Clustering Based Job Runtime Prediction for Backfilling Using Classification

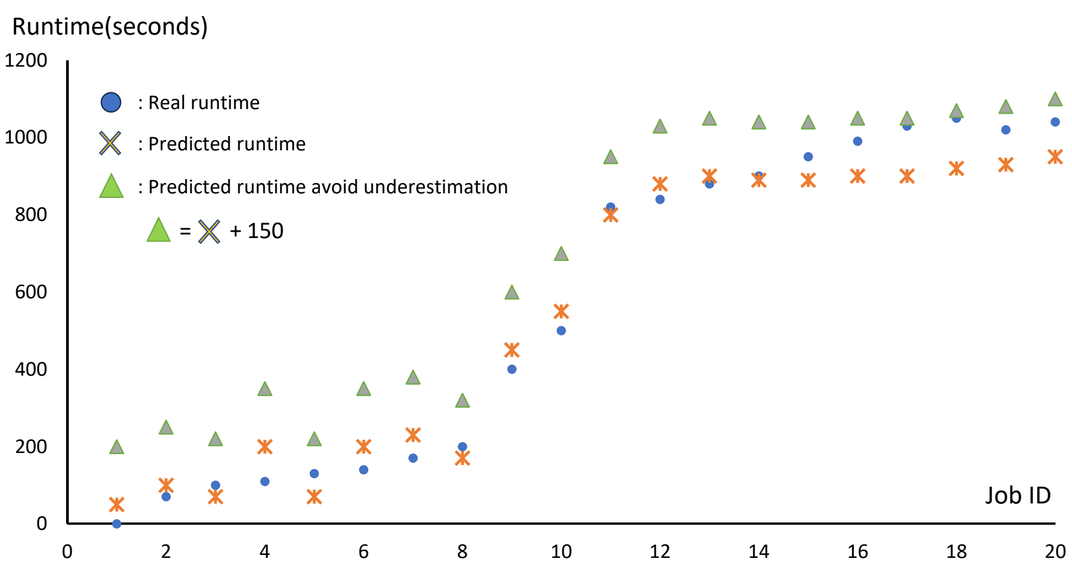
Hang Cui*, Keichi Takahashi*†, Yoichi Shimomura†, Hiroyuki Takizawa*†
*Graduate School of Information Sciences, Tohoku University
† Cyberscience Center, Tohoku University

Introduction

- An underestimation of job runtime causes the job scheduler to terminate the job before it completes.
- In order to avoid this circumstance, users of HPC systems are likely to overestimate their job runtimes compared to the real runtime[1].

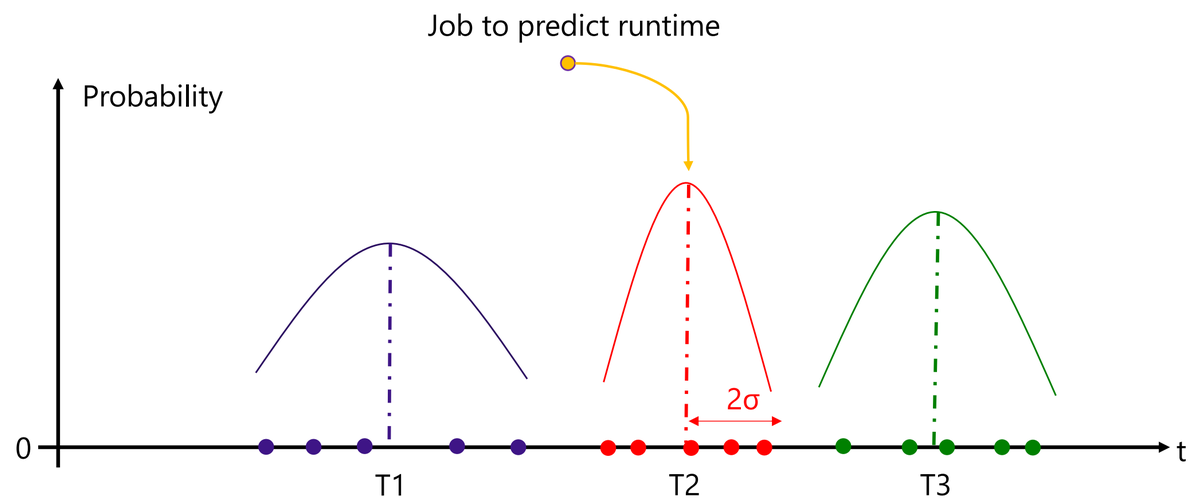
Previous Methodology

- Runtime prediction that can avoid underestimation is important for increasing the system utilization of HPC systems[2].

