Scoring_the_models

December 13, 2020

[1]:
```
%load_ext autoreload
%autoreload 2
```

---

1 Imports

[18]:
```
import pandas as pd
import numpy as np

from deep4deep.utils_w2v_rnn import make_X_check2, my_metrics
```

---

2 Preparing data for scoring

The files "results.csv" have been obtained by running the demo function, in the "**main**", of trainer.py:

```
python -m deep4deep.trainer
```

with the needed local files of data

[4]:
```
# reading the NLP results
my_path = "../raw_data/data_cross_val/"
results_1 = pd.read_csv(my_path+"results_1.csv")
results_2 = pd.read_csv(my_path+"results_2.csv")
results_3 = pd.read_csv(my_path+"results_3.csv")
```

[5]:
```
results_1.head(3)
```

[5]:

	id	name	target	y_pred_NLP
0	890957	Swile (ex-Lunchr)	0.0	0.185844
1	908268	Imcheck Therapeutics	1.0	0.716118
2	867275	Kemwatt	1.0	0.932568

[6]:
```
# Adding the main model predictions on the same three sets
main_model_path = "../raw_data/data_cross_val/y_pred_(RandomForest)/"
```

```
y_pred_forest_1 = pd.read_csv(main_model_path+"y_pred1.csv")
y_pred_forest_2 = pd.read_csv(main_model_path+"y_pred2.csv")
y_pred_forest_3 = pd.read_csv(main_model_path+"y_pred3.csv")
```

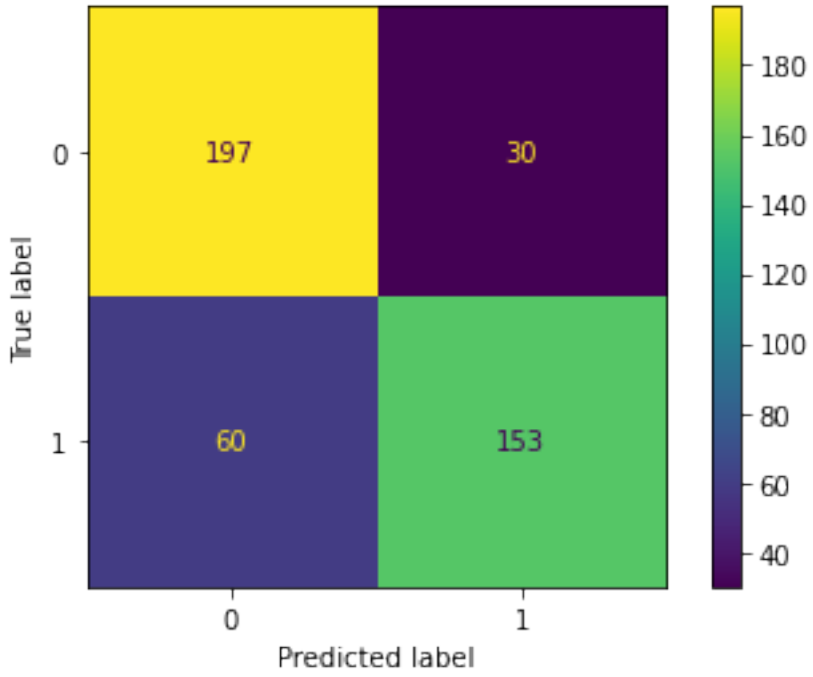
[7]:
```
# '1' is just the name of the column with probability of is_deeptech being 1, i.
 ↪e. True
results_1['y_pred_forest'] = y_pred_forest_1['1']
results_2['y_pred_forest'] = y_pred_forest_2['1']
results_3['y_pred_forest'] = y_pred_forest_3['1']
```

