SYSTEMS ENGINEERING RESEARCH CENTER

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Models for Efficient Testing (MET)

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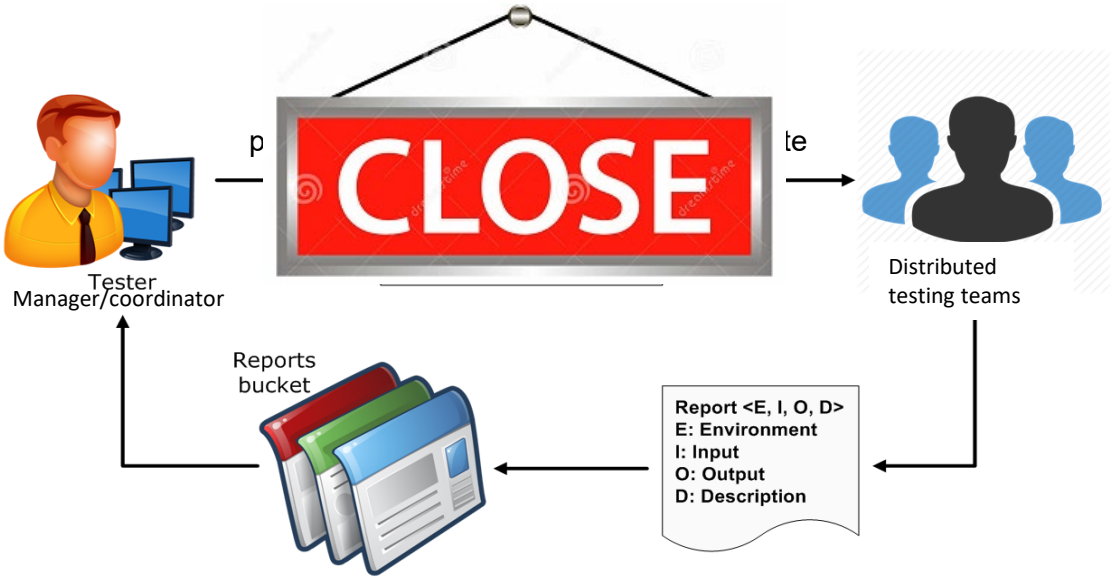
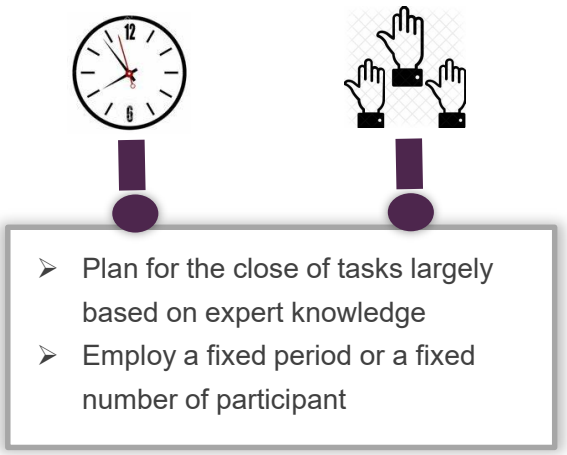
Motivation and Objectives

- Trade-off such as “how much is enough” is challenging, esp. in exploratory testing
  - Insufficient testing can lead to unsatisfying product quality, while
  - excessive testing can result in potential schedule delays and low cost-effectiveness.
- Objective
  - To enable actionable, value-driven decision making on resource allocation and utilization faced by testing managers.



