Static Scheduling in Clouds

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Motivation (1)

Cloud computing gives the *illusion* of ∞ (virtual) resources.

Actually there is a finite amount of (physical) resources.

We would like to efficiently share those resources:

1. being able to distinguish high priority (serving customer *now*) from low priority (batch) requests;
2. schedule accordingly.

Therefore, we should be able to plan ahead computations.

Motivation (2)

Dynamic Scheduling: use work queues, priorities, but limited.

Without knowledge of jobs, this is the best you can do.

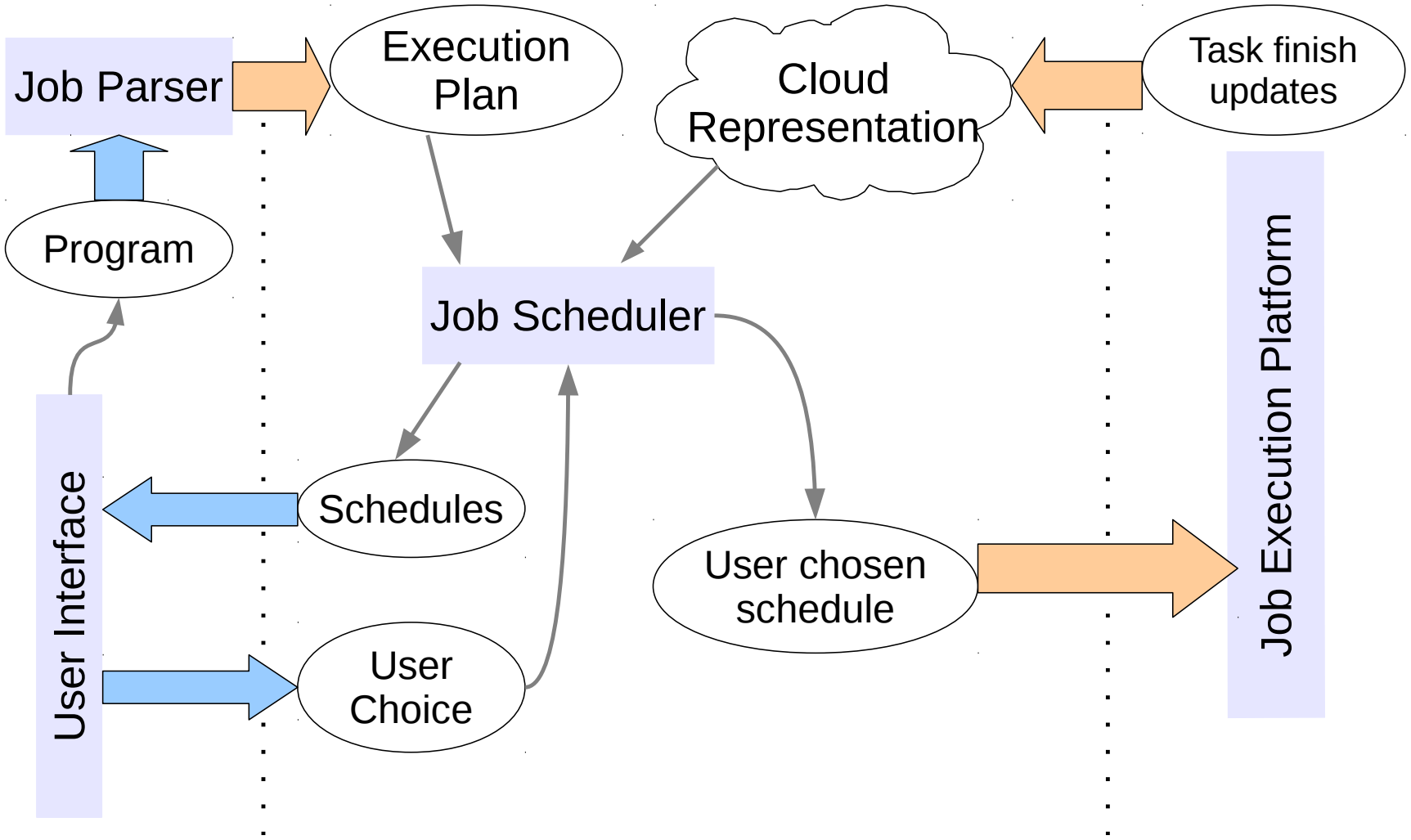
We need to ask the user for:

- what kind of resources his job require;
- a deadline/priority for his job.

