WRT-1011: Models for Efficient Testing (MET)

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Research Task / Overview

MET consists of a set of measurement models, metrics, and machine-learning based models for managing efficient testing processes among distributed testing teams, consisting of:

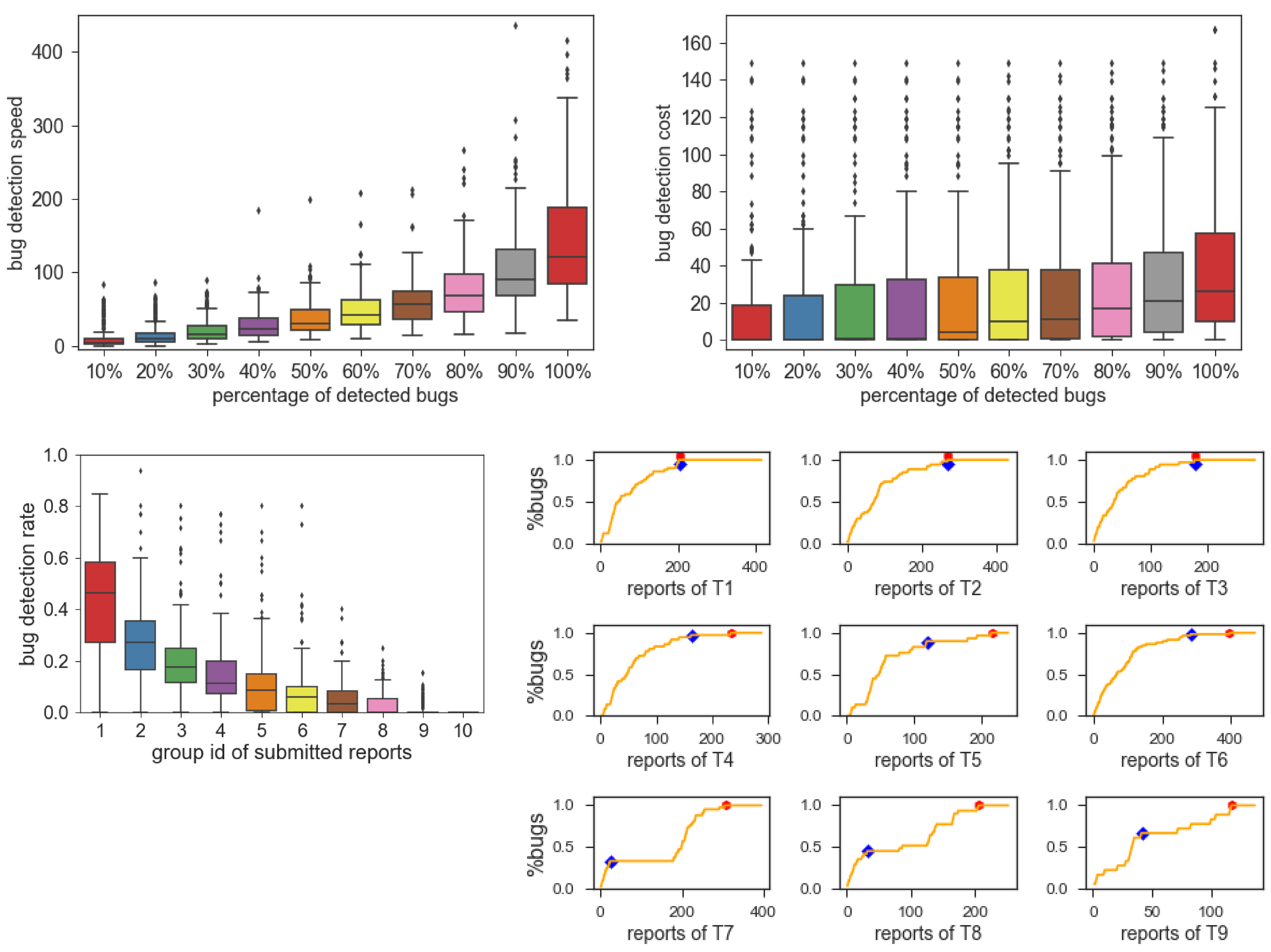
- **A testing measurement model** as well as metrics for characterizing the representative contextual factors of a testing task, the configuration profiles of distributed testing resource, and the dynamic status of testing progress;
- **A testing team formation model** leveraging various machine-learning algorithms for defect prediction, mining defect detection capability of the distributed testing teams from their historical performance data, and recommending testing team formation;
- **A testing completion prediction model** employing incremental sampling technique to dynamically monitor, aggregate testing report data from distributed teams, and measure testing progress towards completion.

