acc: 0.6412 - val\_loss: 0.7434 - val\_acc: 0.6661

Epoch 17/20

44613/44613 [==============================] - 230s 5ms/step - loss: 1.0089 - acc: 0.6427 - val\_loss: 0.7613 - val\_acc: 0.6623

Epoch 18/20

44613/44613 [==============================] - 230s 5ms/step - loss: 0.9975 - acc: 0.6461 - val\_loss: 0.7523 - val\_acc: 0.6615

Epoch 19/20

44613/44613 [==============================] - 231s 5ms/step - loss: 0.9995 - acc: 0.6434 - val\_loss: 0.7464 - val\_acc: 0.6669

Epoch 20/20

44613/44613 [==============================] - 230s 5ms/step - loss: 0.9903 - acc: 0.6517 - val\_loss: 0.7594 - val\_acc: 0.6558

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Layer (type) Output Shape Param #

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embedding\_1 (Embedding) (None, 50, 300) 197438100

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gaussian\_noise\_1 (GaussianNo (None, 50, 300) 0

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dropout\_1 (Dropout) (None, 50, 300) 0

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conv1d\_1 (Conv1D) (None, 50, 64) 96064

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max\_pooling1d\_1 (MaxPooling1 (None, 12, 64) 0

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bidirectional\_1 (Bidirection (None, 12, 300) 258000

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dropout\_2 (Dropout) (None, 12, 300) 0

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bidirectional\_2 (Bidirection (None, 12, 300) 541200

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dropout\_3 (Dropout) (None, 12, 300) 0

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attention\_1 (Attention) (None, 300) 312

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dropout\_4 (Dropout) (None, 300) 0

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dense\_1 (Dense) (None, 3) 903

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activation\_1 (Activation) (None, 3) 0

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Total params: 198,334,579

Trainable params: 896,479

Non-trainable params: 197,438,100

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 423s 9ms/step - loss: 1.3136 - acc: 0.4918 - f1: nan - val\_loss: 0.8773 - val\_acc: 0.5741 - val\_f1: 0.5021

Epoch 2/20

44613/44613 [==============================] - 322s 7ms/step - loss: 1.1922 - acc: 0.5588 - f1: 0.4987 - val\_loss: 0.8117 - val\_acc: 0.6306 - val\_f1: 0.5662

Epoch 3/20

44613/44613 [==============================] - 234s 5ms/step - loss: 1.1470 - acc: 0.5858 - f1: 0.5367 - val\_loss: 0.8214 - val\_acc: 0.6244 - val\_f1: 0.5748

Epoch 4/20

44613/44613 [==============================] - 236s 5ms/step - loss: 1.1222 - acc: 0.5948 - f1: 0.5527 - val\_loss: 0.7654 - val\_acc: 0.6635 - val\_f1: 0.6166

Epoch 5/20

44613/44613 [==============================] - 272s 6ms/step - loss: 1.1036 - acc: 0.6019 - f1: 0.5631 - val\_loss: 0.7895 - val\_acc: 0.6532 - val\_f1: 0.5899

Epoch 6/20

44613/44613 [==============================] - 258s 6ms/step - loss: 1.0903 - acc: 0.6108 - f1: 0.5699 - val\_loss: 0.7762 - val\_acc: 0.6536 - val\_f1: 0.5975

Epoch 7/20

44613/44613 [==============================] - 392s 9ms/step - loss: 1.0780 - acc: 0.6119 - f1: 0.5760 - val\_loss: 0.7741 - val\_acc: 0.6589 - val\_f1: 0.6111

Epoch 8/20

44613/44613 [==============================] - 326s 7ms/step - loss: 1.0637 - acc: 0.6235 - f1: 0.5901 - val\_loss: 0.7735 - val\_acc: 0.6558 - val\_f1: 0.6068

Epoch 9/20

44613/44613 [==============================] - 244s 5ms/step - loss: 1.0597 - acc: 0.6187 - f1: 0.5863 - val\_loss: 0.7591 - val\_acc: 0.6631 - val\_f1: 0.6159

Epoch 10/20

44613/44613 [==============================] - 303s 7ms/step - loss: 1.0550 - acc: 0.6224 - f1: 0.5892 - val\_loss: 0.7551 - val\_acc: 0.6714 - val\_f1: 0.6216

Epoch 11/20

44613/44613 [==============================] - 302s 7ms/step - loss: 1.0465 - acc: 0.6286 - f1: 0.5953 - val\_loss: 0.7607 - val\_acc: 0.6554 - val\_f1: 0.6198

Epoch 12/20

44613/44613 [==============================] - 398s 9ms/step - loss: 1.0352 - acc: 0.6321 - f1: 0.5993 - val\_loss: 0.7541 - val\_acc: 0.6651 - val\_f1: 0.6224

Epoch 13/20

44613/44613 [==============================] - 431s 10ms/step - loss: 1.0331 - acc: 0.6353 - f1: 0.6035 - val\_loss: 0.7492 - val\_acc: 0.6720 - val\_f1: 0.6359

Epoch 14/20

44613/44613 [==============================] - 421s 9ms/step - loss: 1.0218 - acc: 0.6354 - f1: 0.6062 - val\_loss: 0.7495 - val\_acc: 0.6738 - val\_f1: 0.6345

Epoch 15/20

44613/44613 [==============================] - 416s 9ms/step - loss: 1.0210 - acc: 0.6374 - f1: 0.6082 - val\_loss: 0.7677 - val\_acc: 0.6542 - val\_f1: 0.6323

Epoch 16/20

44613/44613 [==============================] - 417s 9ms/step - loss: 1.0132 - acc: 0.6399 - f1: 0.6108 - val\_loss: 0.7538 - val\_acc: 0.6694 - val\_f1: 0.6274

Epoch 17/20

44613/44613 [==============================] - 427s 10ms/step - loss: 1.0097 - acc: 0.6432 - f1: 0.6166 - val\_loss: 0.7423 - val\_acc: 0.6800 - val\_f1: 0.6399

Epoch 18/20

44613/44613 [==============================] - 409s 9ms/step - loss: 1.0070 - acc: 0.6446 - f1: 0.6176 - val\_loss: 0.7579 - val\_acc: 0.6621 - val\_f1: 0.6286

Epoch 19/20

44613/44613 [==============================] - 317s 7ms/step - loss: 1.0023 - acc: 0.6452 - f1: 0.6173 - val\_loss: 0.7404 - val\_acc: 0.6708 - val\_f1: 0.6435

Epoch 20/20

44613/44613 [==============================] - 439s 10ms/step - loss: 0.9946 - acc: 0.6487 - f1: 0.6201 - val\_loss: 0.7617 - val\_acc: 0.6516 - val\_f1: 0.6231

## 300dim conv

None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 58s 1ms/step - loss: 1.3640 - acc: 0.5087 - val\_loss: 1.5112 - val\_acc: 0.3603

Epoch 2/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.2005 - acc: 0.5674 - val\_loss: 0.9506 - val\_acc: 0.5576

Epoch 3/20

44613/44613 [==============================] - 58s 1ms/step - loss: 1.1479 - acc: 0.5915 - val\_loss: 1.0969 - val\_acc: 0.5015

Epoch 4/20

44613/44613 [==============================] - 64s 1ms/step - loss: 1.1220 - acc: 0.6046 - val\_loss: 0.9427 - val\_acc: 0.5626

Epoch 5/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.1053 - acc: 0.6142 - val\_loss: 0.8545 - val\_acc: 0.6189

Epoch 6/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.0901 - acc: 0.6194 - val\_loss: 0.8251 - val\_acc: 0.6316

Epoch 7/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.0895 - acc: 0.6180 - val\_loss: 0.8078 - val\_acc: 0.6407

Epoch 8/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.0743 - acc: 0.6270 - val\_loss: 0.9139 - val\_acc: 0.5923

Epoch 9/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.0690 - acc: 0.6286 - val\_loss: 0.8166 - val\_acc: 0.6395

Epoch 10/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.0614 - acc: 0.6338 - val\_loss: 0.8363 - val\_acc: 0.6373

Epoch 11/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.0567 - acc: 0.6336 - val\_loss: 0.8270 - val\_acc: 0.6290

Epoch 12/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.0562 - acc: 0.6339 - val\_loss: 0.7782 - val\_acc: 0.6532

Epoch 13/20

44613/44613 [==============================] - 61s 1ms/step - loss: 1.0520 - acc: 0.6350 - val\_loss: 0.8013 - val\_acc: 0.6466

Epoch 14/20

44613/44613 [==============================] - 69s 2ms/step - loss: 1.0549 - acc: 0.6347 - val\_loss: 0.8127 - val\_acc: 0.6431

Epoch 15/20

44613/44613 [==============================] - 63s 1ms/step - loss: 1.0433 - acc: 0.6402 - val\_loss: 0.7794 - val\_acc: 0.6613

Epoch 16/20

44613/44613 [==============================] - 64s 1ms/step - loss: 1.0431 - acc: 0.6411 - val\_loss: 0.8361 - val\_acc: 0.6330

Epoch 17/20

44613/44613 [==============================] - 64s 1ms/step - loss: 1.0394 - acc: 0.6409 - val\_loss: 0.8409 - val\_acc: 0.6332

