Minimizing Maximum Response Time and Delay Factor in Broadcast Scheduling

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Overview

- The paper studies two related metrics called maximum response time and maximum delay factor and their weighted versions
- The results obtained from the competitive model are:
  - An online algorithm for maximum delay factor is $O(1/\varepsilon^2)$ – competitive with $(1-\varepsilon)$ speed
  - To show that first-in-first-out is 2 competitive even when page sizes differ.
  - To show that natural greedy algorithm is not O(1)-competitive for maximum delay factor.

Related Works

- Minimizing average flow time and maximizing throughput of satisfied requests when requests have deadlines.
- New Models and Algorithms for Throughput Maximization in Broadcast Scheduling
- Longest wait first for broadcast scheduling.
- This paper answers and provides algorithm for basic temporal constraints on the delivery of data when client requests for data from resources.

JUSTIFICATION

- When all pages are of unit size in broadcasting the paper considers algorithm SSF-W to find solution for minimizing the maximum delay factor.
- To calculate the highest weighted time of page request an algorithm BWF-W is proposed
- Lower bound for a natural greedy algorithm LF is given which achieves competitive ratio of c.

Technique and Solution

Algorithm: SSF-W

Let α_t be the maximum delay factor of any request in SSF-W's queue at time t.

At time t, let $Q(t) = \{J_{p,i} \mid J_{p,i}$ has not been satisfied and $t - a_{p,i}\ S_{p,i} \geq 1\ c\ \alpha_t\}$.

If the machine is free at t, schedule the request in Q(t) with the smallest slack non-preemptively.

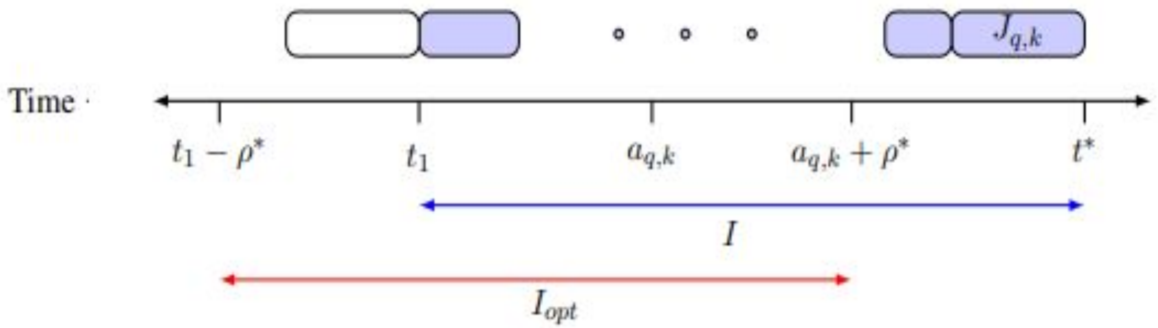

Figure 1: Broadcasts by **FIFO** satisfying requests in $\mathcal{J}_I$ are shown in blue. Note that $a_{q,k}$ and $a_{q,k} + \rho^*$ are not necessarily contained in I.

FIFO For Minimizing Maximum Response Time When Page Sizes Are Different

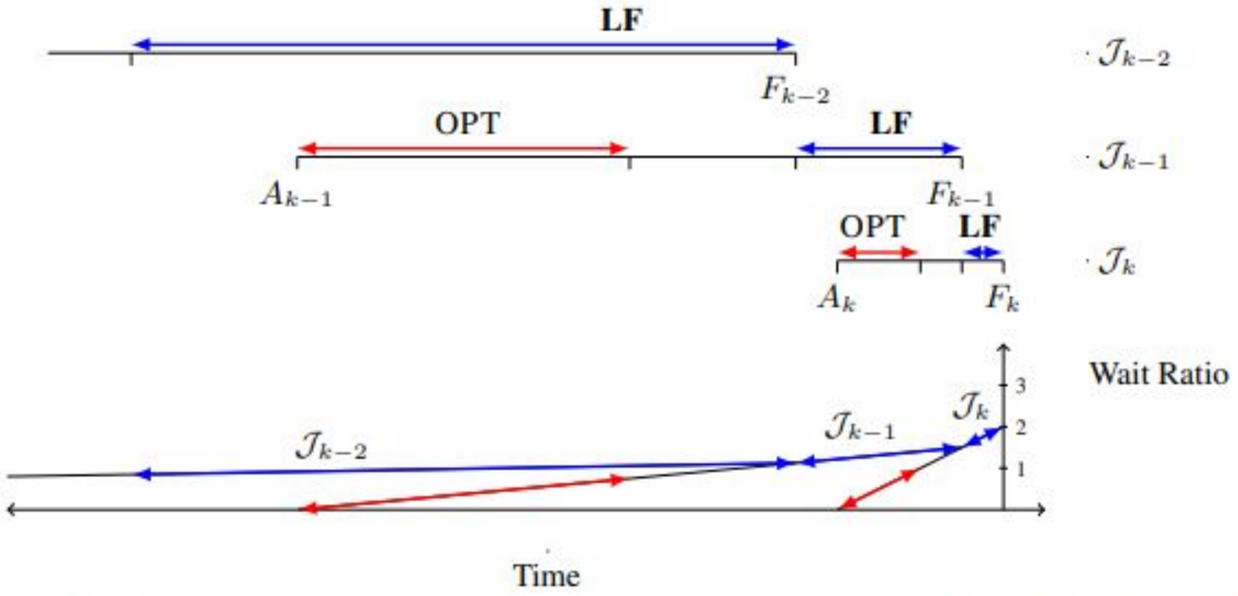

Figure 2: Comparison of scheduling of group $\mathcal{J}_k$, $\mathcal{J}_{k-1}$, and $\mathcal{J}_{k-2}$ by **LF** and OPT.

WE FORMALLY SAY THAT ALGORITHM LF ACHIEVES WAIT RATIO C, WHILE OPT HAS WAIT RATIO ATMOST 1 FOR GIVEN PROBLEM INSTANCE.

Limitations of Proposed Work

- The paper gives the algorithm for maximum delay factor with unit sized jobs with following dependency:

  Algorithm explicity depends on the speed given to it. For different

  sized pages problem is open on whether a (1 + e) – speed algorithm

- Algorithm for c-approximation for c<2, and minimizing the maximum response time offline.

Future Work

- Algorithm explicitly depends on the speed given to it. For different sized pages problem is open on whether there exists a (1 + e)–speed algorithm that is O(1) – competitive.
- Algorithm for c-approximation for c<2, and minimizing the maximum response time offline.

Conclusion

- This paper has given an almost fully scalable algorithm for minimizing and maximum delay factor in broadcasting for unit sized jobs.
- It proved that FIFO is infact 2-competitive for varying sized jobs thus solving the problem for minimizing the maximum response time online in broadcasting scheduling.

References

- Minimizing maximum response time in scheduling broadcasts. By Yair Bartal and S. Muthukrishnan

https://faculty.ucmerced.edu/sim3/papers/MaxDelayArx.pdf