

Q2:

1. Base-Multinomial Naive Bayes

This is the Multinomial Naive Bayes classifier with its default parameter.

It runs for emotion classification.

Confusion matrix:

```
[[ 933  18  0  11  27  3  1  3  0  2  10  1  0  6
   0  44  0  13  41  0 949 10  0  4  0  0  1 12]
 [ 43 362  4  16  15  0  1  1  2  1  7  0  0  4
   0  4  0  13  8  0 708 3  0  2  0  0  0 4]
 [ 14  4 110  78  5  4  2  5  0  6  24 10  0  1
   0  6  0  1  1  0 721 2  0  2  0  1  1 1]
 [ 25 25  50 120  35  5  6  8  0  8  26 10  0  1
   0 17  0  1  2  0 1330 3  0  2  0  1  8 6]
 [ 124 15  6  30 218  4  7  4  3  3  32  3  0  2
   1 14  0  4 14  0 1716 13  0 12  0  1  4 1]
 [ 18  1  0  4  26 43  1  4  0  4  8  0  0  1
   0 18  0  4  6  0 554 17  0  2  0  2  3 0]
 [  7  4  2 10 14  0  48 23  0  1 13  1  0  0
   0  7  0  1  0  0 790 1  0  9  0  0  0 3]
 [ 21  9  3  6 13  2  20 124  1  3  7  0  0  1
   0  8  0  1  3  1 942 1  0  6  0  0  2 7]
 [  9  4  2  5  5  3  2  0 14  1  2  0  0  1
   0  4  0  0  6  0 376 15  0  0  0  0  0 1]
 [ 16  6  6 23 17  0  5  2  2  34 17  4  0  1
   1  3  0  1  1  0 792 5  0  4  0  1  9 0]
 [ 21 15 13 42 35  3  5  4  0  7 129  3  2  0
   1  8  0  0  3  0 1283 2  0  4  0  1  2 2]
 [ 19  3 23 30 18  1  2  1  1  4 12 54  0  0
   0  1  0  0  2  0 438 5  0  1  0  1  3 1]
 [  7  3  3 14  3  0  2  2  0  3  5  0  3  1
   0  1  0  1  1  0 226 1  0  2  0  2  2 1]
 [ 52  5  5  2 14  1  2  5  0  0  2  1  0 26
   2  6  0 41  8  0 410 6  0  1  0  0  0 11]
 [ 10  4  1  6  9  2  1  2  0  2  2  3  1  0
   14  2  0  0  0  0 294 2  0  3  0  0  3 3]
 [ 88  6  0  4  8  5  0  2  1  3  3  0  0  2
   0 943 0 15  2  0 310 9  0  2  0  2  3 1]
 [  1  2  1  1  1  1  1  1  0  1  1  0  0  0
   0  0  0  0  0  0 58 0  0  0  0  0 6 0]
 [ 77 45  0  2 21  4  0  2  2  0  2  0  0  7
   1 36  0 97 29  0 556 6  0  2  0  0  1 2]
 [ 84  8  1  1 16  1  0  0  0  0  2  0  0  2
   0  8  0  8 326 0 490 1  0  1  0  1  0 2]
 [  2  0  1  6  2  0  1  0  0  1  5  0  0  0
   0  1  0  0  0  0 124 1  0  1  0  0  1 1]
 [ 279 112  93 153 273 40  46 83 15 44 169 26  4 23
   7  83  2  38 69  0 9331 42  3 41  0  2 37 30]
 [ 36  2  1  4 27  8  2  0  2  0  6  1  0  1
   0 11  0  2  4  0 658 111  0  1  0  0  0 0]
 [ 26  0  1  3  4  0  0  1  0  1  0  0  0  1
   0  5  0  2  0  0  95 2  0  2  0  0  0 0]
 [ 15  7  4 18 24  0  3  3  1  2 14  0  0  1
   0  5  0  5  2  0 819 6  0 28  0  0  0 3]
 [ 11  1  0  2  7  2  0  1  0  0  0  0  0  1
   0  8  0  1  0  0 108 1  0  1  0  0  0 0]
 [  1  1  2  4  5  2  2  0  0  2  3  1  0  0
   0  8  0  0  1  0 236 0  0  2  0 15 18 0]
 [  4  5  4 10 10  6  2  2  1 12 10  1  0  1
   0  9  0  3  4  0 632 3  0  2  0  6 73 5]
 [ 45  9 10 13 14  3  2 14  0  2  9  2  0  4
   1  4  0  3  3  0 528 0  0  5  0  0  1 49]]
```

Classification report:

	precision	recall	f1-score	support
admiration	0.47	0.45	0.46	2089
amusement	0.54	0.30	0.39	1198
anger	0.32	0.11	0.16	999
annoyance	0.19	0.07	0.10	1689
approval	0.25	0.10	0.14	2231
caring	0.30	0.06	0.10	716
confusion	0.29	0.05	0.09	934
curiosity	0.42	0.10	0.17	1181
desire	0.31	0.03	0.06	450
disappointment	0.23	0.04	0.06	950
disapproval	0.25	0.08	0.12	1585
disgust	0.45	0.09	0.15	622
embarrassment	0.25	0.01	0.02	283
excitement	0.30	0.04	0.08	600
fear	0.50	0.04	0.07	364
gratitude	0.75	0.67	0.71	1409
grief	0.00	0.00	0.00	75
joy	0.38	0.11	0.17	892
love	0.61	0.34	0.44	952
nervousness	0.00	0.00	0.00	147
neutral	0.37	0.84	0.51	11045
optimism	0.41	0.13	0.19	877
pride	0.00	0.00	0.00	143
realization	0.20	0.03	0.05	960
relief	0.00	0.00	0.00	144
remorse	0.42	0.05	0.09	303
sadness	0.41	0.09	0.15	805
surprise	0.34	0.07	0.11	721
accuracy			0.38	34364
macro avg	0.32	0.14	0.16	34364
weighted avg	0.36	0.38	0.31	34364

This is the Multinomial Naive Bayes classifier with its default parameter.