In exchange we can give him an expected completion time.

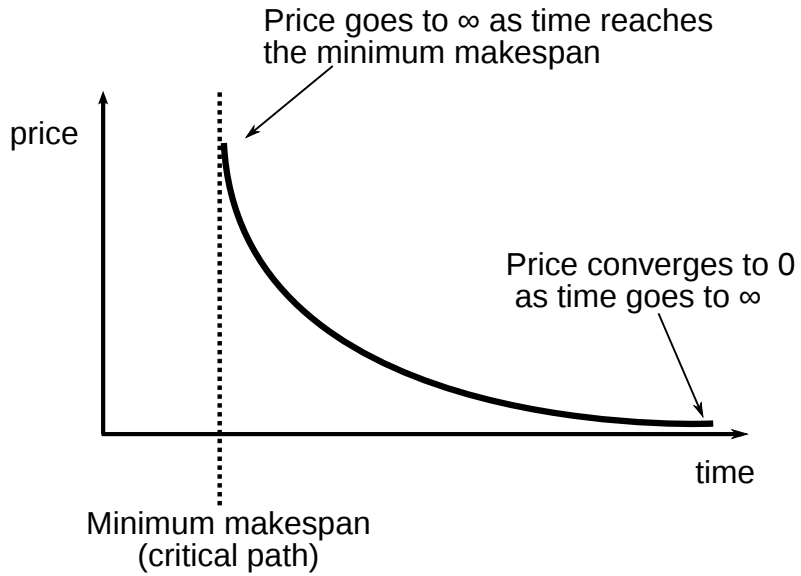
We can also offer choice. (time is money.)

