Unexpected Economic Consequence of Cloud Computing: A Boost to Algorithmic Creativity

Francisco Zapata, Eric Smith, and Vladik Kreinovich

University of Texas at El Paso, El Paso, Texas 79968

fcozpt@outlook.com, esmith2@utep.edu, vladik@utep.edu

1. Algorithms can be made more efficient

- It is well known than many algorithms that we traditionally use are not the most efficient ones.

- This was a big revelation in the 20th century, when it turned out that:

  - not only the traditional algorithms for such exotic things as Fourier transform were not the most efficient ones,

  - but also traditional algorithms for multiplying matrices – and even for multiplying numbers – are far from efficient.

2. Theoreticians win prizes, but practitioners are not impressed

- Researchers still actively work on designing new more and more efficient algorithms.

- These new algorithms win research prizes and academic acclaim.

- However, in most cases, these developments do not attract much interest from the practitioners.

- As a result:
  - while there is a lot of effort for speeding general algorithms – efforts supported by national funding agencies –
  - there is very little effort in speeding specialized algorithms intended for geo-, bio-, engineering, and other applications.

3.   Why, in the past, practitioners were not interested

- In the recent past, this lack of interest was mostly caused by the fact that we were still operating under Moore's Law.

- According to this law, computer speed doubled every two years or so.

- So why invest in speeding up the algorithm by 20% if in two years, we will get a 100% increase for free?

4. Practitioners are still not very interested

- Nowadays, Moore's Law is over.

- However, practitioners are still not very interested.

- The main reason for this is as follows.

- There may be a few time-critical situations when computation time is important.

- However, in general, what would a company gain by using a faster algorithm?

- This company most probably already has computer hardware allowing it to perform all the computations it needs within the required time.

- So there will be no financial gain if these computations are performed faster.

5. But what happens with the transition to cloud computing?

- The above arguments work well when the company owns its computers.

- However, lately:
  - a large portion of computations is done in the cloud,
  - i.e., on computers owned by a cloud service (to which the company pays for these computations).

- What we plan to show is that this drastically changes the situation.

- Many companies may not have realized that.

- However, now it has become financially beneficial to support algorithmic creativity.

6. How a company pays for cloud computing a reminder

- With cloud computing, a company only pays for the actual computations.

- This fact is the main reason why cloud computing is economically beneficial for companies.

- For example, a chain of stores:
  - does not need to buy additional computers to cover spikes in purchase processing needs during the Christmas season;
  - additional computers that will be mostly idle at other times.

- Instead, it can only pay for additional computations during this season – and do not spend any money at other times.

7. This leads to a boost in algorithmic creativity

- Now the company payment is directly proportional to computation time.

- So, any decrease in computation time leads to immediate financial savings.

- For example:

  - if a company spends 3 million dollars a year on cloud computing services, and

  - its computer specialists manage to make its algorithms 20% faster,

  - the company immediately saves 600 000 dollars – not an insignificant amount.

- With this in mind, it has become financially beneficial to try to speed up existing algorithms – i.e., to boost algorithmic creativity.

8. This leads to a boost in algorithmic creativity (cont-d)

- Many companies have not yet recognized this – and this paper is one of the ways to convince them.

- However, the financial logic is clear: the more algorithmic creativity, the larger the company's profit.

9. How this will affect education of computing professionals

- As of now, most companies are not interested in computational efficiency.

- So they hire people who can code – without requiring that these folks are familiar with all the techniques used in making algorithms faster.

- The resulting demand leads to the emphasis on basic skills when teaching computing professionals:
  - as more and more companies will realize that algorithmic creativity is profitable,
  - there will be a larger need for professionals who are more skilled in algorithmics.

- The resulting demand will definitely change the way computer professional are educated.

10. How this will affect education of computing professionals (cont-d)

- This phenomenon will also boost the corresponding theory.

- It will also probably modify this theory since companies will be interested in actual computation time.

- So, the corresponding problems will switch:

  - from optimizing approximate characteristics like number of elementary computational steps

  - to more sophisticated characteristic that will provide a better approximation to the actual computation time.

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