Epoch 18/20

44613/44613 [==============================] - 63s 1ms/step - loss: 1.0294 - acc: 0.6465 - val\_loss: 0.8623 - val\_acc: 0.6238

Epoch 19/20

44613/44613 [==============================] - 61s 1ms/step - loss: 1.0238 - acc: 0.6456 - val\_loss: 0.7975 - val\_acc: 0.6486

Epoch 20/20

44613/44613 [==============================] - 68s 2ms/step - loss: 1.0301 - acc: 0.6486 - val\_loss: 0.7933 - val\_acc: 0.6522

vocab\_size 658127 (658127, 300)

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Layer (type) Output Shape Param #

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embedding\_1 (Embedding) (None, 50, 300) 197438100

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gaussian\_noise\_1 (GaussianNo (None, 50, 300) 0

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dropout\_1 (Dropout) (None, 50, 300) 0

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conv1d\_1 (Conv1D) (None, 50, 64) 96064

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max\_pooling1d\_1 (MaxPooling1 (None, 12, 64) 0

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global\_max\_pooling1d\_1 (Glob (None, 64) 0

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dense\_1 (Dense) (None, 3) 195

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activation\_1 (Activation) (None, 3) 0

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Total params: 197,534,359

Trainable params: 96,259

Non-trainable params: 197,438,100

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 63s 1ms/step - loss: 1.3480 - acc: 0.5069 - f1: 0.4485 - val\_loss: 0.8685 - val\_acc: 0.5915 - val\_f1: 0.5379

Epoch 2/20

44613/44613 [==============================] - 58s 1ms/step - loss: 1.2037 - acc: 0.5686 - f1: 0.5231 - val\_loss: 0.8505 - val\_acc: 0.6177 - val\_f1: 0.5873

Epoch 3/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.1542 - acc: 0.5892 - f1: 0.5478 - val\_loss: 0.9839 - val\_acc: 0.5558 - val\_f1: 0.5106

Epoch 4/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.1195 - acc: 0.6116 - f1: 0.5657 - val\_loss: 0.8708 - val\_acc: 0.6121 - val\_f1: 0.5681

Epoch 5/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.1044 - acc: 0.6123 - f1: 0.5705 - val\_loss: 0.9187 - val\_acc: 0.5830 - val\_f1: 0.5444

Epoch 6/20

44613/44613 [==============================] - 56s 1ms/step - loss: 1.0935 - acc: 0.6176 - f1: 0.5800 - val\_loss: 0.8235 - val\_acc: 0.6278 - val\_f1: 0.5982

[0.5379, 0.5873, 0.5106, 0.5681, 0.5444, 0.5982, 0.5900, 0.6061, 0.5870, 0.6043, 0.5659]

Epoch 7/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.0804 - acc: 0.6233 - f1: 0.5883 - val\_loss: 0.8453 - val\_acc: 0.6254 - val\_f1: 0.5900

Epoch 8/20

44613/44613 [==============================] - 61s 1ms/step - loss: 1.0745 - acc: 0.6260 - f1: 0.5907 - val\_loss: 0.8188 - val\_acc: 0.6403 - val\_f1: 0.6061

Epoch 9/20

44613/44613 [==============================] - 63s 1ms/step - loss: 1.0696 - acc: 0.6304 - f1: 0.5935 - val\_loss: 0.8682 - val\_acc: 0.6111 - val\_f1: 0.5870

Epoch 10/20

44613/44613 [==============================] - 59s 1ms/step - loss: 1.0632 - acc: 0.6316 - f1: 0.5985 - val\_loss: 0.8195 - val\_acc: 0.6359 - val\_f1: 0.6043

Epoch 11/20

44613/44613 [==============================] - 57s 1ms/step - loss: 1.0561 - acc: 0.6369 - f1: 0.6015 - val\_loss: 0.9118 - val\_acc: 0.5943 - val\_f1: 0.5659

Epoch 12/20

44613/44613 [==============================] - 59s 1ms/step - loss: 1.0522 - acc: 0.6371 - f1: 0.6049 - val\_loss: 0.7954 - val\_acc: 0.6560 - val\_f1: 0.6235

Epoch 13/20

44613/44613 [==============================] - 71s 2ms/step - loss: 1.0489 - acc: 0.6373 - f1: 0.6053 - val\_loss: 0.8243 - val\_acc: 0.6397 - val\_f1: 0.6153

Epoch 14/20

44613/44613 [==============================] - 70s 2ms/step - loss: 1.0447 - acc: 0.6412 - f1: 0.6093 - val\_loss: 0.8202 - val\_acc: 0.6397 - val\_f1: 0.6182

Epoch 15/20

[0.5379, 0.5873, 0.5106, 0.5681, 0.5444, 0.5982, 0.5900, 0.6061, 0.5870, 0.6043, 0.5659, 0.6235, 0.6153, 0.6182, 0.6127, 0.6001, 0.6405, 0.6432, 0.6329, 0.6378]

44613/44613 [==============================] - 80s 2ms/step - loss: 1.0414 - acc: 0.6404 - f1: 0.6100 - val\_loss: 0.8209 - val\_acc: 0.6367 - val\_f1: 0.6127

Epoch 16/20

44613/44613 [==============================] - 115s 3ms/step - loss: 1.0332 - acc: 0.6456 - f1: 0.6159 - val\_loss: 0.8614 - val\_acc: 0.6234 - val\_f1: 0.6001

Epoch 17/20

44613/44613 [==============================] - 117s 3ms/step - loss: 1.0356 - acc: 0.6446 - f1: 0.6162 - val\_loss: 0.7790 - val\_acc: 0.6587 - val\_f1: 0.6405

Epoch 18/20

44613/44613 [==============================] - 117s 3ms/step - loss: 1.0300 - acc: 0.6445 - f1: 0.6169 - val\_loss: 0.7697 - val\_acc: 0.6665 - val\_f1: 0.6432

Epoch 19/20

44613/44613 [==============================] - 123s 3ms/step - loss: 1.0235 - acc: 0.6501 - f1: 0.6217 - val\_loss: 0.8018 - val\_acc: 0.6544 - val\_f1: 0.6329

Epoch 20/20

44613/44613 [==============================] - 119s 3ms/step - loss: 1.0243 - acc: 0.6468 - f1: 0.6197 - val\_loss: 0.7936 - val\_acc: 0.6597 - val\_f1: 0.6378

## 300div cov + lstmdense merge lstmlstmdense add merge

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Layer (type) Output Shape Param # Connected to

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input\_1 (InputLayer) (None, 50) 0

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embedding\_1 (Embedding) (None, 50, 300) 197438100 input\_1[0][0]

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gaussian\_noise\_1 (GaussianNoise (None, 50, 300) 0 embedding\_1[0][0]

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dropout\_1 (Dropout) (None, 50, 300) 0 gaussian\_noise\_1[0][0]

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conv1d\_1 (Conv1D) (None, 50, 300) 450300 dropout\_1[0][0]

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max\_pooling1d\_1 (MaxPooling1D) (None, 12, 300) 0 conv1d\_1[0][0]

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bidirectional\_1 (Bidirectional) (None, 12, 300) 541200 max\_pooling1d\_1[0][0]

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dropout\_2 (Dropout) (None, 12, 300) 0 bidirectional\_1[0][0]

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bidirectional\_2 (Bidirectional) (None, 12, 300) 541200 dropout\_2[0][0]

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dropout\_4 (Dropout) (None, 12, 300) 0 bidirectional\_2[0][0]

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attention\_1 (Attention) (None, 300) 312 dropout\_2[0][0]

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attention\_2 (Attention) (None, 300) 312 dropout\_4[0][0]

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dropout\_3 (Dropout) (None, 300) 0 attention\_1[0][0]

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dropout\_5 (Dropout) (None, 300) 0 attention\_2[0][0]

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merge\_1 (Merge) (None, 300) 0 dropout\_3[0][0]

dropout\_5[0][0]

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dense\_1 (Dense) (None, 3) 903 merge\_1[0][0]

==================================================================================================

Total params: 198,972,327

Trainable params: 1,534,227

Non-trainable params: 197,438,100

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None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 544s 12ms/step - loss: 1.3402 - acc: 0.4739 - f1: nan - val\_loss: 0.9299 - val\_acc: 0.5386 - val\_f1: 0.4669 - 1-train.f1\_pn: 0.5193 - 2-val.f1\_pn: 0.5235

Epoch 2/20

44613/44613 [==============================] - 536s 12ms/step - loss: 1.1744 - acc: 0.5695 - f1: 0.5151 - val\_loss: 0.7819 - val\_acc: 0.6486 - val\_f1: 0.6005 - 1-train.f1\_pn: 0.6309 - 2-val.f1\_pn: 0.6322

Epoch 3/20

44613/44613 [==============================] - 536s 12ms/step - loss: 1.1241 - acc: 0.5901 - f1: 0.5474 - val\_loss: 0.8396 - val\_acc: 0.6147 - val\_f1: 0.5705 - 1-train.f1\_pn: 0.6067 - 2-val.f1\_pn: 0.6047

Epoch 4/20

44613/44613 [==============================] - 536s 12ms/step - loss: 1.0947 - acc: 0.6033 - f1: 0.5640 - val\_loss: 0.7547 - val\_acc: 0.6639 - val\_f1: 0.6188 - 1-train.f1\_pn: 0.6568 - 2-val.f1\_pn: 0.6472