Flextic Overview



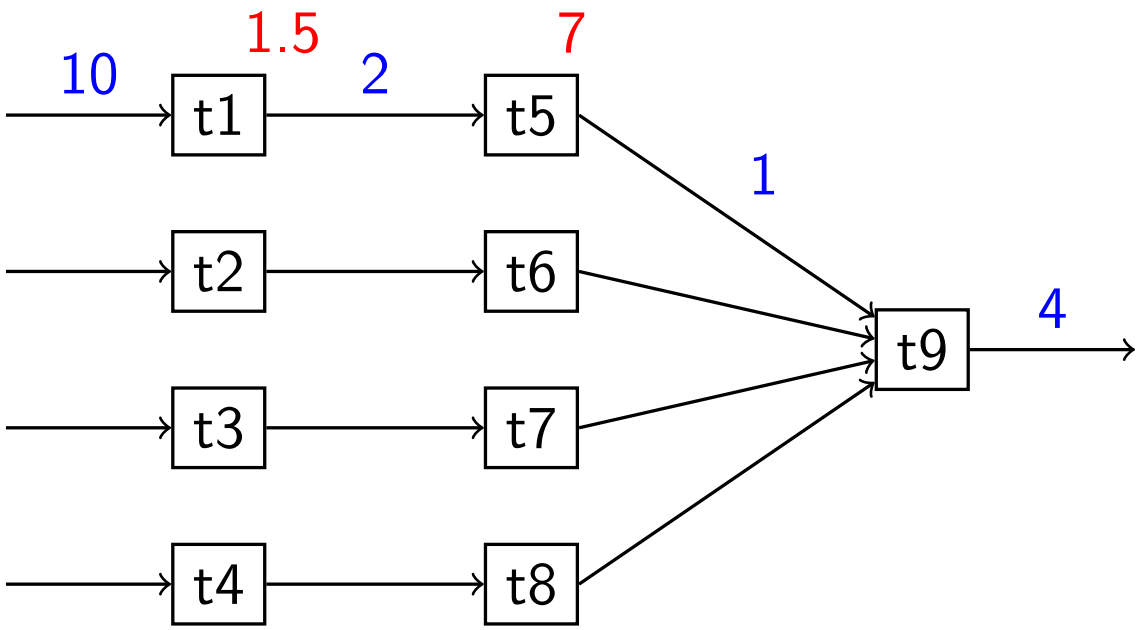
Giving incentive to plan in advance

The scheduler returns not one but many possible schedules with different finish times.
Use a pricing model to associate a cost to the schedules.
Include the "scheduling difficulty" in the cost, give a discount to schedule with later finish time.



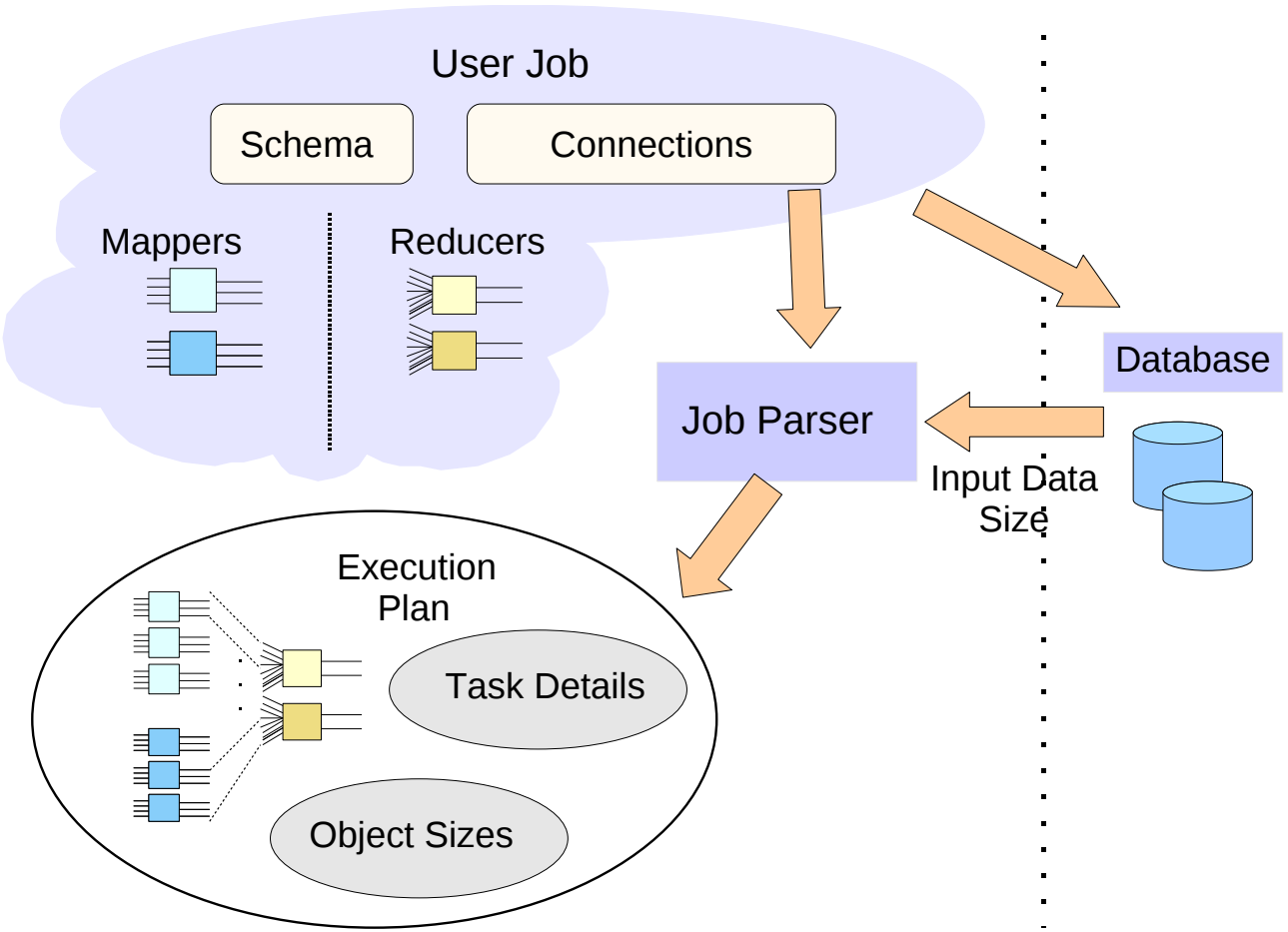
Problem: static scheduling is *hard*.
Only possible if the scheduler can handle the work load.