---

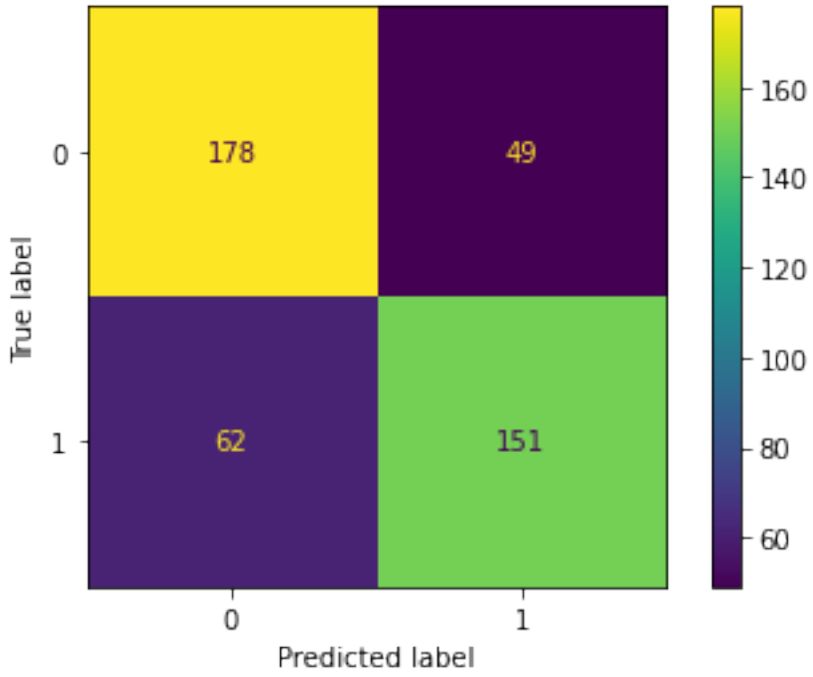
3 Computing the NLP only scores

[8]:
```
# using make_X_check2 function to compute metrics and convert a float to binary
# here y_pred_binary refers to the NLP prediction
NLP_d1 = my_metrics(make_X_check2(results_1, name_for_y_pred='y_pred_NLP'))
NLP_d2 = my_metrics(make_X_check2(results_2, name_for_y_pred='y_pred_NLP'))
NLP_d3 = my_metrics(make_X_check2(results_3, name_for_y_pred='y_pred_NLP'))

# the make_X_check2 function displays the metrics and the confusion matrix for␣
 ↪each of its run, on top of returning
# a dictionnary of metrics. Hiding ouput for subsequent runs
```

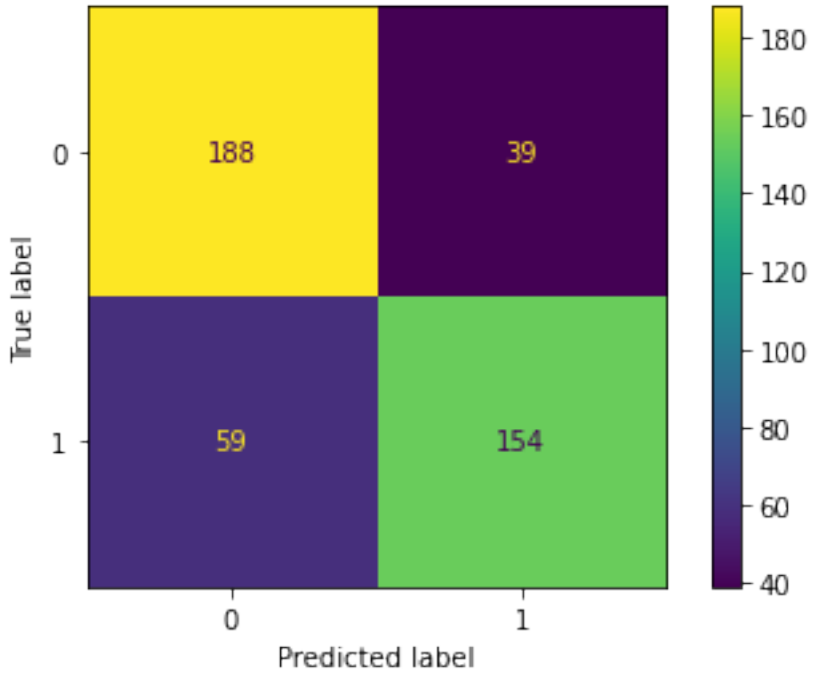
```
accuracy: 79.55 %
precision: 83.61 %
recall: 71.83 %
f1: 77.27 %
Confusion matrix
```




```
80.0    84.0    72.0    77.0
accuracy: 74.77 %
precision: 75.50 %
recall: 70.89 %
f1: 73.12 %
Confusion matrix
```




```
75.0    76.0    71.0    73.0
accuracy: 77.73 %
precision: 79.79 %
recall: 72.30 %
f1: 75.86 %
Confusion matrix
```



78.0 80.0 72.0 76.0

[9]:
```
results_1.head(3)
```

[9]:

	id	name	target	y_pred_NLP	y_pred_forest	y_pred_binary	TP	TN	FP	FN
0	890957	Swile (ex-Lunchr)	0.0	0.185844	0.22	0	False	True	False	False
1	908268	Imcheck Therapeutics	1.0	0.716118	0.99	1	True	False	False	False
2	867275	Kemwatt	1.0	0.932568	0.69	1	True	False	False	False

Average precision over 3 NLP runs:

[10]:
```
sum([NLP_d1['precision'],NLP_d2['precision'],NLP_d3['precision']])/3
# this figure was 83% using the NLP model training on the last day of the␣
 ↪project, but went slightly lower after
# a retraining (which is normal as it depends on the random split used)
# ultimately a retraining on the full dataset should maintain or increase the␣
 ↪performance
```

[10]: 0.7963310116367962

Average recall over 3 NLP runs:

[11]:
```
# Recall
sum([NLP_d1['recall'],NLP_d2['recall'],NLP_d3['recall']])/3
```

[11]:
```
0.7167449139280127
```

[12]:
```
# Saving NLP processed results to disk
results_1.to_csv(my_path+"NLP_results_1.csv", index=False)
results_2.to_csv(my_path+"NLP_results_2.csv", index=False)
results_3.to_csv(my_path+"NLP_results_3.csv", index=False)
```