It runs for sentiment classification.

Confusion matrix:

```
[[ 929  578 1402  887]
 [ 309 4116 2142 1255]
 [ 632 2001 5423 2989]
 [ 294  951 2086 8370]]
```

Evaluation matrix:

	precision	recall	f1-score	support
ambiguous	0.43	0.24	0.31	3796
negative	0.54	0.53	0.53	7822
neutral	0.49	0.49	0.49	11045
positive	0.62	0.72	0.66	11701
accuracy			0.55	34364
macro avg	0.52	0.49	0.50	34364
weighted avg	0.54	0.55	0.54	34364

2. Base-Decision Tree

This is the decision tree classifier with its default parameter.

It runs for emotion classification.

Confusion matrix

```
[[1168  42  14  57 118  18  12  17  15  12  22  6  3  50
   4  64  2  54  74  1 254  39  9 15  2  0  1 16]
 [ 71 678  18  43  56  6 14  9  3  7 14  9  1 17
   2  4  0  51  8  2 147  8  1 11  1  5  3  9]
 [ 34  24 351 145  34 14 26 18  3 32 42 32  7  5
   2  1  1  4  3  1 188  4  0  8  2  4  9  5]
 [ 46  80 207 398 100 31 42 46 13 74 97 48 14 15
   3 13  1  7  6  4 390  6  0 20  2  4 13  9]
 [204 43  55 134 603 66 44 39 31 43 84 15 14 28
   9 22  1 39 35  8 616 38  5 28  5  4  7 11]
 [ 45 16 18 44  80 189  9 12 13 14 22  2  2  4
   4 15  2  8 12  8 153 25  0  5  2  4  8  0]
 [ 17 25 27 54  58 10 275 135  2 14 35  6  1  3
   1  5  2  2  4  3 232  2  0  8  0  1  4  8]
 [ 34 18 33 60  58 14 173 396  7 11 15  0  4 18
   1  9  0  8  4  3 270  4  1  9  0  0  4 27]
 [ 19 11  7 21  35 18  9 11 131 12 10  1  2  5
   3  3  2  7 10  0  97 29  0  3  1  1  2  0]
 [ 25 31 56 113  63 21 24 17 16 168 69 17 10  3
   7  1  2  6  8  5 205 14  0 11  2 10 36 10]
 [ 29 47 109 197 123 21 57 25 14 68 369 22 13  2
   8  5  1  6  5  1 401 14  0 16  1  7 13 11]
 [ 15 15 74  92  32  4 15  6  3 33 46 143 11  3
   12  1  0  1  2  0 101  4  0  3  0  1  4  1]
 [  7 14 20 39 19  2  5  7  0 19 14 10 40  2
   2  1  2  2  4  2  55  3  0  1  0  8  2  3]
 [ 82 32 14 18 35  7 11 24  9  8 17  1  1 130
   2  8  0 51 11  1 105  7  1  5  0  1  4 15]
 [ 12  9 20 28 16  8  6  2  2 17 12 19  6  0
 120  0  1  0  1  7  60  3  1  3  1  0  6  4]
 [129 14  6 17 26 20  1  3  4  8  8  2  1  5
   0 1041  2 25  6  0 50 15  0  1  8 13  3  1]
 [  4  4  5  6  5  3  2  1  2  6  2  0  2  0
   3  1  5  0  0  0 15  0  0  2  0  4  3  0]
 [110 108  4 20 63 21  4  9 18 11 10  1  3 51
   4 35  1 215 50  1 127  7  2  6  6  0  1  4]
 [143 27  8 15 47 19  8  7 19  5 10  4  0 17
   2 11  0 42 474  0 77  7  0  4  0  1  3  2]
 [  3  4  8 17 12  7  5  4  2 11  4  4  2  1
   8  1  0  1  0 14 32  0  1  0  0  1  2  3]
 [533 311 437 658 1107 246 394 379 144 294 534 120 52 149
   69 75 11 172 126 34 4793 101  9 110 14 21 69 83]
 [ 59 14 18 41 88 39 19 20 35 16 31  5  5 18
   4 21  0 15  9  1 213 191  2  5  2  1  4  1]
 [ 33  1  3  4 17  3  5  1  0  4  2  1  0  2
   0  4  1  6  2  1 38  6  8  0  1  0  0  0]
 [ 39 33 29 62 112 12 33 18 12 36 64  9  2  8
   4  7  1 11  6  4 347  8  1 72  1  6  4 19]
 [ 12  2  1  5 32  7  1  1  2  1  2  1  1  2
   2  9  0 15  0  0 29  1  0  1 14  0  1  2]
 [  2  4  4 14  6 14  8  2  2 19 20  4 14  0
   1 18  2  0  3  2 46  1  0  6  1 82 28  0]
 [ 15 11 30 57 47 38 11 11  7 89 38 15  8  4
   7  8  7  6  7 11 182  2  1 10  0 31 149  3]
 [ 65 31 23 42 42  3 38 28  1 16 23 10  7 30
   5  5  4 13  2  4 165  5  0 19  0  1  3 136]]
```