Epoch 5/20

44613/44613 [==============================] - 536s 12ms/step - loss: 1.0679 - acc: 0.6139 - f1: 0.5799 - val\_loss: 0.7469 - val\_acc: 0.6671 - val\_f1: 0.6223 - 1-train.f1\_pn: 0.6647 - 2-val.f1\_pn: 0.6494

Epoch 6/20

44613/44613 [==============================] - 535s 12ms/step - loss: 1.0525 - acc: 0.6176 - f1: 0.5873 - val\_loss: 0.7877 - val\_acc: 0.6288 - val\_f1: 0.5985 - 1-train.f1\_pn: 0.6426 - 2-val.f1\_pn: 0.6188

Epoch 7/20

44613/44613 [==============================] - 534s 12ms/step - loss: 1.0344 - acc: 0.6202 - f1: 0.5928 - val\_loss: 0.7244 - val\_acc: 0.6692 - val\_f1: 0.6502 - 1-train.f1\_pn: 0.6762 - 2-val.f1\_pn: 0.6445

Epoch 8/20

44613/44613 [==============================] - 534s 12ms/step - loss: 1.0187 - acc: 0.6291 - f1: 0.6031 - val\_loss: 0.7269 - val\_acc: 0.6677 - val\_f1: 0.6582 - 1-train.f1\_pn: 0.6756 - 2-val.f1\_pn: 0.6358

Epoch 9/20

44613/44613 [==============================] - 537s 12ms/step - loss: 1.0123 - acc: 0.6334 - f1: 0.6087 - val\_loss: 0.7310 - val\_acc: 0.6800 - val\_f1: 0.6672 - 1-train.f1\_pn: 0.6856 - 2-val.f1\_pn: 0.6463

Epoch 10/20

44613/44613 [==============================] - 535s 12ms/step - loss: 0.9981 - acc: 0.6394 - f1: 0.6148 - val\_loss: 0.7141 - val\_acc: 0.6800 - val\_f1: 0.6642 - 1-train.f1\_pn: 0.6944 - 2-val.f1\_pn: 0.6523

Epoch 11/20

44613/44613 [==============================] - 535s 12ms/step - loss: 0.9889 - acc: 0.6419 - f1: 0.6208 - val\_loss: 0.7214 - val\_acc: 0.6732 - val\_f1: 0.6620 - 1-train.f1\_pn: 0.6969 - 2-val.f1\_pn: 0.6477

Epoch 12/20

44613/44613 [==============================] - 537s 12ms/step - loss: 0.9731 - acc: 0.6491 - f1: 0.6285 - val\_loss: 0.7440 - val\_acc: 0.6708 - val\_f1: 0.6673 - 1-train.f1\_pn: 0.6820 - 2-val.f1\_pn: 0.6246

Epoch 13/20

44613/44613 [==============================] - 533s 12ms/step - loss: 0.9680 - acc: 0.6497 - f1: 0.6283 - val\_loss: 0.7286 - val\_acc: 0.6726 - val\_f1: 0.6677 - 1-train.f1\_pn: 0.7065 - 2-val.f1\_pn: 0.6437

Epoch 14/20

44613/44613 [==============================] - 537s 12ms/step - loss: 0.9602 - acc: 0.6525 - f1: 0.6330 - val\_loss: 0.7686 - val\_acc: 0.6704 - val\_f1: 0.6646 - 1-train.f1\_pn: 0.6804 - 2-val.f1\_pn: 0.6203

Epoch 15/20

44613/44613 [==============================] - 554s 12ms/step - loss: 0.9495 - acc: 0.6564 - f1: 0.6382 - val\_loss: 0.8048 - val\_acc: 0.6605 - val\_f1: 0.6541 - 1-train.f1\_pn: 0.6794 - 2-val.f1\_pn: 0.6267

Epoch 16/20

44613/44613 [==============================] - 617s 14ms/step - loss: 0.9389 - acc: 0.6606 - f1: 0.6440 - val\_loss: 0.7854 - val\_acc: 0.6585 - val\_f1: 0.6551 - 1-train.f1\_pn: 0.6761 - 2-val.f1\_pn: 0.6086

Epoch 17/20

44613/44613 [==============================] - 1007s 23ms/step - loss: 0.9279 - acc: 0.6645 - f1: 0.6474 - val\_loss: 0.7515 - val\_acc: 0.6760 - val\_f1: 0.6685 - 1-train.f1\_pn: 0.7216 - 2-val.f1\_pn: 0.6447

Epoch 18/20

44613/44613 [==============================] - 1038s 23ms/step - loss: 0.9192 - acc: 0.6665 - f1: 0.6504 - val\_loss: 0.7787 - val\_acc: 0.6649 - val\_f1: 0.6617 - 1-train.f1\_pn: 0.7032 - 2-val.f1\_pn: 0.6190

Epoch 19/20

44613/44613 [==============================] - 1034s 23ms/step - loss: 0.9164 - acc: 0.6714 - f1: 0.6561 - val\_loss: 0.8080 - val\_acc: 0.6609 - val\_f1: 0.6569 - 1-train.f1\_pn: 0.6807 - 2-val.f1\_pn: 0.5982

Epoch 20/20

44613/44613 [==============================] - 1039s 23ms/step - loss: 0.9069 - acc: 0.6718 - f1: 0.6564 - val\_loss: 0.9068 - val\_acc: 0.6613 - val\_f1: 0.6592 - 1-train.f1\_pn: 0.6625 - 2-val.f1\_pn: 0.5922

## concatenate merge

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 1063s 24ms/step - loss: 1.3178 - acc: 0.4917 - f1: nan - val\_loss: 0.8455 - val\_acc: 0.6008 - val\_f1: 0.5604 - 1-train.f1\_pn: 0.5841 - 2-val.f1\_pn: 0.5889

Epoch 2/20

44613/44613 [==============================] - 1040s 23ms/step - loss: 1.1695 - acc: 0.5710 - f1: 0.5197 - val\_loss: 0.7829 - val\_acc: 0.6486 - val\_f1: 0.5820 - 1-train.f1\_pn: 0.6260 - 2-val.f1\_pn: 0.6325

Epoch 3/20

44613/44613 [==============================] - 1031s 23ms/step - loss: 1.1276 - acc: 0.5898 - f1: 0.5480 - val\_loss: 0.7627 - val\_acc: 0.6597 - val\_f1: 0.6142 - 1-train.f1\_pn: 0.6390 - 2-val.f1\_pn: 0.6390

Epoch 4/20

44613/44613 [==============================] - 945s 21ms/step - loss: 1.0886 - acc: 0.6026 - f1: 0.5671 - val\_loss: 0.7710 - val\_acc: 0.6508 - val\_f1: 0.6055 - 1-train.f1\_pn: 0.6425 - 2-val.f1\_pn: 0.6370

Epoch 5/20

44613/44613 [==============================] - 968s 22ms/step - loss: 1.0656 - acc: 0.6145 - f1: 0.5798 - val\_loss: 0.7371 - val\_acc: 0.6742 - val\_f1: 0.6383 - 1-train.f1\_pn: 0.6639 - 2-val.f1\_pn: 0.6554

Epoch 6/20

44613/44613 [==============================] - 1194s 27ms/step - loss: 1.0457 - acc: 0.6202 - f1: 0.5922 - val\_loss: 0.7329 - val\_acc: 0.6675 - val\_f1: 0.6562 - 1-train.f1\_pn: 0.6591 - 2-val.f1\_pn: 0.6306

Epoch 7/20

44613/44613 [==============================] - 1597s 36ms/step - loss: 1.0285 - acc: 0.6216 - f1: 0.5946 - val\_loss: 0.7297 - val\_acc: 0.6827 - val\_f1: 0.6634 - 1-train.f1\_pn: 0.6725 - 2-val.f1\_pn: 0.6524

Epoch 8/20

44613/44613 [==============================] - 1029s 23ms/step - loss: 1.0114 - acc: 0.6331 - f1: 0.6092 - val\_loss: 0.7267 - val\_acc: 0.6679 - val\_f1: 0.6584 - 1-train.f1\_pn: 0.6756 - 2-val.f1\_pn: 0.6394

Epoch 9/20

44613/44613 [==============================] - 1013s 23ms/step - loss: 1.0021 - acc: 0.6343 - f1: 0.6125 - val\_loss: 0.7257 - val\_acc: 0.6796 - val\_f1: 0.6676 - 1-train.f1\_pn: 0.6871 - 2-val.f1\_pn: 0.6536

Epoch 10/20

44613/44613 [==============================] - 1031s 23ms/step - loss: 0.9918 - acc: 0.6406 - f1: 0.6172 - val\_loss: 0.7268 - val\_acc: 0.6792 - val\_f1: 0.6693 - 1-train.f1\_pn: 0.6954 - 2-val.f1\_pn: 0.6506

Epoch 11/20

44613/44613 [==============================] - 1030s 23ms/step - loss: 0.9764 - acc: 0.6479 - f1: 0.6268 - val\_loss: 0.7282 - val\_acc: 0.6776 - val\_f1: 0.6695 - 1-train.f1\_pn: 0.6941 - 2-val.f1\_pn: 0.6427