[13]:
```
# Dropping the columns that were created and used for NLP scoring
results_1.drop(columns=['TP','TN','FP','FN', 'y_pred_binary'], inplace=True)
results_2.drop(columns=['TP','TN','FP','FN', 'y_pred_binary'], inplace=True)
results_3.drop(columns=['TP','TN','FP','FN', 'y_pred_binary'], inplace=True)
```

---

4 Making the two models "vote" and computing general scores

[15]:
```
results_1.head(3)
```

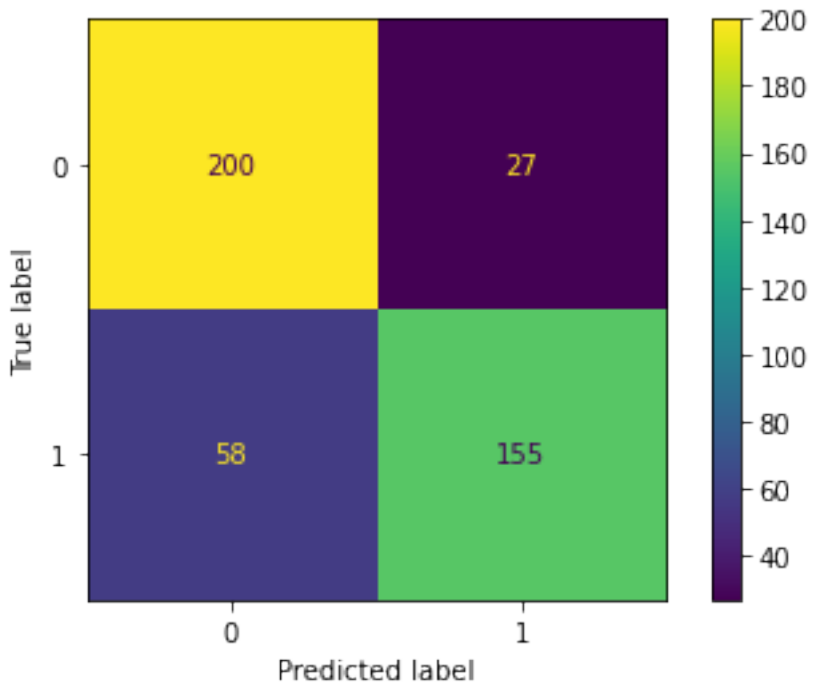
[15]:

	id	name	target	y_pred_NLP	y_pred_forest
0	890957	Swile (ex-Lunchr)	0.0	0.185844	0.22
1	908268	Imcheck Therapeutics	1.0	0.716118	0.99
2	867275	Kemwatt	1.0	0.932568	0.69

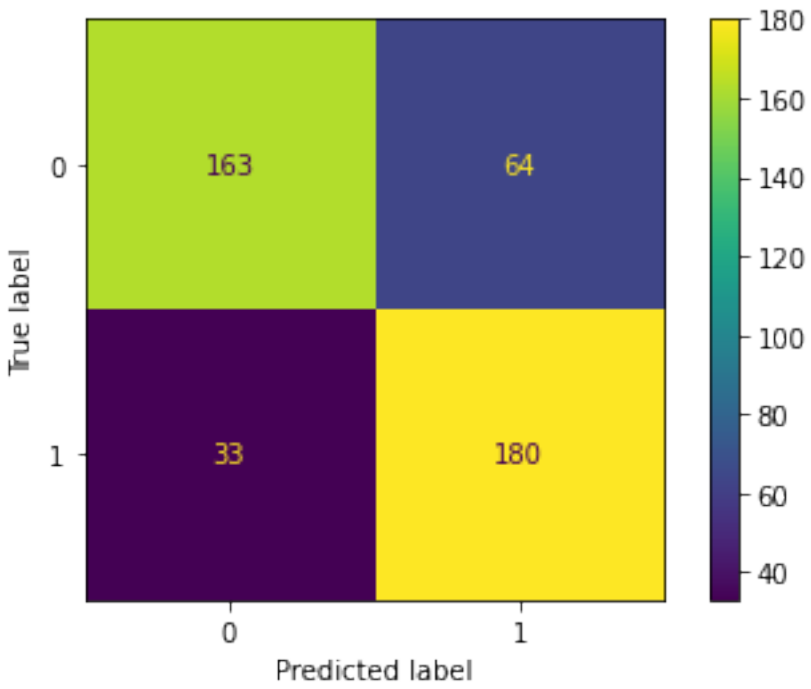
[16]:
```
# the take_measure function uses the given function as 'voting strategy'
# and only takes the main model's prediction if there is no text for NLP to␣
 ↪vote
#(=NLP dataset has "NaN" for the company)

def take_measure(row, function):
    if row['y_pred_NLP'] == np.nan:
        return row['y_pred_forest']
    if function == 'mean':
        return row[['y_pred_forest','y_pred_NLP']].mean()
    if function == 'min':
        return row[['y_pred_forest','y_pred_NLP']].min()
    if function == 'max':
        return row[['y_pred_forest','y_pred_NLP']].max()
    else:
        print("not a known function")
    return None
```