Data & Analysis

A pilot study was conducted on 316 real-world mobile application testing projects from one of the largest software crowdtesting platform. The results reveals an average of 32% wasteful spending in testing cost [2].

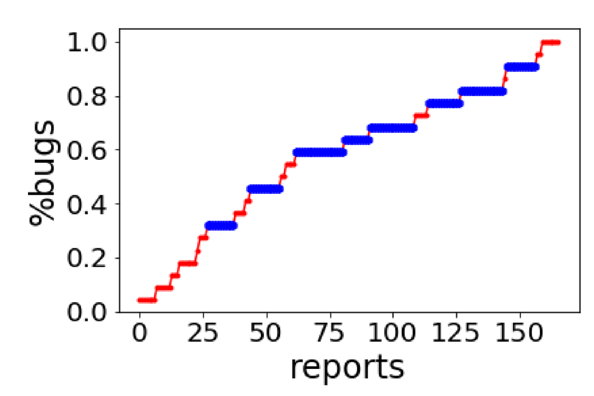
Bug Arrival Patterns:

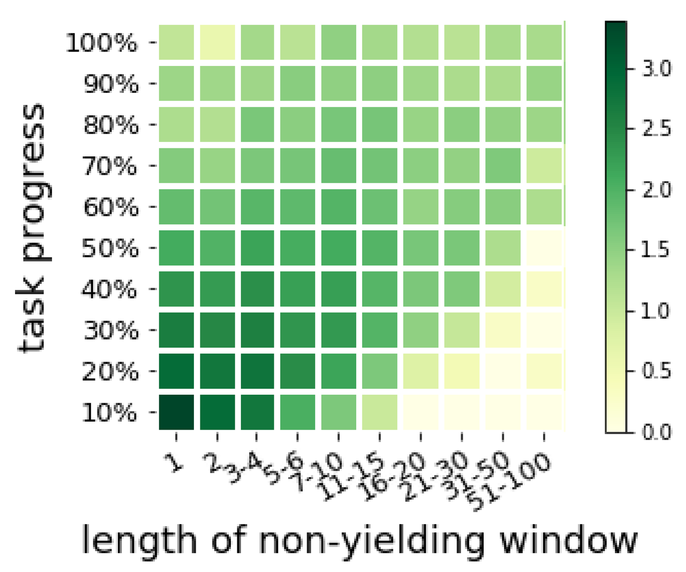
1) Large variation in bug detection speed and cost;
2) Decreasing bug detection rates over time;
3) Plateau effect of bug arrival curves (Non-yielding windows in testing processes).