Jobs Model

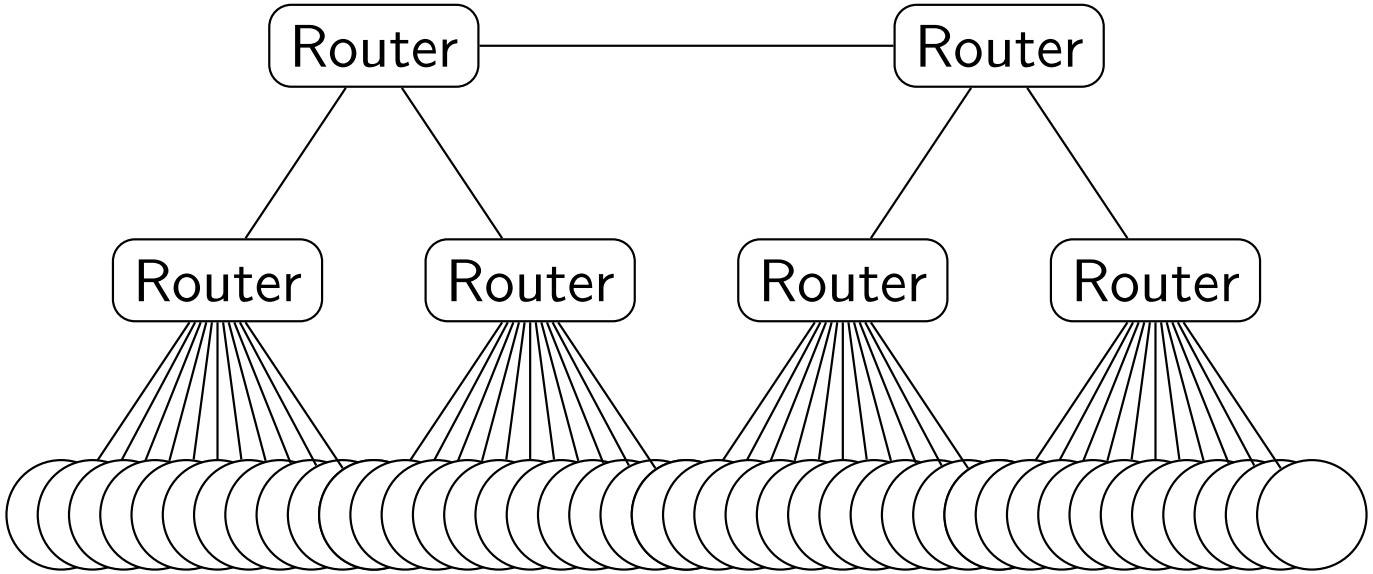


- A Job is a directed acyclic task (DAG) of tasks.
- Node are marked with worst case duration.
- Edges are marked with data transfer.
- duration and data can be parametric in the input.