Epoch 12/20

44613/44613 [==============================] - 1028s 23ms/step - loss: 0.9712 - acc: 0.6511 - f1: 0.6301 - val\_loss: 0.7234 - val\_acc: 0.6720 - val\_f1: 0.6647 - 1-train.f1\_pn: 0.7088 - 2-val.f1\_pn: 0.6519

Epoch 13/20

44613/44613 [==============================] - 1022s 23ms/step - loss: 0.9606 - acc: 0.6549 - f1: 0.6350 - val\_loss: 0.7647 - val\_acc: 0.6683 - val\_f1: 0.6629 - 1-train.f1\_pn: 0.6794 - 2-val.f1\_pn: 0.6267

Epoch 14/20

44613/44613 [==============================] - 1022s 23ms/step - loss: 0.9481 - acc: 0.6603 - f1: 0.6417 - val\_loss: 0.7440 - val\_acc: 0.6744 - val\_f1: 0.6692 - 1-train.f1\_pn: 0.7151 - 2-val.f1\_pn: 0.6465

Epoch 15/20

44613/44613 [==============================] - 1020s 23ms/step - loss: 0.9461 - acc: 0.6599 - f1: 0.6413 - val\_loss: 0.7289 - val\_acc: 0.6742 - val\_f1: 0.6679 - 1-train.f1\_pn: 0.7118 - 2-val.f1\_pn: 0.6454

Epoch 16/20

44613/44613 [==============================] - 1018s 23ms/step - loss: 0.9285 - acc: 0.6642 - f1: 0.6471 - val\_loss: 0.7323 - val\_acc: 0.6758 - val\_f1: 0.6692 - 1-train.f1\_pn: 0.7231 - 2-val.f1\_pn: 0.6481

Epoch 17/20

44613/44613 [==============================] - 1020s 23ms/step - loss: 0.9221 - acc: 0.6649 - f1: 0.6476 - val\_loss: 0.7657 - val\_acc: 0.6629 - val\_f1: 0.6598 - 1-train.f1\_pn: 0.7084 - 2-val.f1\_pn: 0.6290

Epoch 18/20

44613/44613 [==============================] - 1019s 23ms/step - loss: 0.9136 - acc: 0.6694 - f1: 0.6532 - val\_loss: 0.7659 - val\_acc: 0.6746 - val\_f1: 0.6681 - 1-train.f1\_pn: 0.7099 - 2-val.f1\_pn: 0.6323

Epoch 19/20

44613/44613 [==============================] - 1019s 23ms/step - loss: 0.9044 - acc: 0.6734 - f1: 0.6583 - val\_loss: 0.7990 - val\_acc: 0.6696 - val\_f1: 0.6665 - 1-train.f1\_pn: 0.7089 - 2-val.f1\_pn: 0.6232

Epoch 20/20

44613/44613 [==============================] - 1020s 23ms/step - loss: 0.8909 - acc: 0.6787 - f1: 0.6643 - val\_loss: 0.8462 - val\_acc: 0.6562 - val\_f1: 0.6528 - 1-train.f1\_pn: 0.6881 - 2-val.f1\_pn: 0.6028

## conv merge lstmdense merge lstmlstmdense addmerge

None

Class weights: {'neutral': 1.0, 'positive': 1.129360547294623, 'negative': 2.8736872392461517}

Train on 44613 samples, validate on 4957 samples

Epoch 1/20

44613/44613 [==============================] - 979s 22ms/step - loss: 1.3717 - acc: 0.5154 - f1: 0.4765 - val\_loss: 1.0686 - val\_acc: 0.5104 - val\_f1: 0.4835

Epoch 2/20

44613/44613 [==============================] - 973s 22ms/step - loss: 1.1847 - acc: 0.5808 - f1: 0.5479 - val\_loss: 0.9842 - val\_acc: 0.5265 - val\_f1: 0.4849

Epoch 3/20

44613/44613 [==============================] - 1406s 32ms/step - loss: 1.1246 - acc: 0.6012 - f1: 0.5696 - val\_loss: 0.8611 - val\_acc: 0.6032 - val\_f1: 0.5698

Epoch 4/20

44613/44613 [==============================] - 861s 19ms/step - loss: 1.1007 - acc: 0.6115 - f1: 0.5815 - val\_loss: 0.8827 - val\_acc: 0.6030 - val\_f1: 0.5764

Epoch 5/20

44613/44613 [==============================] - 838s 19ms/step - loss: 1.0772 - acc: 0.6221 - f1: 0.5950 - val\_loss: 0.9301 - val\_acc: 0.5836 - val\_f1: 0.5555

Epoch 6/20

44613/44613 [==============================] - 832s 19ms/step - loss: 1.0724 - acc: 0.6213 - f1: 0.5967 - val\_loss: 0.8111 - val\_acc: 0.6365 - val\_f1: 0.6115

Epoch 7/20

44613/44613 [==============================] - 855s 19ms/step - loss: 1.0506 - acc: 0.6296 - f1: 0.6065 - val\_loss: 0.8184 - val\_acc: 0.6246 - val\_f1: 0.6065

Epoch 8/20

44613/44613 [==============================] - 846s 19ms/step - loss: 1.0452 - acc: 0.6326 - f1: 0.6096 - val\_loss: 0.7336 - val\_acc: 0.6663 - val\_f1: 0.6449

Epoch 9/20

44613/44613 [==============================] - 858s 19ms/step - loss: 1.0349 - acc: 0.6387 - f1: 0.6187 - val\_loss: 0.7560 - val\_acc: 0.6597 - val\_f1: 0.6422

Epoch 10/20

44613/44613 [==============================] - 852s 19ms/step - loss: 1.0296 - acc: 0.6382 - f1: 0.6201 - val\_loss: 0.9000 - val\_acc: 0.6078 - val\_f1: 0.5800

Epoch 11/20

44613/44613 [==============================] - 840s 19ms/step - loss: 1.0072 - acc: 0.6500 - f1: 0.6312 - val\_loss: 0.9256 - val\_acc: 0.5967 - val\_f1: 0.5781

Epoch 12/20

44613/44613 [==============================] - 838s 19ms/step - loss: 1.0108 - acc: 0.6517 - f1: 0.6339 - val\_loss: 0.8289 - val\_acc: 0.6377 - val\_f1: 0.6185

Epoch 13/20

44613/44613 [==============================] - 837s 19ms/step - loss: 0.9840 - acc: 0.6541 - f1: 0.6392 - val\_loss: 0.8613 - val\_acc: 0.6177 - val\_f1: 0.5992

Epoch 14/20

44613/44613 [==============================] - 838s 19ms/step - loss: 0.9902 - acc: 0.6560 - f1: 0.6409 - val\_loss: 0.7685 - val\_acc: 0.6603 - val\_f1: 0.6361

Epoch 15/20

44613/44613 [==============================] - 851s 19ms/step - loss: 0.9817 - acc: 0.6590 - f1: 0.6428 - val\_loss: 0.8182 - val\_acc: 0.6411 - val\_f1: 0.6279

Epoch 16/20

44613/44613 [==============================] - 845s 19ms/step - loss: 0.9747 - acc: 0.6611 - f1: 0.6491 - val\_loss: 0.8035 - val\_acc: 0.6490 - val\_f1: 0.6356

Epoch 17/20

44613/44613 [==============================] - 837s 19ms/step - loss: 0.9702 - acc: 0.6665 - f1: 0.6532 - val\_loss: 0.7633 - val\_acc: 0.6645 - val\_f1: 0.6545

Epoch 18/20

44613/44613 [==============================] - 837s 19ms/step - loss: 0.9685 - acc: 0.6667 - f1: 0.6535 - val\_loss: 0.7713 - val\_acc: 0.6623 - val\_f1: 0.6521

Epoch 19/20

44613/44613 [==============================] - 788s 18ms/step - loss: 0.9630 - acc: 0.6677 - f1: 0.6540 - val\_loss: 0.8340 - val\_acc: 0.6359 - val\_f1: 0.6244

Epoch 20/20

44613/44613 [==============================] - 446s 10ms/step - loss: 0.9443 - acc: 0.6736 - f1: 0.6605 - val\_loss: 0.7958 - val\_acc: 0.6528 - val\_f1: 0.6429

## lstm

Epoch 1/20

44613/44613 [==============================] - 375s 8ms/step - loss: 1.2884 - acc: 0.5083 - f1: nan - val\_loss: 0.7907 - val\_acc: 0.6391 - val\_f1: 0.5936

Epoch 2/20

44613/44613 [==============================] - 364s 8ms/step - loss: 1.1672 - acc: 0.5735 - f1: 0.5193 - val\_loss: 0.7973 - val\_acc: 0.6191 - val\_f1: 0.5850

Epoch 3/20

44613/44613 [==============================] - 359s 8ms/step - loss: 1.1300 - acc: 0.5849 - f1: 0.5434 - val\_loss: 0.7406 - val\_acc: 0.6659 - val\_f1: 0.6417

Epoch 4/20

44613/44613 [==============================] - 358s 8ms/step - loss: 1.1123 - acc: 0.5971 - f1: 0.5552 - val\_loss: 0.7682 - val\_acc: 0.6482 - val\_f1: 0.6214

