A foundation for MDE

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Outline

1. Introduction

2. An example: UML-RT/RoseRT

3. Conclusions

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Introduction

- MDE promises to improve software development by focusing on models
- Many successes and failures
- Problems:
  - Lack of adoption
  - *Ad hoc* methods, tools and applications

    ... exacerbated by ...
  - a lack of foundations
- Grand challenge: develop a foundation for MDE

Introduction

- Foundations of MDE ⟹foundations of modelling languages
- Foundations of modelling languages:
  - syntax,
  - semantics,
  - pragmatics
- Consider UML-RT and RoseRT as an example of:
  - what can be achieved
  - what is missing

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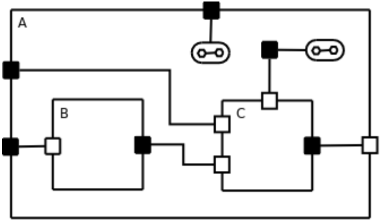
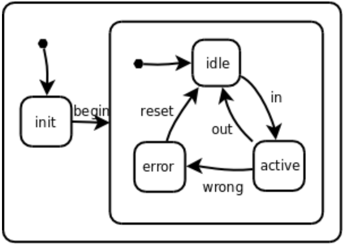
UML-RT and RoseRT

- UML-RT: a UML profile for real-time, distributed and embedded systems.
- RoseRT (now Rational Technical Developer): UML-RT implementation
  - modelling environment,
  - code generation,
  - (some) analysis

UML-RT models



A capsule diagram



A state machine diagram

Why is UML-RT/RoseRT successful?

- Simple notation/syntax
- Manageable mix of effective features which guarantee strong properties that simplify design and analysis:
  - strong encapsulation with interaction via ports,
  - run-to-completion semantics
  - no orthogonal regions
  - etc...
- Tool support
  - good use of models: automatic code generation, (limited) analysis,
  - flexibility

What is missing?

- Features:
  - Action language
  - Behavioural interface specifications
  - "Real" real-time, schedulability analysis,
  - ...
- Tools:
  - Better analysis
  - Debugging/animation, etc.
- Questions:
  - How does multi-threading interact with RTC semantics?
  - ...
- Formal semantics

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Solutions

- Identification of core features
- Clarify their semantics and fundamental properties
  - our approach for real-time systems: real-time process algebra
  - UML: a λ-calculus of software modelling
- Study impact of model transformations on properties
- Study language patterns

Conclusions

- Even successful approaches to MDE have a lot of room for improvement
- We need more research in foundations
  - … more specifically we need research on modelling languages
  - … with special focus on formal semantics and pragmatics

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