[22]:
```
threshold = 0.5

# using the function for the "voting"
# then using the threhsold to convert to a "is_deeptech" yes or no prediction
results_1['y_pred_common_mean'] = results_1.apply(lambda x: take_measure(x,␣
↪'mean'), axis=1)
results_1['y_pred_common_mean_binary'] = [1 if item >threshold else 0 for item␣
↪in results_1.y_pred_common_mean]

results_1['y_pred_common_max'] = results_1.apply(lambda x: take_measure(x,␣
↪'max'), axis=1)
results_1['y_pred_common_max_binary'] = [1 if item >threshold else 0 for item␣
↪in results_1.y_pred_common_max]

results_1['y_pred_common_min'] = results_1.apply(lambda x: take_measure(x,␣
↪'min'), axis=1)
results_1['y_pred_common_min_binary'] = [1 if item >threshold else 0 for item␣
↪in results_1.y_pred_common_min]

common_mean_d1 = my_metrics(make_X_check2(results_1,␣
↪name_for_y_pred='y_pred_common_mean_binary'))
common_max_d1 = my_metrics(make_X_check2(results_1,␣
↪name_for_y_pred='y_pred_common_max_binary'))
common_min_d1 = my_metrics(make_X_check2(results_1,␣
↪name_for_y_pred='y_pred_common_min_binary'))

results_1.drop(columns=['y_pred_binary'], inplace=True)
```

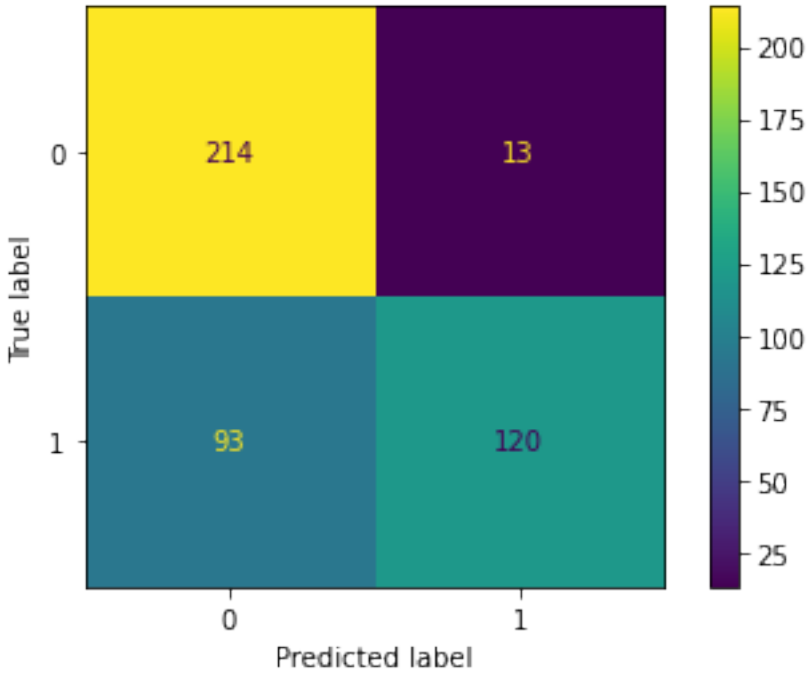
```
accuracy: 80.68 %
precision: 85.16 %
recall: 72.77 %
f1: 78.48 %
Confusion matrix
```




```
81.0    85.0    73.0    78.0
accuracy: 77.95 %
precision: 73.77 %
recall: 84.51 %
f1: 78.77 %
Confusion matrix
```




```
78.0    74.0    85.0    79.0
accuracy: 75.91 %
precision: 90.23 %
recall: 56.34 %
f1: 69.36 %
Confusion matrix
```



76.0 90.0 56.0 69.0

[23]:
```
# What "results" look like by now (transposed for legibility)
results_1.head(3).T
#
```

[23]:

	0	1	2
id	890957	908268	867275
name	Swile (ex-Lunchr)	Imcheck Therapeutics	Kemwatt
target	0	1	1
y_pred_NLP	0.185844	0.716118	0.932568
y_pred_forest	0.22	0.99	0.69
y_pred_common_mean	0.202922	0.853059	0.811284
y_pred_common_mean_binary	0	1	1
y_pred_common_max	0.22	0.99	0.932568
y_pred_common_max_binary	0	1	1
y_pred_common_min	0.185844	0.716118	0.69
y_pred_common_min_binary	0	1	1
TP	False	True	True
TN	True	False	False
FP	False	False	False
FN	False	False	False

[28]:
```
print("Classification success metrics for run 1, using each of the 3 voting␣
 ↪strategies, mean, max and min:")
```

```
common_mean_d1, common_max_d1, common_min_d1
```

