Simulation Modeling of UML Software Architectures

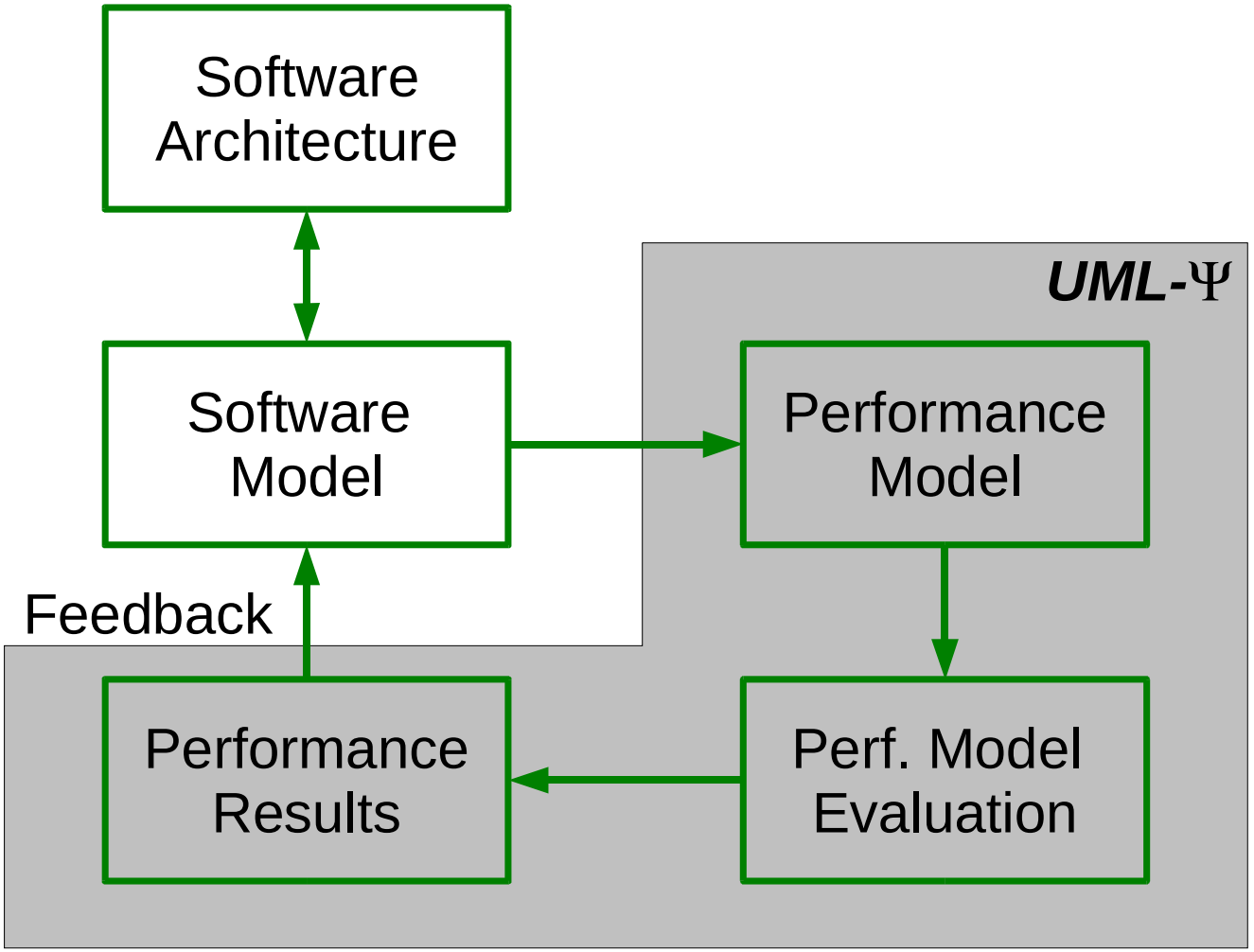
Simonetta Balsamo, Moreno Marzolla

Dipartimento di Informatica,
Università Ca' Foscari di Venezia
{balsamo,marzolla}@dsi.unive.it

