

# Semantics of UML

## Mapping UML Actions to the System Model

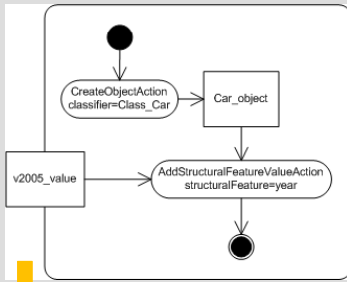
Michelle L. Crane and Juergen Dingel, Queen's University  
Bran Selic, IBM Rational

<http://www.cs.queensu.ca/~crane/documents/phdresearch.htm>



### Activities

- represents the execution of a computation
- used to see actions in context
- sequential/concurrent
- fork/join, decision/merge



### Activity Diagram Linear Form

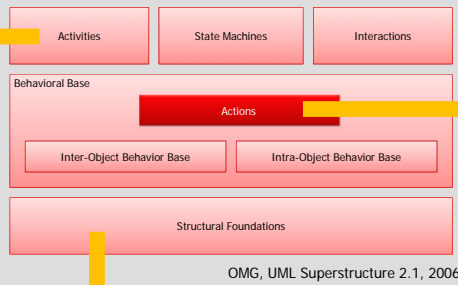
- ADLF inspired by Petri Net Linear Form (PNLF)
- represent activity diagram in human-readable form
- collaboration with NIST and Griffith University

```
<InitialNode>
-> (CreateObjectAction classifier=Class_Car)
-> [Car_object]
-> (AddStructuralFeatureValueAction *add
structuralFeature=year);
[v2005_value]
-> (*add)
-> <ActivityFinal>.
```

### Contributions

- Theoretical
  - careful examination → inconsistencies, ambiguities, over- or under-specification
  - System Model
  - UML Specification
  - formal semantics for most (if not all) UML actions
  - formal semantics for some UML activity constructs
- Practical
  - textual notation for activity diagrams
  - interpreter for UML actions/activities
    - shows how the semantic domain is affected by execution of actions
    - some visualization, but of semantic domain, not activity diagrams themselves

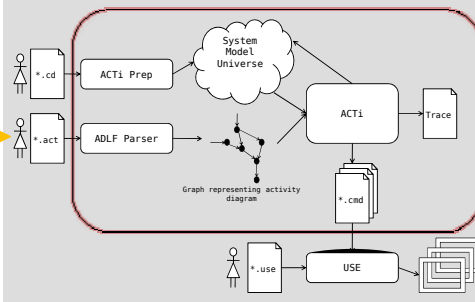
### UML 3-layer Semantic Architecture



### System Model

- UML 2 Semantics Project
- meant to represent the structural foundation, using math – sets and relations
- "universe": all possible elements that could exist – all values, all objects, all types, all operations, etc.
- UML Model is just a large state machine; each state is a snapshot of the current universe

### ACTi Process



### Questions

- Does the three-layer architecture work?
  - Can we build actions on top of a structural foundation?
  - Can we build behaviour, e.g., activities, on top of those actions?
- Are actions really suitable as "fundamental units of behaviour"?
- Is the System Model a suitable semantic domain for (at least part of) UML?
- Can we find ways to improve the System Model and UML Actions/Activities?

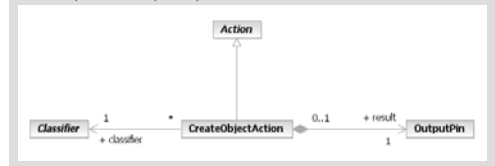
### UML Actions

- "all behaviour in a modeled system is ultimately caused by actions"
- actions are "fundamental units of behaviour"
- comparable to "executable instructions in traditional programming languages"

OMG, UML Superstructure 2.1, 2006

### Individual Actions

- 45 actions (36 concrete)
- attributes
- input/output pins



### Visualizing Execution

- USE = UML-based Specification Environment (University of Bremen)
- combined with a \*.use model, representing the System Model, we can use the \*.cmd files to visualize:
  - System Model universe
  - global state machine representing the UML model (activity diagram and underlying structure)
  - each transition represents a step in the activity diagram
  - how the state (data store, control store, event store) change as the activity is executed