Classification-report:

	precision	recall	f1-score	support
admiration	0.40	0.56	0.47	2089
amusement	0.41	0.57	0.48	1198
anger	0.22	0.35	0.27	999
annoyance	0.16	0.24	0.19	1689
approval	0.20	0.27	0.23	2231
caring	0.22	0.27	0.24	716
confusion	0.22	0.29	0.25	934
curiosity	0.31	0.34	0.32	1181
desire	0.25	0.29	0.27	450
disappointment	0.16	0.17	0.17	950
disapproval	0.23	0.23	0.23	1585
disgust	0.28	0.23	0.26	622
embarrassment	0.17	0.14	0.16	283
excitement	0.23	0.21	0.22	600
fear	0.41	0.33	0.37	364
gratitude	0.75	0.74	0.75	1409
grief	0.10	0.07	0.08	75
joy	0.28	0.24	0.26	892
love	0.54	0.50	0.52	952
nervousness	0.12	0.10	0.10	147
neutral	0.51	0.43	0.47	11045
optimism	0.36	0.22	0.27	877
pride	0.16	0.04	0.07	143
realization	0.19	0.08	0.11	960
relief	0.19	0.09	0.12	144
remorse	0.39	0.28	0.32	303
sadness	0.38	0.19	0.25	805
surprise	0.36	0.19	0.25	721
accuracy			0.36	34364
macro avg	0.29	0.27	0.27	34364
weighted avg	0.37	0.36	0.36	34364

This is the decision tree classifier with its default parameter.

It runs for sentiment classification.

Confusion matrix:

```
[[1795  583  956  462]
 [ 869 4616 1585  752]
 [1548 2489 5176 1832]
 [ 842 1405 2417 7037]]
```

Classification report:

	precision	recall	f1-score	support
ambiguous	0.36	0.48	0.41	3796
negative	0.51	0.59	0.55	7822
neutral	0.51	0.47	0.49	11045
positive	0.70	0.60	0.65	11701
accuracy			0.54	34364
macro avg	0.52	0.53	0.52	34364
weighted avg	0.56	0.54	0.55	34364

3. Base-Multi Layered Perceptron

This is the multilayered perceptron classifier with default parameters.

It runs for emotion.

Classification-report:

	precision	recall	f1-score	support
admiration	0.48	0.53	0.50	2089
amusement	0.48	0.55	0.51	1198
anger	0.29	0.29	0.29	999
annoyance	0.20	0.17	0.18	1689
approval	0.26	0.16	0.20	2231
caring	0.27	0.18	0.22	716
confusion	0.26	0.17	0.20	934
curiosity	0.33	0.27	0.29	1181
desire	0.31	0.28	0.29	450
disappointment	0.18	0.12	0.14	950
disapproval	0.24	0.22	0.23	1585
disgust	0.31	0.24	0.27	622
embarrassment	0.24	0.20	0.22	283
excitement	0.28	0.18	0.22	600
fear	0.43	0.40	0.41	364
gratitude	0.77	0.75	0.76	1409
grief	0.07	0.04	0.05	75
joy	0.31	0.30	0.30	892
love	0.54	0.57	0.55	952
nervousness	0.15	0.13	0.14	147
neutral	0.47	0.61	0.53	11045
optimism	0.33	0.31	0.32	877
pride	0.17	0.07	0.10	143
realization	0.18	0.11	0.14	960
relief	0.19	0.10	0.13	144
remorse	0.36	0.39	0.37	303
sadness	0.33	0.30	0.32	805
surprise	0.32	0.30	0.31	721
accuracy			0.40	34364
macro avg	0.31	0.28	0.29	34364
weighted avg	0.38	0.40	0.39	34364

Confusion matrix:

```
[[1105  32  6  34  58  8  3  14  7  9  20  6  3  44
   2  58  1  65  75  2 432  31 11 13  5  1  8 36]
 [ 31 656  8  38  23  5  9  8  4  7  20 10  1 13
   5  6  0  73 16  1 220  7  0 13  0  7  4 13]
 [ 18  8 289 139 12  9 11 14  1 19 42 43  9  3
   4  2  0  6  6  3 316  6  1  8  0  3 13 14]
 [ 30 56 130 292 39 12 20 32 15 52 95 58 17  6
   7 15  1 14  4  6 687 13  0 24  0  8 28 28]
 [162 31 24 73 362 34 27 22 22 20 85 13 14 18
  10 26  1 38 45  4 1021 62  5 45  4 13 28 22]
 [ 26 13 11 19 33 128  4  7  5  8 23  3  4  0
   8 13  2 15 13 11 291 41  1  9  2  7 17  2]
 [ 11 21 13 35 29  7 155 107  2  9 34 10  2  3
   4 10  1  5  6  4 425  4  0 17  0  1  3 16]
 [ 22 23 12 33 21  6  66 314  8 10 19  2  5 13
   1  7  1  8  9  5 520 10  0 17  0  4  6 39]
 [ 10  8  5  6 12  8  4  5 125  6 11  0  1  3
   2  2  0  6 12  0 161 50  1  6  1  1  3  1]
 [ 19 17 25 78 25 12 11 13 14 111 49 20  9  2
   9  2  2 10 14  7 372 17  0 20  2 14 59 17]
 [ 27 33 56 107 59 13 23 16  7 37 343 18 15  2
  15  7  3  7  6  2 689 14  1 25  1  8 33 18]
 [ 12  7 55 59 16  1  6  6  5 18 36 150  9  2
  18  2  0  2  2  0 175  7  0  6  0  2 17  9]
 [  5  7  9 24  5  3  2  6  0 12 13  6 58  3
   3  2  2  0  5  3 82  2  1 10  0 12  4  4]
 [ 59 18 13  9 11  2  4 27  8  3  7  1  3 107
   2  9  0 50 15  3 194 15  2  4  0  1  4 29]
 [  6  6 10 10 10  3  3  4  1 10 11 14  7  0
 144  0  1  0  2  7 82  3  2  7  0  3 13  5]
 [110 13  4 11 10 10  0  0  1 11  3  1  0  5
   0 1056  1 43  3  0 61 21  1  2  8 26  4  4]
 [  2  2  2  4  2  2  1  0  1  2  2  0  2  0
   4  1  3  2  0  0 28  1  0  0  0  2 12  0]
 [ 79 93  5 10 34 10  2 10 12  7  8  1  3 31
   5 25  1 270 58  1 188 12  4  5  8  0  2  8]
 [ 82 16  4  8 21  8  2  4  8  4  4  0  0  6
   2  8  0 41 545  1 159 12  0  8  0  1  3  5]
 [  2  2  3 13  7  4  4  0  0  5  7  3  1  0
   7  1  0  1  0 19 55  1  0  1  0  2  5  4]
 [330 243 235 363 461 125 185 293 110 159 442 86 58 75
  65 76 10 148 139 28 6689 175 13 183 21 37 149 147]
 [ 48  7 10 10 37 24 14  9 24  9 23  3  2  8
   3 12  0 18  8  1 306 269  5  9  2  2  8  6]
 [ 31  0  3  3  8  1  2  1  0  4  1  0  1  2
   0  3  1 11  2  1 47  6 10  3  0  1  0  1]
 [ 22 22 16 34 50  9 18 13  7 27 60 10  5  3
   5  3  1 11 11  3 464 12  1 106  3  5 13 26]
 [ 12  3  0  4 11  5  1  0  2  3  1  1  1  1
   0 10  0 17  0  3 45  2  0  1 14  0  6  1]
 [  0  2  5  8  2  5  3  4  3  9  9  2  6  0
   0  9  2  3  2  0 55  1  0 12  0 117 44  0]
 [  9  9 14 29 17 15  4  4  6 55 22 11  5  2
   5  3  7  8 11 12 235  8  0 12  0 50 245  7]
 [ 41 15 15 29 17  2 13 21  1  8 15  6  3 26
   5  5  2 11  4  4 234  2  0 19  2  0  6 215]]
```