Software Performance Modeling

- Early identification of performance problems in Software Architectures is very useful
  - Changing the design costs more if done late
- Two approaches to SA performance evaluation
  - Measurement-based
    - require a running system
  - Model-based
    - can be done at the design stage

Model-Based Approach



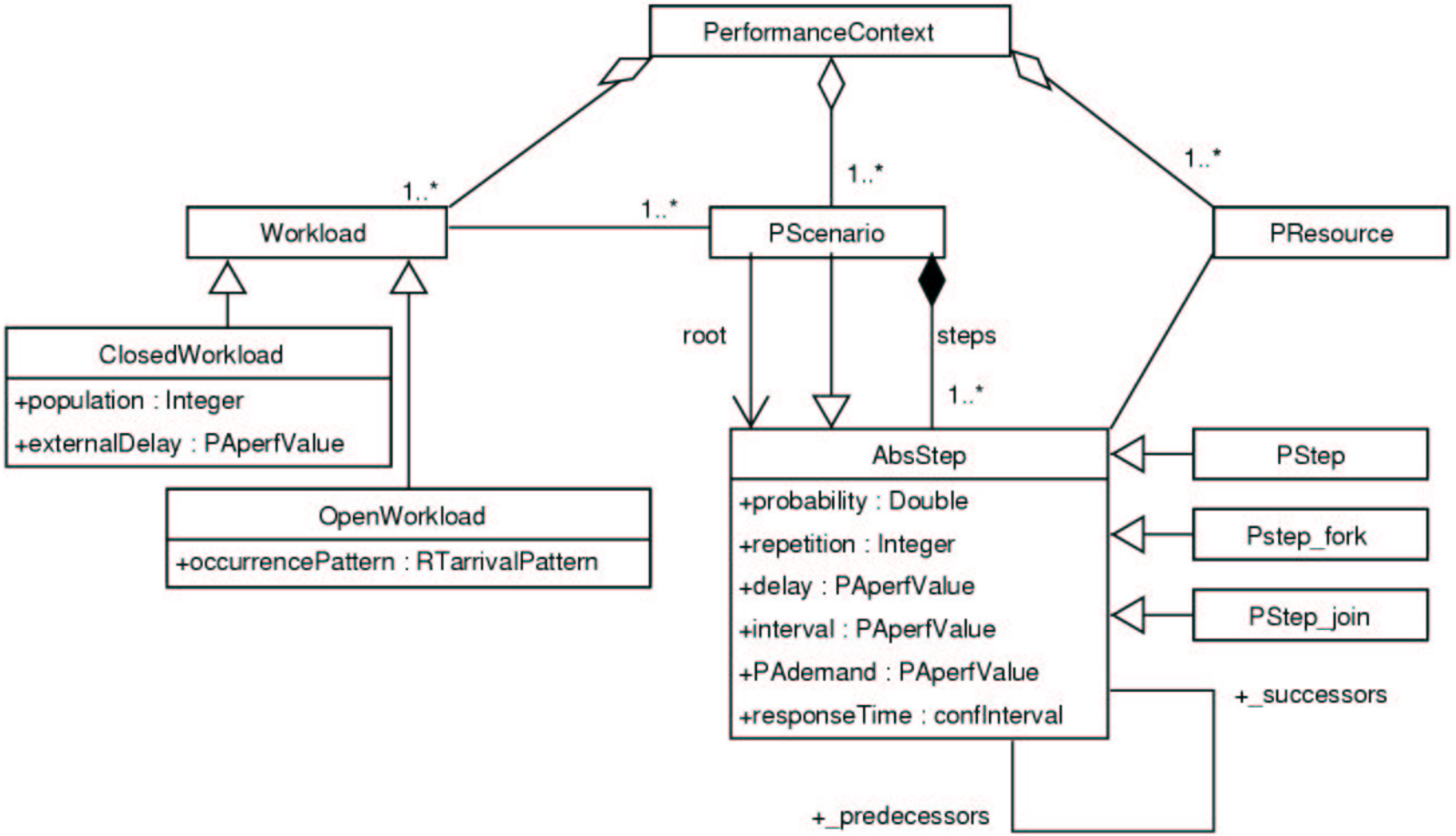
Simulation for Software Performance Evaluation