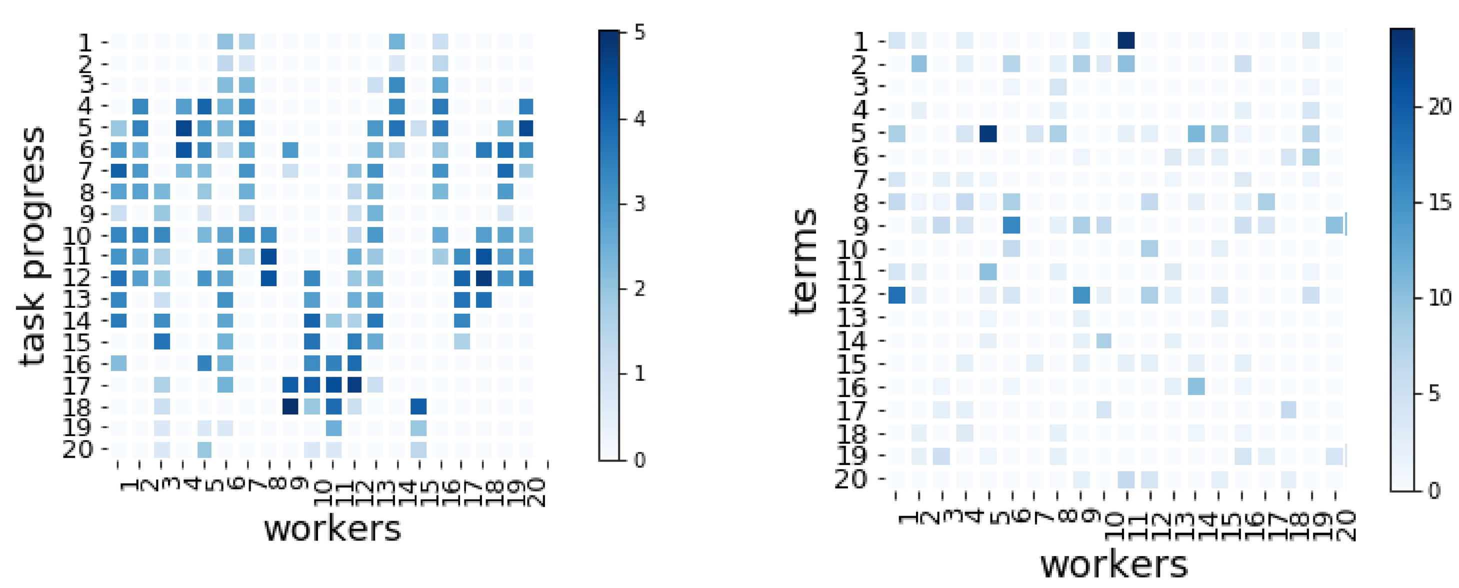


Understanding Non-Yielding Windows:

1) Frequency/intensity;
2) Tester's activeness;
3) Tester's preference.







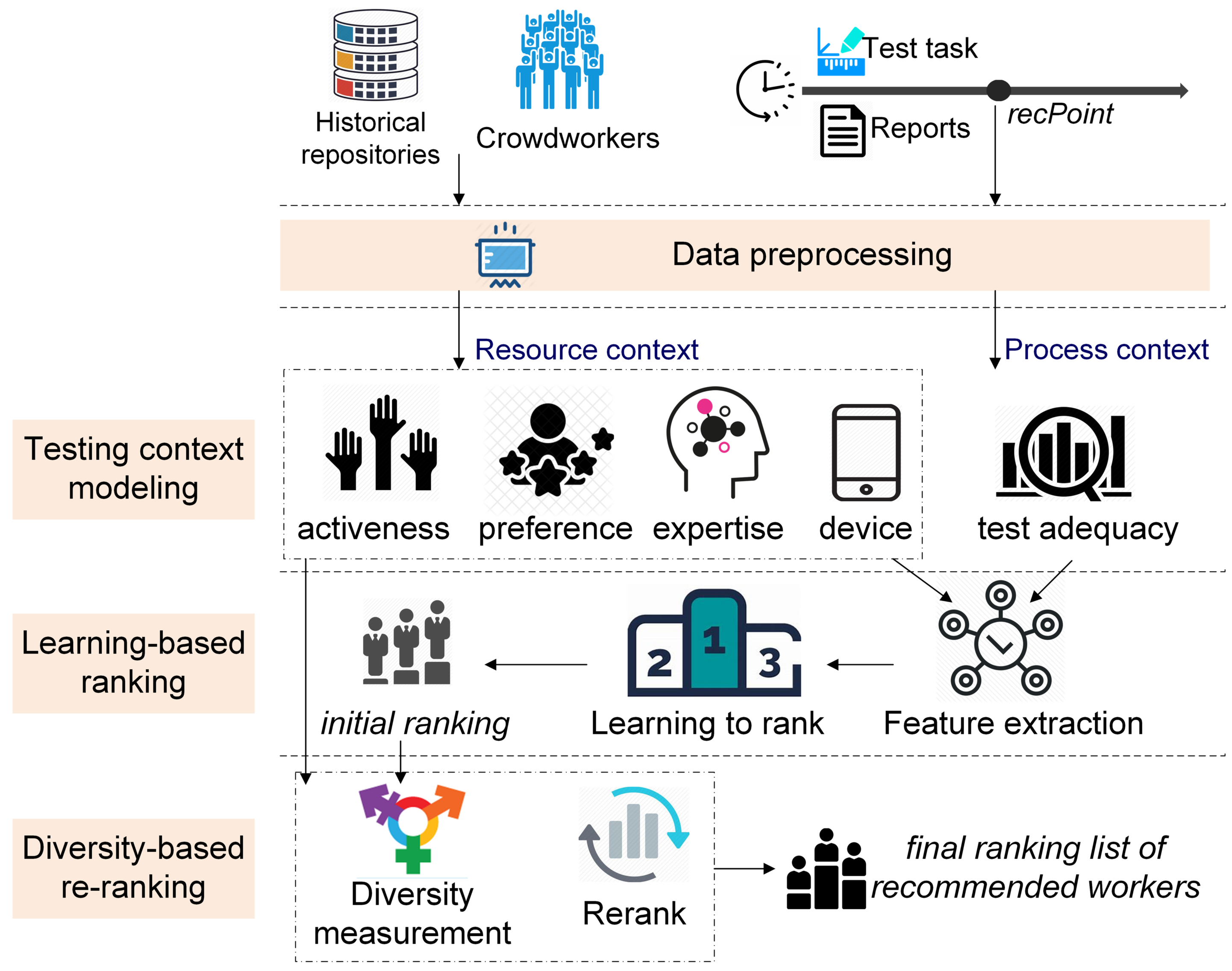
This suggests the need for in-process testing resource recommendation to break non-yielding windows with respect to dynamic testing adequacy prediction.