This is the multilayered perceptron classifier with default parameters.

It runs for sentiment.

Confusion matrix:

```
[[1804  584  950  458]
 [ 872 4622 1568  760]
 [1565 2489 5158 1833]
 [ 847 1411 2427 7016]]
```

Classification report:

	precision	recall	f1-score	support
ambiguous	0.35	0.48	0.41	3796
negative	0.51	0.59	0.55	7822
neutral	0.51	0.47	0.49	11045
positive	0.70	0.60	0.64	11701
accuracy			0.54	34364
macro avg	0.52	0.53	0.52	34364
weighted avg	0.56	0.54	0.55	34364

4. Top-Multinomial Naive Bayes

This is the Multinomial Bayes classifier with gridSearchCV.

hyperParameter tested: alphaFloat = {'alpha': (0.5, 0.0, 1.0, 10.0)}

The best hyper parameter tested was alpha at 0 but due to python warnings , alpha was set at 1×10^{-10} or 0.0000000001

It runs for emotion.

Confusion matrix:

```
[[1047  37  11  23  54  22  14  16  14  14  19  8  6  62
   5  74  2  70  92  3 352  36  21  18  8  3 15  43]
 [ 37 631  16  30  25  7  9  9  9 11 20 10  3  25
   8  8  0  58  18  1 192  14  3  21  2  6 12 13]
 [ 19  8 321  97  11 21 20 15  0  21 53 54 10 12
   5  3  1  5  9  5 256  9  1 10  1  4 13 15]
 [ 36 60 170 240  46 34 44 45 18 60 92 75 31 23
  12 20  2  9 15 15 506 26  4 34  0 13 32 27]
 [158 43 33 54 363 79 41 24 34 30 96 26 21 32
  12 51  1 41 55 15 762 81 22 57 22 24 28 26]
 [ 23 12  8 18 36 201 10  9  8  8 18  6  2  5
   5 26  4 14 11 16 193 42  2 11  4  7 17  0]
 [ 15 19 14 25 21 14 213 109  4  9 42 12  4  8
   4 12  1  5  5  4 332 12  2 31  0  5  1 11]
 [ 26 22 16 27 26 22  92 332 14  9 20  5  8 25
   3 17  1  7 13 13 399 12  1 20  0  4 10 37]
 [ 12  6  6  3 11 17  6  3 143  5  9  1  2 10
   2  7  0 12 13  0 124 39  2  5  2  3  2  5]
 [ 23 15 30 57 28 22  25 15 18 124 48 30 21  8
  11  7  9  8 12 12 270 20  1 22  6 19 62 27]
 [ 28 39 55 83 67 28  54 21 12 49 285 34 21  3
  15 13  5  6 13  4 598 23  4 39  8 21 36 21]
 [ 16  7 65 38 19  3 11  9  4 22 35 155 18  3
  21  1  3  3  4  1 135  7  1  7  1  3 24  6]
 [  6  8  5 20  5  6  4  4  0  5 16 13 58  3
   4  1  4  2  9  3 70  3  1  9  0 11  7  6]
 [ 50 20 16  3 12  3 11 21 10  6  2  1  3 123
   1 12  0 61 22  5 148 14  4 10  0  2  7 33]
 [  3  7  9 15 10  6  7  3  2 13  8 17  6  1
 134  2  3  1  1 11 75  5  2  6  0  2  8  7]
 [ 99 12  4 11 17 16  2  3  1 17  8  0  1  7
   3 1004  3 41  3  0 77 23  1  3 17 28  4  4]
 [  3  2  3  2  0  1  1  1  1  2  4  0  2  0
   4  0  6  0  2  1 20  1  1  1  0  7 10  0]
 [ 78 95  4  8 27 26  2  9 16 10  3  3  5 46
   4 41  1 250 55  2 139  9 11 12 19  2  6  9]
 [ 87 15  2  3 24 13  3  5 19  2  4  3  0  9
   2 16  0 32 518  2 157 14  1 10  0  1  6  4]
 [  2  2  3  8  7  4 10  0  9  6  5  5  1
  11  1  0  3  0 21 31  2  0  3  0  4  5  4]
 [353 272 301 350 533 300 315 334 152 219 467 159 93 167
  81 143 27 175 171 64 5309 227 44 276 66 60 175 212]
 [ 42 13 10 12 36 49 19 24 13 19  5  5 15
   9 21  1 18 11  2 226 247  7 20 10  7  9 10]
 [ 30  2  3  3  8  4  2  2  0  2  1  1  1  4
   0  7  1  5  3  1 38  5 11  2  3  0  2  2]
 [ 25 23 20 28 46 14 28 12  8 28 61 18  8  7
   8 13  2 18 12  7 341 26  5 133  7 14 13 35]
 [  8  1  0  0  9  7  1  1  2  2  1  3  1  3
   2 12  0 12  2  5 34  1  1  3 28  0  5  0]
 [  2  3  3  3  7  8  7  1  3  7  9  6  7  0
   0  4  3  2  4  1 45  2  0 11  1 126 38  0]
 [  6 12 13 12 19 35 11  2 11 49 22 14  9  4
  10  6 11  5 12 16 211  6  1 11  4 57 225 11]
 [ 26 17 22 20 20  5 16 28  2 13 13  8  8 42
   5  8  3 12  8  5 195  3  0 19  5  1  2 215]]
```


