A Component Concept for Abstract State Machines

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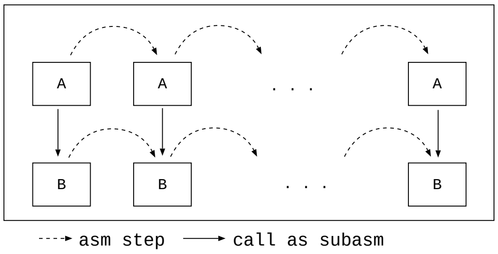
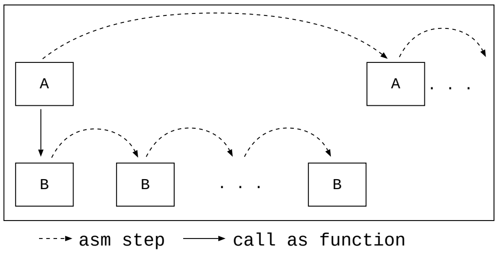
Abstract. The Abstract State Machine (ASM) [9] approach has already proven to be suitable for large-scale specifications of realistic systems [7, 6, 11, 13]. Due to the fact that the ASM approach defines a notion of *executing* specifications, it provides a perfect basis for a language, which can be used as a specification language as well as a high-level programming language. However, in order to upgrade to a realistic programming language, such a language must – besides other features – add a modularization concept to the core ASM constructs in order to provide the possibility to structure large-scale ASM-formalizations and to flexibly define reusable specification units. The language XASM[1] – which stands for *Extensible ASM* – realizes a component-based modularization concept based on the notion of external functions as defined in ASMs. In the presentation, the component-based modularization concept of XASM will be briefly described.

XASM formalizations are structured using "**asm**. . . **endasm**" units each of which can be seen as a component containing a certain part of an overall ASM specification. In order to correctly integrate the component concept into the ASM framework, there exists two kinds of relationships between these units; these relationships will be refered to as "use modes" in the sequel. An **asm** can be accessed by other **asms** in either of the following two ways:

If an asm A uses B as **sub-asm**, it means that B – possibly together with arguments, if the arity of $B > 0$ – is used as a *rule* in the body of A. If this rule fires, the rules of **asm** B fire, which may result in updating locations of functions declared in A. The sub-asm-use relation between **asms** may contain cycles; lazy evaluation techniques are used to avoid an infinite number of rules. The call as subasm is illustrated in the figure. The sub-asm B and its parent asm A step simultaneously; formally they can be seen as one single ASM.



Asm A uses B as a **function**, if B is defined as **external function** in A. In this case, B – possibly together with arguments, if the arity of $B > 0$ – is used as a *term* in the body of A. Recursion is allowed, so that the function-use relation between **asms** may contain cycles. The call as function is illustrated in the figure. During the run of the function-asm B, its parent A doesn't make any step; from A's point of view B's run happens in zero time. As depicted in the figure,



B behaves like a "normal" asm, the iterations shown here are caused by the steps of the B-asm itself.

In each of the above cases, we call A the *parent-asm* of B, if A uses B as sub-asm or as function. In any case, the **asm** must be declared in the parent **asm**. As part of its meta information, an **asm** can be marked as a function or as a sub-asm, so that it can only be used by other **asms** in the specified way.

The XASM language is fully implemented. The system is used as the basis for the Montages/Gem-Mex, where generated XASM code is translated into an interpreter for the language specified using Montages, a semi-visual method for specifying the syntax and semantics of programming languages [2–5, 12, 8, 10].

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