Polymorphic Computers — Virtualization of Instruction Set and Microarchitecture

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Abstract: Today, virtualization is often discussed on rather high abstraction levels (infrastructure, platform, software as a service). In contrast, in this talk the AMIDAR processor concept [GH05] will be presented, which allows virtualization of the instruction set level as well as on the microarchitectural level.

Running different instruction sets on the same hardware and microarchitecture is not a new idea. Particularly, in the early days of microprogrammed machines, it was quite common to run different application specific instruction sets on the same machine. After microprogramming was abandoned due to its performance issues, instruction set architectures (ISA) became rather static. The proposed AMIDAR concept allows changeable instruction sets, yet provides execution efficiency close to modern pipelined processors. Candidate ISAs for this approach are not typical RISC ISAs but rather popular abstract ISAs like Java Bytecode, .NET intermediate language or the LLVM bitcode. Similar to software execution environments for these ISAs, AMIDAR processors will also optimize the execution of instruction sequences, but on the hardware level.

Varying the amount and selection of microarchitectural components is also a well developed technique. It is used to build different processor variants for the same ISA, but targeting very different design goals (energy efficiency, performance, throughput). In almost any processor architecture these selections are made before the processor is designed. In AMIDAR processors, these choices are made at runtime and dynamically depending on the characteristic of the running application. This can be seen as a virtualization of hardware resources, where the processor decides itself how to make best use of the available resources. To this end, a reconfigurable fabric can be included in AMIDAR processors, for which the configuration is created at runtime [DH11].

The talk presents achievements, current status and an outlook of the AMIDAR project.

References