Parametric Jobs



Infrastructure Model



Datacenter as a tree-like graph:

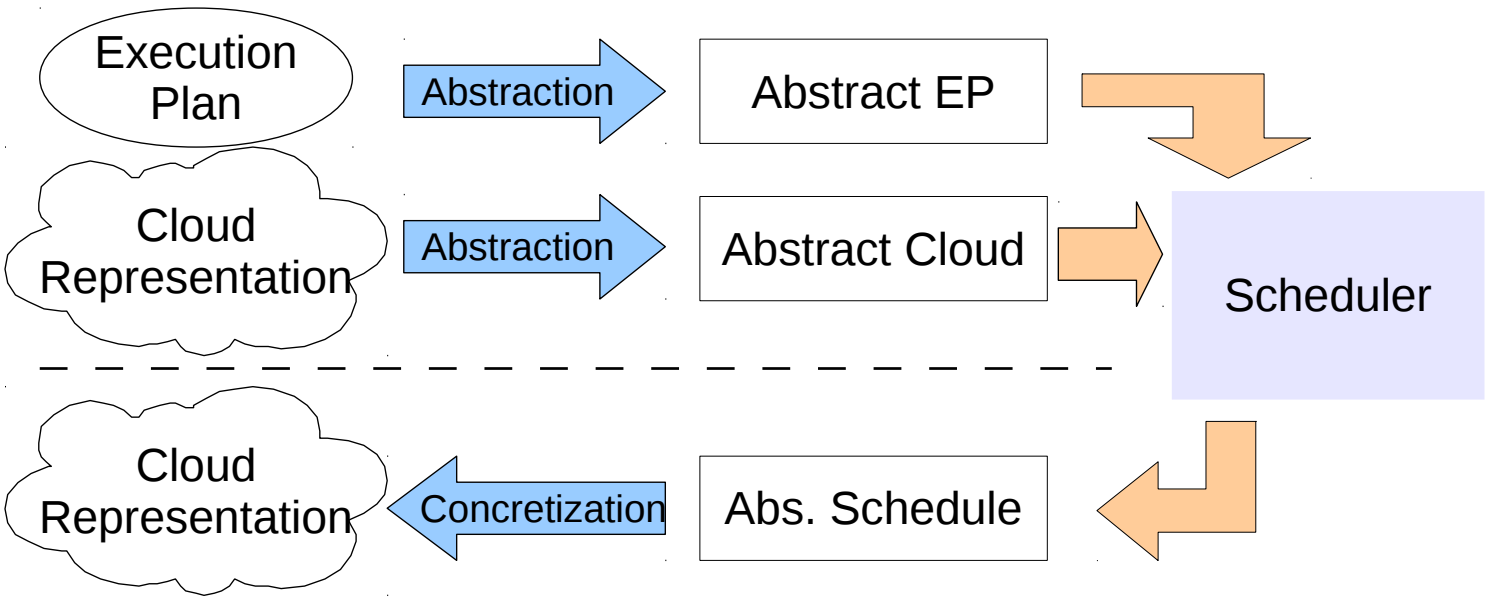
- internal nodes are router;
- leaves are compute nodes (computation speed);
- edges specifies the bandwidth.

Scheduling Large Jobs using Abstraction [EuroSys 2011]