Epoch 5/20

44613/44613 [==============================] - 368s 8ms/step - loss: 1.0919 - acc: 0.6046 - f1: 0.5653 - val\_loss: 0.7843 - val\_acc: 0.6312 - val\_f1: 0.6005

Epoch 6/20

44613/44613 [==============================] - 423s 9ms/step - loss: 1.0833 - acc: 0.6059 - f1: 0.5663 - val\_loss: 0.7737 - val\_acc: 0.6383 - val\_f1: 0.6176

Epoch 7/20

44613/44613 [==============================] - 374s 8ms/step - loss: 1.0752 - acc: 0.6086 - f1: 0.5724 - val\_loss: 0.7433 - val\_acc: 0.6631 - val\_f1: 0.6355

Epoch 8/20

44613/44613 [==============================] - 362s 8ms/step - loss: 1.0566 - acc: 0.6166 - f1: 0.5843 - val\_loss: 0.7356 - val\_acc: 0.6657 - val\_f1: 0.6410

Epoch 9/20

44613/44613 [==============================] - 361s 8ms/step - loss: 1.0551 - acc: 0.6153 - f1: 0.5831 - val\_loss: 0.7705 - val\_acc: 0.6371 - val\_f1: 0.6123

Epoch 10/20

44613/44613 [==============================] - 361s 8ms/step - loss: 1.0492 - acc: 0.6187 - f1: 0.5858 - val\_loss: 0.7494 - val\_acc: 0.6530 - val\_f1: 0.6358

Epoch 11/20

44613/44613 [==============================] - 361s 8ms/step - loss: 1.0412 - acc: 0.6218 - f1: 0.5893 - val\_loss: 0.7188 - val\_acc: 0.6766 - val\_f1: 0.6523

Epoch 12/20

44613/44613 [==============================] - 361s 8ms/step - loss: 1.0330 - acc: 0.6236 - f1: 0.5941 - val\_loss: 0.7347 - val\_acc: 0.6643 - val\_f1: 0.6437

Epoch 13/20

44613/44613 [==============================] - 231s 5ms/step - loss: 1.0337 - acc: 0.6230 - f1: 0.5927 - val\_loss: 0.7425 - val\_acc: 0.6579 - val\_f1: 0.6394

Epoch 14/20

[0.5936, 0.5850, 0.6417, 0.6214, 0.6005, 0.6176, 0.6355, 0.6410, 0.6123, 0.6358, 0.6523, 0.6437, 0.6394, 0.6410, 0.6627, 0.6546, 0.6360, 0.6582, 0.6532, 0.6485]

44613/44613 [==============================] - 2025s 45ms/step - loss: 1.0223 - acc: 0.6299 - f1: 0.6038 - val\_loss: 0.7495 - val\_acc: 0.6581 - val\_f1: 0.6410

Epoch 15/20

44613/44613 [==============================] - 197s 4ms/step - loss: 1.0202 - acc: 0.6305 - f1: 0.6029 - val\_loss: 0.7127 - val\_acc: 0.6821 - val\_f1: 0.6627

Epoch 16/20

44613/44613 [==============================] - 198s 4ms/step - loss: 1.0161 - acc: 0.6303 - f1: 0.6028 - val\_loss: 0.7228 - val\_acc: 0.6748 - val\_f1: 0.6546

Epoch 17/20

44613/44613 [==============================] - 199s 4ms/step - loss: 1.0106 - acc: 0.6343 - f1: 0.6070 - val\_loss: 0.7224 - val\_acc: 0.6661 - val\_f1: 0.6360

Epoch 18/20

44613/44613 [==============================] - 197s 4ms/step - loss: 1.0079 - acc: 0.6339 - f1: 0.6058 - val\_loss: 0.7249 - val\_acc: 0.6800 - val\_f1: 0.6582

Epoch 19/20

44613/44613 [==============================] - 197s 4ms/step - loss: 1.0032 - acc: 0.6359 - f1: 0.6103 - val\_loss: 0.7240 - val\_acc: 0.6796 - val\_f1: 0.6532

Epoch 20/20

44613/44613 [==============================] - 197s 4ms/step - loss: 1.0023 - acc: 0.6365 - f1: 0.6103 - val\_loss: 0.7434 - val\_acc: 0.6663 - val\_f1: 0.6485

## bilstm

[0.6334, 0.6313, 0.6288, 0.6228, 0.6258, 0.6500, 0.6424, 0.6624]

Epoch 1/20

44613/44613 [==============================] - 686s 15ms/step - loss: 1.2612 - acc: 0.5218 - f1: 0.4364 - val\_loss: 0.7676 - val\_acc: 0.6603 - val\_f1: 0.6334

Epoch 2/20

44613/44613 [==============================] - 668s 15ms/step - loss: 1.1511 - acc: 0.5793 - f1: 0.5298 - val\_loss: 0.7557 - val\_acc: 0.6514 - val\_f1: 0.6313

Epoch 3/20

44613/44613 [==============================] - 666s 15ms/step - loss: 1.1115 - acc: 0.5959 - f1: 0.5559 - val\_loss: 0.7534 - val\_acc: 0.6538 - val\_f1: 0.6288

Epoch 4/20

44613/44613 [==============================] - 666s 15ms/step - loss: 1.0876 - acc: 0.6061 - f1: 0.5691 - val\_loss: 0.7581 - val\_acc: 0.6462 - val\_f1: 0.6228

Epoch 5/20

44613/44613 [==============================] - 683s 15ms/step - loss: 1.0703 - acc: 0.6116 - f1: 0.5784 - val\_loss: 0.7473 - val\_acc: 0.6494 - val\_f1: 0.6258

Epoch 6/20

44613/44613 [==============================] - 666s 15ms/step - loss: 1.0547 - acc: 0.6143 - f1: 0.5833 - val\_loss: 0.7315 - val\_acc: 0.6698 - val\_f1: 0.6500

Epoch 7/20

44613/44613 [==============================] - 664s 15ms/step - loss: 1.0439 - acc: 0.6203 - f1: 0.5903 - val\_loss: 0.7362 - val\_acc: 0.6607 - val\_f1: 0.6424

Epoch 8/20

44613/44613 [==============================] - 661s 15ms/step - loss: 1.0391 - acc: 0.6248 - f1: 0.5941 - val\_loss: 0.7117 - val\_acc: 0.6825 - val\_f1: 0.6624

Epoch 9/20

44613/44613 [==============================] - 662s 15ms/step - loss: 1.0342 - acc: 0.6258 - f1: 0.5958 - val\_loss: 0.7222 - val\_acc: 0.6673 - val\_f1: 0.6389

Epoch 10/20

44613/44613 [==============================] - 661s 15ms/step - loss: 1.0243 - acc: 0.6281 - f1: 0.5986 - val\_loss: 0.7328 - val\_acc: 0.6663 - val\_f1: 0.6527

Epoch 11/20

44613/44613 [==============================] - 665s 15ms/step - loss: 1.0153 - acc: 0.6312 - f1: 0.6063 - val\_loss: 0.7179 - val\_acc: 0.6730 - val\_f1: 0.6630

Epoch 12/20

44613/44613 [==============================] - 669s 15ms/step - loss: 1.0070 - acc: 0.6354 - f1: 0.6097 - val\_loss: 0.7115 - val\_acc: 0.6798 - val\_f1: 0.6667

Epoch 13/20

44613/44613 [==============================] - 669s 15ms/step - loss: 0.9982 - acc: 0.6380 - f1: 0.6118 - val\_loss: 0.7219 - val\_acc: 0.6696 - val\_f1: 0.6519

Epoch 14/20

44613/44613 [==============================] - 665s 15ms/step - loss: 0.9938 - acc: 0.6411 - f1: 0.6162 - val\_loss: 0.7235 - val\_acc: 0.6685 - val\_f1: 0.6546

Epoch 15/20

44613/44613 [==============================] - 675s 15ms/step - loss: 0.9892 - acc: 0.6419 - f1: 0.6176 - val\_loss: 0.7390 - val\_acc: 0.6661 - val\_f1: 0.6541

Epoch 16/20

44613/44613 [==============================] - 667s 15ms/step - loss: 0.9876 - acc: 0.6456 - f1: 0.6218 - val\_loss: 0.7158 - val\_acc: 0.6762 - val\_f1: 0.6616

Epoch 17/20

[0.6334, 0.6313, 0.6288, 0.6228, 0.6258, 0.6500, 0.6424, 0.6624, 0.6389, 0.6527, 0.6630, 0.6667, 0.6519, 0.6546, 0.6541, 0.6616, 0.6614, 0.6623, 0.6741, 0.6645]

44613/44613 [==============================] - 668s 15ms/step - loss: 0.9776 - acc: 0.6466 - f1: 0.6221 - val\_loss: 0.7272 - val\_acc: 0.6748 - val\_f1: 0.6614

Epoch 18/20

44613/44613 [==============================] - 665s 15ms/step - loss: 0.9760 - acc: 0.6468 - f1: 0.6252 - val\_loss: 0.7144 - val\_acc: 0.6790 - val\_f1: 0.6623