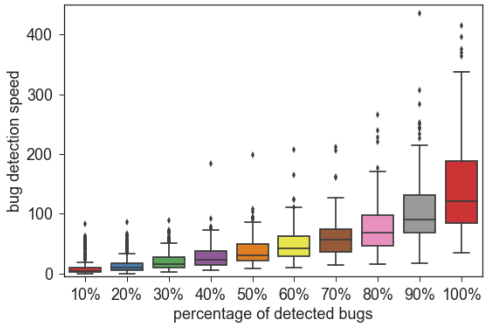


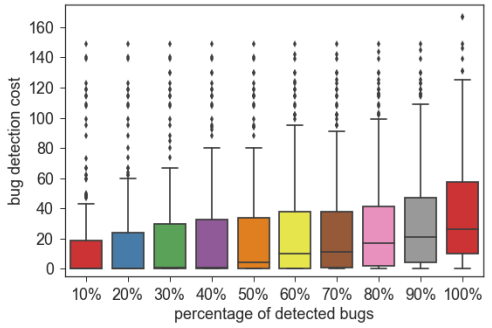
Project Overview

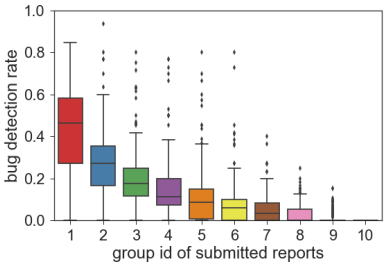
- MET project
  - Investigates, characterizes distributing testing processes
  - Develops a set of Machine Learning-based approaches to support efficient testing management across distributed testing teams
- MET consists of
  - **A testing measurement model**
    - For characterizing the representative contextual factors of a testing process
  - **A in-process team formation model**
    - Matching, learning, ranking, and dynamically tuning the configuration of distributed testing teams to maximize testing adequacy
    - Leveraging natural language processing (NLP) and learning-to-rank algorithms
  - **A early completion detection model**
    - Monitoring, aggregating testing reports, predicting total defects, and automate testing completion detection

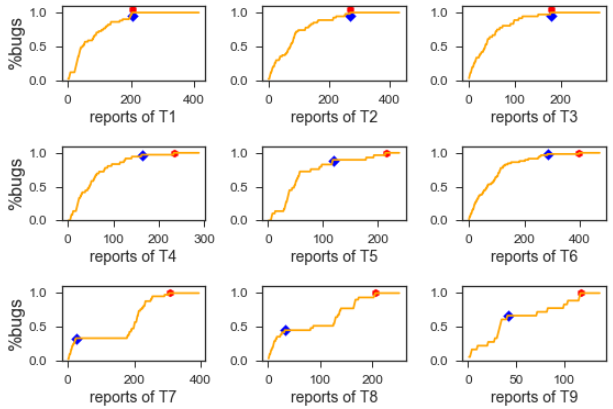
Pilot Study – Analysis Results

- A pilot study: 636 real-world mobile application testing projects.
- Observation: Excessive engagement leading to waste due to duplicated effort.
  - Average wasteful spending over 636 projects: **32%**





