alsched: SCHEDULING OF MIXED WORKLOADS IN HETEROGENEOUS CLOUDS
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HETEROGENEITY AND SCHEDULING

- Large clusters shared by varied workloads
- Batch frameworks, like Hadoop
- Elastic services, like web frontends
- Cluster nodes increasingly heterogeneous
- Static: amount of RAM, #cores, GPU?, ...
- Dynamic: cached executables, storage/net locality, ...
- alsched: matching diverse needs to resources
- Utility functions used to express placement constraints
- alsched arbitrates conflicts quantitatively

PLACEMENT CONSTRAINTS

- Mandatory or preferred task placement restrictions
- Defined over machine attributes or subsets
- Hard constraints communicate requirements
- Must avoid machines with attribute X
- Must run on machines with attribute Y
- Require kernel version > 2.6.35
- Soft constraints communicate preferences
- Prefer machines with attribute X
- Locality: prefer k tasks on same rack with infiniband (e.g., MPI)
- Affinity: prefer to run close to data
- Anti-affinity: prefer to spread tasks (e.g., for availability)

PRELIMINARY EVALUATION

- Simulated workload of n-body type jobs
- Scheduling policies compared:
  - Soft – soft constraint-aware placement
  - Hard – soft constraints treated as hard
  - None – soft constraints are ignored

COMPOSABLE UTILITY FUNCTIONS

- Map resource subsets to utility values
- Express both hard & soft constraints
- Quantify benefits of preferences
- Primitives: “n choose k”, linear “n choose k”

- Operators:
  - Min/Max/Sum(u1, u2, u3, ... un) → min/max/sum of its children
  - Scale(f, u) → f * u
  - Step(M, u) → M iff u ≥ M and 0 o.w.
- Examples:
  - Colocate k tasks on the same rack, else schedule anywhere
  - Primary + backup service instance
  - Specialized hardware

TWO-LEVEL CHANGE DECISIONS

- Inverse offers: must give up X of Y where Z
- Use utility functions to guide inverse offers

CONTINUING RESEARCH

- Automatic generation of utility functions
- Handling imperfectly specified utility functions
- Handling placement change decisions
- Inverse offers