Epoch 19/20

44613/44613 [==============================] - 669s 15ms/step - loss: 0.9694 - acc: 0.6494 - f1: 0.6286 - val\_loss: 0.6933 - val\_acc: 0.6879 - val\_f1: 0.6741

Epoch 20/20

44613/44613 [==============================] - 670s 15ms/step - loss: 0.9664 - acc: 0.6503 - f1: 0.6293 - val\_loss: 0.7116 - val\_acc: 0.6788 - val\_f1: 0.6645

## origin

Epoch 1/20

44613/44613 [==============================] - 1736s 39ms/step - loss: 1.2521 - acc: 0.5246 - f1: nan - val\_loss: 0.7797 - val\_acc: 0.6395 - val\_f1: 0.5913

Epoch 2/20

44613/44613 [==============================] - 1693s 38ms/step - loss: 1.1206 - acc: 0.5885 - f1: 0.5406 - val\_loss: 0.7287 - val\_acc: 0.6712 - val\_f1: 0.6446

Epoch 3/20

44613/44613 [==============================] - 1694s 38ms/step - loss: 1.0879 - acc: 0.6022 - f1: 0.5617 - val\_loss: 0.7276 - val\_acc: 0.6669 - val\_f1: 0.6368

Epoch 4/20

44613/44613 [==============================] - 1722s 39ms/step - loss: 1.0639 - acc: 0.6086 - f1: 0.5731 - val\_loss: 0.7183 - val\_acc: 0.6712 - val\_f1: 0.6543

Epoch 5/20

44613/44613 [==============================] - 1700s 38ms/step - loss: 1.0495 - acc: 0.6135 - f1: 0.5812 - val\_loss: 0.7048 - val\_acc: 0.6893 - val\_f1: 0.6616

Epoch 6/20

44613/44613 [==============================] - 1703s 38ms/step - loss: 1.0256 - acc: 0.6242 - f1: 0.5937 - val\_loss: 0.7165 - val\_acc: 0.6724 - val\_f1: 0.6555

Epoch 7/20

44613/44613 [==============================] - 1697s 38ms/step - loss: 1.0161 - acc: 0.6275 - f1: 0.5972 - val\_loss: 0.7032 - val\_acc: 0.6807 - val\_f1: 0.6669

Epoch 8/20

44613/44613 [==============================] - 1526s 34ms/step - loss: 1.0016 - acc: 0.6326 - f1: 0.6052 - val\_loss: 0.7235 - val\_acc: 0.6659 - val\_f1: 0.6463

Epoch 9/20

44613/44613 [==============================] - 882s 20ms/step - loss: 0.9926 - acc: 0.6334 - f1: 0.6071 - val\_loss: 0.7211 - val\_acc: 0.6722 - val\_f1: 0.6586

Epoch 10/20

[0.5913, 0.6446, 0.6368, 0.6543, 0.6616, 0.6555, 0.6669, 0.6463, 0.6586, 0.6701, 0.6670, 0.6637, 0.6887, 0.6834, 0.6738, 0.6892, 0.6718, 0.6744]

44613/44613 [==============================] - 869s 19ms/step - loss: 0.9870 - acc: 0.6367 - f1: 0.6102 - val\_loss: 0.7002 - val\_acc: 0.6869 - val\_f1: 0.6701

Epoch 11/20

44613/44613 [==============================] - 865s 19ms/step - loss: 0.9782 - acc: 0.6426 - f1: 0.6172 - val\_loss: 0.7046 - val\_acc: 0.6881 - val\_f1: 0.6670

Epoch 12/20

44613/44613 [==============================] - 865s 19ms/step - loss: 0.9687 - acc: 0.6487 - f1: 0.6220 - val\_loss: 0.7196 - val\_acc: 0.6784 - val\_f1: 0.6637

Epoch 13/20

44613/44613 [==============================] - 865s 19ms/step - loss: 0.9608 - acc: 0.6493 - f1: 0.6274 - val\_loss: 0.6844 - val\_acc: 0.6996 - val\_f1: 0.6887

Epoch 14/20

44613/44613 [==============================] - 863s 19ms/step - loss: 0.9541 - acc: 0.6540 - f1: 0.6314 - val\_loss: 0.6751 - val\_acc: 0.6990 - val\_f1: 0.6834

Epoch 15/20

44613/44613 [==============================] - 867s 19ms/step - loss: 0.9519 - acc: 0.6515 - f1: 0.6284 - val\_loss: 0.6957 - val\_acc: 0.6889 - val\_f1: 0.6738

Epoch 16/20

44613/44613 [==============================] - 867s 19ms/step - loss: 0.9518 - acc: 0.6557 - f1: 0.6315 - val\_loss: 0.6829 - val\_acc: 0.6956 - val\_f1: 0.6892

Epoch 17/20

44613/44613 [==============================] - 866s 19ms/step - loss: 0.9387 - acc: 0.6569 - f1: 0.6372 - val\_loss: 0.6954 - val\_acc: 0.6839 - val\_f1: 0.6718

Epoch 18/20

44613/44613 [==============================] - 866s 19ms/step - loss: 0.9351 - acc: 0.6583 - f1: 0.6358 - val\_loss: 0.6961 - val\_acc: 0.6891 - val\_f1: 0.6744

Epoch 19/20

44613/44613 [==============================] - 867s 19ms/step - loss: 0.9222 - acc: 0.6622 - f1: 0.6406 - val\_loss: 0.7068 - val\_acc: 0.6788 - val\_f1: 0.6688

Epoch 20/20

44613/44613 [==============================] - 869s 19ms/step - loss: 0.9268 - acc: 0.6623 - f1: 0.6397 - val\_loss: 0.6971 - val\_acc: 0.6849 - val\_f1: 0.6771

[0.5913, 0.6446, 0.6368, 0.6543, 0.6616, 0.6555, 0.6669, 0.6463, 0.6586, 0.6701, 0.6670, 0.6637, 0.6887, 0.6834, 0.6738, 0.6892, 0.6718, 0.6744, 0.6688, 0.6771]

## con origin

## concatenate all

cov+lstm+cont+conv+lstm+cont+lstm

conv +lstm + concent +conv

## origin merge

Epoch 1/20

44613/44613 [==============================] - 911s 20ms/step - loss: 1.2392 - acc: 0.5346 - f1: nan - val\_loss: 0.8191 - val\_acc: 0.6141 - val\_f1: 0.5697

Epoch 2/20

44613/44613 [==============================] - 1029s 23ms/step - loss: 1.1148 - acc: 0.5964 - f1: 0.5515 - val\_loss: 0.7456 - val\_acc: 0.6655 - val\_f1: 0.6288

Epoch 3/20

44613/44613 [==============================] - 961s 22ms/step - loss: 1.0799 - acc: 0.6076 - f1: 0.5688 - val\_loss: 0.7139 - val\_acc: 0.6734 - val\_f1: 0.6549

Epoch 4/20

44613/44613 [==============================] - 938s 21ms/step - loss: 1.0574 - acc: 0.6152 - f1: 0.5806 - val\_loss: 0.7403 - val\_acc: 0.6655 - val\_f1: 0.6428

Epoch 5/20

44613/44613 [==============================] - 1046s 23ms/step - loss: 1.0461 - acc: 0.6203 - f1: 0.5875 - val\_loss: 0.7070 - val\_acc: 0.6770 - val\_f1: 0.6565

Epoch 6/20

44613/44613 [==============================] - 918s 21ms/step - loss: 1.0294 - acc: 0.6239 - f1: 0.5947 - val\_loss: 0.7136 - val\_acc: 0.6740 - val\_f1: 0.6569

Epoch 7/20

44613/44613 [==============================] - 1008s 23ms/step - loss: 1.0146 - acc: 0.6276 - f1: 0.6006 - val\_loss: 0.7113 - val\_acc: 0.6746 - val\_f1: 0.6550

Epoch 8/20

44613/44613 [==============================] - 1085s 24ms/step - loss: 1.0055 - acc: 0.6360 - f1: 0.6077 - val\_loss: 0.7339 - val\_acc: 0.6581 - val\_f1: 0.6431

Epoch 9/20

44613/44613 [==============================] - 979s 22ms/step - loss: 0.9951 - acc: 0.6369 - f1: 0.6114 - val\_loss: 0.7162 - val\_acc: 0.6663 - val\_f1: 0.6560

[0.5697, 0.6288, 0.6549, 0.6428, 0.6565, 0.6569, 0.6550, 0.6431, 0.6560]

Epoch 10/20

44613/44613 [==============================] - 944s 21ms/step - loss: 0.9857 - acc: 0.6406 - f1: 0.6172 - val\_loss: 0.7211 - val\_acc: 0.6750 - val\_f1: 0.6603

Epoch 11/20

44613/44613 [==============================] - 917s 21ms/step - loss: 0.9747 - acc: 0.6433 - f1: 0.6196 - val\_loss: 0.6980 - val\_acc: 0.6798 - val\_f1: 0.6682

Epoch 12/20

44613/44613 [==============================] - 915s 21ms/step - loss: 0.9686 - acc: 0.6476 - f1: 0.6263 - val\_loss: 0.7131 - val\_acc: 0.6768 - val\_f1: 0.6647

Epoch 13/20

44613/44613 [==============================] - 907s 20ms/step - loss: 0.9675 - acc: 0.6498 - f1: 0.6258 - val\_loss: 0.6930 - val\_acc: 0.6869 - val\_f1: 0.6740