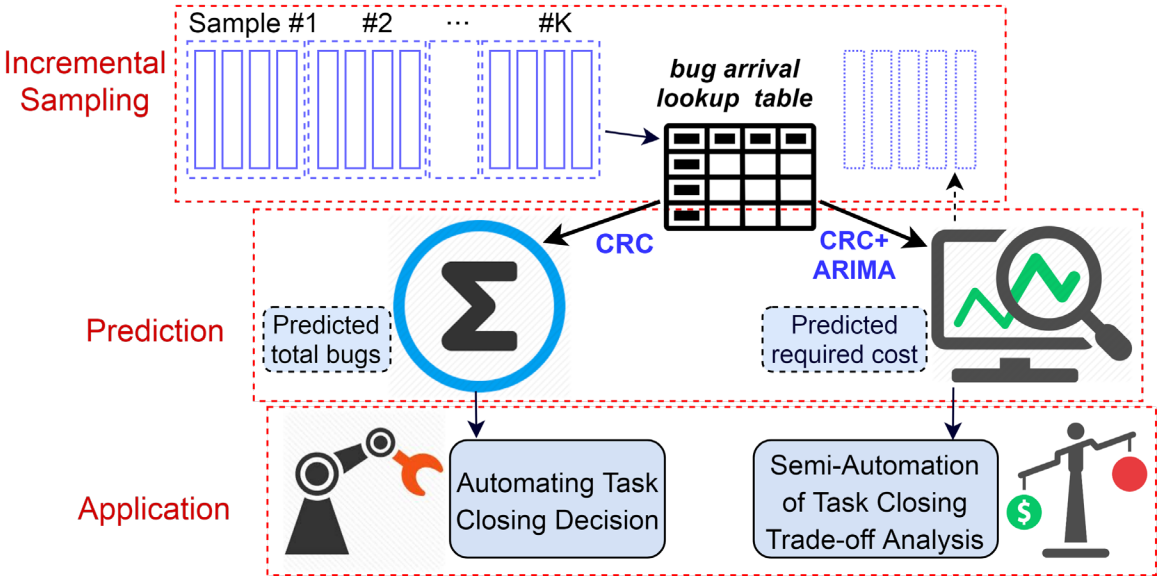


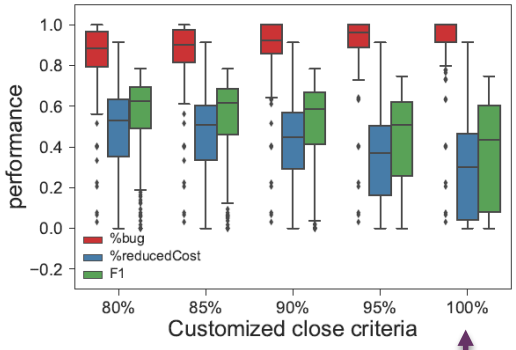


Bug Arrival Patterns:

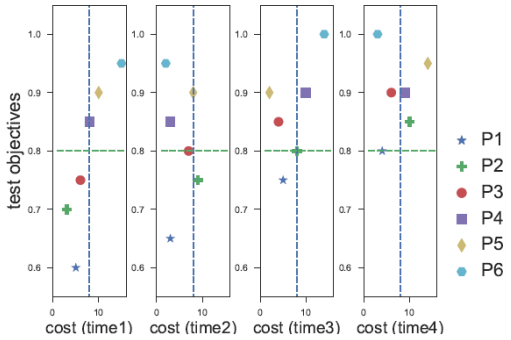
1) Large variation in bug detection speed and cost;
2) Decreasing bug detection rates over time;
3) Plateau effect of bug arrival curves.

