Check Low-Power Violations by Using Machine Learning Based Classifier

Chi-Ming Lee, Chung-An Wang, Cheok-Yan Goh, Chia-Cheng Tsai,
Chien-Hsin Yeh, Chia-Shun Yeh, Chin-Tang Lai
MediaTek Inc., Hsinchu, Taiwan
{Ross.Lee, CA.Wang, Paddy.Wu, Joseph.Tsai, Chien.Yeh, Jason.Yeh, Citi.Lai}@mediatek.com

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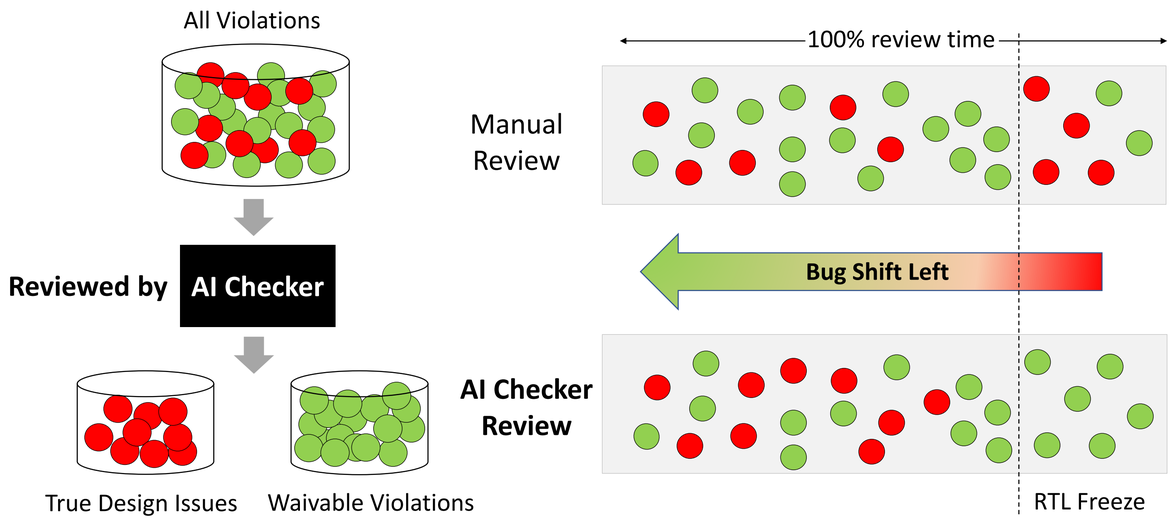
INTRODUCTION

The violation check process for design verification involves iterative simulations to ensure a design's correct functionality and behavior before its tape-out. In each simulation iteration, the violations are output to flag suspicious conditions. Designers need to manually review the violations which are either waivable violations (false alarms) or true design issues that must be fixed. The review process requires cross-team expertise of design domain knowledge and lots of time to investigate violations. As the complexity of the design increases, the overwhelming workload during the time-limited violation review process may jeopardize the correction for the RTL code and induce Engineering Change Order (ECO) after RTL freeze.

OBJECTIVES

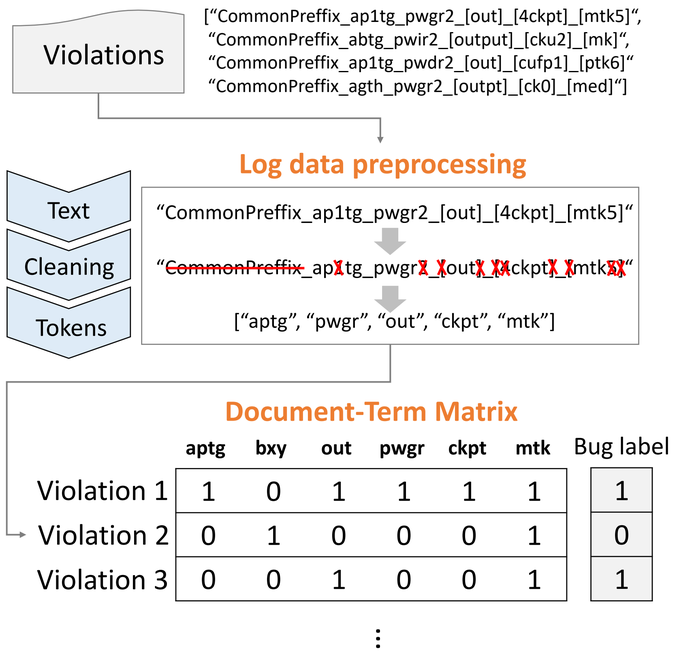
We present a solution with a machine learning based AI Checker to identify highly dubious violations. We aim to reduce manual review effort on violations and shift the bugs left, making them solved earlier.



