Towards General Distributed Resource Selection

This research formulates and investigates the resource selection problem in a way that can predict the cost of executing a task on a resource which it is agnostic of specific task and resource properties, and that is generalizable to the range of metrics. Particularly, the excerpt develops a model to describe the requirements of tasks and estimate the cost of running that task on an arbitrary resource using baseline measurements from a reference machine. The model does not take into account any parallelism which a task exploits during its execution as well as the integrated cost model with the Condor matchmaking algorithm to enable resource selection.

Experimental validation of the model shows that it provides execution time estimates with 157–171% error on XSEDE resources and 18–31% of OSG resources. Nonetheless, the predictions can still be used to determine which resource yields the smallest execution time. The article methodology, use the task execution cost model to select resources for a bag-of tasks of up to 1024 GROMACS MD simulations across the target resources. Experiments show that by using the model's estimates, it reduces the workload's time-to-completion up to ~85% when compared to the random distribution of workload across the same resources. By incorporating the model into the Condor matchmaking algorithm to address the resource selection problem, the algorithm is used primarily in resource brokers to determine whether a job can run on a given resource. By adapting the matchmaking algorithm with our model, we can use the algorithm to determine which resource to use to execute a task. The task execution cost model and the adapted matchmaking algorithm are used to distribute a bag-of-task workload of GROMACS MD simulations across both HPC and HTC resources based on the expected time-to-completion of each task of the workload. For workloads of up to 1024 GROMACS simulations, the results show a reduction in the time to completion by 67–85% compared to randomly distribute the workload across the same resources. This shows that inaccurate predictions of execution times can still be used to select resources better than random. Moreover, it is possible to select resources where we have no historical data better than random.

The results demonstrated the usefulness of this approach on XSEDE, but they are not limited to the traditional distributed resource. For example, the resource selection models could be used to select a heterogeneous virtual machine "instances" from federated cloud resources and metrics such as (fiscal) costs of instances. These extensions will be useful as the WLCG moves to incorporate cloud resources and spot markets into their mix of resources.