iSENSE: Completion-Aware Crowdtesting Management





30% Cost reduction

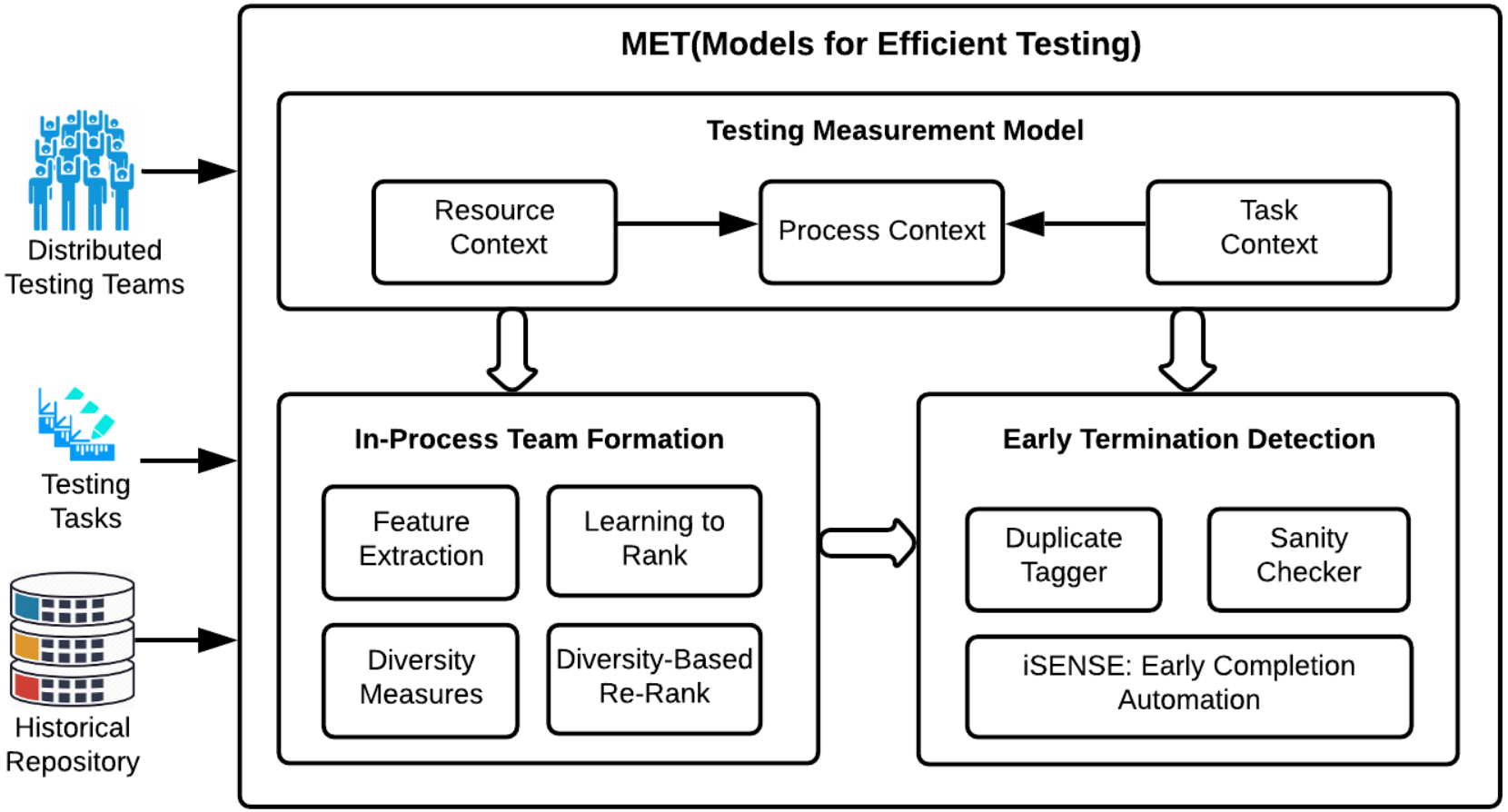


Evaluation: Baidu Crowd Test dataset;

1. Automated close management: 30% cost reduction.
2. Trade-off analysis support.

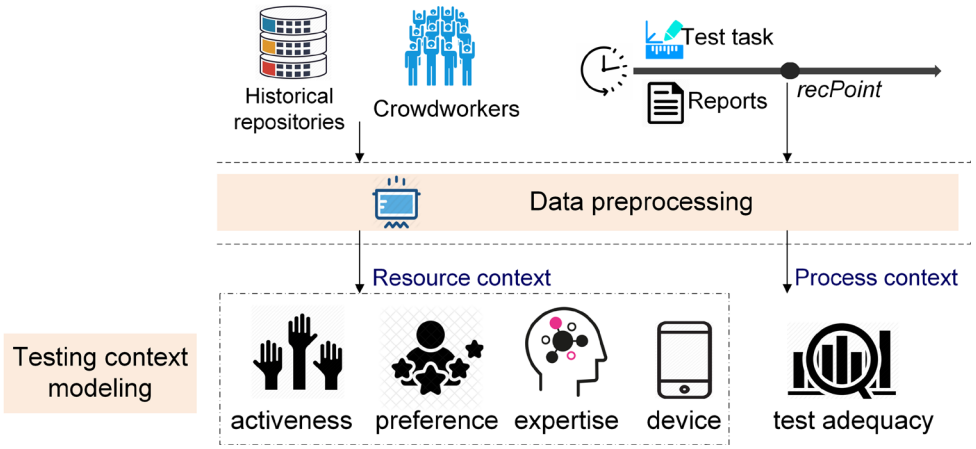
(**ACM SigSoft Distinguished Paper Award**) J. Wang, Y. Yang, R. Krishna, T. Menzies, Q. Wang. "iSENSE: Completion-aware Crowdtesting Management". ICSE 2019.

Research Vision

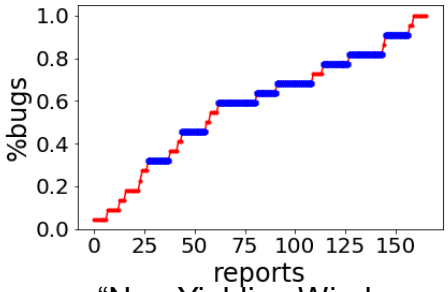


Testing Measurement Model (TMM)