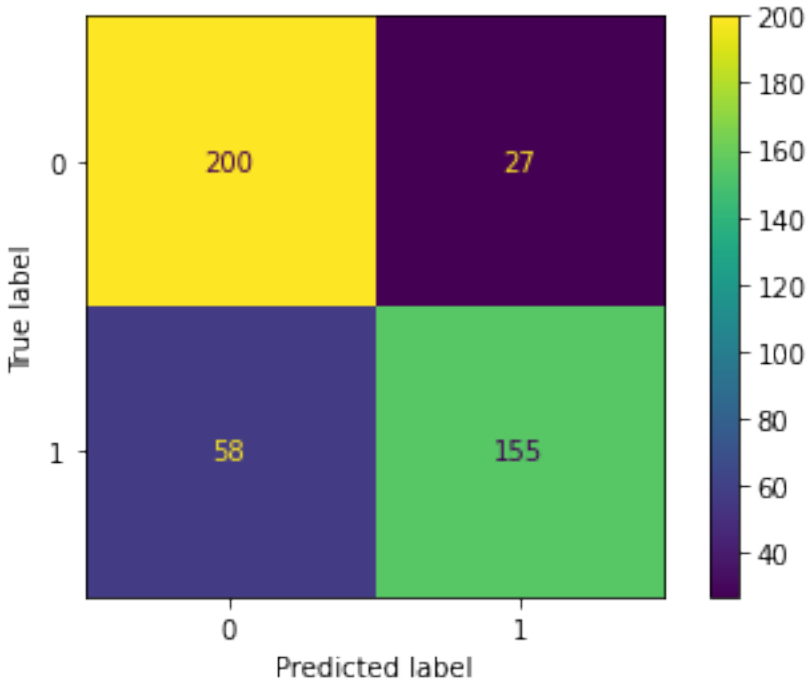
Classification success metrics for run 1, using each of the 3 voting strategies, mean, max and min:

[28]:
```
({'accuracy': 0.8068181818181818,
  'precision': 0.8516483516483516,
  'recall': 0.7276995305164319,
  'f1': 0.7848101265822784},
 {'accuracy': 0.7795454545454545,
  'precision': 0.7377049180327869,
  'recall': 0.8450704225352113,
  'f1': 0.787746170678337},
 {'accuracy': 0.759090909090909,
  'precision': 0.9022556390977443,
  'recall': 0.5633802816901409,
  'f1': 0.6936416184971097})
```

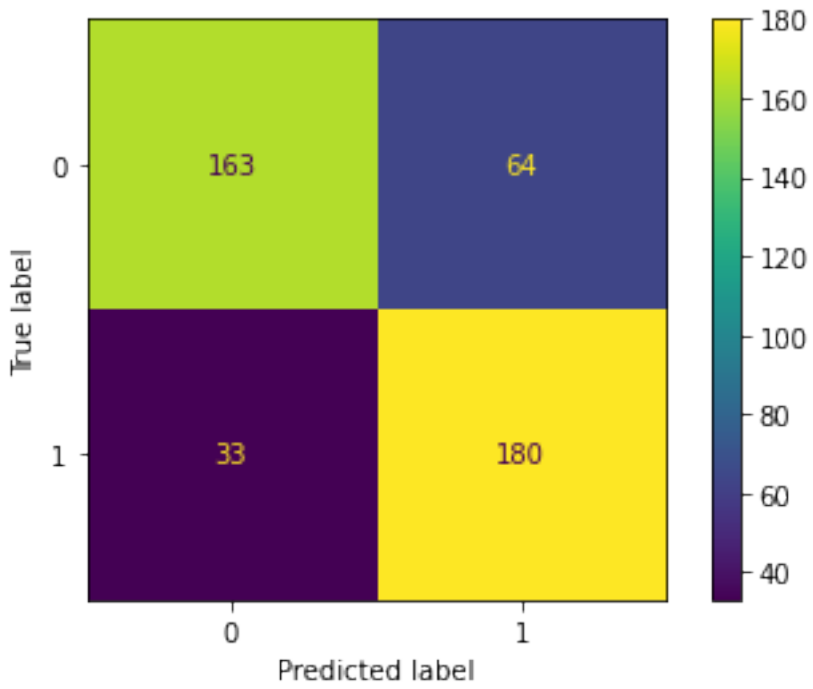
[34]:
```
threshold = 0.5
results_2['y_pred_common_mean'] = results_1.apply(lambda x: take_measure(x,␣
↪'mean'), axis=1)
results_2['y_pred_common_mean_binary'] = [1 if item >threshold else 0 for item␣
↪in results_1.y_pred_common_mean]

results_2['y_pred_common_max'] = results_1.apply(lambda x: take_measure(x,␣
↪'max'), axis=1)
results_2['y_pred_common_max_binary'] = [1 if item >threshold else 0 for item␣
↪in results_1.y_pred_common_max]

results_2['y_pred_common_min'] = results_1.apply(lambda x: take_measure(x,␣
↪'min'), axis=1)
results_2['y_pred_common_min_binary'] = [1 if item >threshold else 0 for item␣
↪in results_1.y_pred_common_min]

common_mean_d2 = my_metrics(make_X_check2(results_1,␣
↪name_for_y_pred='y_pred_common_mean_binary'))
common_max_d2 = my_metrics(make_X_check2(results_1,␣
↪name_for_y_pred='y_pred_common_max_binary'))
common_min_d2 = my_metrics(make_X_check2(results_1,␣
↪name_for_y_pred='y_pred_common_min_binary'))

results_2.drop(columns=['y_pred_binary'], inplace=True)
```

```
accuracy: 80.68 %
precision: 85.16 %
recall: 72.77 %
f1: 78.48 %
```

