



Figure 4: Comparison between our expectation inference method and majority voting for MLP (similar results for LR).

sults in better models for both *CyberAttack* and *PoliticianDeath*. Our manual investigation reveals that workers’ annotations are of high reliability, which explains the relatively good performance of majority voting. Despite limited margin for improvement, our method of expectation inference improves the performance of majority voting by 0.4% and 1.19% AUC on *CyberAttack* and *PoliticianDeath*, respectively.

## 5 Related Work

**Event Detection.** The techniques for event extraction from microblogging platforms can be classified according to their domain specificity and their detection method (?). Early works mainly focus on open domain event detection (?; ?; ?). Our work falls into the category of domain-specific event detection (?), which has drawn increasing attention due to its relevance for various applications such as cyber security (?; ?) and public health (?; ?). In terms of technique, our proposed detection method is related to the recently proposed weakly supervised learning methods (?; ?; ?). This comes in contrast with fully-supervised learning methods, which are often limited by the size of the training data (e.g., a few hundred examples) (?; ?).

**Human-in-the-Loop Approaches.** Our work extends weakly supervised learning methods by involving humans in the loop (?). Existing human-in-the-loop approaches mainly leverage crowds to label individual data instances (?; ?) or to debug the training data (?; ?) or components (?; ?; ?) of a machine learning system. Unlike these works, we leverage crowd workers to label sampled microposts in order to obtain keyword-specific expectations, which can then be generalized to help classify microposts containing the same keyword, thus amplifying the utility of the crowd. Our work is further connected to the topic of inter-

pretability and transparency of machine learning models (?; ?; ?), for which humans are increasingly involved, for instance for post-hoc evaluations of the model’s interpretability. In contrast, our approach directly solicits informative keywords from the crowd for model training, thereby providing human-understandable explanations for the improved model.

## 6 Conclusion

In this paper, we presented a new human-AI loop approach for keyword discovery and expectation estimation to better train event detection models. Our approach takes advantage of the disagreement between the crowd and the model to discover informative keywords and leverages the joint power of the crowd and the model in expectation inference. We evaluated our approach on real-world datasets and showed that it significantly outperforms the state of the art and that it is particularly useful for detecting events where relevant microposts are semantically complex, e.g., the death of a politician. As future work, we plan to parallelize the crowdsourcing tasks and optimize our pipeline in order to use our event detection approach in real-time.

## 7 Acknowledgements

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