```
/usr/bin/python3 /Users/yiningxiang/PycharmProjects/CorrineAndJessica/A2/analysis_with_bonus.py
/Users/yiningxiang/Library/Python/3.9/lib/python/site-packages/urllib3/__init__.py:35: NotOpenSSLWarning: urllib3 v2 only supports OpenSSL 1.1.1+, currently the 'ssl' module is compiled with 'LibreSSL 2.8.3'. See: https://github.com/urllib3/urllib3/issues/3020
  warnings.warn(
============================================================
BONUS - Both Binary and Multi-class Sentiment Analysis
============================================================

============================================================
TRAINING BINARY SENTIMENT MODEL
============================================================
/Users/yiningxiang/Library/Python/3.9/lib/python/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - accuracy: 0.7738 - loss: 0.5313 - val_accuracy: 0.8700 - val_loss: 0.3304
Epoch 2/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8624 - loss: 0.3343 - val_accuracy: 0.8800 - val_loss: 0.2973
Epoch 3/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - accuracy: 0.8856 - loss: 0.2813 - val_accuracy: 0.8950 - val_loss: 0.2543
```

```
Epoch 4/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.9224 - loss: 0.2097 - val_accuracy: 0.9000 - val_loss: 0.2508
Epoch 5/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.9515 - loss: 0.1396 - val_accuracy: 0.8910 - val_loss: 0.2891
Epoch 6/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.9701 - loss: 0.0922 - val_accuracy: 0.8790 - val_loss: 0.3477
Epoch 7/10
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - accuracy: 0.9796 - loss: 0.0632 - val_accuracy: 0.8910 - val_loss: 0.3788
Epoch 7: early stopping
Restoring model weights from the end of the best epoch: 4.
Binary model - Validation accuracy: 0.9000
32/32 ━━━━━━━━━━━━━━━━━━━━ 0s 989us/step

Binary Classification Report (Validation):
              precision    recall  f1-score   support

    Negative       0.79      0.76      0.77       225
    Positive       0.93      0.94      0.94       775

    accuracy                           0.90      1000
   macro avg       0.86      0.85      0.85      1000
weighted avg       0.90      0.90      0.90      1000


================================================================================
```

```
TRAINING MULTI-CLASS SENTIMENT MODEL (BONUS TASK)
================================================================================
/Users/yiningxiang/Library/Python/3.9/lib/python/site-packages/keras/src/layers/core/dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
Epoch 1/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - accuracy: 0.5731 - loss: 1.3055 - val_accuracy: 0.6270 - val_loss: 0.9614
Epoch 2/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.6482 - loss: 0.9674 - val_accuracy: 0.6750 - val_loss: 0.9017
Epoch 3/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.6848 - loss: 0.8789 - val_accuracy: 0.6840 - val_loss: 0.8144
Epoch 4/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.7023 - loss: 0.7561 - val_accuracy: 0.6960 - val_loss: 0.8054
Epoch 5/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - accuracy: 0.7188 - loss: 0.6797 - val_accuracy: 0.6970 - val_loss: 0.8458
Epoch 6/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.7362 - loss: 0.6026 - val_accuracy: 0.6910 - val_loss: 0.9120
Epoch 7/15
63/63 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - accuracy: 0.7729 - loss: 0.5271 - val_accuracy: 0.6940 - val_loss: 0.9605
Epoch 7: early stopping
Restoring model weights from the end of the best
```

```
63 epoch: 4.
64 Multi-class model - Validation accuracy: 0.6960
65 32/32 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step
66
67 Multi-class Classification Report (Validation):
68               precision    recall  f1-score
   support
69
70      Score 1       0.44      0.79      0.57
   101
71      Score 2       0.00      0.00      0.00
           49
72      Score 3       0.25      0.01      0.03
           75
73      Score 4       0.38      0.03      0.06
   148
74      Score 5       0.76      0.97      0.85
   627
75
76     accuracy                           0.70
   1000
77    macro avg       0.37      0.36      0.30
   1000
78 weighted avg       0.60      0.70      0.60
   1000
79
80 /Users/yiningxiang/Library/Python/3.9/lib/python/
   site-packages/sklearn/metrics/_classification.py:
   1565: UndefinedMetricWarning: Precision is ill-
   defined and being set to 0.0 in labels with no
   predicted samples. Use `zero_division` parameter
   to control this behavior.
81   _warn_prf(average, modifier, f"{metric.
   capitalize()} is", len(result))
82 /Users/yiningxiang/Library/Python/3.9/lib/python/
   site-packages/sklearn/metrics/_classification.py:
   1565: UndefinedMetricWarning: Precision is ill-
   defined and being set to 0.0 in labels with no
   predicted samples. Use `zero_division` parameter
   to control this behavior.
83   _warn_prf(average, modifier, f"{metric.
```

```
 83 capitalize()} is", len(result))
 84 /Users/yiningxiang/Library/Python/3.9/lib/python/
    site-packages/sklearn/metrics/_classification.py:
    1565: UndefinedMetricWarning: Precision is ill-
    defined and being set to 0.0 in labels with no
    predicted samples. Use `zero_division` parameter
    to control this behavior.
 85   _warn_prf(average, modifier, f"{metric.
    capitalize()} is", len(result))
 86
 87 ================================================
    ==============================
 88 GENERATING PREDICTIONS FOR TEST DATA
 89 ================================================
    ==============================
 90 16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 849us/step
 91 16/16 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step
 92
 93 Binary predictions saved to '
    Bonus_Team6predictions.txt'
 94 Multi-class predictions saved to '
    Bonus_Team6multiclass_predictions.txt'
 95
 96 Binary prediction summary:
 97 Total predictions: 500
 98 Positive reviews predicted: 374 (74.80%)
 99 Negative reviews predicted: 126 (25.20%)
100
101 Multi-class prediction summary:
102 Score 1: 117 reviews (23.40%)
103 Score 2: 0 reviews (0.00%)
104 Score 3: 1 reviews (0.20%)
105 Score 4: 10 reviews (2.00%)
106 Score 5: 372 reviews (74.40%)
107
108 ================================================
    ==============================
109 BUSINESS INSIGHTS ANALYSIS
110 ================================================
    ==============================
111 Analyzing 1154 negative reviews...
```

```
112
113 1. Most frequent words in negative reviews:
114    not: 2183
115    like: 635
116    taste: 598
117    product: 520
118    would: 462
119    flavor: 428
120    good: 422
121    one: 405
122    food: 307
123    chip: 302
124    coffee: 263
125    tea: 253
126    bag: 249
127    get: 241
128    better: 238
129    much: 236
130    even: 218
131    make: 216
132
133 2. Most common phrases in negative reviews:
134    'taste like': 83
135    'not good': 81
136    'would not': 79
137    'not buy': 63
138    'could not': 60
139    'not like': 54
140    'not bad': 49
141    'not taste': 45
142    'taste not': 40
143    'dog food': 40
144    'hot cocoa': 40
145    'hot chocolate': 40
146    'not even': 39
147    'not know': 38
148    'flavor not': 37
149    'not sure': 36
150    'not get': 36
151    'much better': 36
152    'potato chip': 35
```

```
    'grocery store': 35

Average VADER compound score for negative reviews
    : 0.0972

VADER compound score statistics by Score:
            mean       std
Score
1     -0.082671  0.436524
2      0.125068  0.397358
3      0.290352  0.392499
4      0.561080  0.266410
5      0.633974  0.230690

Process finished with exit code 0

```