Assumption: job and infrastructure regularity

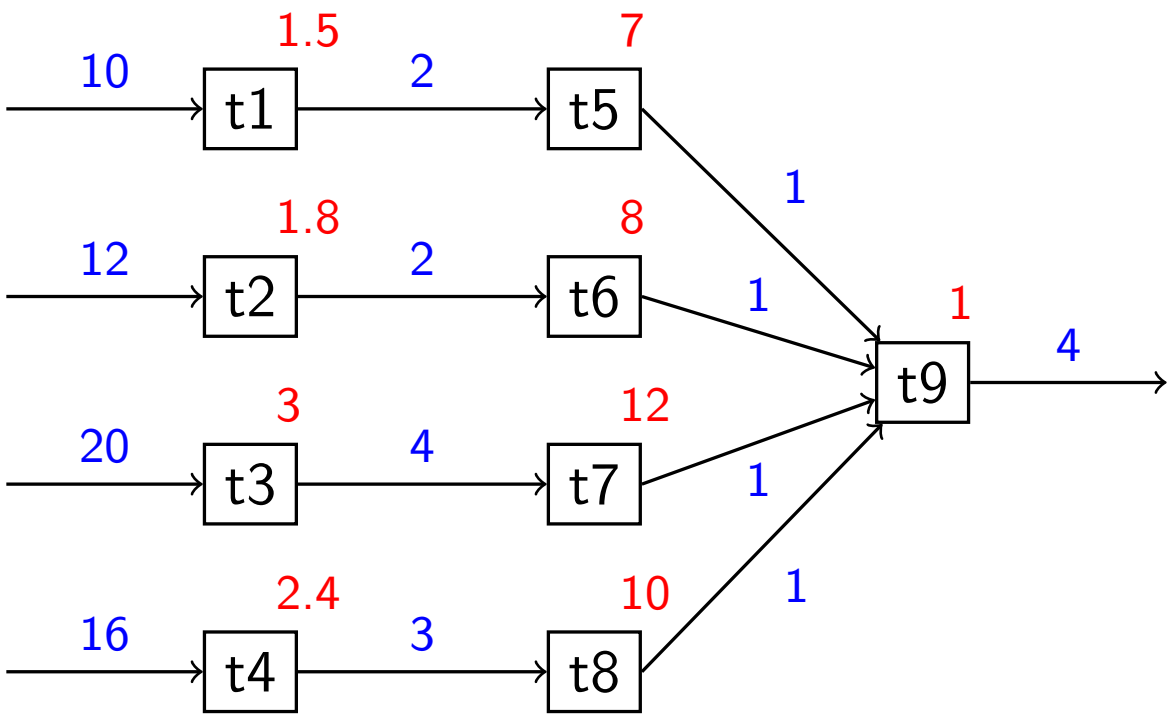
Idea: regularity makes large scale scheduling feasible

How: Using abstraction techniques



Abstraction for jobs:

Group independent tasks as per a topological sort. Merge them into an abstract task.