Epoch 14/20

44613/44613 [==============================] - 942s 21ms/step - loss: 0.9594 - acc: 0.6510 - f1: 0.6309 - val\_loss: 0.6885 - val\_acc: 0.6871 - val\_f1: 0.6731

Epoch 15/20

44613/44613 [==============================] - 925s 21ms/step - loss: 0.9552 - acc: 0.6522 - f1: 0.6296 - val\_loss: 0.7039 - val\_acc: 0.6782 - val\_f1: 0.6676

Epoch 16/20

[0.5697, 0.6288, 0.6549, 0.6428, 0.6565, 0.6569, 0.6550, 0.6431, 0.6560, 0.6603, 0.6682, 0.6647, 0.6740, 0.6731, 0.6676, 0.6758, 0.6703, 0.6795, 0.6916, 0.6692]

44613/44613 [==============================] - 956s 21ms/step - loss: 0.9497 - acc: 0.6513 - f1: 0.6316 - val\_loss: 0.6869 - val\_acc: 0.6920 - val\_f1: 0.6758

Epoch 17/20

44613/44613 [==============================] - 886s 20ms/step - loss: 0.9475 - acc: 0.6587 - f1: 0.6368 - val\_loss: 0.7092 - val\_acc: 0.6849 - val\_f1: 0.6703

Epoch 18/20

44613/44613 [==============================] - 883s 20ms/step - loss: 0.9370 - acc: 0.6606 - f1: 0.6394 - val\_loss: 0.6900 - val\_acc: 0.6891 - val\_f1: 0.6795

Epoch 19/20

44613/44613 [==============================] - 883s 20ms/step - loss: 0.9318 - acc: 0.6619 - f1: 0.6427 - val\_loss: 0.6686 - val\_acc: 0.7039 - val\_f1: 0.6916

Epoch 20/20

44613/44613 [==============================] - 885s 20ms/step - loss: 0.9285 - acc: 0.6629 - f1: 0.6441 - val\_loss: 0.7217 - val\_acc: 0.6790 - val\_f1: 0.6692

## three lstm

Epoch 1/20

44613/44613 [==============================] - 2062s 46ms/step - loss: 1.2820 - acc: 0.5081 - f1: nan - val\_loss: 0.7814 - val\_acc: 0.6377 - val\_f1: 0.5997

Epoch 2/20

44613/44613 [==============================] - 2194s 49ms/step - loss: 1.1562 - acc: 0.5772 - f1: 0.5267 - val\_loss: 0.7723 - val\_acc: 0.6498 - val\_f1: 0.6177

Epoch 3/20

44613/44613 [==============================] - 2215s 50ms/step - loss: 1.1070 - acc: 0.5957 - f1: 0.5560 - val\_loss: 0.7406 - val\_acc: 0.6688 - val\_f1: 0.6321

Epoch 4/20

44613/44613 [==============================] - 2180s 49ms/step - loss: 1.0831 - acc: 0.6079 - f1: 0.5674 - val\_loss: 0.7371 - val\_acc: 0.6635 - val\_f1: 0.6297

Epoch 5/20

44613/44613 [==============================] - 2339s 52ms/step - loss: 1.0600 - acc: 0.6105 - f1: 0.5727 - val\_loss: 0.7120 - val\_acc: 0.6730 - val\_f1: 0.6491

Epoch 6/20

44613/44613 [==============================] - 1684s 38ms/step - loss: 1.0398 - acc: 0.6195 - f1: 0.5869 - val\_loss: 0.7153 - val\_acc: 0.6732 - val\_f1: 0.6497

Epoch 7/20

44613/44613 [==============================] - 1355s 30ms/step - loss: 1.0257 - acc: 0.6275 - f1: 0.5961 - val\_loss: 0.7538 - val\_acc: 0.6512 - val\_f1: 0.6283

Epoch 8/20

[0.5997, 0.6177, 0.6321, 0.6297, 0.6491, 0.6497, 0.6283, 0.6691, 0.6670, 0.6518, 0.6551, 0.6709, 0.6686, 0.6668, 0.6736]

44613/44613 [==============================] - 1337s 30ms/step - loss: 1.0196 - acc: 0.6281 - f1: 0.5961 - val\_loss: 0.7119 - val\_acc: 0.6774 - val\_f1: 0.6691

Epoch 9/20

44613/44613 [==============================] - 1296s 29ms/step - loss: 1.0032 - acc: 0.6317 - f1: 0.6056 - val\_loss: 0.6924 - val\_acc: 0.6813 - val\_f1: 0.6670

Epoch 10/20

44613/44613 [==============================] - 1315s 29ms/step - loss: 0.9946 - acc: 0.6350 - f1: 0.6089 - val\_loss: 0.7150 - val\_acc: 0.6748 - val\_f1: 0.6518

Epoch 11/20

44613/44613 [==============================] - 1295s 29ms/step - loss: 0.9856 - acc: 0.6423 - f1: 0.6155 - val\_loss: 0.7114 - val\_acc: 0.6730 - val\_f1: 0.6551

Epoch 12/20

44613/44613 [==============================] - 1356s 30ms/step - loss: 0.9690 - acc: 0.6486 - f1: 0.6217 - val\_loss: 0.6948 - val\_acc: 0.6861 - val\_f1: 0.6709

Epoch 13/20

44613/44613 [==============================] - 1288s 29ms/step - loss: 0.9652 - acc: 0.6469 - f1: 0.6227 - val\_loss: 0.7000 - val\_acc: 0.6800 - val\_f1: 0.6686

Epoch 14/20

44613/44613 [==============================] - 1449s 32ms/step - loss: 0.9533 - acc: 0.6530 - f1: 0.6296 - val\_loss: 0.6997 - val\_acc: 0.6825 - val\_f1: 0.6668

Epoch 15/20

44613/44613 [==============================] - 1522s 34ms/step - loss: 0.9528 - acc: 0.6528 - f1: 0.6293 - val\_loss: 0.6899 - val\_acc: 0.6873 - val\_f1: 0.6736

Epoch 16/20

44613/44613 [==============================] - 1375s 31ms/step - loss: 0.9399 - acc: 0.6556 - f1: 0.6334 - val\_loss: 0.7353 - val\_acc: 0.6764 - val\_f1: 0.6615

Epoch 17/20

44613/44613 [==============================] - 1370s 31ms/step - loss: 0.9449 - acc: 0.6571 - f1: 0.6339 - val\_loss: 0.6969 - val\_acc: 0.6849 - val\_f1: 0.6725

Epoch 18/20

[0.5997, 0.6177, 0.6321, 0.6297, 0.6491, 0.6497, 0.6283, 0.6691, 0.6670, 0.6518, 0.6551, 0.6709, 0.6686, 0.6668, 0.6736, 0.6615, 0.6725, 0.6834, 0.6662, 0.6731]

44613/44613 [==============================] - 1344s 30ms/step - loss: 0.9327 - acc: 0.6598 - f1: 0.6384 - val\_loss: 0.6844 - val\_acc: 0.6954 - val\_f1: 0.6834

Epoch 19/20

44613/44613 [==============================] - 1265s 28ms/step - loss: 0.9308 - acc: 0.6609 - f1: 0.6392 - val\_loss: 0.7037 - val\_acc: 0.6792 - val\_f1: 0.6662

Epoch 20/20

44613/44613 [==============================] - 1219s 27ms/step - loss: 0.9263 - acc: 0.6612 - f1: 0.6401 - val\_loss: 0.6992 - val\_acc: 0.6855 - val\_f1: 0.6731

## one lstm

Epoch 1/20

44613/44613 [==============================] - 572s 13ms/step - loss: 1.2670 - acc: 0.5217 - f1: nan - val\_loss: 0.8592 - val\_acc: 0.5949 - val\_f1: 0.5370

Epoch 2/20

44613/44613 [==============================] - 727s 16ms/step - loss: 1.1389 - acc: 0.5848 - f1: 0.5278 - val\_loss: 0.7730 - val\_acc: 0.6391 - val\_f1: 0.6084

Epoch 3/20

44613/44613 [==============================] - 713s 16ms/step - loss: 1.1015 - acc: 0.6021 - f1: 0.5564 - val\_loss: 0.7600 - val\_acc: 0.6524 - val\_f1: 0.6192

Epoch 4/20

44613/44613 [==============================] - 717s 16ms/step - loss: 1.0767 - acc: 0.6093 - f1: 0.5665 - val\_loss: 0.7854 - val\_acc: 0.6332 - val\_f1: 0.6021

Epoch 5/20

44613/44613 [==============================] - 714s 16ms/step - loss: 1.0636 - acc: 0.6124 - f1: 0.5749 - val\_loss: 0.7263 - val\_acc: 0.6786 - val\_f1: 0.6429

Epoch 6/20

44613/44613 [==============================] - 715s 16ms/step - loss: 1.0536 - acc: 0.6210 - f1: 0.5832 - val\_loss: 0.7571 - val\_acc: 0.6480 - val\_f1: 0.6229

Epoch 7/20

44613/44613 [==============================] - 712s 16ms/step - loss: 1.0441 - acc: 0.6209 - f1: 0.5866 - val\_loss: 0.7280 - val\_acc: 0.6752 - val\_f1: 0.6573

Epoch 8/20

44613/44613 [==============================] - 713s 16ms/step - loss: 1.0363 - acc: 0.6225 - f1: 0.5910 - val\_loss: 0.7285 - val\_acc: 0.6716 - val\_f1: 0.6505

Epoch 9/20

[0.5370, 0.6084, 0.6192, 0.6021, 0.6429, 0.6229, 0.6573, 0.6505, 0.6463, 0.6571, 0.6484, 0.6537, 0.6607, 0.6459, 0.6698, 0.]

