Leveraging Resource Bottleneck Awareness and Optimizations for Data Analytics Performance

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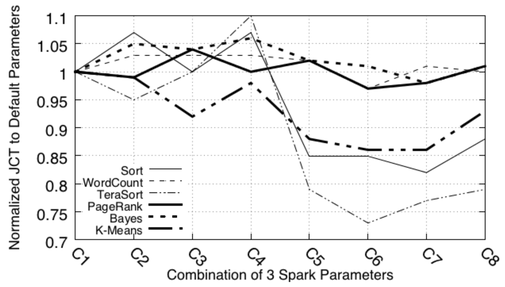
Introduction

***Spark Tuning*:**
- Current tuning work is resource-oblivious
- Spark has dozens of performance affecting parameters, previous tuning work modifies one at a time

Spark Memory Management:
- Spark LRU caching policy is DAG-oblivious
- Current DAG-aware solutions do not take into account the reference-distance and gaps between data usage

Motivation

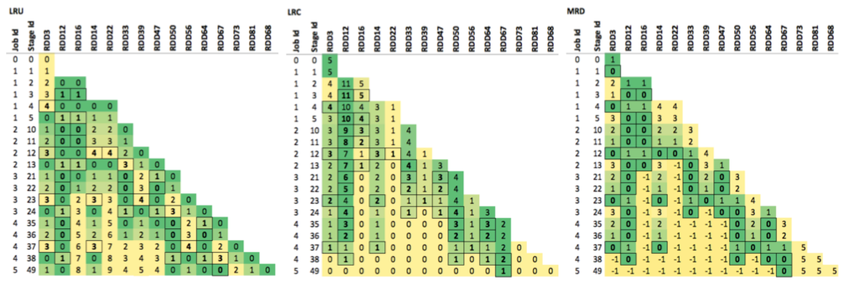


PETS:

Comparison of effect of 3 Spark parameter combinations

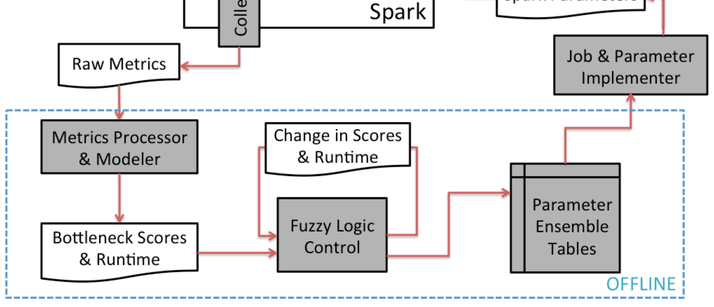
MRD:

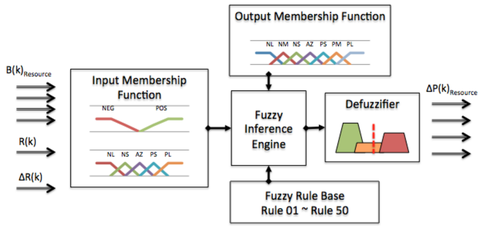
Comparison of different cache management policies for ConnectedComponents



