Anotace dizertační práce

Analýza a návrh systému pro řízení vytížení výpočetních prostředků a toku dat v systémech sběru dat

Analysis and Design of System for Control of Load of Computional Resources and Data Flow in Data Acquisition Systems

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In particle physics, a trigger is a system which uses criteria to decide which events from detectors are to be kept, discarding the rest. Presently, a vast majority of physics experiments rely on a hardware trigger implementation, with some employing the use of a "high-level trigger" on top of the hardware implementation.

A high-level trigger normally entails online reconstruction of physics events in order to further assist with the filtering process. A significant downside of a hardware implementation of a trigger system is that such a system is only able to utilize signal from low-latency detectors in order to perform decisions. With recent technology developments, the creation of a "trigger-less" data acquisition system is becoming increasingly feasible. Such a system would not contain a hardware trigger, and only make use of a high-level trigger to filter the events.

The Ph.D. candidate will be tasked with designing universal architectural patterns for such a system, as well as the underlying scheduling and data-flow managing algorithms.

Devising a set of efficient scheduling algorithms is the research part of the task – it is almost always the case that online event reconstruction is very resource-heavy, and therefore necessitates usage of processor farms in order to satisfy the needs of a given experiment. The time to process a single event may depend on a multitude of factors, and may only be an approximation, or even be unknown.

Formally, the Ph.D. candidate will devise approximation algorithms for variations of the NP-complete $P \mid \beta \mid C_{max}$ scheduling problem, namely:

Non-preemptive $P \mid \textit{online-}r_j \mid C_{max}$ problem with approximate (bounded) job size

Non-preemptive $P \mid \textit{online-}r_j \mid C_{max}$ problem with estimated (unbounded) job size

Non-preemptive $P \mid \textit{online-}r_j \mid C_{max}$ problem with unknown job length

The approximated or estimated value of the job size becomes known at job release time.

He or she will also explore the possible relaxations or further restrictions of these problems, as fit for this particular use case (exploitation of additional information). Finally, he or she will investigate the offline forms of the former two variants of the problem – in this case, all jobs and their respective approximated or estimated sizes are known beforehand. The output of an algorithm solving this problem would not be a schedule, but rather a decision plan for the scheduler (provided the decisions yield only an approximation of the optimum, what space complexity can be achieved?).

After designing the algorithms and a fitting general architectural solution, the Ph.D. candidate will also be tasked with the implementation of such a system for a selected physics experiment.

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