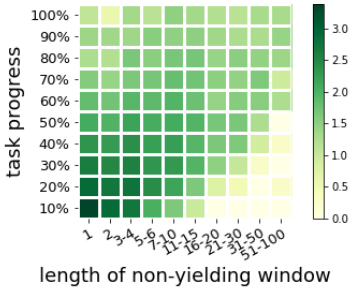
- Two sub-models
  - **Process context sub-model:** in-process progress-oriented information
    - **Testing requirement matrix**: represent the task's requirements in the vector space of descriptive terms from testing requirements.
    - **Test adequacy:** To measure the testing progress regarding to what degree each descriptive term has been tested.
  - **Resource context sub-model:** characteristics of distributed testing teams
    - **Activeness**: a set of metrics to characterize a team's activeness over certain period
    - **Preference:** distribution of term intensity from a testing team's historical reports
    - **Expertise**: distribution of term intensity from a testing team's unique bug reports
    - **Devices**: environmental factors such as testing devices, equipment, etc.



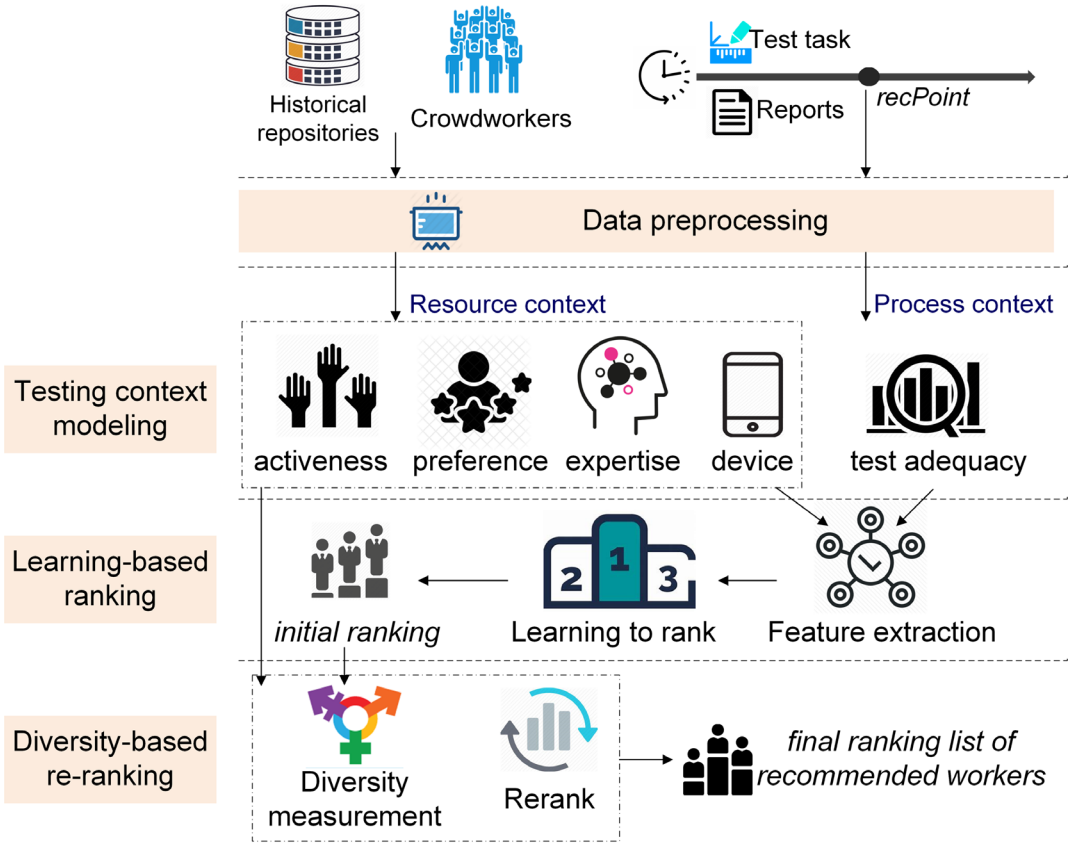
iRec: In-Process Team Recommendation



"Non-Yielding Windows (NYW)"



