Utility-based Uploading Strategy in Cloud Scenarios

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Outline

1. Introduction
2. Problem Formulation
3. Models
4. Analysis
5. Simulation Results
6. Conclusions and the Future Work

Introduction

- The Cloud provider
  - We care customers.
  - We'd like to **make money**!
- How to make money?
  - Profit= (Unit Price – Unit Cost)*Number of Users
  - Lower cost leads lower price and more users.
  - **Lower data center's cost!**
- User
  - The task should be finished quickly.

Cost is HUGE!

- Data center burns money!
  - Annual cost to operate a single data center runs between $10 million and $25 million

- Use less machines if possible!
  - Lower the running power cost!
  - Lower cooling power cost!
  - Don't even need to buy them!

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Problems

- How to save machine number?
  - Run more jobs in less machines
  - However, users need to wait for a longer time. (Customers might complain, and quit the contract.)
- How to save time?
  - Just rent more machines for a single job
- With a limited budget.
  - If you want to go quickly, go alone. If you want to go far, go together.
- Key issue:
  - Should I wait?
  - How long should I wait?

Simplification

- Balance customers' satisfaction and data center cost
- Simplification:
  - Task Finishing Time → Customers' Satisfaction
  - Running Machines Cost → Data Center Cost

Again, balancing Time and Money!

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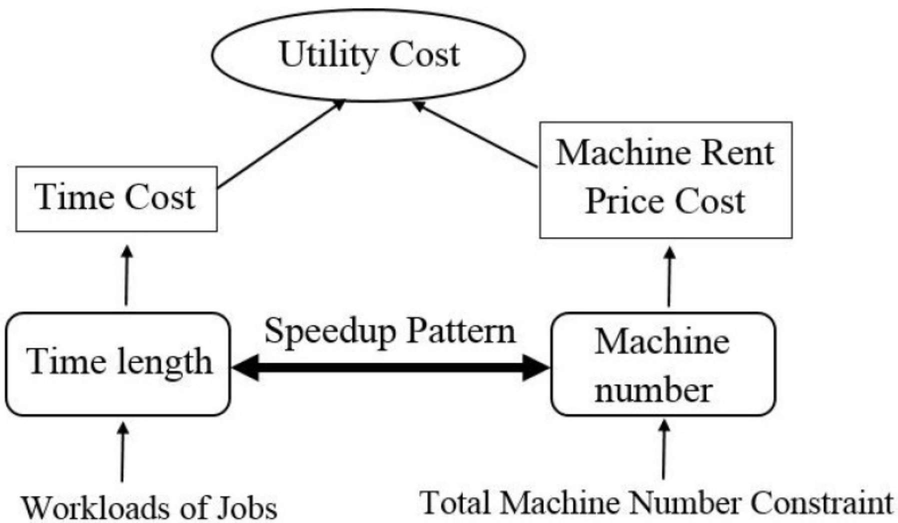
Utility-based VM Model

- Utility Cost Model

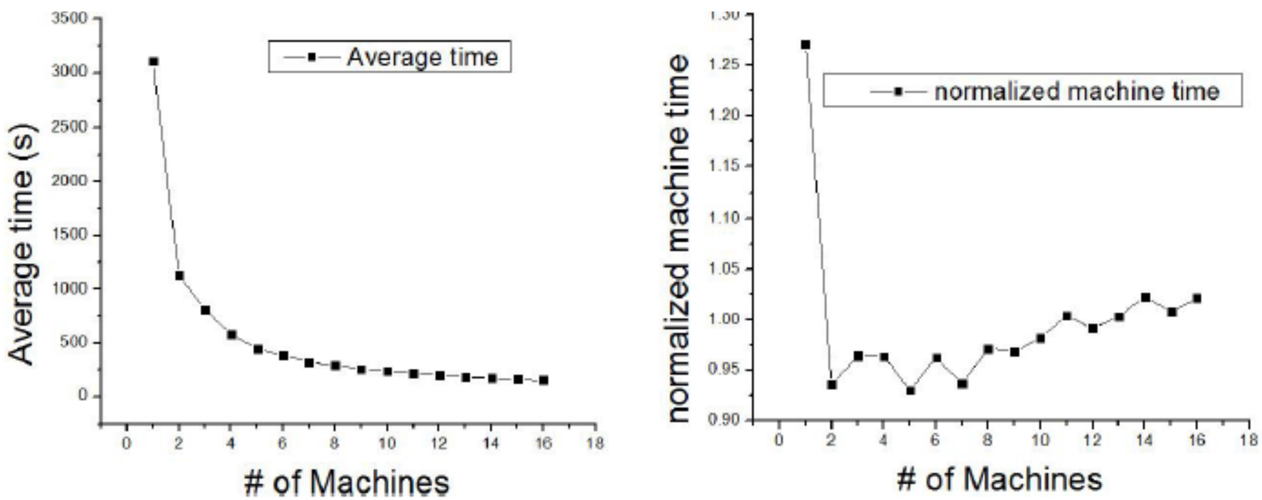


$$U_i = B_i - p_i - b \times t_i$$

- Then we just need to minimize the utility cost to maximize the profit for cloud providers.

Utility-based VM Model (Cont'd)

- More VMs assign to a job will make this job run faster.
- However, the processing speed not linearly increase with the number of machines.

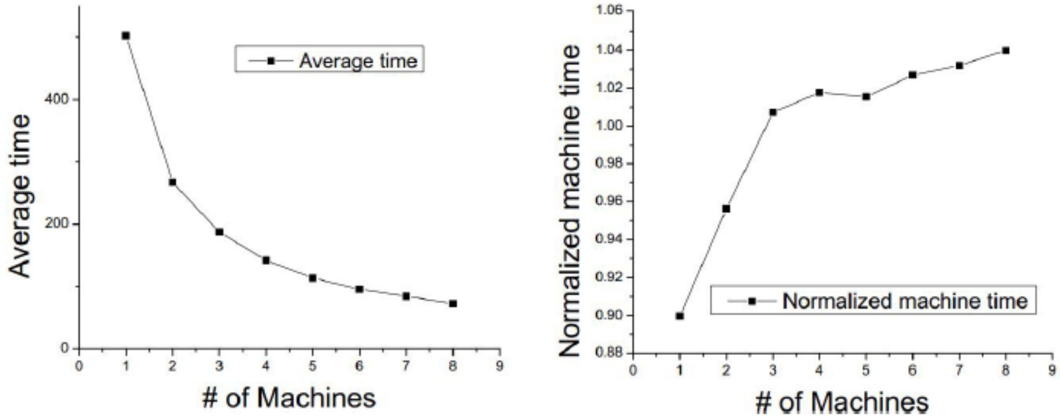


(a) Average Time

(b) Normalized Machine Time

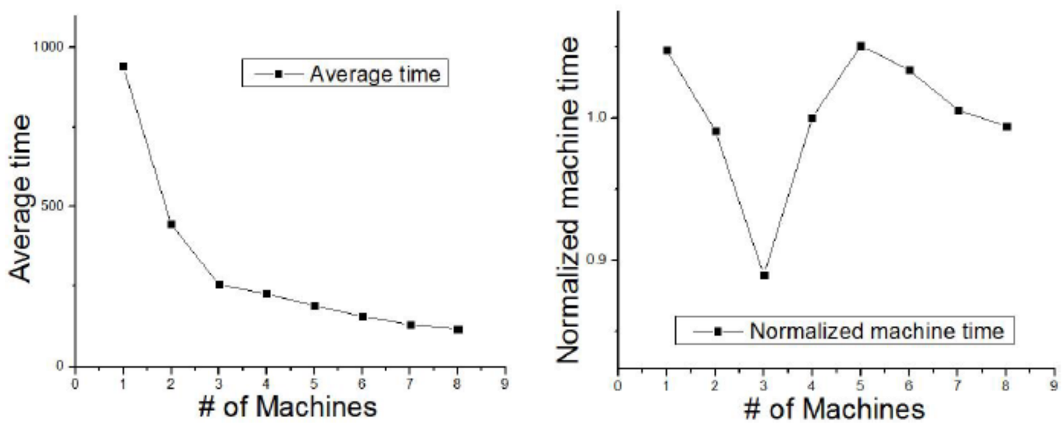
Fig. 3. Word Count

- The processing speed not linearly increase with the number of machines.



(a) Average Time (b) Normalized Machine Time

Fig. 4. Pentomino



(a) Average Time (b) Normalized Machine Time

Fig. 5. TeraSort

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Analysis

- In some cases, users only care about the time, and pay little attention to the rent price.
  - minimize the time cost first, then consider minimizing the machine rent price.
- In some cases, users only care about the Price
  - minimize the rent price first, then consider minimizing the machine time cost.
- A simple policy-shifting algorithm
  - In case, we don't know which one is more important

More Analysis

- We want to maximize the utility directly.
  - We provide a greedy algorithm to make a balance between performance and time complexity.

Algorithm 6 *Group Utility – greedy size*

Input: Workloads of all jobs, total number of machines, and speedup property of machines;

h=1
while There is a jobs not in groups $g_1, g_2, ..., g_h$ **do**
  for g_h from 1 to maximum number of machines M **do**
    while $N > \sum_1^h g_j$ **do**
      Set Number of jobs in g_{h+1} as g_h
    Compute total $U = \sum(B_i - Uc_i)$ of the all group;
    $h = h + 1$;
  Compare and find out the best number of jobs for g_h. Schedule jobs in groups with that number.

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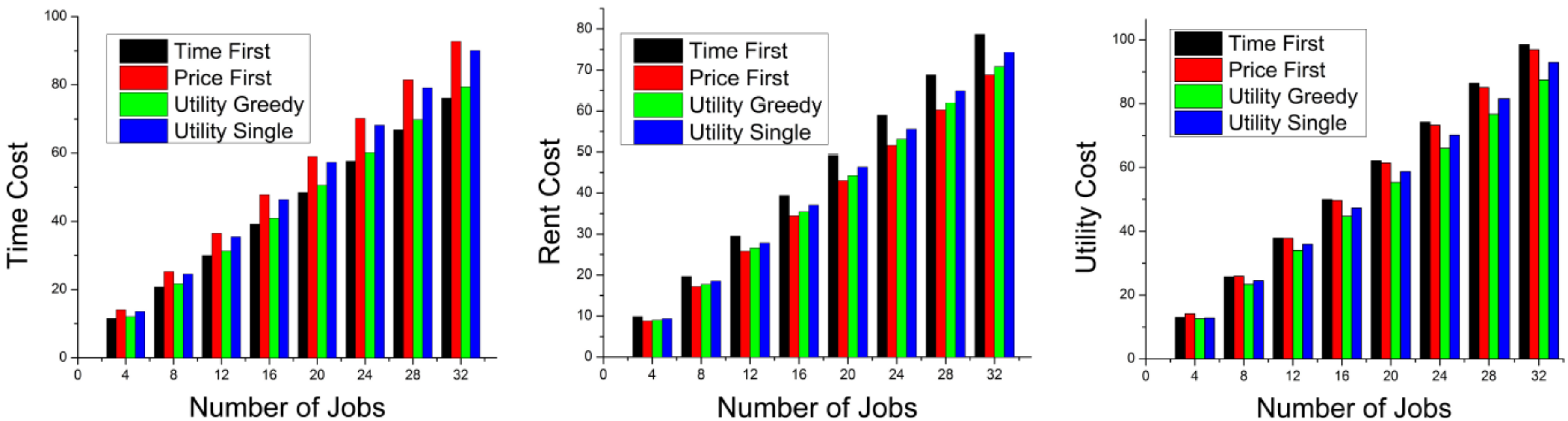
Simulation

- Simulation setting
  - 8 Dell R210 Servers.
    - dual core Intel Celeron processor.
    - 4 GB of RAM
  - Cisco small business 300 Series Managed Switch
  - Tasks (three common applications in the Hadoop cloud framework)
    - Word Count, Pentomino, and TeraSort

Simulation

- Algorithms
  - Time-first algorithm
  - Price-first algorithm
  - Utility-single algorithm
  - Utility-greedy algorithm

Simulation (cont'd)



(a) Time Cost (b) Rent Cost (c) Utility Cost

Simulation Results of 4 Algorithms for Word Count

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Conclusions

- We consider the design and analysis utility-based scheduler in the cloud environment. Unlike all existing works, we propose the notion of the utility for the Virtual Machine management.
- The model presented here opens the door for an in-depth study of how to schedule in the presence of phase overlapping. There are a wide variety of open questions remaining with respect to the design of algorithms that minimize response time

Thank you!

Questions?

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