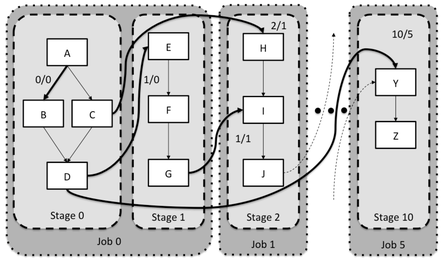
Design

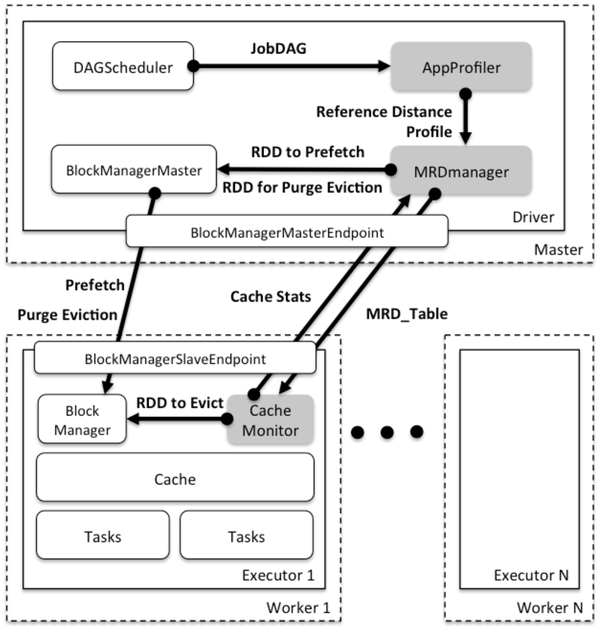
PETS:
- Use of Fuzzy Logic with resource awareness feedback
- Tuning is expedited by the use of Parameter Ensemble Tables, which allow multiple parameters to be tuned simultaneously





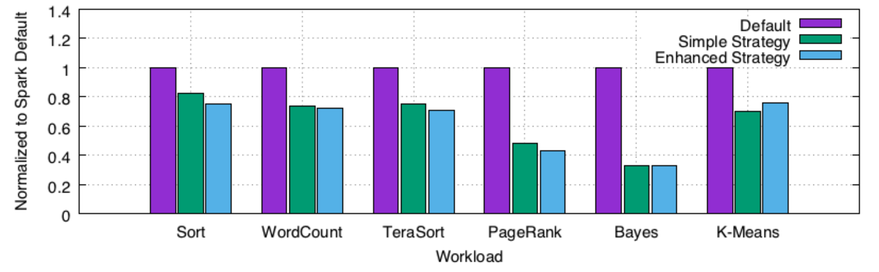
MRD:
- Reference-distance (job and stage) is defined the distance between current workflow processing and data block usage
- MRD has centralized (pre-fetch and purge) and distributed (eviction) components

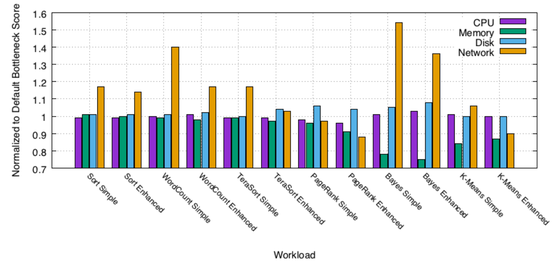


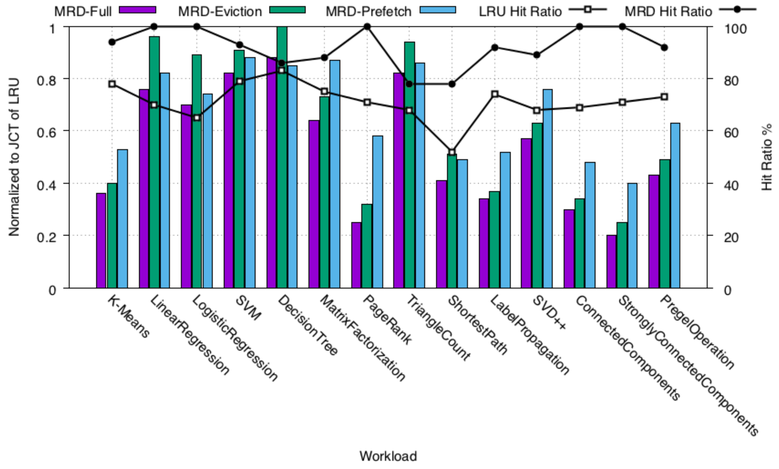


Evaluation

PETS:
- *Speedups of up to x4.78;*
- *Convergence as low as 2 iterations;*
- *Performance stable with varying workload data sizes, homogenous and heterogeneous clusters, and varying initial parameters.*







MRD:
- *Average performance improvement over LRU by 53% and up to 4x faster;*
- *Improvement over other DAG-aware caching policies up to 68% and on average 32%;*
- *Best results with workloads that are I/O intensive, have high stage-reference distance and high reference per stage values.*