Classification-report:

CPU times: user 4.66 s, sys: 983 ms, total: 5.64 s

Wall time: 25.5 s

best alpha parameter for emotion {'alpha': 0.0}

	precision	recall	f1-score	support
admiration	0.46	0.50	0.48	2089
amusement	0.45	0.53	0.49	1198
anger	0.28	0.32	0.30	999
annoyance	0.20	0.14	0.17	1689
approval	0.24	0.16	0.20	2231
caring	0.21	0.28	0.24	716
confusion	0.22	0.23	0.22	934
curiosity	0.32	0.28	0.30	1181
desire	0.27	0.32	0.29	450
disappointment	0.16	0.13	0.15	950
disapproval	0.21	0.18	0.19	1585
disgust	0.23	0.25	0.24	622
embarrassment	0.16	0.20	0.18	283
excitement	0.19	0.20	0.20	600
fear	0.35	0.37	0.36	364
gratitude	0.66	0.71	0.68	1409
grief	0.06	0.08	0.07	75
joy	0.29	0.28	0.28	892
love	0.47	0.54	0.51	952
nervousness	0.09	0.14	0.11	147
neutral	0.47	0.48	0.48	11045
optimism	0.27	0.28	0.28	877
pride	0.07	0.08	0.07	143
realization	0.17	0.14	0.15	960
relief	0.13	0.19	0.16	144
remorse	0.29	0.42	0.34	303
sadness	0.29	0.28	0.28	805
surprise	0.27	0.30	0.29	721
accuracy			0.36	34364
macro avg	0.27	0.29	0.27	34364
weighted avg	0.36	0.36	0.36	34364

This is the Multinomial Bayes classifier with gridSearchCV.

hyperParameter tested: alphaFloat = {'alpha': (0.5, 0.0, 1.0, 10.0)}

The best hyper parameter tested was alpha at 0.5

It runs for sentiment.

Confusion matrix:

```
[[1102  590 1276  828]
 [ 399 4203 2031 1189]
 [ 847 2074 5219 2905]
 [ 407  995 2036 8263]]
```

Classification-report:

CPU times: user 1min 9s, sys: 8.5 s, total: 1min 18s
Wall time: 1min 18s
best alpha parameter for sentiment {'alpha': 0.5}

	precision	recall	f1-score	support
ambiguous	0.40	0.29	0.34	3796
negative	0.53	0.54	0.54	7822
neutral	0.49	0.47	0.48	11045
positive	0.63	0.71	0.66	11701
accuracy			0.55	34364
macro avg	0.51	0.50	0.50	34364
weighted avg	0.54	0.55	0.54	34364

5. Top-Decision Tree

This is a Decision Tree classifier with gridsearchCV with hyperparameters tested:

1. criterion: Gini,entropy
2. max depth: 50, 100
3. min samples split: 2,5,10

The best hyper parameters being criterion:gini, max depth of 100, min sample split of 2

It runs for emotion.

