Petri Net Based System Analysis

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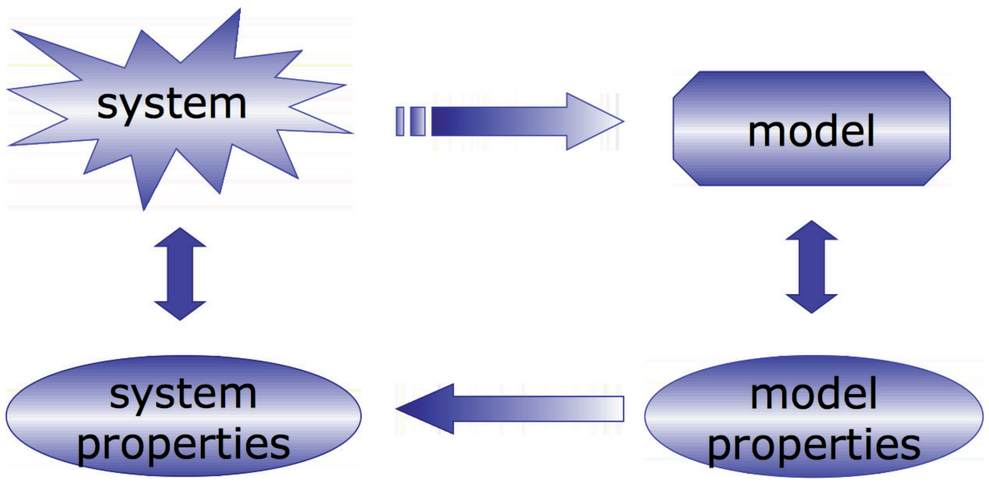
Model-based System Analysis

Verification of Technical Systems

- requirements certification
- quality improvement
- proof engineering

Typical Net Properties

- ordinary
- 1-bounded
- live, reversible
- communicating state machines
- exponential, state space growth



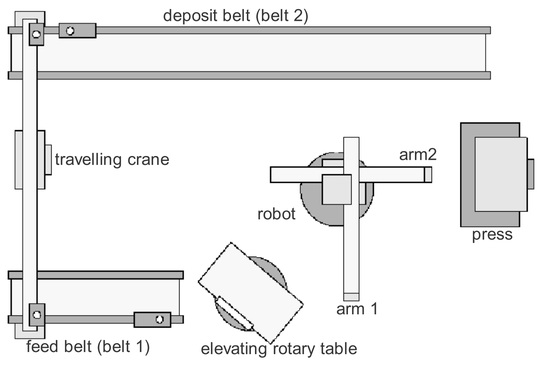
Validation of Natural Systems

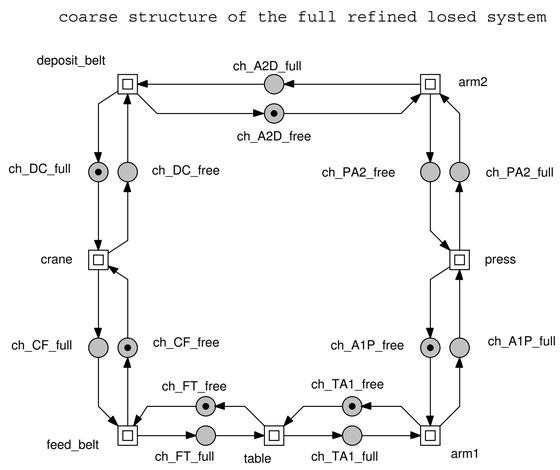
- understanding
- experiment design
- behaviour prediction

Typical Net Properties

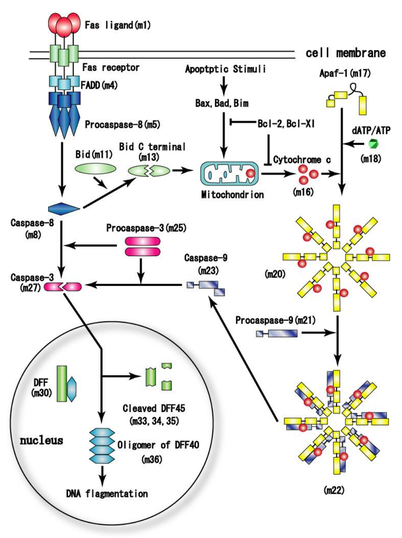
- non-ordinary
- k-bounded / unbounded
- live, reversible, BUT: how to prove?
- apparently unstructured
- over-exponential state space growth

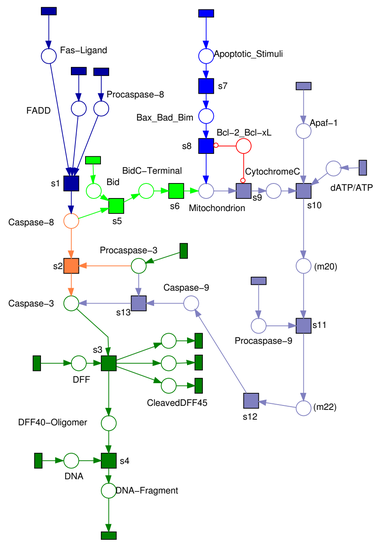
Production Cell [18]



