POEMS

POEMS - Performance Of End-to-End Models of HPC Systems

Research Team

Adve - compilers ---> performance models
Bagrodia - parallel simulators, I/O and network models
Browne - parallel computation, systems modeling
Houstis - performance data base
Lubeck - applications and models
Teller - memory hierarchy models
Vernon - analytic models

6/16/97

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What is to be modeled?

Workload			
comp	I/O	comm.	application
			operating system
			processor architecture
			network architecture

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Application Requirements

1. end-to-end models

2. Model Development and Evaluation - 10% rule

3. Confidence in results

4. Accuracy - resolve system architecture alternatives

5. Reuse of Components

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Technology Requirements

1. Multi-domain models

2. Multi-level models

3. Multi-method evaluation

4. Parallel evaluation

5. Associative Interactions

6. Preservation of behavior patterns across levels of abstraction

7. Automatic synthesis of performance models

8. Associative Interactions

9. Multiple time/space scales

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POEMS Constituents

1. Specification Language - capture and composition

2. Model Libraries - applications, operating systems, architectures

3. Performance Data Base - Execution Data ----> performance models

4. Model Evaluation - simulators, analytic solvers, actual hardware

5. Model Generation - Programs ----> performance models

7. Interfaces to performance monitors

8. Systems Management Language

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Validations

Component model validation
existing applications, existing architectures
LANL ASCI applications
GloMo, Quorum, etc

Collaborations
SGI
Cray
IBM

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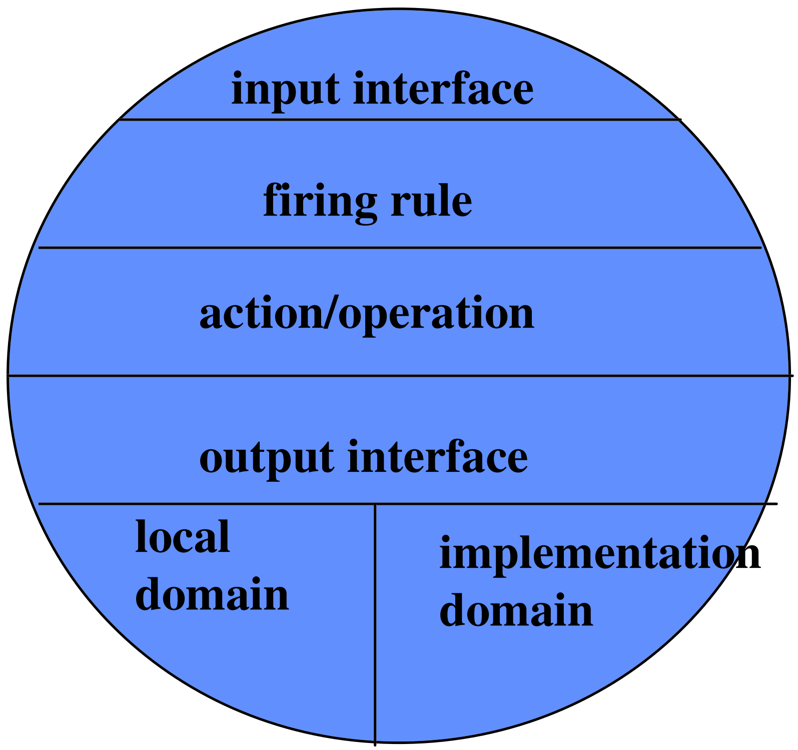
Representation Issues - Model of Parallel Computation

Generalized Dependence Graph

Nodes, relationships, transactions



node specification

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Associative Model of Interaction

1. set of parameters

2. set of attributes

3. profiles - subset of attributes

4. selectors- a template for a conditional expression with slots for attributes or attribute values

5. hyperactive messages - messages which contain an executable action.

6. Parameter mappings

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Input Interface

(transaction specifications - units of work processed, parameters)
(profile - specifications for what transaction the model can process)

Output Interface

(transaction specifications, parameters)
(selector - specifications for the target model for the transaction)

Hyperactive Transactions - transactions contain executables.

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Application of Associative Interface

1. Construct input and output interfaces for each model component.

2. Construct transaction and parameter maps.

3. Resolve at each of: compile time, link time and runtime.

4. Invoke mappings as required.

Example Model Specification

cache (transactions, parameters profile)

transactions - instructions = {single, block}
parameters - none
profile - state resolution = {full, stochastic}
- cache type = {direct, set associative)
- cycle time = {value}

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How is all of this possible?

- **Existing resources**
  - **HPF compilers**
  - **parallel simulators**
  - **analytic solvers**
  - **algorithm analyses**

Collaboration from vendors

- **access to data**
- **access to measurements**

Experienced Investigators