2022 Summer ELG 5142 Ubiquitous Sensing and Smart City Assignment Two

Professor: Dr. Burak Kantarci

Teaching Assistant: Zhiyan Chen, Email: zchen241@uottawa.ca

Reem Abdel-salam, Email: reem.abdelsalam13@gmail.com

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Assignment two is based on machine learning (ML) approaches to identify fake tasks. An ensemble framework is required to implemented as showing in the Figure 1. The ensemble framework has an aggregator and three base estimators including random forest (RF), Adaboost, and NaiveBayes (NB). Aggregator module is to make final decision based on:

1. majority voting rule. For example, for tasks_i, RF estimates it as fake; Adaboost estimates it as legitimate; NB predicts it as legitimate; aggregator decision is legitimate since two MLs estimation results are legitimate for task_i.
2. Weighted sum of the classifier decisions. For example,

   Training accuracy of RF is X

   Training accuracy of Adaboost is Y

   Training accuracy of Naïve Bayes is Z

   w_{RF} = X/(X+Y+Z)

   $w_{Adaboost}$ = Y/(X+Y+Z)

   w_{NB} = Z/(X+Y+Z)

   Prediction of Adaboost = $P_{Adaboost}$

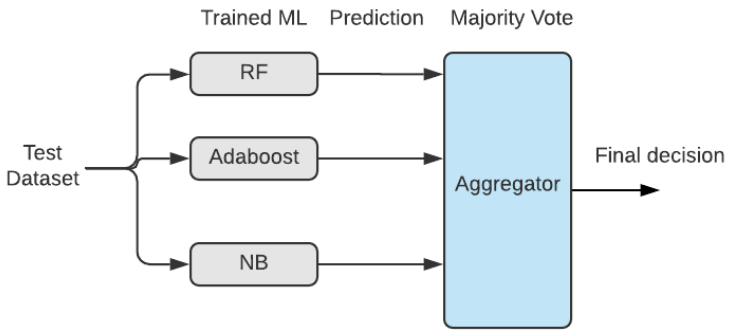
   Prediction of RF= P_{RF}

   Prediction of NB = P_{NB}

   Aggregated output = P_{RF} * w_{RF} + P_{NB} * w_{NB} + $P_{Adaboost}$ * $w_{Adaboost}$

$$Final\ Decision = \begin{cases} 1(Legitimate) & If\ (AggregatedOutput > 0.5) \\ 0\ (Fake/Illegitimate) & Otherwise \end{cases}$$

Figure 1 Ensemble framework overview



Assignment Background

Consider this: Fake tasks are harmful for MCS platform and participants, so it is critical to identify

them and remove them. ML-based methods are widely used to detect fake tasks. Meanwhile, ensemble learning has proven to be more effective to boost performance.

Assignment Steps

1. Use the provided dataset with fake tasks and legitimate tasks for this assignment

   Dataset can be downloaded via this link (http://nextconlab.academy/MCSData/MCS-FakeTaskDetection.html)

2. Split the dataset into two for training (80%) and test (20%)

3. Train individual MLs separately using training dataset

4. Apply test dataset to get prediction results by trained MLs (e.g., RF, Adaboost, and NB)

5. Use the majority voting-based aggregator to make final decision for each task

   - Aggregator follows majority rule to make decision
   - For instance, if two models (e.g., RF and Adaboost) predict a task as legitimate, and one model (e.g., NB) predicts the task as fake, Aggregator decision is legitimate.

6. Use the weighted sum aggregation to make final decision for each task

   - Aggregator follows the following principle to make decision

   Aggregated output = P_{RF} * w_{RF} + P_{NB} * w_{NB} + $P_{Adaboost}$ * $w_{Adaboost}$

   $$\boldsymbol{Final\ Decision} = \begin{cases} \mathbf{1}(\boldsymbol{Legitimate}) & \boldsymbol{If\ (AggregatedOutput} > \mathbf{0.5}) \\ \mathbf{0}\ (\boldsymbol{Fake/Illegitimate}) & \boldsymbol{Otherwise} \end{cases}$$ See earlier explanations for further details.

7. Compare the two ensemble framework performance to each other, and with individual MLs

8. Plot a barchart figure to show accuracy comparison results

Required Sections in the assignment:

Points you need to include in your assignment report:

1. In the report, please include code, test results and accuracy comparison figure
2. Test results for RF, Adaboost, NB, and the two ensemble frameworks with following format (classification_report can be used which is shown in sample code tutorial_fake_task_detection.py)

	precision	recall	f1-score	support
class 0	0.6667	0.9091	0.7692	22
leg class 1	0.9882	0.9438	0.9655	178
accuracy			0.9400	200
macro avg	0.8275	0.9265	0.8674	200
weighted avg	0.9529	0.9400	0.9439	200

3. Comparison figure with the format as follows. Please note this figure is just illustrative; the accuracy values are not actual representation of the classifier performances: