NO NEED TO RUSH: DEALING WITH DEADLINES IN EV CHARGING

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In this work, we consider a queueing system where tasks arrive as a Poisson process and have generally distributed job sizes. Each task has a (generally distributed) deadline, correlated with the job length. The system may serve each task k at any rate $0 \leqslant r_k \leqslant 1$, and has constrained capacity, i.e. $\sum_k r_k \leqslant C$ where the sum is over simultaneous jobs. These leave the system either when service is complete or upon expiration of its deadline. Inspired by the electric vehicle charging facilities, we consider however that *partial service* performed on each job is useful, since the energy will be available to the EV.

In this scenario, we are interested on how the service is distributed across users. Building upon previous formulations for the processor-sharing policy (Gromoll et. al. 2006, Aveklouris et. al. 2017), we propose a fluid limit analysis for such systems that includes many common policies such as earliest-deadline-first, least-laxity first or shortest-remaining-processing time. We show that in the limit the reneged work is invariant across efficient policies, but its distribution is highly dependent on policy. This leads to potential unfairness across jobs. We then derive a natural policy, dubbed least-laxity-ratio, that preserves proportional fairness in overload.

Finally, we extend our modeling formulation to include age-based policies such as FIFO, LIFO or Least Attained Service. Such age based policies are interesting to deal with the case where the system does not know the deadline. We show that in overload, LIFO, Least-attained-service and Earliest Deadline First have exactly the same performance: a striking result given that the latter makes explicit use of the deadlines. Similar analogies can be built between other deadline-aware, age-aware policies and size-aware policies.

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