Code Generation and Compilation for Multi-Phase Tasks

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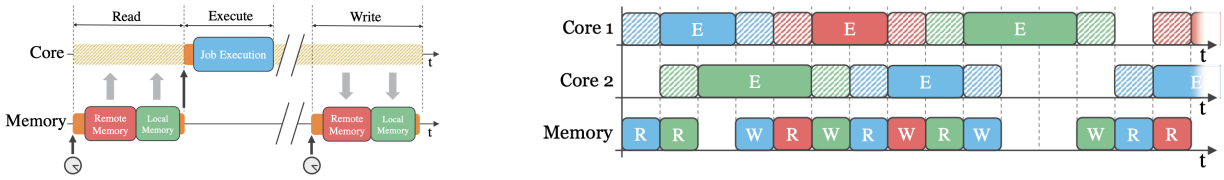
The advent of multi-core platforms brings many possibilities for embedded system designers. However, these architectures often implement complicated memory hierarchies that aggravate their timing analysis [1].
One way to tackle this problem is based on memory-centric approaches [2], where access to shared memory is co-scheduled with computation tasks. Such a treatment allows to account and plan for possible memory-contention scenarios which can significantly increase the predictability of the system.
Many industrial domains already today employ similar execution models. Typically, the execution is divided into three distinct phases, *read-execute-write* (see Fig. 1). While the read and write phase access shared memory, the execute phase only operates on local copies of variables and thus accesses no shared data. This model can for example be found in the automotive domain [3, 4] or in the avionics domain [5]. Approaches for dynamic [6, 7, 8, 9]. as well as static [4, 10] scheduling have been proposed for this model.
While this model provides predictability, applications are often not designed to follow the phased model. Manual transformation and management of memory operations is further cumbersome and source for errors. To alleviate those challenges, code generation and compilation approaches exist that produce PREM-compliant code [11, 12, 13, 14].



(a) (b)

Figure 1: (a) Memory and execution phases for one task instance (with read and write phase split into access to different memory areas). (b) Example schedule for the read-execute-write model.

Scope and Outline of the Master Thesis Project

The aim of the thesis is to investigate automated methods to transform and/or compile programs to follow the phased execution model and be compliant with an existing execution framework for mullti-phase tasks. The performance of the approach will be compared against unmodified applications on a real multi-core platform.

1. A state-of-the-art analysis of the thesis domain.
2. Conceptual design of the proposed code-transformation or compilation methods to generate tasks compliant to the phased execution model.
3. Implementation of the proposed method.
4. Extensive evaluations of the method.

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