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computer science 12

Master Thesis

Priority Point Exploration for EDF-Like Scheduling

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The choice of a scheduler has major impact on the schedulability of a task set. For the standard task model (without self-suspension) Earliest-Deadline-First (EDF) provides the best schedulability guarantee. However, several mechanisms, like multiprocessor locking protocols, shared resources, etc., induce self-suspending behavior. For such tasks, the existing optimality proof for EDF does not hold anymore. In such a case, empirical searches can be conducted to identify a scheduler that makes a task set schedulable. However, due to the extensive amount of priority-based schedulers, finding a proper scheduler can be challenging.

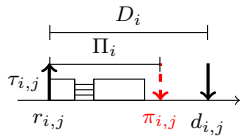

Figure 1: Relative priority point Π_i and corresponding global priority point $\pi_{i,j}$.

Here, EDF-Like scheduling comes into play. With EDF-Like scheduling, each task τ_i is equipped with a relative priority point Π_i. Similar to EDF scheduling, the relative priority point is translated into a global priority point $\pi_{i,j}$ (as shown in Figure 1), and the job with the earliest global priority is scheduled first (as shown in Figure 2). By configuring the priority points, many different scheduling algorithms can be modeled, including Fixed-Priority (FP) scheduling, First-In-First-Out (FIFO), and EDF.

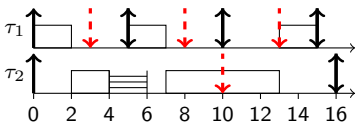

Figure 2: Example schedule under EDF-Like scheduling.

Since a schedulability test is already provided in our previous result, we can formulate the scheduler-choice as an optimization problem.

Find: Π_i

Such that: Task set is feasible under EDF-Like scheduling using the schedulability test.

There are a variety of different approaches that can be pursed to solve this optimization problem, for example:

- Genetic programming
- Iterative tuning approaches
- ...

We already have some initial result for the genetic programming and iterative tuning that can be iterated upon. Moreover, the work by Wang et al. [2] might be applicable. However, novel approaches are welcome as well.

In this thesis,[1] the student gets familiar with self-suspending tasks and with the schedulability analysis presented in [3]. The student chooses suitable optimization methods and conducts the optimization. A comparison with typical algorithms like EDF, FP or FIFO should be conducted.

Required Skills:

- Knowledge about real-time systems.
- Interest in self-suspending tasks.

Acquired Skills after the thesis:

- Knowledge about dedicated optimization strategies.
- Knowledge about self-suspending tasks and EDF-Like scheduling.

References:

[1] Mario Günzel, Kuan-Hsun Chen, Jian-Jia Chen, and Ching-Chi Lin. "Priority Point Exploration in EDF-Like Scheduling for Self-Suspending Tasks." 2023. Workshop on OPtimization for Embedded and ReAl-time systems (OPERA) co-located with the 44th IEEE Real-Time Systems Symposium (RTSS). (PDF)

[2] Sen Wang, Dong Li, Shao-Yu Huang, Xuanliang Deng, Ashrarul Sifat, Changhee Jung, Ryan Williams, and Haibo Zeng. "Real-Time Systems Optimization with Black-box Constraints and Hybrid Variables." 2023. Workshop on OPtimization for Embedded and ReAl-time systems (OPERA) co-located with the 44th IEEE Real-Time Systems Symposium (RTSS). (PDF)

[3] Mario Günzel, Georg von der Brüggen, Kuan-Hsun Chen, and Jian-Jia Chen. "EDF-Like Scheduling for Self-Suspending Real-Time Tasks." 2022 IEEE Real-Time Systems Symposium (RTSS). IEEE, 2022.

[1] Other suggestions and related topics are also welcome. Please do not hesitate to make an appointment.