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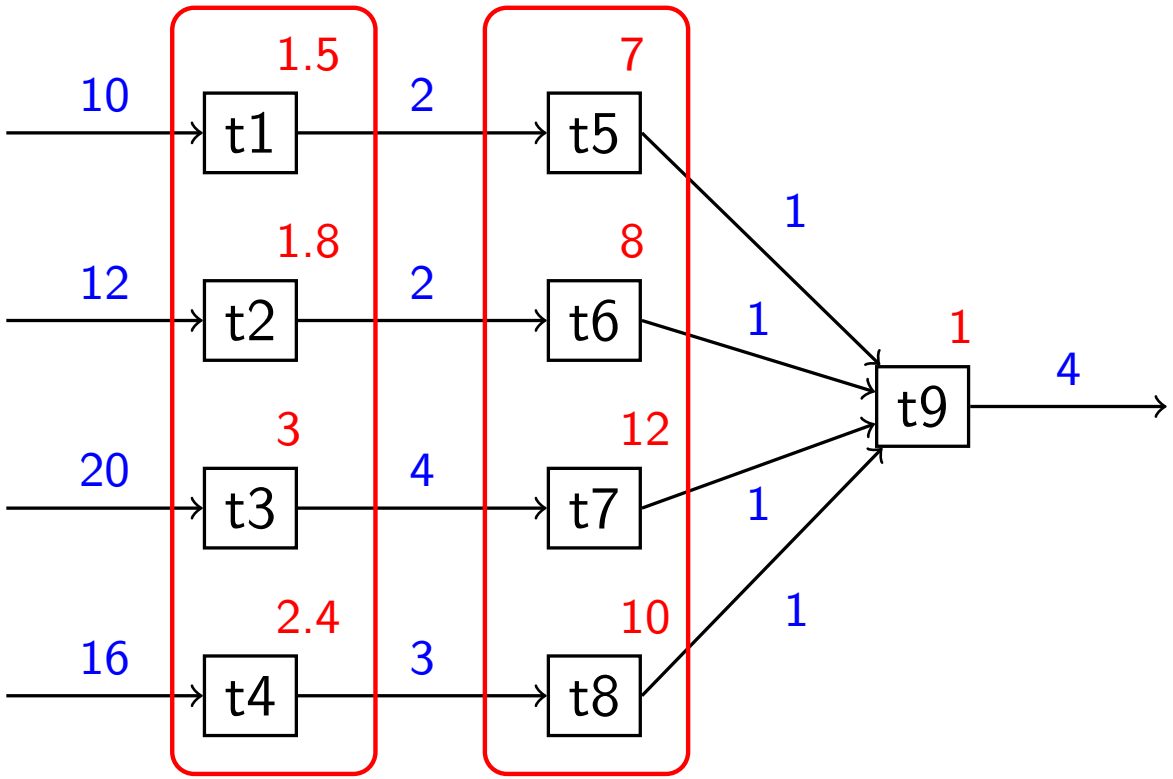

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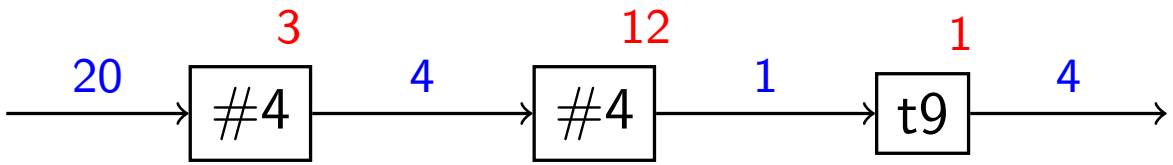
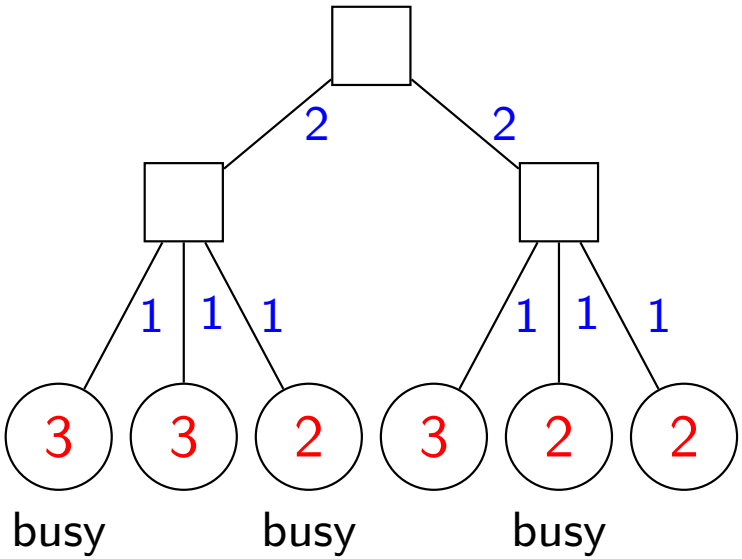
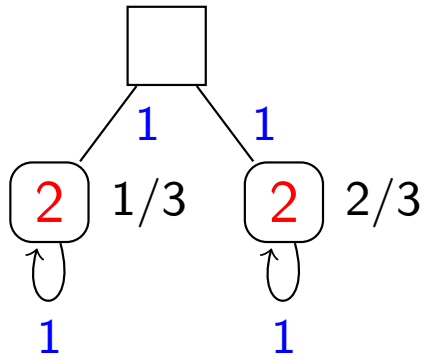