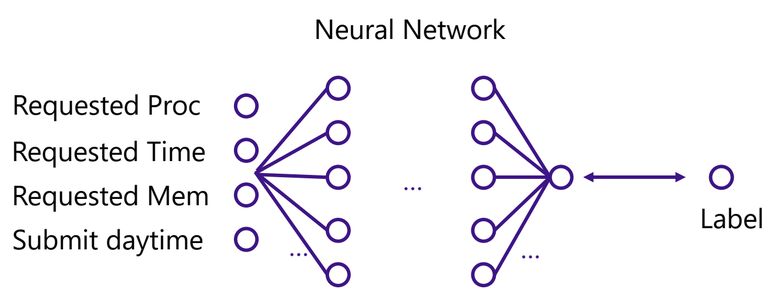


Proposed Methodology

- The runtime prediction is translated into classification of jobs into categories.
- The mean and standard deviation of runtimes within each category are calculated in advance, and the predicted runtime of a job is the mean runtime plus two-sigma, means two standard deviations.

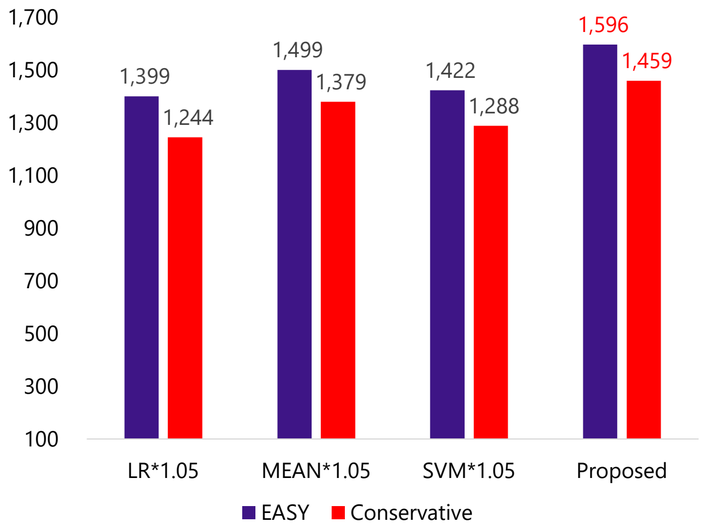


- Neural network is used to select the category.

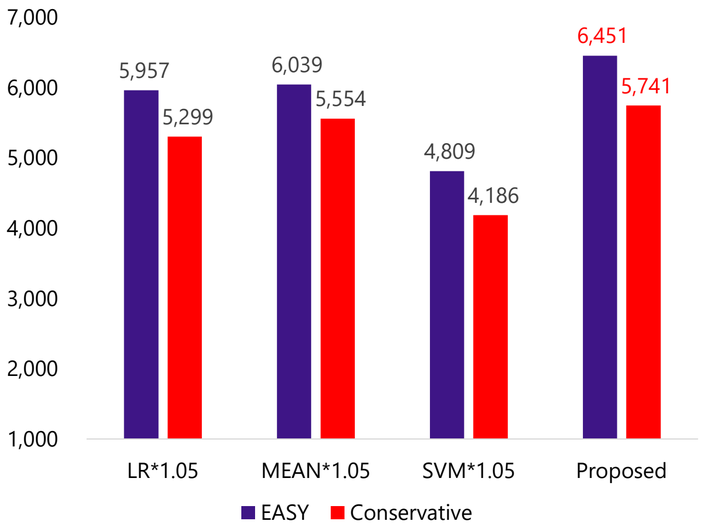


Evaluation

- After performing the prediction of the runtime, it is passed to the simulator. The simulator is modified to use the predicted runtime for backfilling to generate the scheduling result.



Backfilled job count of ANL



Backfilled job count of SDSC

- The datasets used in the evaluation are ANL and SDSC job trace.
- The number of the backfilled jobs when scheduling the jobs in the HPC system are counted using different approaches to predict the runtime of these jobs.
- More jobs are backfilled when the proposed approach is used to predict the runtime.

Conclusion

- According to evaluation, the proposed approach tends to predict a runtime that is bigger than the real runtime compared to other previous approaches.
- Rescheduling can be avoided because of this feature, which makes more jobs are backfilled.

References

[1] Zhengxiong Hou et al., Optimizing job scheduling by using borad learning to predict execution time on HPC clusters, CCF Transactions on High Performance Computing, 23, February, 2023
[2] Mohammed Tanash et al., “Ensemble Prediction of Job Resources to Improve System Performance for Slurm-Based HPC Systems”, PEARC ’21: Practice and Experience in Advanced Research Computing, July 2021, Article No.: 21, Pages 1-8

This study was partially supported by JSPS KAKENHI Grant Numbers JP21H03449 and JP22K19764.

URL: https://www.hpc.is.tohoku.ac.jp
Email: cui.hang.s4@dc.tohoku.ac.jp