Jockey: Guaranteed Job Latency in Data Parallel Clusters

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Deadlines and Varying Latency

- Users of data parallel clusters now demand predictable latency
- Predictable latency can be required for deadlines with business partners; missing a deadline can have financial consequences

It would be easy to provide deadlines if job latency had low variance; unfortunately, it does not.

Why does latency vary?

- Pipeline complexity: Users develop multi-stage pipelines of dependant jobs, variance in earlier jobs impacts later ones
- Noisy environment: Simultaneous data parallel jobs compete for highly utilized shared resources, which can also fail

The Cosmos Environment

- Cosmos is Microsoft’s data parallel processing environment
- It primarily supports Bing, Microsoft AdCenter, and MSN
- Cosmos clusters contain 1000s of commodity servers, each running multiple tasks for many jobs
- Resources are managed by granting tokens to tasks
- Tokens are de-normalized weights in the scheduler and guarantee a fixed slice of CPU and memory

Expressing Performance Targets

For single jobs, scale doesn’t matter

For multiple jobs, use financial penalty

Users provide utility curves to express performance targets

Our Goal: Maximize utility, while minimizing resources by dynamically adjusting the allocation

Jockey

Conceptually, Jockey is
1) a function from progress and allocation to remaining run time
2) a control-loop which dynamically adjusts the resource allocation

Our paper provides details and evaluation of each component

Evaluation

How Jockey Managed a Real Job in a Production Cluster

Deadline lowered from 140 min. to 70 min.

Jockey’s Performance Relative to other Allocation Schemes

- Only missed 1 of 94 deadlines
- Control-loop is stable and successful

Our Goal: Maximize utility, while minimizing resources by dynamically adjusting the allocation

Problem | Solution
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Pipeline complexity | Use a simulator
Noisy environment | Dynamic control

Jockey works without requiring latency guarantees from individual cluster components

- When a shared environment is underloaded, guaranteed latency brings predictability to the user experience
- When a shared environment is overloaded, utility-based resource allocation ensures jobs are completed by importance

Compared with a naive max allocation scheme, and simulator and control-loop independently

- 21 jobs in production cluster, CPU use: ~80%
- Two metrics: Did jobs complete before deadline? Minimized impact on the rest of the cluster?