Abstraction for infrastructure:

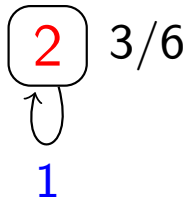
Merge nodes to according to network topology:



Concrete System



Medium abstraction



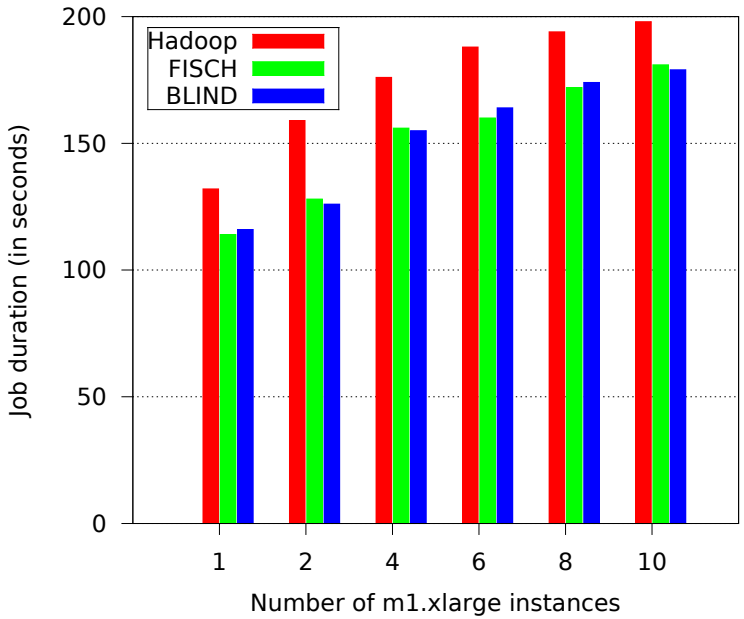
Coarsest abstraction

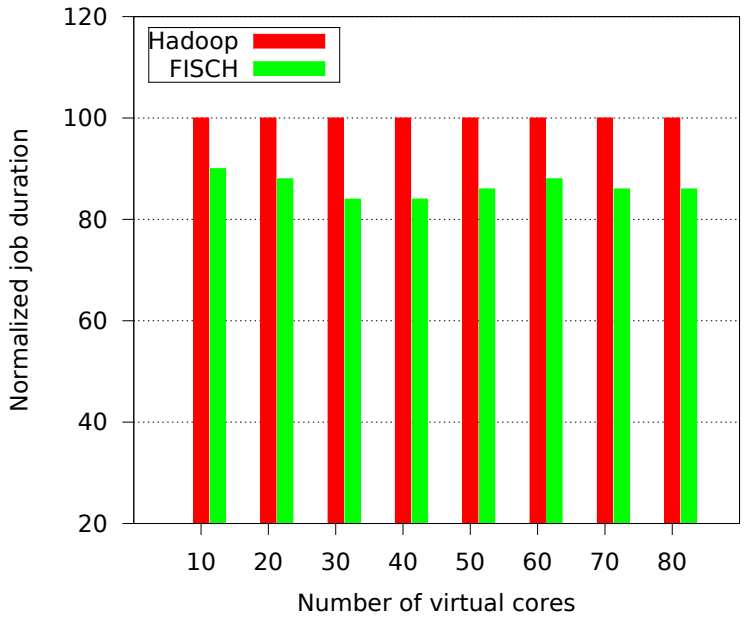
Experiments: compared to Hadoop

Caution: static scheduling alone will not work.

- Task duration are conservative estimates;
- Variability of the performance of the compute node.

We use static scheduling with backfilling.





- The jobs are MapReduce jobs doing image transformation.
- Hadoop streaming version 0.19.0

Questions ?