Towards Machine Learning of Time Task Scheduling in Cyber-Physical Systems

Yuan FANG[†] [‡] Sian En OOI[†] Yuto LIM[†] Yasuo TAN[†]

[†] Japan Advanced Institute of Science and Technology (JAIST),
1-1 Asahidai, Nomi, Ishikawa, 923-1292 JAPAN
[‡] Dalian Polytechnic University (DPU), No.1 Qinggongyuan, Dalian, Liaoning, CHINA

1 Introduction

Cyber-Physical Systems (CPS) are complex systems with tight composition of computation, communications and control technologies. The modeling and analysis that act an important part of the model-driven system of systems (SoS) development play also a great significant role in CPS. Scheduling algorithms are an important part of CPS model design. With the increasing number of system service tasks, CPS needs to complete computing, control, and communication in a limited amount of time. The newly added physical devices and newly generated system services will impose higher time requirements on task scheduling calculations. To adapt to such conditions, CPS application system often adopt machine learning techniques to eliminate the need for unnecessary redesign. In this paper, we present machine learning method for time task scheduling based on the Simple and Proximate Time Model (SPTimo) framework for to solve the problem of efficient scheduling when the system scale is expanded.

2 The SPTimo Framework

There are different systems in one CPS application system, which is called platform. Each platform has different devices that generate the tasks. The allocated result is called schedule, while the allocating process is called scheduling which is conducted by a scheduler equipped in the system. The operation generated by each device is called a time task. The SPTimo Framework structure is included three sub-models, named as computation model, control model and communication model. A service request requires connecting different platforms in a specific order.

3 Machine Learning for Task Scheduling

Machine Learning (ML) was introduced in the late 1950's as a technique artificial intelligence (AI). In the last decade, machine learning techniques have been used extensively for a wide range of tasks including classification, regression and density estimation in a variety of application areas networks. For event task scheduling algorithms, there are First in First Out (FIFO), Shortest Job First (SJF), Round Robin (RR), Priority First (PF), and so on. For CPS application,

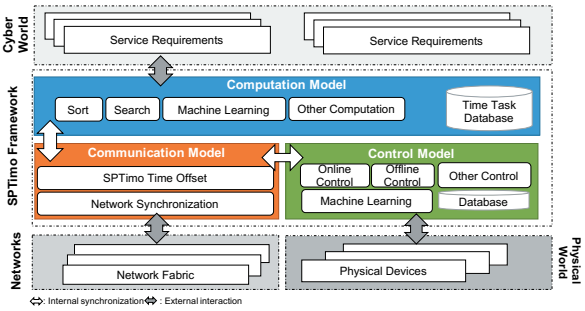

Figure 1SPTimo Framework

there are many tasks that are required in real time. So, time task scheduling algorithms, there are Earliest Deadline First (EDF), Least Laxity First (LLF) etc. The CPS is a complex system with a motivation of supporting more intelligent decision-making and autonomous control. Here, machine learning is important to extract the different levels of abstractions needed to perform the AI tasks with limited human intervention. Different scheduling algorithms have different results and different efficiency for meeting the same task requirements. As Fig.1 shown, the time task database is as the training database for ML. At the first, we choose the Decision Tree (DT), which a classification method for predicting labels of data by iterating the input data through a learning tree. During this process, the feature properties are compared relative to decision conditions to reach a specific category.

4 Conclusion

The role of machine learning in CPS system task scheduling was discussed in this paper. A task scheduling database and algorithm flow based on machine learning are designed.

References

[1] Alsheikh M A, Lin S, Niyato D, et al. Machine learning in wireless sensor networks: Algorithms, strategies, and applications. *IEEE Communications Surveys and Tutorials,* 2014, 16(4): 1996-2018.