Goals & Objectives

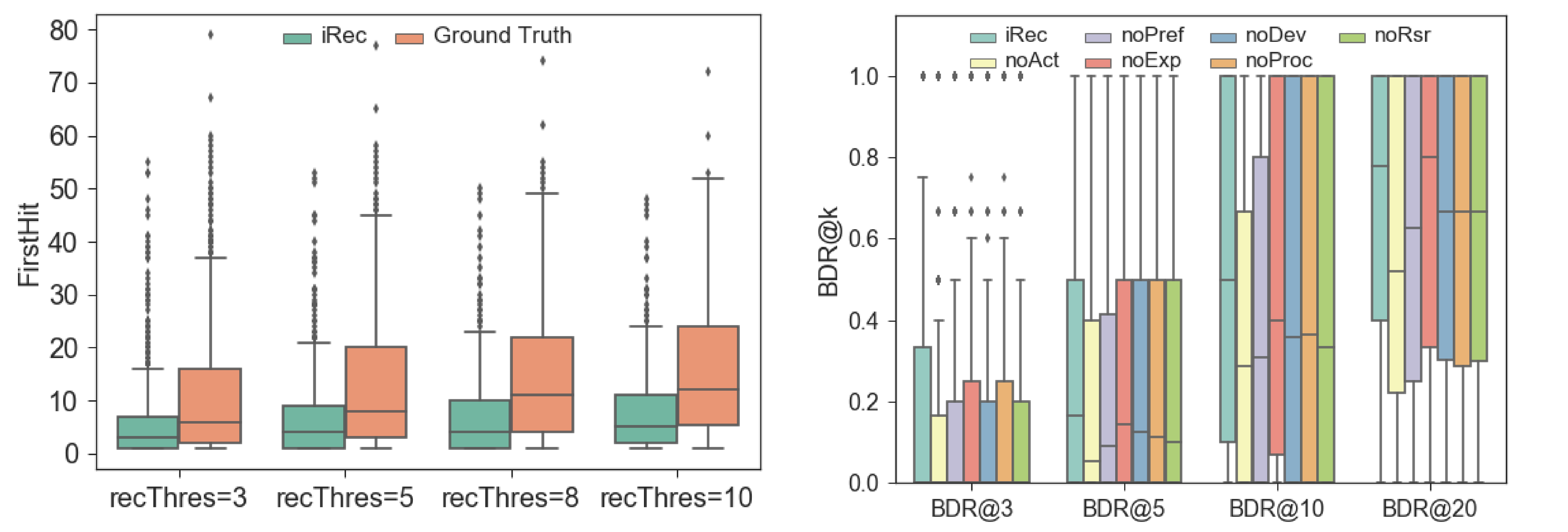
Trade-offs such as "how much testing is enough" are critical yet challenging decisions in planning and managing software and systems testing [1]. Insufficient testing can lead to unsatisfying product quality, while excessive testing can result in potential schedule delays and low cost-effectiveness. This is especially true for the software-intensive systems in the defense domain, given their ever increasing system complexity, the lack of testing processes and resources, as well as the intense schedule pressure. In this project, we plan to investigate and develop a set of models to support efficient testing management. The ultimate goals is to enable actionable, value-driven decision making on resource allocation and utilization faced by testing managers.

Methodology

A context-aware in-process tester recommendation approach, iRec, is developed to dynamically monitor, learn, and rank a diverse set of capable testers, in order to increase testing efficiency.



Initial Evaluation Results:



Future Research

The initial evaluation results demonstrated iRec's potential benefits in shortening the non-yielding window, improving bug detection efficiency, and reducing testing cost.

Directions of future work include:

1) Design and conduct more user study to validate the usage of iRec;
2) Further evaluate on cross-platform datasets; and
3) Explore and incorporate more context-related information to improve the performance.

Contacts/References

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References:

1. W. E. Lewis, Software testing and continuous quality improvement. CRC press, 2016.
2. J. Wang, Y. Yang, R. Krishn, T. Menzies, Q. Wang, "iSENSE: Completion-Aware Crowdtesting Management," in Proc. of the Int'l Conf. on Software Engineering (ICSE'19), 2019 May 25 (pp. 912-923). IEEE Press.