Introduction to Petri Nets

A particular vision of Petri Nets

- A “good” model of Discrete Event Systems
  - Beyond the models based on automata

- Explicit representation of the “system structure”
  - Differential Feature

- Adapted methodologies for model construction
  - Modular/hierarchical models

- Model for all phases of the life cycle
  - Modelling – Analysis – Synthesis – Implementation …
At the end of the lectures you must know

- What’s a Petri Net as Formal Model
  - Definitions – Notations – Basic Mathematical Tools

- How from a “simple system” you can obtain a Petri Net to understand some facet of it
  - Modelling capabilities – Abstraction process – Modelling

- How a Petri Net can be exploited in the different phases of the design cycle of a system
  - Analysis – Synthesis – Back to the system

Part I – Introduction to Petri Nets

- Definition
- Concepts and tools
- Analysis techniques with emphasis in Structure Theory

Part II – Resource Allocation Systems

- RAS Abstraction: A view of the system
- Methodology for model construction
- The design cycle: Modelling – Analysis – Synthesis
Outline – Part I

I. Basic concepts of Petri Nets
II. The paradigm of Petri Nets
III. Petri Nets as executable models
IV. Structural objects of Petri Nets
V. Properties of Petri Nets. The analysis problem
VI. State Space based analysis methods
VII. Structural analysis of Petri Nets
VIII. Transformation of Petri Nets
IX. Subclasses of Petri Nets
X. Application domains and life cycle

Outline – Part II

XI. Resource Allocation Systems (RAS). Abstraction
XII. Construction of PNs. Families of PNs for RAS
XIII. Examples of Modelling from different domains
XIV. RAS properties and PN properties
XV. Characterizations of the Liveness property
XVI. The Liveness Enforcing Problem (LEP)
XVII. Structural Methods for LEP - Monitors
XVIII. Structural Methods for LEP - Virtual Resources
XIX. Structural Methods for LEP - Assertions
XX. Some suggestions for future research
Basic Bibliography (I)

Books


- Originates from the Advanced Course on Petri Nets held in Dagstuhl, Germany, October 1996.

Basic Bibliography (II)

Surveys


## About Petri Nets…

### General
Petri Nets World: Online services for the international Petri Nets community
http://www.informatik.uni-hamburg.de/TGI/PetriNets/

### Tools
- **RENEW** - The Reference Net Workshop
  http://www.renew.de/
- **INA** - Integrated Net Analyzer
  http://www2.informatik.hu-berlin.de/~starke/ina.html

### Conferences
- **International Conference on Application and Theory of Petri Nets and Concurrency** (33 editions)
  http://www.informatik.uni-hamburg.de/TGI/events/pn2012/
- **International Conference on Application of Concurrency to System Design** (12 editions)
  http://www.informatik.uni-hamburg.de/TGI/events/acsd2012/acsd2012.shtml
- Many Meetings with Petri Nets Topics
  http://www.informatik.uni-hamburg.de/TGI/PetriNets/meetings/#PetriNets

### Standards
Petri Nets Standards and PNML
http://www.pnml.org/
http://www.petrinets.info/standard.php

### Journals
- **LNCS Transactions on Petri Nets and Other Models of Concurrency (ToPNoC)**
  http://www.springer.com/computer/lncs?SGWID=0-164-6-417809-0
- Many Journals from IEEE, Springer, Elsevier, etc
  - Formal Methods in System Design
  - Theoretical Computer Science
  - Discrete Event Dynamic Systems

### Application Domains
- Digital Circuits, VHDL, Control Software, GRAFCET, Software Engineering,
  Flexible Manufacturing Systems, Biological Systems, Workflow Systems,
  Business Processes, Telecommunication Systems, Protocol Engineering,…….