UML Modeling of Finite State Machines and Molecular Machines

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Xholon

- A tool that executes models of systems.
  - Including event-driven applications
  - Including models of complex systems
  - Systems can be of arbitrary size
  - Embedded systems, controllers
  - Agent-based, swarms, etc.

- Goal of Xholon
  - To be able to model and execute a broad range of event-driven and complex systems.
Xholon Modeling Constructs

- The basic Xholon modeling constructs are aligned with UML 2 and SysML constructs.
  - SysML is designed for Systems Engineering modeling, UML for software modeling.
- These constructs include - classes, composite structure, parts, ports, connectors, state machines.
- Active objects are agents, each with its own independent behavior.
Composite Structure, Ports

**G*PaseSystem**

**pKinase : PKinase**
- sub : Substrate
- reg : Regulation

**pPhosphatase : PPhosphatase**
- sub : Substrate
- reg : Regulation

**gPase : GPase**
- prd : Product
- sub : Substrate
- sub : Substrate [*]

**g1P : G1P**
- sub : Substrate

**gly : Gly**
- sub : Substrate
UML 2 Xholon Models

- My paper shows the creation of models of biological systems (at the molecular level) using a UML tool (MagicDraw)
- Models of enzyme regulation
- These models are transformed into an XML and Java format, and
- Subsequently executed using the Xholon tool
Progression of models

- This paper explores several different versions of a simple biological system, using UML 2 composite structure.
  - **Models 1 & 2**: message passing, state machines for behavior, symbolic
  - **Model 3**: molecular machine (direct access to each others internals), partly symbolic
  - **Model 4**: molecular machine, non-symbolic
  - **Model 5**: integration into a larger existing system
  - **Model 6**: a Lego blocks model