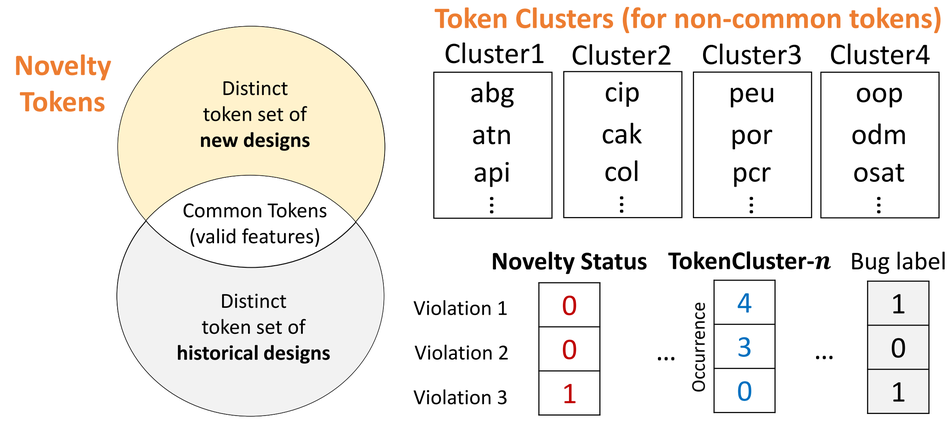
APPROACH

We proposed three steps to learn an AI Checker for violation classification. In the first step, we convert violation log texts into Bag-of-words (BoW) vectors and form a Document-term Matrix (DTM). Next, we generate two features to represent critical data characteristics of violation logs, increasing the generalization ability and robustness of the model. Finally, we constructed an ensemble model to diversify predictions and optimize the classification performance.

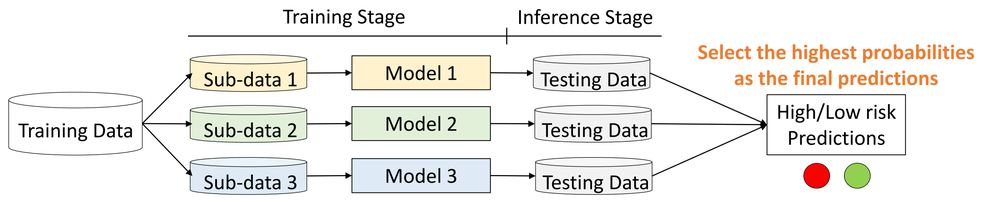
[Step 1] Preprocess the data to train machine learning models



[Step 2] Utilize physical characteristics to construct features



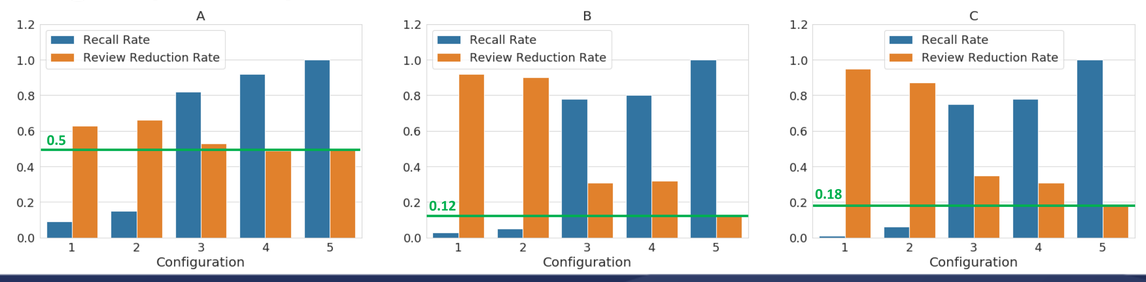
[Step 3] Train the ensemble model to boost performance



RESULTS

We could observe that as more methods joined in, the recall rate was closer to 1. There was a trade-off between the recall and review reduction rate. In our Config.5, we could achieve 50%, 12% and 18% review effort reduction for designs {A, B, C}.

Model	Approach	Config.
SVM	Data preprocessing	1
XGBoost	Data preprocessing	2
XGBoost	Data preprocessing and novelty feature	3
XGBoost	Data preprocessing, novelty feature and token-cluster feature	4
Ensemble XGBoost	**Data preprocessing, novelty feature and token-cluster feature**	**5**



CONCLUSIONS

This work proposed an approach that applied ML techniques to assist the violation review process and presented the empirical study on the Isolation check. The result demonstrated that **we could reduce at least 12% and up to 50% review effort without human experts' involvement while detecting all design issues**. It achieved the shift left of design issues so domain experts could tackle bugs earlier. Hopefully, starting from the promising experiment result of 3 designs, the proposed AI Checker can be generally applied to other design check flows.

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