Scheduling for MW applications

E. Heymann, M.A. Senar and E. Luque

Computer Architecture and Operating Systems Group

Universitat Autònoma of Barcelona
SPAIN

Contents

- Statement of the problem.
- Simulation framework.
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Objective

- To develop and evaluate efficient scheduling policies for parallel applications with the following MW model:

```
for i=1 to M
  for j=1 to NTasks
    do F(j) ---> { Expectation
                 { Variance
  end
  [computation]
end
```

In an opportunistic environment

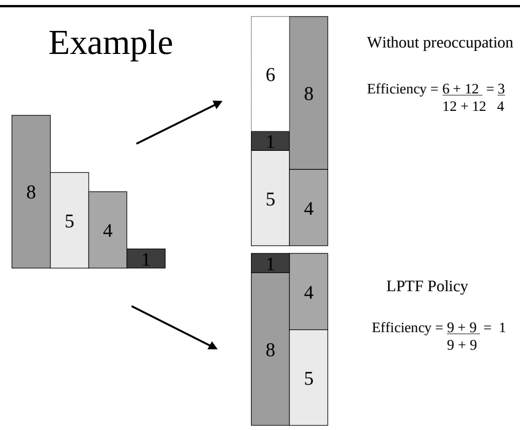
Objective

- How many workers ?
- How to assign tasks to workers ?

➔ Efficiency without forgetting performance.

➔ How sensitive is efficiency with respect to variance changes.

Example



Platforms

- Dedicated homogeneous machines.
- Non-dedicated (such as Condor) homogeneous machines.
- Non-dedicated (such as Condor) heterogeneous machines.

Policies Simulated

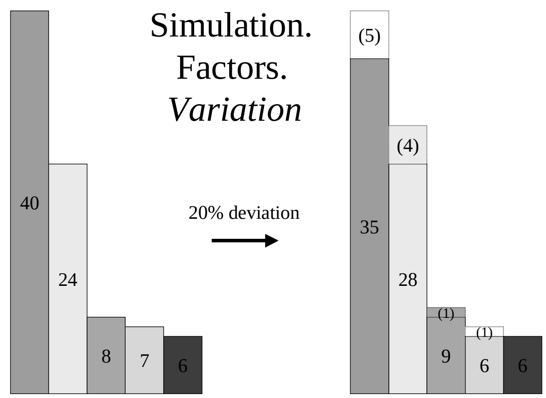
- LPTF: Largest processing time first
- LPTF on Average
- Random
- Random and Average

Policy	Next task to be assigned
LPTF	The biggest task
LPTF on Average	The biggest task considering execution times without variation
Random	A random task
Random & Average	1st *iteration:* A rand task *Next iterations:* The biggest task based on execution times of previous iterations

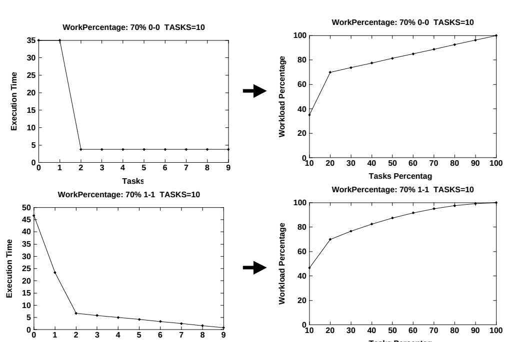
Simulation

- Response Variables:
  - Efficiency
  - Execution Time

Simulation. Factors. *Variation*



Simulation. Factors. Workload

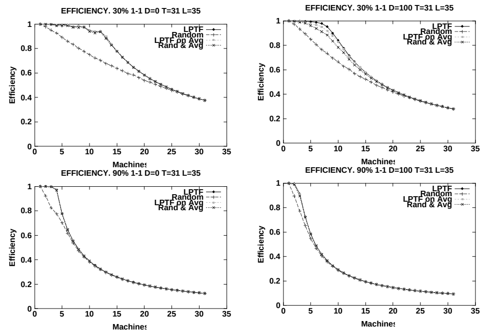


Simulation. Factors

- Processor Number ➔ 31, 100, 300
- Standard Deviation ➔ 0, 10, 30, 60, 100
- External Loop ➔ 10, 35, 50, 100
- Workload ➔ 20%load: 30, 40, 50, 60, 70, 80, 90
  - ➔ 20%dist: equal, decreasing
  - ➔ 80%dist: equal, decreasing