Confusion matrix:

```
[[ 953  34  10  34  84  8  6  13  12  8  19  4  1  39
   1 56  2 39 78 0 619 28 8 10 1 1 1 20]
 [ 48 650  7 35 29 4 8 6 2 5 9 5 1 12
   2 4 0 33 13 1 293 6 1 7 1 5 3 8]
 [ 21 16 232 89 23 7 14 11 3 17 22 29 5 2
   1 1 0 2 4 0 480 3 0 3 2 5 3 4]
 [ 32 58 109 203 47 14 21 27 9 38 38 31 7 8
   1 11 0 6 12 1 983 4 0 10 2 5 8 4]
 [ 138 27 26 62 297 31 19 21 13 24 44 9 5 9
   5 19 1 30 43 2 1351 24 1 11 2 4 6 7]
 [ 36 11 9 26 40 93 6 2 7 8 10 0 0 0
   3 13 1 7 14 5 387 21 0 3 2 6 6 0]
 [ 11 22 19 29 30 4 181 58 0 10 21 5 1 2
   0 3 0 2 4 2 513 2 0 5 0 0 4 6]
 [ 23 20 14 30 28 10 86 221 5 7 9 0 4 8
   2 7 0 4 4 2 672 2 0 4 0 0 0 19]
 [ 11 8 3 11 13 8 7 5 94 7 6 0 1 3
   2 3 1 5 12 0 222 25 0 0 1 1 1 0]
 [ 24 25 33 57 28 14 16 9 10 72 33 9 7 2
   4 1 0 3 7 2 542 6 0 6 1 9 24 6]
 [ 26 38 61 91 60 13 35 12 8 31 168 15 7 2
   2 3 1 4 9 0 960 9 0 7 0 8 10 5]
 [ 14 14 50 56 15 1 5 4 2 17 27 100 5 2
   9 1 0 0 2 0 287 2 0 2 0 2 4 1]
 [ 5 7 11 17 8 2 2 5 0 8 8 9 20 2
   0 0 1 1 3 1 164 1 0 0 0 6 0 2]
 [ 62 21 4 9 15 6 3 16 6 3 9 0 1 86
   1 7 0 35 14 0 265 7 1 1 1 1 4 22]
 [ 7 8 11 14 10 5 2 2 2 7 7 12 4 0
   95 0 0 0 4 2 158 3 0 3 0 0 5 3]
 [ 109 10 5 15 17 19 1 3 4 4 5 0 1 5
   0 1030 2 23 7 0 107 13 0 0 9 16 2 2]
 [ 4 4 2 3 0 0 0 0 1 4 2 0 0 0
   1 1 2 0 0 0 46 0 0 0 0 3 2 0]
 [ 101 99 3 8 32 18 4 7 14 7 8 2 1 38
   2 24 1 186 45 1 269 4 2 5 7 0 0 4]
 [ 89 23 7 12 32 13 5 4 13 2 8 4 0 15
   2 9 0 34 507 0 159 7 0 3 0 1 2 1]
 [ 2 3 7 9 3 1 4 3 1 5 2 3 1 0
   5 1 0 0 0 8 85 0 0 0 0 1 1 2]
 [ 334 231 214 273 388 91 193 152 61 118 238 54 18 43
   28 57 4 82 143 7 8097 55 5 46 13 16 37 47]
 [ 47 12 8 19 43 23 11 11 29 7 12 2 3 8
   1 18 0 11 10 0 417 175 1 2 2 1 3 1]
 [ 20 1 2 0 6 0 1 0 0 1 1 0 0 1
   0 4 1 7 2 0 85 2 7 1 1 0 0 0]
 [ 23 26 17 33 49 6 13 10 5 17 29 7 1 3
   3 4 0 5 7 4 641 5 0 29 1 5 2 15]
 [ 11 3 1 2 12 5 0 0 2 0 1 0 1 1
   2 9 0 8 2 0 68 1 0 1 12 0 1 1]
 [ 2 3 3 8 4 12 3 1 2 12 16 3 8 1
   0 14 2 0 2 2 91 1 0 6 1 84 22 0]
 [ 10 9 15 32 19 15 4 8 3 47 23 6 5 1
   5 7 4 2 7 7 418 1 1 8 0 37 107 4]
 [ 44 23 14 28 14 1 32 16 1 9 14 6 4 22
   4 5 0 6 4 3 340 4 0 9 0 0 2 116]]
```

Classification-report:

CPU times: user 29.4 s, sys: 1.4 s, total: 30.8 s

Wall time: 5min 48s

best parameters for emotion {'criterion': 'gini', 'max_depth': 100, 'min_samples_split': 2}

	precision	recall	f1-score	support
admiration	0.43	0.45	0.44	2089
amusement	0.46	0.55	0.50	1198
anger	0.26	0.23	0.24	999
annoyance	0.17	0.12	0.14	1689
approval	0.22	0.13	0.17	2231
caring	0.22	0.13	0.16	716
confusion	0.26	0.20	0.22	934
curiosity	0.35	0.19	0.24	1181
desire	0.31	0.21	0.25	450
disappointment	0.15	0.08	0.10	950
disapproval	0.22	0.11	0.14	1585
disgust	0.33	0.17	0.22	622
embarrassment	0.18	0.07	0.10	283
excitement	0.28	0.14	0.19	600
fear	0.54	0.26	0.35	364
gratitude	0.79	0.73	0.76	1409
grief	0.10	0.03	0.04	75
joy	0.34	0.21	0.26	892
love	0.53	0.54	0.53	952
nervousness	0.16	0.05	0.08	147
neutral	0.43	0.73	0.54	11045
optimism	0.42	0.20	0.27	877
pride	0.26	0.05	0.08	143
realization	0.16	0.03	0.05	960
relief	0.21	0.08	0.11	144
remorse	0.39	0.29	0.33	303
sadness	0.41	0.13	0.20	805
surprise	0.39	0.16	0.23	721
accuracy			0.40	34364
macro avg	0.32	0.22	0.25	34364
weighted avg	0.37	0.40	0.36	34364

This is a Decision Tree classifier with gridsearchCV with hyperparameters:

1. criterion: Gini,entropy
2. max depth: 50, 100
3. min samples split: 2,5,10

The best hyper parameters being criterion:gini, max depth of 100, min sample split of

2

It runs for sentiment.

Confusion matrix:

```
[[1233  441 1764  358]
 [ 589 3327 3330  576]
 [ 888 1598 7340 1219]
 [ 572 1058 4019 6052]]
```

Classification report:

```
CPU times: user 27 s, sys: 1.19 s, total: 28.2 s
Wall time: 5min 23s
best parameters for sentiment {'criterion': 'gini', 'max_depth': 100, 'min_samples_split': 2}
      precision    recall  f1-score   support

ambiguous      0.38      0.32      0.35      3796
negative       0.52      0.42      0.47      7822
neutral        0.45      0.67      0.53     11045
positive       0.74      0.52      0.61     11701

accuracy              0.52      34364
macro avg           0.52      0.48      0.49      34364
weighted avg       0.56      0.52      0.52      34364
```

6. Top-Multi-Layered Perceptron

This is multi-layered perceptron classifier with gridsearchCV

With hyperparameter list of activation: ('relu','identity','logistic','tanh'),
'hidden_layer_sizes':((30,50),(10,10,10)), 'solver':('adam','sgd')

Best Hyperparameters:

1. activation: relu
2. network architectures: 2 hidden layers with 30, 50 nodes
3. Adam

It runs for emotion.