- Simulation often considered a solution technique for analytical performance models
- Our approach: use simulation as the performance model
- Advantages:
  - Mapping between software model and performance model very easy
  - Can represent general software models
  - Easy to report feedback

UML

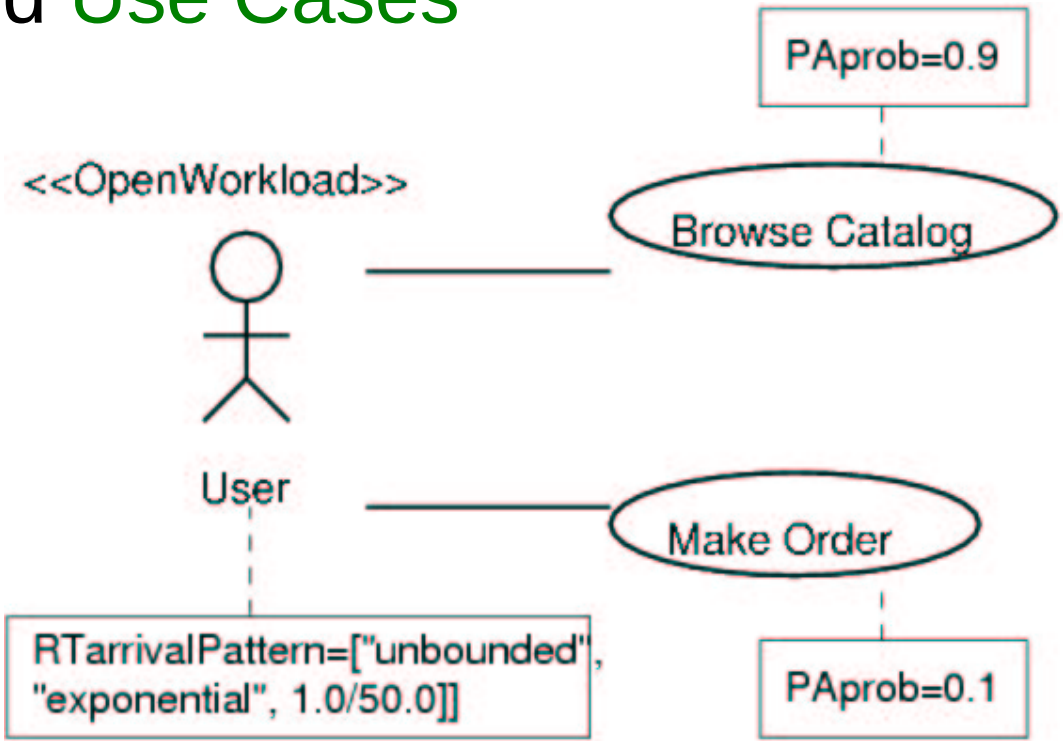
- UML is a standard notation for high-level software description
- Different kinds of diagrams available
- UML-Ψ uses two kinds of diagrams:
  - Use Case Diagrams
  - Activity Diagrams