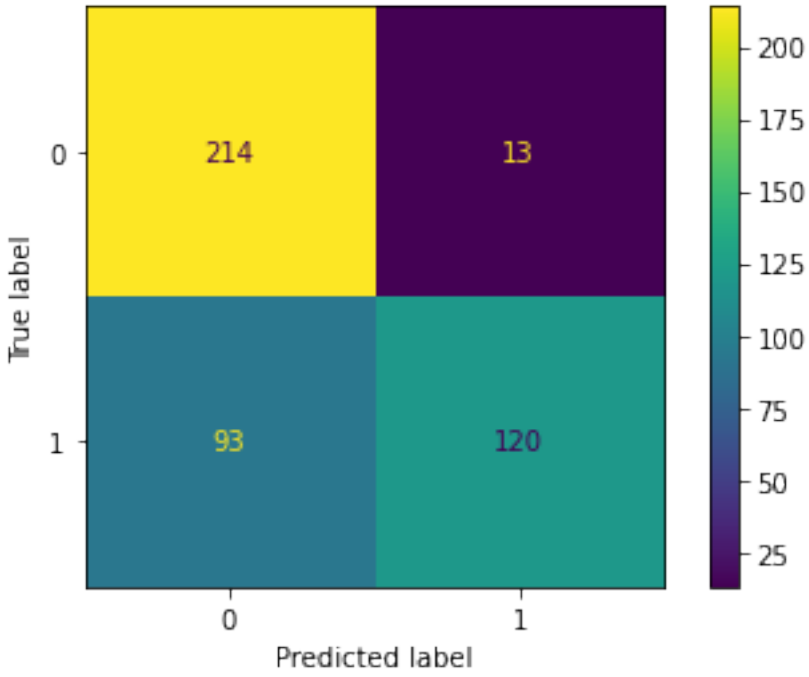
```
Confusion matrix
```




```
81.0    85.0    73.0    78.0
accuracy: 77.95 %
precision: 73.77 %
recall: 84.51 %
f1: 78.77 %
Confusion matrix
```




```
78.0    74.0    85.0    79.0
accuracy: 75.91 %
precision: 90.23 %
recall: 56.34 %
f1: 69.36 %
Confusion matrix
```



76.0 90.0 56.0 69.0

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
<ipython-input-34-5bc905c0d61f> in <module>
     13 common_min_d2 = my_metrics(make_X_check2(results_1,␣
 ↪name_for_y_pred='y_pred_common_min_binary'))
     14
---> 15 results_2.drop(columns=['y_pred_binary'], inplace=True)

~/.pyenv/versions/data/envs/NLP/lib/python3.8/site-packages/pandas/core/frame.p␣
 ↪in drop(self, labels, axis, index, columns, level, inplace, errors)
   4165                 weight  1.0     0.8
   4166         """
-> 4167         return super().drop(
   4168             labels=labels,
   4169             axis=axis,

~/.pyenv/versions/data/envs/NLP/lib/python3.8/site-packages/pandas/core/generic
 ↪py in drop(self, labels, axis, index, columns, level, inplace, errors)
   3885         for axis, labels in axes.items():
   3886             if labels is not None:
-> 3887                 obj = obj._drop_axis(labels, axis, level=level,␣
 ↪errors=errors)
```

```
   3888
   3889         if inplace:

~/.pyenv/versions/data/envs/NLP/lib/python3.8/site-packages/pandas/core/generic
 ↪py in _drop_axis(self, labels, axis, level, errors)
   3919                 new_axis = axis.drop(labels, level=level, errors=errors
   3920             else:
-> 3921                 new_axis = axis.drop(labels, errors=errors)
   3922             result = self.reindex(**{axis_name: new_axis})
   3923

~/.pyenv/versions/data/envs/NLP/lib/python3.8/site-packages/pandas/core/indexes
 ↪base.py in drop(self, labels, errors)
   5282         if mask.any():
   5283             if errors != "ignore":
-> 5284                 raise KeyError(f"{labels[mask]} not found in axis")
   5285             indexer = indexer[~mask]
   5286         return self.delete(indexer)