Confusion matrix:

```

[[1090 36 5 25 63 14 12 12 8 7 20 6 1 43
 8 62 0 50 92 0 451 28 4 13 1 2 3 33]
[ 33 694 10 26 19 3 12 8 2 6 19 8 2 12
 3 7 0 37 11 1 245 7 0 11 0 1 7 14]
[ 15 11 283 112 17 9 13 11 1 21 46 50 5 2
 6 4 0 3 5 0 349 8 0 6 0 3 6 13]
[ 27 57 113 250 49 14 34 34 10 40 95 56 18 6
 14 21 0 4 9 1 746 12 2 22 0 6 24 25]
[ 146 43 23 59 382 50 33 17 15 21 87 21 11 18
 13 25 1 33 49 1 1025 57 3 37 6 12 19 24]
[ 23 13 5 24 37 155 5 11 4 10 20 1 4 0
 9 17 1 10 15 4 281 35 0 7 3 8 13 1]
[ 9 26 11 22 28 5 203 111 1 9 36 10 2 6
 1 7 0 2 4 3 400 7 0 14 0 1 1 15]
[ 19 23 11 23 25 14 90 321 4 5 12 7 5 12
 0 8 1 4 9 3 517 8 0 12 0 3 4 41]
[ 10 7 3 7 16 10 6 5 110 5 7 0 1 4
 4 3 0 4 12 0 187 38 0 4 0 0 4 3]
[ 21 18 27 52 32 13 18 14 8 113 60 33 7 3
 8 1 0 6 12 1 398 14 0 13 2 11 50 15]
[ 26 40 58 76 62 11 37 16 1 27 342 28 15 2
 22 11 0 4 9 1 720 16 0 17 0 6 25 13]
[ 9 9 52 39 22 1 6 5 3 19 38 174 9 1
 26 4 0 2 2 0 179 5 0 3 0 1 8 5]
[ 5 9 11 22 6 4 3 6 0 6 8 14 59 3
 4 2 1 0 6 1 85 1 0 7 0 11 5 4]
[ 57 20 7 6 12 1 7 21 3 4 6 1 3 99
 3 15 0 53 20 2 206 10 0 2 0 1 6 35]
[ 3 8 9 10 8 6 2 3 0 9 8 19 6 0
 152 0 1 0 2 6 84 5 1 4 0 0 11 7]
[ 101 14 4 6 8 10 2 1 2 6 5 1 1 2
 2 1077 0 31 6 0 70 19 1 3 4 24 6 3]
[ 1 0 3 3 0 2 0 1 2 3 3 0 2 0
 3 0 2 1 1 0 30 1 0 0 0 3 14 0]
[ 74 110 7 10 34 13 4 7 10 3 7 1 2 26
 3 36 1 240 61 1 204 8 2 5 9 1 4 9]
[ 69 14 2 5 20 8 3 6 10 0 4 3 0 6
 2 9 0 22 592 0 159 4 0 7 0 1 4 2]
[ 2 3 4 8 7 5 3 2 0 7 7 2 2 0
 7 1 0 0 0 13 59 1 0 2 0 2 5 5]
[ 278 264 228 300 520 164 261 306 73 145 436 121 49 78
 76 79 5 102 164 13 6777 148 2 140 15 33 118 150]
[ 40 8 6 14 45 31 15 6 25 8 20 4 4 10
 9 20 0 12 11 0 310 250 3 8 2 3 6 7]
[ 28 0 2 2 8 4 2 2 0 4 2 0 1 2
 0 7 0 7 3 1 54 4 7 0 0 1 2 0]
[ 16 25 16 26 54 8 21 11 4 17 54 13 3 6
 6 3 0 6 14 2 505 13 0 93 0 6 9 29]
[ 10 2 0 4 14 7 3 1 1 2 2 2 0 1
 0 14 0 14 0 1 47 4 0 1 9 0 4 1]
[ 0 3 4 4 5 9 4 2 1 6 8 2 4 0
 0 7 0 1 2 0 57 3 0 7 0 137 37 0]
[ 5 9 10 25 15 16 5 3 6 42 31 14 8 1
 7 5 4 4 13 4 277 5 0 13 0 61 216 6]
[ 45 21 17 17 13 2 23 26 0 14 15 8 2 23
 6 5 1 9 4 2 229 2 0 7 1 0 5 224]]

```

Classification-report:

```
CPU times: total: 18min 37s
Wall time: 46min 57s
best parameters for emotions {'activation': 'relu', 'hidden_layer_sizes': (30, 50), 'max_iter': 7, 'solver': 'adam'}
precision    recall  f1-score   support

   admiration    0.46    0.56    0.51    2089
    amusement    0.49    0.57    0.52    1198
        anger    0.30    0.30    0.30     999
    annoyance    0.20    0.13    0.16    1689
    approval    0.27    0.14    0.19    2231
        caring    0.27    0.18    0.21     716
    confusion    0.27    0.19    0.22     934
    curiosity    0.35    0.31    0.33    1181
        desire    0.31    0.28    0.30     450
disappointment    0.19    0.12    0.15     950
   disapproval    0.23    0.21    0.22    1585
        disgust    0.32    0.21    0.26     622
   embarrassment    0.28    0.20    0.23     283
    excitement    0.28    0.17    0.21     600
        fear    0.40    0.42    0.41     364
    gratitude    0.75    0.76    0.76    1409
        grief    0.00    0.00    0.00       75
        joy    0.32    0.29    0.31     892
        love    0.52    0.59    0.55     952
   nervousness    0.07    0.03    0.04     147
        neutral    0.46    0.62    0.53    11045
    optimism    0.37    0.28    0.32     877
        pride    0.42    0.06    0.10     143
   realization    0.24    0.09    0.13     960
        relief    0.16    0.06    0.08     144
        remorse    0.38    0.46    0.42     303
        sadness    0.36    0.26    0.31     805
        surprise    0.33    0.28    0.30     721

 accuracy          0.41    34364
  macro avg    0.32    0.28    0.29    34364
  weighted avg    0.38    0.41    0.39    34364
```

This is multi-layered perceptron classifier with gridsearchCV

With hyperparameter list of activation: ('relu','identity','logistic','tanh'),
'hidden_layer_sizes':((30,50),(10,10,10)), 'solver':('adam','sgd')

Best Hyperparameters:

1. activation: logistic
2. network architectures: 2 hidden layers with 3, 50 nodes
3. Adam solver

It runs for sentiment.