The Simulation (Meta)Model



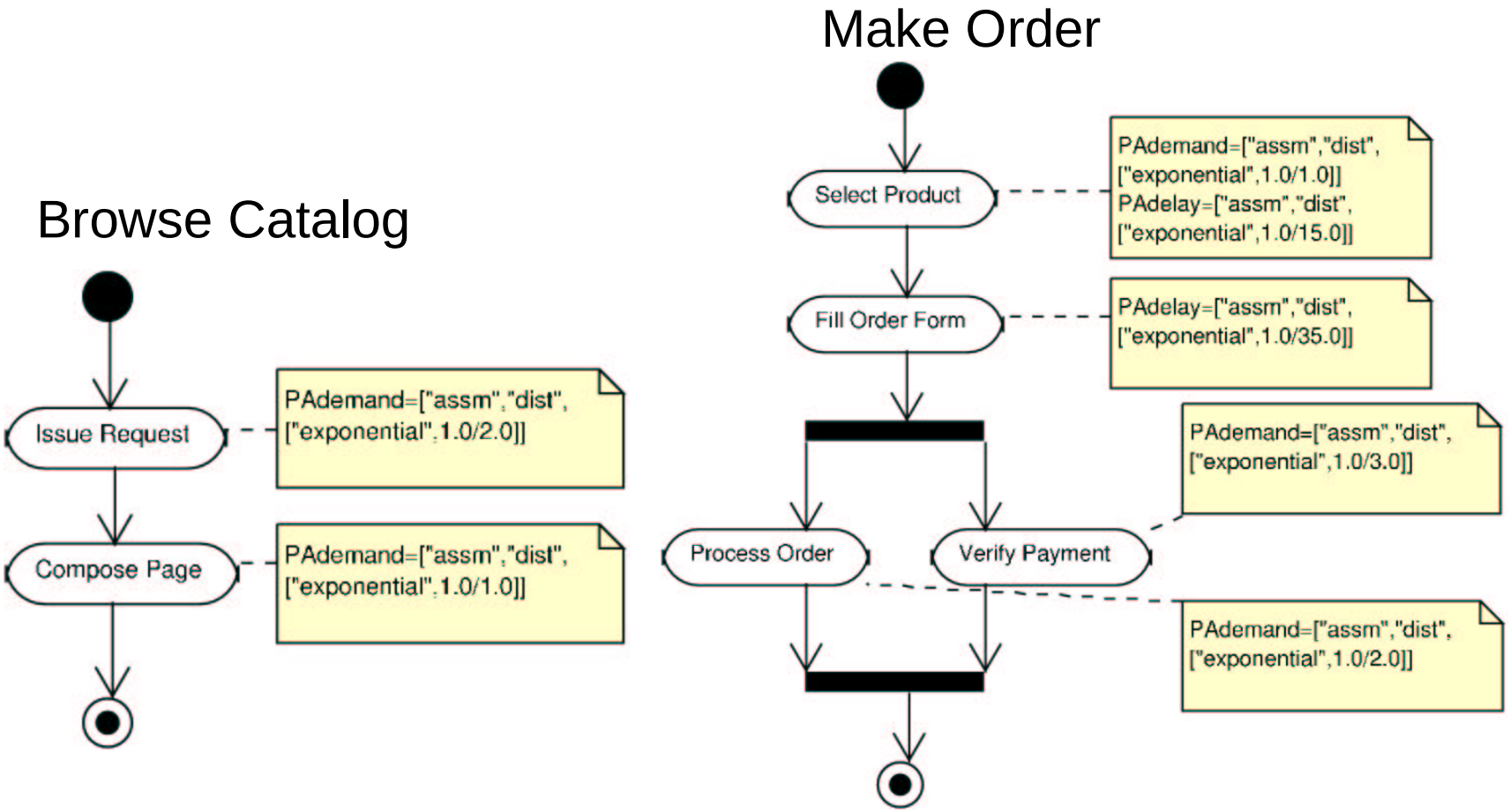
Use Case Diagrams

- Actors are used to represent workloads applied to the system
- Each new user performs one of the associated Use Cases



Activity Diagrams

- Each Use Case is expanded into a number of activities



How UML-Ψ works / 1

- The starting point is a set of UML Use Case and Activity diagrams.
  - We use ArgoUML as a graphical tool for manipulating UML diagrams
- UML diagrams are exported in XMI format
- UML-Ψ parses the XMI file, building the simulation model
  - Actors → Workload
  - Use Cases → PScenario
  - Activities → AbsStep

How UML-Ψ works / 2

- Annotations define parameters of the simulation model
- The simulation model is executed
  - Based on a custom process-oriented, discrete-event C++ simulation library, providing SIMULA-like process scheduling facilities
- Simulation computes the average delays of Activities and Use Cases execution
- Results are put into the original XMI file as tags associated to the appropriate UML element

Conclusions

- We proposed a simulation-based performance modeling approach for UML software architectures
- UML annotations based on a subset of the UML Performance Profile
- Simulation model is implemented in C++
- Feedback reported at the UML level

Future Work

- We are currently working on resource modeling in a UML context using Deployment diagrams
  - Active resources have been implemented
  - Passive resources still work in progress
- We are also extending the approach to performance evaluation of mobile systems
  - No “standard” way to represent mobility in UML