KeyError: "['y_pred_binary'] not found in axis"
```

[35]:
```
print("Classification success metrics for run 2:")
common_mean_d2, common_max_d2, common_min_d2
```

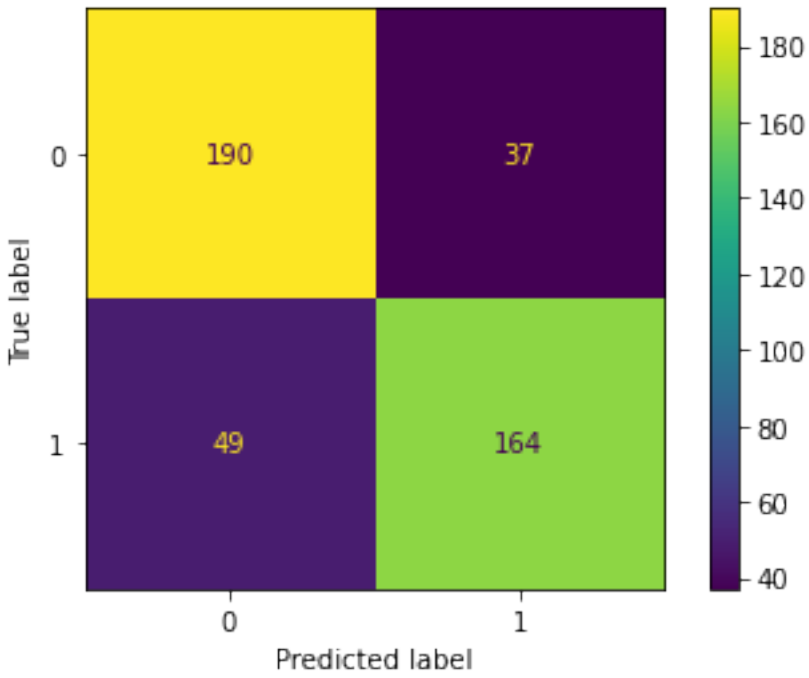
```
Classification success metrics for run 2:
```

[35]:
```
({'accuracy': 0.8068181818181818,
  'precision': 0.8516483516483516,
  'recall': 0.7276995305164319,
  'f1': 0.7848101265822784},
 {'accuracy': 0.7795454545454545,
  'precision': 0.7377049180327869,
  'recall': 0.8450704225352113,
  'f1': 0.787746170678337},
 {'accuracy': 0.759090909090909,
  'precision': 0.9022556390977443,
  'recall': 0.5633802816901409,
  'f1': 0.6936416184971097})
```

[36]:
```
threshold = 0.5
results_3['y_pred_common_mean'] = results_3.apply(lambda x: take_measure(x,␣
 ↪'mean'), axis=1)
results_3['y_pred_common_mean_binary'] = [1 if item >threshold else 0 for item␣
 ↪in results_3.y_pred_common_mean]

results_3['y_pred_common_max'] = results_3.apply(lambda x: take_measure(x,␣
 ↪'max'), axis=1)
```

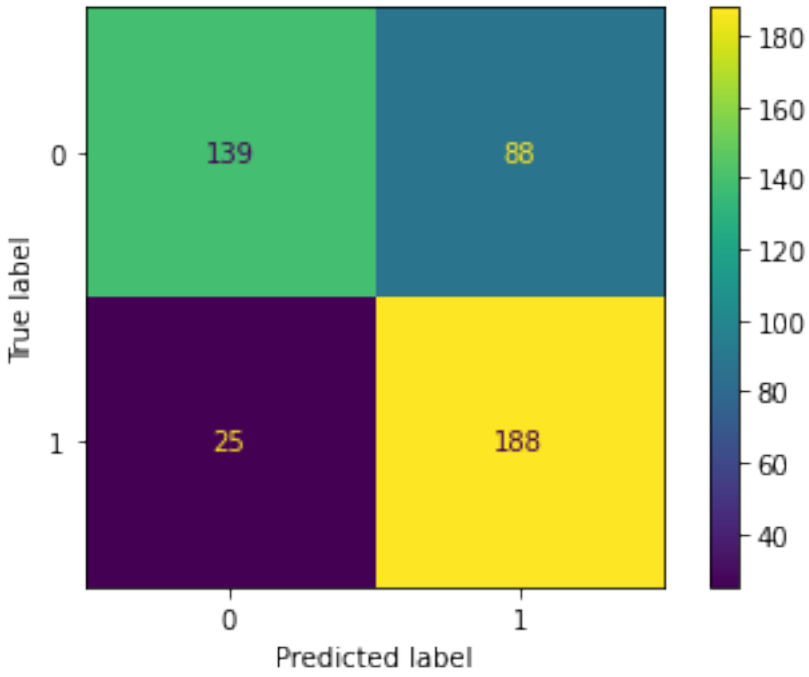
```
results_3['y_pred_common_max_binary'] = [1 if item >threshold else 0 for item␣
 ↪in results_3.y_pred_common_max]

results_3['y_pred_common_min'] = results_3.apply(lambda x: take_measure(x,␣
 ↪'min'), axis=1)
results_3['y_pred_common_min_binary'] = [1 if item >threshold else 0 for item␣
 ↪in results_3.y_pred_common_min]