44613/44613 [==============================] - 726s 16ms/step - loss: 1.0237 - acc: 0.6277 - f1: 0.5965 - val\_loss: 0.7308 - val\_acc: 0.6671 - val\_f1: 0.6463

Epoch 10/20

44613/44613 [==============================] - 737s 17ms/step - loss: 1.0132 - acc: 0.6306 - f1: 0.6019 - val\_loss: 0.7347 - val\_acc: 0.6726 - val\_f1: 0.6571

Epoch 11/20

44613/44613 [==============================] - 738s 17ms/step - loss: 1.0097 - acc: 0.6338 - f1: 0.6064 - val\_loss: 0.7435 - val\_acc: 0.6673 - val\_f1: 0.6484

Epoch 12/20

44613/44613 [==============================] - 736s 16ms/step - loss: 1.0000 - acc: 0.6386 - f1: 0.6101 - val\_loss: 0.7432 - val\_acc: 0.6671 - val\_f1: 0.6537

Epoch 13/20

44613/44613 [==============================] - 743s 17ms/step - loss: 0.9914 - acc: 0.6439 - f1: 0.6144 - val\_loss: 0.7265 - val\_acc: 0.6752 - val\_f1: 0.6607

Epoch 14/20

44613/44613 [==============================] - 735s 16ms/step - loss: 0.9937 - acc: 0.6425 - f1: 0.6164 - val\_loss: 0.7336 - val\_acc: 0.6655 - val\_f1: 0.6459

Epoch 15/20

44613/44613 [==============================] - 742s 17ms/step - loss: 0.9811 - acc: 0.6453 - f1: 0.6194 - val\_loss: 0.7201 - val\_acc: 0.6845 - val\_f1: 0.6698

Epoch 16/20

44613/44613 [==============================] - 734s 16ms/step - loss: 0.9774 - acc: 0.6478 - f1: 0.6233 - val\_loss: 0.7671 - val\_acc: 0.6568 - val\_f1: 0.6415

Epoch 17/20

44613/44613 [==============================] - 736s 17ms/step - loss: 0.9731 - acc: 0.6466 - f1: 0.6234 - val\_loss: 0.7327 - val\_acc: 0.6784 - val\_f1: 0.6640

Epoch 18/20

44613/44613 [==============================] - 737s 17ms/step - loss: 0.9692 - acc: 0.6495 - f1: 0.6244 - val\_loss: 0.7133 - val\_acc: 0.6817 - val\_f1: 0.6703

Epoch 19/20

[0.5370, 0.6084, 0.6192, 0.6021, 0.6429, 0.6229, 0.6573, 0.6505, 0.6463, 0.6571, 0.6484, 0.6537, 0.6607, 0.6459, 0.6698, 0.6415, 0.6640, 0.6703, 0.6660, 0.6694]

44613/44613 [==============================] - 739s 17ms/step - loss: 0.9637 - acc: 0.6515 - f1: 0.6279 - val\_loss: 0.7271 - val\_acc: 0.6786 - val\_f1: 0.6660

Epoch 20/20

44613/44613 [==============================] - 736s 16ms/step - loss: 0.9616 - acc: 0.6540 - f1: 0.6303 - val\_loss: 0.7338 - val\_acc: 0.6827 - val\_f1: 0.6694

## conv +one lstm

Epoch 1/20

44613/44613 [==============================] - 622s 14ms/step - loss: 1.3286 - acc: 0.4832 - f1: nan - val\_loss: 0.8485 - val\_acc: 0.6052 - val\_f1: 0.5255

Epoch 2/20

44613/44613 [==============================] - 559s 13ms/step - loss: 1.1836 - acc: 0.5647 - f1: 0.5037 - val\_loss: 0.7961 - val\_acc: 0.6318 - val\_f1: 0.5781

Epoch 3/20

44613/44613 [==============================] - 543s 12ms/step - loss: 1.1323 - acc: 0.5877 - f1: 0.5417 - val\_loss: 0.7903 - val\_acc: 0.6391 - val\_f1: 0.5832

Epoch 4/20

44613/44613 [==============================] - 545s 12ms/step - loss: 1.0999 - acc: 0.5987 - f1: 0.5601 - val\_loss: 0.7540 - val\_acc: 0.6625 - val\_f1: 0.6177

Epoch 5/20

44613/44613 [==============================] - 543s 12ms/step - loss: 1.0758 - acc: 0.6111 - f1: 0.5754 - val\_loss: 0.7490 - val\_acc: 0.6663 - val\_f1: 0.6278

Epoch 6/20

44613/44613 [==============================] - 543s 12ms/step - loss: 1.0587 - acc: 0.6157 - f1: 0.5829 - val\_loss: 0.7936 - val\_acc: 0.6201 - val\_f1: 0.5871

Epoch 7/20

44613/44613 [==============================] - 537s 12ms/step - loss: 1.0450 - acc: 0.6221 - f1: 0.5898 - val\_loss: 0.7663 - val\_acc: 0.6454 - val\_f1: 0.6175

Epoch 8/20

[0.5255, 0.5781, 0.5832, 0.6177, 0.6278, 0.5871, 0.6175, 0.6269, 0.6584, 0.6414, 0.6511, 0.6615, 0.6513, 0.6249, ]

44613/44613 [==============================] - 575s 13ms/step - loss: 1.0276 - acc: 0.6284 - f1: 0.6004 - val\_loss: 0.7490 - val\_acc: 0.6520 - val\_f1: 0.6269

Epoch 9/20

44613/44613 [==============================] - 545s 12ms/step - loss: 1.0123 - acc: 0.6336 - f1: 0.6084 - val\_loss: 0.7337 - val\_acc: 0.6716 - val\_f1: 0.6584

Epoch 10/20

44613/44613 [==============================] - 545s 12ms/step - loss: 1.0047 - acc: 0.6362 - f1: 0.6108 - val\_loss: 0.7513 - val\_acc: 0.6605 - val\_f1: 0.6414

Epoch 11/20

44613/44613 [==============================] - 537s 12ms/step - loss: 0.9911 - acc: 0.6423 - f1: 0.6202 - val\_loss: 0.7501 - val\_acc: 0.6633 - val\_f1: 0.6511

Epoch 12/20

44613/44613 [==============================] - 541s 12ms/step - loss: 0.9806 - acc: 0.6470 - f1: 0.6244 - val\_loss: 0.7355 - val\_acc: 0.6730 - val\_f1: 0.6615

Epoch 13/20

44613/44613 [==============================] - 541s 12ms/step - loss: 0.9757 - acc: 0.6468 - f1: 0.6260 - val\_loss: 0.7436 - val\_acc: 0.6681 - val\_f1: 0.6513

Epoch 14/20

44613/44613 [==============================] - 541s 12ms/step - loss: 0.9566 - acc: 0.6563 - f1: 0.6357 - val\_loss: 0.8204 - val\_acc: 0.6336 - val\_f1: 0.6249

Epoch 15/20

44613/44613 [==============================] - 575s 13ms/step - loss: 0.9544 - acc: 0.6546 - f1: 0.6360 - val\_loss: 0.7624 - val\_acc: 0.6613 - val\_f1: 0.6501

Epoch 16/20

44613/44613 [==============================] - 623s 14ms/step - loss: 0.9432 - acc: 0.6615 - f1: 0.6423 - val\_loss: 0.7732 - val\_acc: 0.6490 - val\_f1: 0.6384

Epoch 17/20

[0.5255, 0.5781, 0.5832, 0.6177, 0.6278, 0.5871, 0.6175, 0.6269, 0.6584, 0.6414, 0.6511, 0.6615, 0.6513, 0.6249, 0.6501, 0.6384, 0.6547, 0.6707, 0.6611, 0.6629]

44613/44613 [==============================] - 556s 12ms/step - loss: 0.9365 - acc: 0.6638 - f1: 0.6462 - val\_loss: 0.7410 - val\_acc: 0.6669 - val\_f1: 0.6547

Epoch 18/20

44613/44613 [==============================] - 598s 13ms/step - loss: 0.9243 - acc: 0.6678 - f1: 0.6520 - val\_loss: 0.7643 - val\_acc: 0.6766 - val\_f1: 0.6707

Epoch 19/20

44613/44613 [==============================] - 581s 13ms/step - loss: 0.9216 - acc: 0.6694 - f1: 0.6527 - val\_loss: 0.7860 - val\_acc: 0.6665 - val\_f1: 0.6611

Epoch 20/20

44613/44613 [==============================] - 597s 13ms/step - loss: 0.9127 - acc: 0.6724 - f1: 0.6568 - val\_loss: 0.7740 - val\_acc: 0.6675 - val\_f1: 0.6629