Special Session on Machine Learning for Test and Diagnosis

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I. Introduction

The special session focuses on using Machine Learning (ML) techniques on different applications in test and diagnosis. The first contribution discusses how to close the gap between working silicon and a working system by using ML. The second presentation then talks an alternative ML view and its various applications such as functional verification, Fmax prediction, and production yield optimization. The last presentation discusses using supervised ML on volume diagnosis to further improve the accuracy of identifying root causes.

II. Data-Driven Resiliency Solutions for Boards and Systems (Krishnendu Chakrabarty)

This presentation will describe how data analytics and real-time monitoring can be used to ensure that boards and systems operate as intended. In the first part of the talk, the speaker will focus on the resilience problem for complex boards; we are seeing a significant gap today between working silicon and a working board, which is reflected in failures at the board level that cannot be duplicated at the component level. The speaker will describe how machine learning, statistical techniques, and information-theoretic analysis can be used to close the gap between working silicon and a working system. Next, the presenter will describe how time-series analysis can be used to detect anomalies in complex core router systems. The effectiveness of proactive fault tolerance depends on whether anomalies can be accurately detected before a failure occurs. However, traditional anomaly detection techniques fail to detect “outliers” when the monitored data involves temporal measurements and exhibits significantly different statistical characteristics for its constituent features. The speaker will describe a feature-categorization-based hybrid method to overcome the difficulty of detecting anomalies in features with different statistical characteristics. A correlation analyzer will be described to remove irrelevant and redundant features. A comprehensive set of experimental results will be presented for data collected during 30 days of field operation from over 20 core routers deployed by customers of a major telecom company.

III. Machine Learning For Feature-Based Analytics in Some Test Applications (Li-C. Wang)

Applying machine learning in Electronic Design Automation (EDA) and Test has received growing interests in recent years. One approach to analyze data from design and test processes can be called feature-based analytics. In this context, the talk explains the inadequacy of adopting a traditional machine learning problem formulation view. Then, an alternative machine learning view is presented where learning from data is treated as an iterative feature search process. The concept of learnable is explained between the traditional big data learning and the small/limited dataset learning commonly encountered in EDA and Test applications. The theoretical and practical considerations for implementing such an iterative feature search process are discussed in the context of various applications such as functional verification, Fmax prediction, and production yield optimization.

IV. Supervised Techniques for Volume Diagnosis (Gaurav Veda)

Traditionally, determining defect distributions in digital logic has relied heavily on diagnosis of scan based test failures followed by failure analysis (FA) techniques. More recently, to address the challenge of increasing fabrication complexity, and at the same time, market pressure to reduce cost/cycle times, unsupervised machine learning approaches to identify root causes from volume diagnosis results, have emerged as a powerful methodology. Supervised machine learning techniques offer an exciting new way of further improving the accuracy of identifying root causes from volume diagnosis results. In this talk, we will present some supervised learning techniques that have shown a lot of promise in our internal research. These techniques provide accurate results, as well as a reliable path to accommodate new defects in new technologies such as cell internal root causes. We’ve only begun to scratch the surface and this is an area of active research. We will also mention promising future research directions.