Semi-Clairvoyance in Mixed-Criticality Scheduling

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In mixed-criticality scheduling theory

- each job is characterized as being of either high criticality or low criticality
- it is assumed that each job is characterized by two WCET parameters: a low-criticality one and a high-criticality one

A run-time algorithm is defined to be correct if it

- meets all deadlines if each job completes execution within its low-criticality WCET, and
- meets all high-criticality deadlines if each job completes execution within its high-criticality WCET

Two different kinds of run-time algorithms have been considered:

- Clairvoyant algorithms know beforehand whether any job is going to exceed its low-criticality WCET or not
- On-line algorithms are non-clairvoyant: they only learn whether any job will exceed its low-criticality WCET upon some job actually doing so

Clairvoyance is an abstract idealization that cannot be realized in practice; it provides a basis against which the performance of (actual) on-line algorithms may be compared.
IN THIS PAPER...

We introduced the notion of semi-clairvoyance for run-time algorithms

• A semi-clairvoyant run-time algorithm knows whether a job will exceed its low-criticality WCET at the instant that the job arrives at the scheduler
• Whereas clairvoyance is an abstraction, we identified conditions under which semi-clairvoyance is realizable in practice

We derived an algorithm, LPSC*, for scheduling collections of dual-criticality jobs

• LPSC has polynomial run-time and a speedup factor of 1.5 when compared to an idealized clairvoyant scheduler (We have also shown that this is the smallest possible speedup factor)
  • No non-clairvoyant on-line algorithm for jobs can have a speedup factor smaller than 1.61
  • Hence semi-clairvoyance strictly dominates non-clairvoyance

We derived an algorithm for scheduling collections of dual-criticality tasks

• This algorithm is optimal, and has polynomial running time
  • No non-clairvoyant on-line algorithm for tasks with speedup factor smaller than 4/3 is known

*LPSC stands for Linear-Programming based Semi-Clairvoyant scheduler
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