common_mean_d3 = my_metrics(make_X_check2(results_3,␣
 ↪name_for_y_pred='y_pred_common_mean_binary'))
common_max_d3 = my_metrics(make_X_check2(results_3,␣
 ↪name_for_y_pred='y_pred_common_max_binary'))
common_min_d3 = my_metrics(make_X_check2(results_3,␣
 ↪name_for_y_pred='y_pred_common_min_binary'))

results_3.drop(columns=['y_pred_binary'], inplace=True)
```

```
accuracy: 80.45 %
precision: 81.59 %
recall: 77.00 %
f1: 79.23 %
Confusion matrix
```

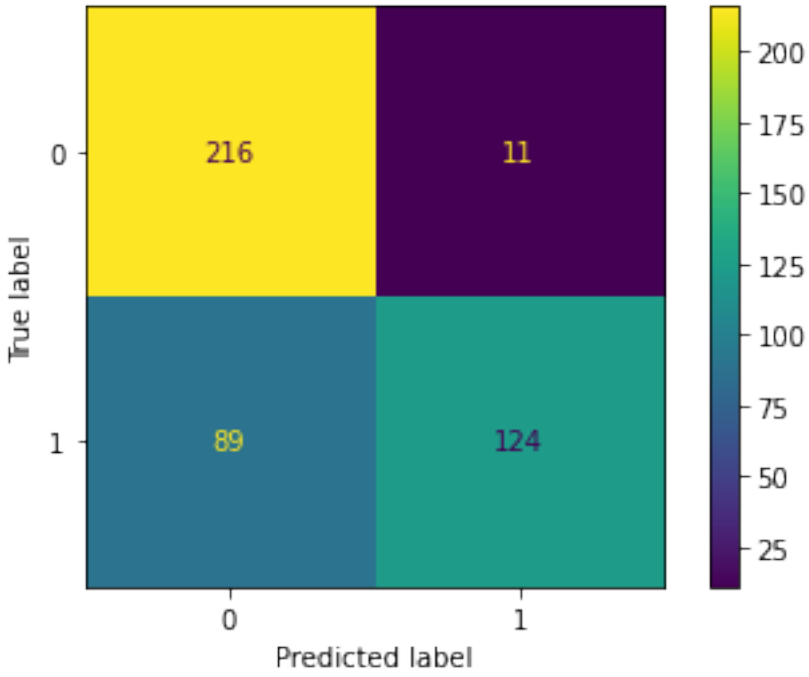



```
80.0    82.0    77.0    79.0
accuracy: 74.32 %
```

```
precision: 68.12 %
recall: 88.26 %
f1: 76.89 %
Confusion matrix
```




```
74.0    68.0    88.0    77.0
accuracy: 77.27 %
precision: 91.85 %
recall: 58.22 %
f1: 71.26 %
Confusion matrix
```




```
77.0    92.0    58.0    71.0
```

[37]:
```
print("Classification success metrics for run 3:")
common_mean_d3, common_max_d3, common_min_d3
```

```
Classification success metrics for run 3:
```

[37]:
```
({'accuracy': 0.8045454545454546,
  'precision': 0.8159203980099502,
  'recall': 0.7699530516431925,
  'f1': 0.7922705314009663},
 {'accuracy': 0.7431818181818182,
  'precision': 0.6811594202898551,
  'recall': 0.8826291079812206,
  'f1': 0.768916155419223},
 {'accuracy': 0.7727272727272727,
  'precision': 0.9185185185185185,
  'recall': 0.5821596244131455,
  'f1': 0.7126436781609196})
```

4.0.1 On the three runs, 'min' is the best 'voting approach' for maximizing precision.

Scores with 'min' used as 'voting approach' between the tow models (main model and NLP):

[38]:
```
global_precision_min =␣
↪(common_min_d1['precision']+common_min_d2['precision']+common_min_d3['precision'])/
↪3
global_precision_min
# again, the value was 91% when we did the calculation on the last day of the␣
↪project,
# it can vary slightly with repetition
```

[38]:
```
0.907676598904669
```

[39]:
```
global_recall_min =␣
↪(common_min_d1['recall']+common_min_d2['recall']+common_min_d3['recall'])/3
global_recall_min
```

[39]:
```
0.5696400625978091
```

Scores with max Max allows to maximize recall instead of precision, while mean strikes a balance

[40]:
```
global_precision_max =␣
↪(common_max_d1['precision']+common_max_d2['precision']+common_max_d3['precision'])/
↪3
global_precision_max
```

[40]:
```
0.7188564187851431
```

[41]:
```
global_recall_max =␣
↪(common_max_d1['recall']+common_max_d2['recall']+common_max_d3['recall'])/3
global_recall_max
```

[41]:
```
0.8575899843505477
```

---

[42]:
```
# Saving processed results to disk
results_1.to_csv(my_path+"voting_results_1.csv", index=False)
results_2.to_csv(my_path+"voting_results_2.csv", index=False)
results_3.to_csv(my_path+"voting_results_3.csv", index=False)
```