NYWs distribution across testing cycles

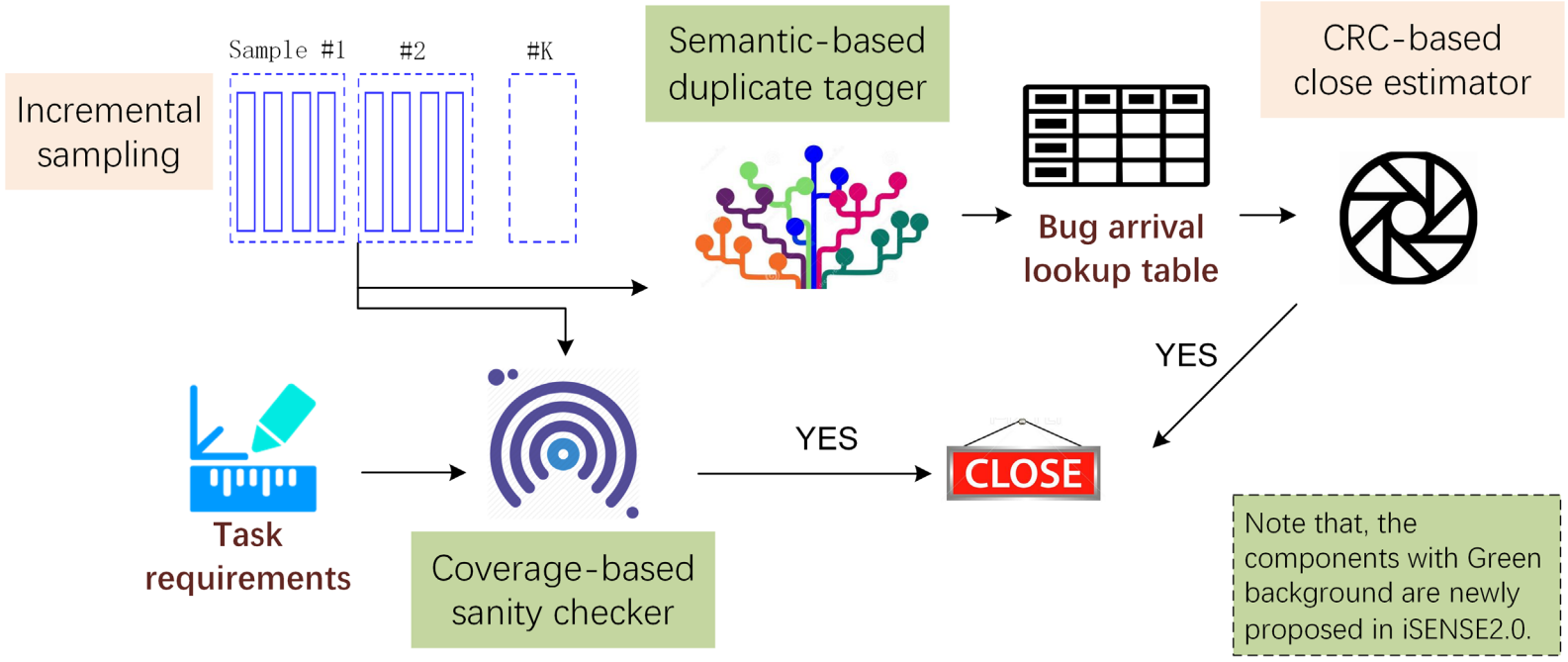


Evaluation: Baidu Crowd Test dataset; Reduction of the NYWs by 50% - 58% ; Reduction of cost by about 10% on median

J. Wang, Y. Yang, S. Wang, Q. Wang. Submitted to ICSE 2020, under review.

Work in progress: iSENSE 2.0

- Extending iSENSE with new components
  - —Automated Duplicate Tagger
    - Analyzing the duplicate status of received crowd reports leveraging on semantic analysis
  - —Coverage-based Sanity Checker
    - Reinforce the stability and performance of close prediction.



Next Steps

- Elaborate the testing measurement model (TMM)
  - To address specific needs for characterizing DoD task/process/resource context
  - Refine core underlying metric: **Testing Process Adequacy**
- Integrate TMM with iRec and iSENSE 2.0
- Empirical validation of existing models on cross-platform datasets
  - In-process team recommendation
  - Early completion detection
- Seeking collaboration in further evaluation in DoD testing projects.

Thank you!

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