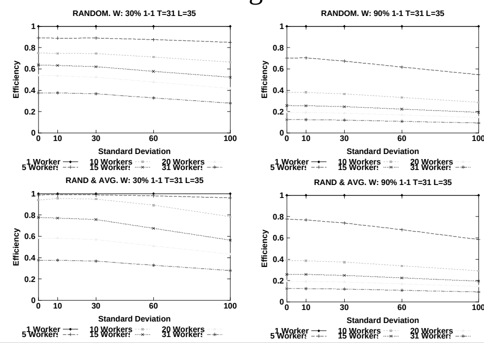
Simulation Results

Dedicated homogeneous machines



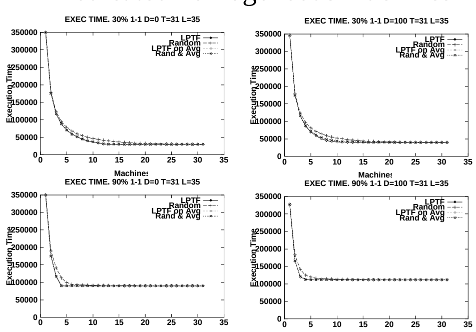
Simulation Results

Dedicated homogeneous machines



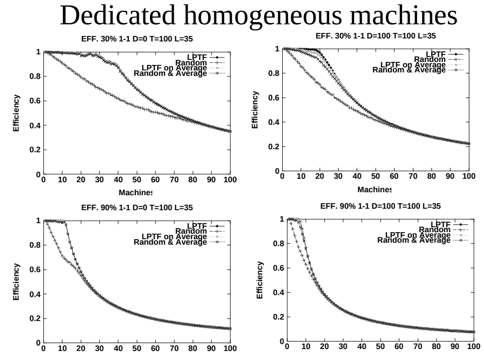
Simulation Results

Dedicated homogeneous machines



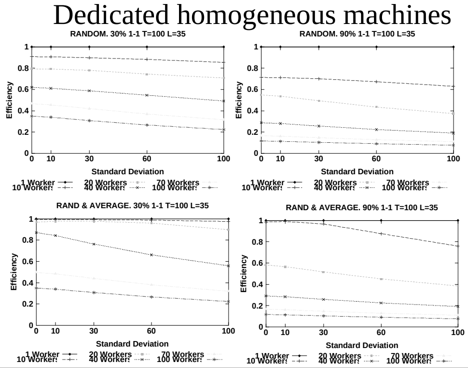
Simulation Results

Dedicated homogeneous machines



Simulation Results

Dedicated homogeneous machines



Simulation Conclusions

Dedicated homogeneous machines

Rough analysis:

- Variance does not seem to make efficiency significantly worse.
- External loop does not affect efficiency.
- To achieve an efficiency > 80% and an execution time < 1.1 respect to LPTF execution time, the number of workers should range between 15% of the tasks number (90% load) and 40% (30% load).

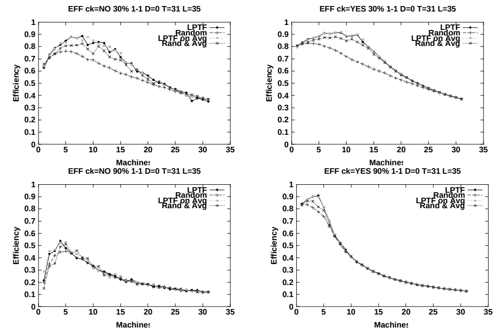
Simulation

Non-dedicated homogeneous machines

- Factors:
  - Processor Number √
  - Standard Deviation √
  - External Loop → Only 35
  - Workload √
  - Probability of loosing and getting machines
  - Checkpoint → Always
    → Never
    → Only for “big” tasks that have been “a long time” in execution

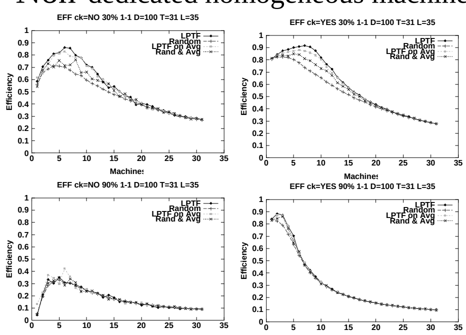
Simulation Results

Non-dedicated homogeneous machines



Simulation Results

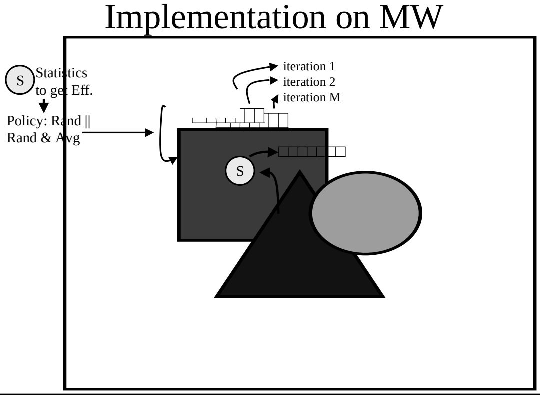
Non-dedicated homogeneous machines



Implementation on MW

- Support to the desired Program Model.
- Computation of the Efficiency.
- Scheduling policies → Random
  → Random & Average

Implementation on MW



Future

- Non-dedicated homogeneous machines:
  - Complete the simulations.
  - Duplication of large tasks. (?)
- Non-dedicated heterogeneous machines:
  - Use dynamic load information (provided by Condor) to rank machines.
- Implementation on MW:
  - Test the MW scheduling policies with large applications.