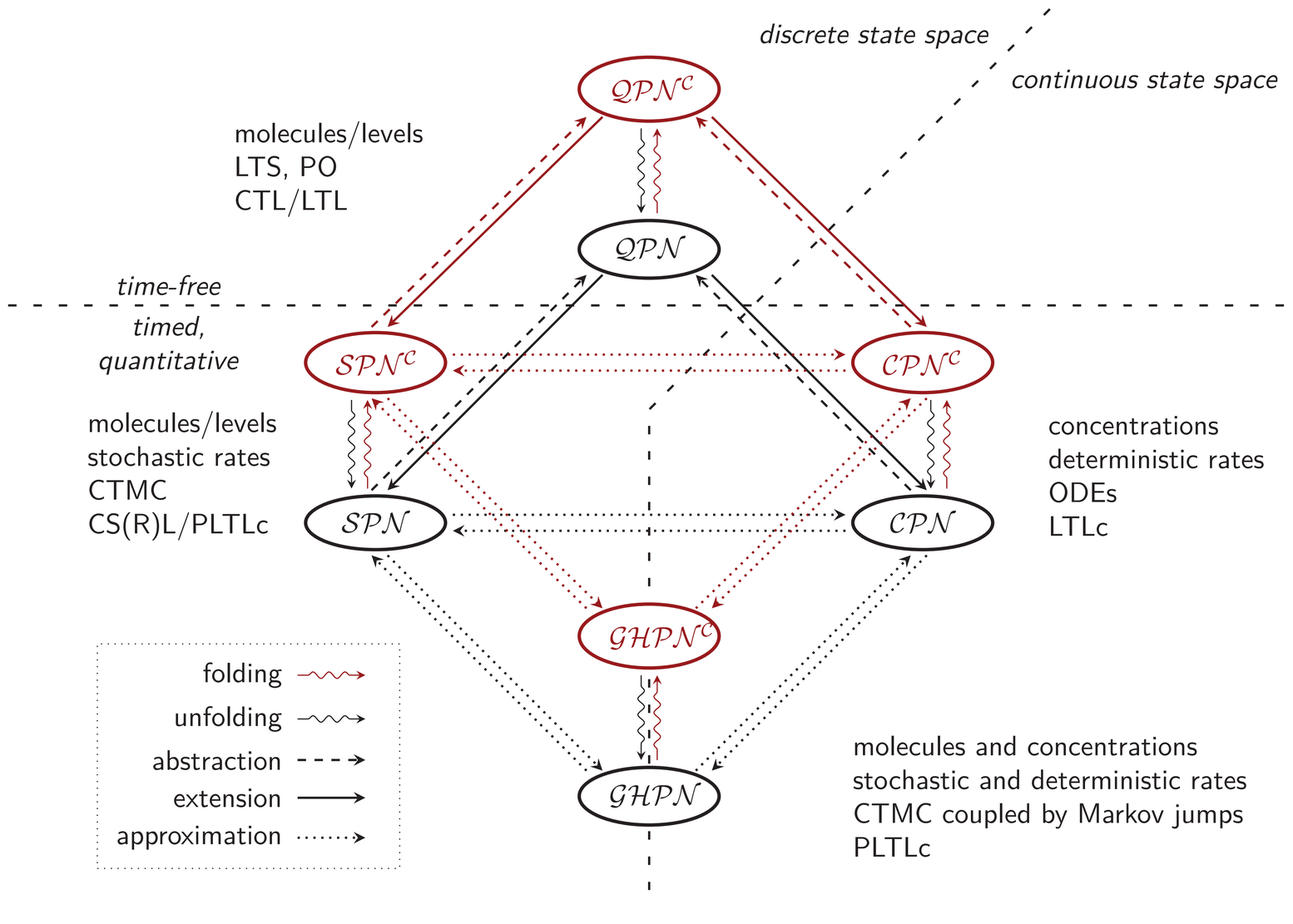


Apoptosis in Mammalian Cells [17]





Conceptional Framework



Tool Kit

CHARLIE [23]

Static – Net Structure
- Net classes
- Siphon Trap Property
- Place/Transition invariants
- Dependent Sets

Dynamic – Reachability graph
- Liveness, reversibilty, dead states
- Explicit CTL/LTL model checker
- Path search
- Visualisation
- Analysis of Time(d) Petri nets
- Shortest/Longest paths

SNOOPY [2,5]

Modelling/Animation
- Different Petri net formalism e.g., QPN, (X)SPN, CPN, GHPN, TPN
- Colored nets: QPN, (X)SPN, CPN, GHPN
- Hierarchies, logical nodes, colouring

Analysis/Simulation
- Stochastic Simulation Algorithm (SSA)
- Stiff/unstiff ODE solvers
- Fast adaptive uniformization (FAU)

Import/Export
- SBML, PNML, (C)ANDL, CSV

MARCIE [1,4,7,8]

Qualitative Analysis of bounded nets
- Symbolic State Space representation with Interval Decision Diagrams (IDDs)
- Reversibility, liveness, dead states, SCCs
- CTL model checking

Numerical Analysis of bounded (G)SPNs
- IDD-based “on-the-fly" CTMC representation
- Transient/steady-state analysis (multi-threaded)
- CSRL model checking (multi-threaded)

Simulative Analysis of unbounded (X)SPN
- Stochastic Simulation Algorithm (SSA)
- Fast adaptive uniformization (FAU)
- PLTLc model checking

Cooperations

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- David Gilbert, Brunel Univ. London, UK
- Mostafa Herajy, Port Said University, Egypt
- Jetty Kleijn, Univ. Leiden, Netherlands
- Fei Liu, Harbin Institute of Technology, China
- Wolfgang Marwan, Univ. Magdeburg, Germany
- Louchka Popova-Zeugmann, HU Berlin, Germany
- K. Sriram, IIIT Delhi, India
- Soliman Sylvain, INRIA Paris, France

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Analysis Methods / Tools

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