Predicting Node Failure in Cloud Service Systems

Abstract
In recent years, many traditional software systems have migrated to cloud computing platforms and are provided as online services. The service quality matters because system failures could seriously affect business and user experience. A cloud service system typically contains a large number of computing nodes. In reality, nodes may fail and affect service availability. In this paper, we propose a failure prediction technique, which can predict the failure-proneness of a node in a cloud service system based on historical data, before node failure actually happens. The ability to predict faulty nodes enables the allocation and migration of virtual machines to the healthy nodes, therefore improving service availability. Predicting node failure in cloud service systems is challenging, because node failure could be caused by a variety of reasons and reflected by many temporal and spatial signals. Furthermore, the failure data is highly imbalanced. To tackle these challenges, we propose MING, a novel technique that combines: 1) a LSTM model to incorporate the temporal data, 2) a Random Forest model to incorporate spatial data; 3) a ranking model that embeds the intermediate results of the two models as feature inputs and ranks the nodes by their failure-proneness, 4) a cost-sensitive function to identify the optimal threshold for selecting the faulty nodes. We evaluate our approach using real-world data collected from a cloud service system. The results confirm the effectiveness of the proposed approach. We have also successfully applied the proposed approach in industrial practice. As far as we know, this is the first time node failure prediction is applied in a production cloud service environment.