Essential Ingredients for a WCET Annotation Language

Timing Analysis Cluster Meeting

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Joint work within ARTIST2 of the Compilers Activity and the Timing Analysis Activity

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Overview

- The WCET Annotation Language Challenge
- Fundamentals
- First steps towards a common WCET annotation language
- Attributes of timing information
- List of timing information
- Future work

The WCET Annotation Language Challenge

- Announced in July 2007
- Motivation:

  Mastering the WCET Annotation Language Challenge is essential for consolidating and advancing the state-of-the-art:

  Precision and performance of WCET analysis depends on expressiveness and usability of the annotation language
- Goal:

  Define a common WCET annotation language to enable the annotation of benchmarks in a tool-independent way.

Fundamentals

- Using the name of “timing annotations” rather than “WCET annotations”
- The annotation language does not need to be as expressive as the programming language
  - only properties of the program behavior have to be described, there is no need to describe the full program semantics
  - avoiding unnecessary expressiveness in the annotation language keeps the WCET analysis efficient.
- Distinction between timing information and timing annotations
- Flow information is subset of timing information

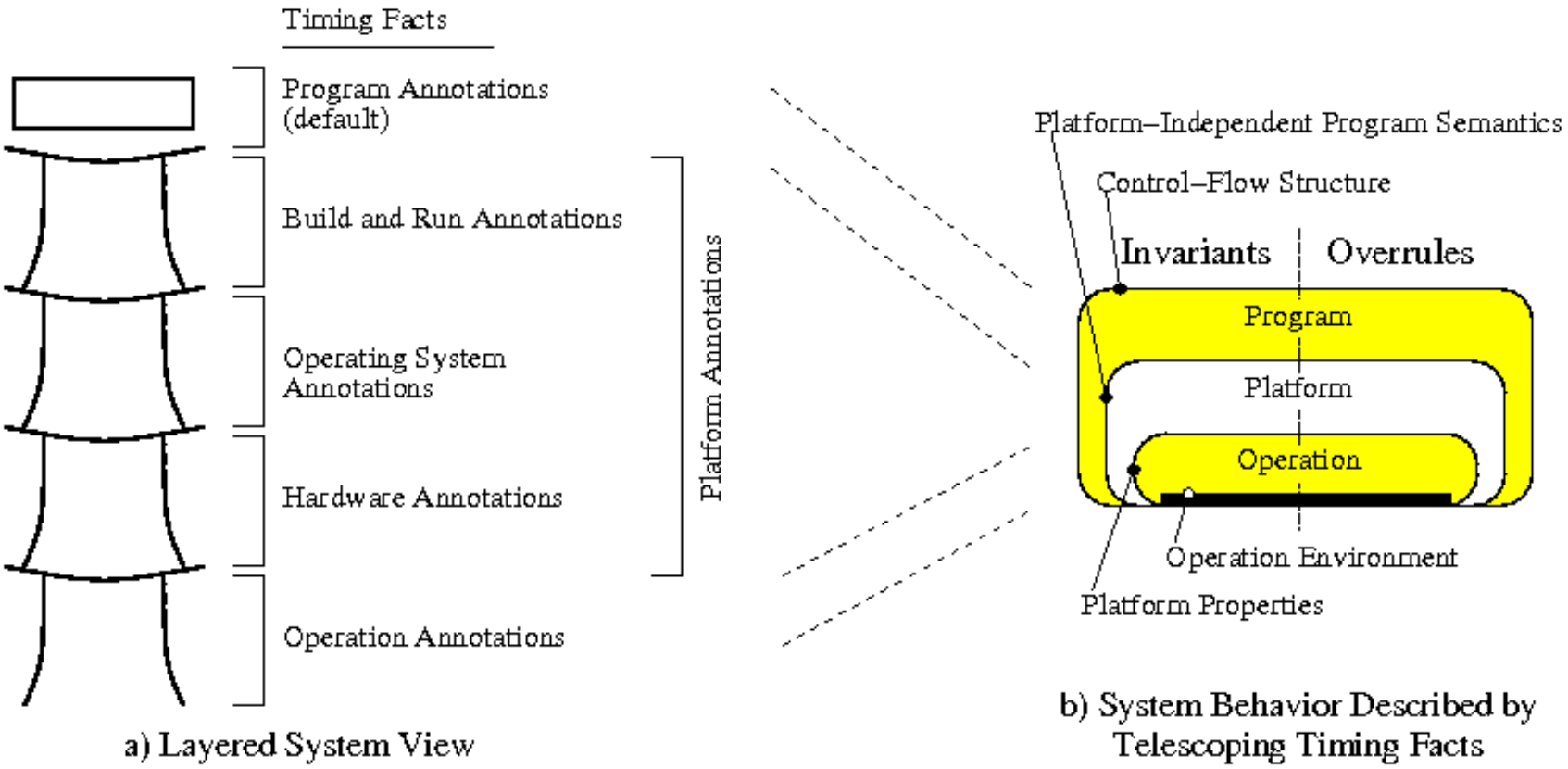
First Steps Towards a Common Annot. Lang.

- Analysis of existing tools and papers to extract timing annotation constructs
- Description of existing annotation constructs in a language-independent way
- Identification of additional constructs
  (e.g., invariants/overrules, annotation layers, selective use by grouping)
- Timing information that is not connected with the program code is left out of the annotation language
- Summarization of the results in a technical report to collect feedback

Attributes of Timing Information

- Annotation class: invariant vs. overrule
  SB_F…feasible system behavior
  invariant: $SB_F \subseteq SB(I_{inv})$
  overrule: $\neg(SB_F \subseteq SB(I_{ovr}))$
  overrules can be used to describe application modes
- Annotation layer:
  program, platform, operation
- Annotation groups:
  - symbolic name with a textual description
    (no predefined semantics)
  - groups may be nested
  - use: selective use of timing information (e.g., multiple platforms, different sets of overrules)

Layered Timing Annotations



different annotation layers

invariants vs. overrules

High-level Annotations

- Loop bounds
- Recursion bounds
- Linear flow constraints
- Variable value restrictions
- Summaries of external functions
  (e.g., side effects, value ranges of results)
  - used to describe an external function for which no code is available

Addressable Units

- Control-flow addressable units
  - basic blocks
  - control-flow edges
  - subgraphs
- Loop contexts
- Call contexts
- Control-flow paths

Control-flow Information

- Specification of unreachable code
- Specification of predicate evaluation
- Control-flow reconstruction

Hardware-specific Low-level Annotations

- Specification of clock rate
- Specification of memory map and memory accesses
- Absolute time bounds

Future Work

- Discussion within the ARTIST2 Timing Analysis Activity to get a common view on the requirements of a timing annotation language.
- Setting up a homepage to collect and publish different proposals towards the common timing annotation language.
- Local meetings with WCET tool vendors and research groups to discuss the instantiation of concrete timing annotation languages.