Classification-report:

```
CPU times: total: 18min 34s
Wall time: 46min 52s
best parameters for sentiment {'activation': 'logistic', 'hidden_layer_sizes': (30, 50), 'max_iter': 7, 'solver': 'adam'}
precision    recall  f1-score   support

   ambiguous    0.42    0.32    0.36    3796
    negative    0.56    0.51    0.53    7822
        neutral    0.50    0.55    0.52   11045
    positive    0.66    0.70    0.68   11701

 accuracy          0.56    34364
  macro avg    0.54    0.52    0.53    34364
  weighted avg    0.56    0.56    0.56    34364
```

Q3:

1. Base-MLP

This is the multilayer perceptron classifier with default parameters.

It runs on the embedding of Reddit posts for emotion.

Classification-report:

	precision	recall	f1-score	support
admiration	0.00	0.00	0.00	2089
amusement	0.00	0.00	0.00	1195
anger	0.00	0.00	0.00	998
annoyance	0.00	0.00	0.00	1688
approval	0.00	0.00	0.00	2230
caring	0.00	0.00	0.00	716
confusion	0.00	0.00	0.00	934
curiosity	0.00	0.00	0.00	1180
desire	0.00	0.00	0.00	450
disappointment	0.00	0.00	0.00	950
disapproval	0.00	0.00	0.00	1585
disgust	0.00	0.00	0.00	621
embarrassment	0.00	0.00	0.00	283
excitement	0.00	0.00	0.00	600
fear	0.00	0.00	0.00	364
gratitude	0.21	0.00	0.01	1409
grief	0.00	0.00	0.00	75
joy	0.00	0.00	0.00	891
love	0.00	0.00	0.00	952
nervousness	0.00	0.00	0.00	147
neutral	0.32	1.00	0.49	11035
optimism	0.00	0.00	0.00	877
pride	0.00	0.00	0.00	143
realization	0.00	0.00	0.00	960
relief	0.00	0.00	0.00	144
remorse	0.00	0.00	0.00	303
sadness	0.00	0.00	0.00	805
surprise	0.00	0.00	0.00	721
accuracy			0.32	34345
macro avg	0.02	0.04	0.02	34345
weighted avg	0.11	0.32	0.16	34345

This is the multilayer perceptron classifier with default parameters.

It runs on the embedding of Reddit posts for sentiment.

Classification-report:

	precision	recall	f1-score	support
ambiguous	0.00	0.00	0.00	3795
negative	0.00	0.00	0.00	7819
neutral	0.36	0.24	0.29	11035
positive	0.35	0.81	0.49	11696
accuracy			0.35	34345
macro avg	0.18	0.26	0.19	34345
weighted avg	0.23	0.35	0.26	34345

2. Top-MLP

This is a multilayer perceptron classifier with hyperparameters:

1. Activation: identity

2. hidden_layer_sizes: (30, 50)

3. solver: adam

It runs on embedding of Redit posts for emotion:

Classification-report:

	precision	recall	f1-score	support
admiration	0.00	0.00	0.00	2089
amusement	0.00	0.00	0.00	1195
anger	0.00	0.00	0.00	998
annoyance	0.00	0.00	0.00	1688
approval	0.00	0.00	0.00	2230
caring	0.00	0.00	0.00	716
confusion	0.00	0.00	0.00	934
curiosity	0.00	0.00	0.00	1180
desire	0.00	0.00	0.00	450
disappointment	0.00	0.00	0.00	950
disapproval	0.00	0.00	0.00	1585
disgust	0.00	0.00	0.00	621
embarrassment	0.00	0.00	0.00	283
excitement	0.00	0.00	0.00	600
fear	0.00	0.00	0.00	364
gratitude	0.19	0.00	0.01	1409
grief	0.00	0.00	0.00	75
joy	0.00	0.00	0.00	891
love	0.00	0.00	0.00	952
nervousness	0.00	0.00	0.00	147
neutral	0.32	1.00	0.49	11035
optimism	0.00	0.00	0.00	877
pride	0.00	0.00	0.00	143
realization	0.00	0.00	0.00	960
relief	0.00	0.00	0.00	144
remorse	0.00	0.00	0.00	303
sadness	0.00	0.00	0.00	805
surprise	0.00	0.00	0.00	721
accuracy			0.32	34345
macro avg	0.02	0.04	0.02	34345
weighted avg	0.11	0.32	0.16	34345

This is a multilayer perceptron classifier with hyperparameters:

1. Activation: identity

2. hidden_layer_sizes: (30, 50)

3. solver: adam

It runs on embedding of Redit posts for sentiment:

Classification-report:

	precision	recall	f1-score	support
ambiguous	0.00	0.00	0.00	3795
negative	0.00	0.00	0.00	7819
neutral	0.35	0.33	0.34	11035
positive	0.35	0.72	0.47	11696
accuracy			0.35	34345
macro avg	0.18	0.26	0.20	34345
weighted avg	0.23	0.35	0.27	34345