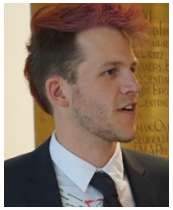
The Theory Cluster

Topics in The Theory Cluster

Algorithms	Frank, Hendrik Jan, Walter, Rudy
Automatic Verification	Alfons, Marcello, Frank
Artificial Intelligence	Walter, Mathys, Vedran, Henning
Business Processes and Networks	Pieter, Frank
Category Theory and Semantics	Henning, Mathys
Concurrency	Jetty[1], Farhad, Frank
Coalgebra and Behaviour	Henning, Marcello
Combinatorics and Graph Theory	Frank, Hendrik Jan, Walter
Combinatorial Game Theory	Hendrik Jan, Walter
Natural Computing	Hendrik Jan, Jeanette
Type Theory and Formalised Proofs	Henning
Quantum Learning and Optimisation	Charles, Mathys, Vedran

[1] Back in June 2020



Henning Basold

Logic and Type Theory

Proof Theory

Implement Proof Checker

Develop Learning Application

Proof Assistants

Formalised Train Control

Probabilistic Types

Automatic Deduction

Coinductive Logic Programming

Coalgebra

Modelling

Theory

Time Scales

Coinductive Types

Category Theory

Categorical Logic

Applications

Tool for Bio-Modelling

Program Semantics

Reaction Systems

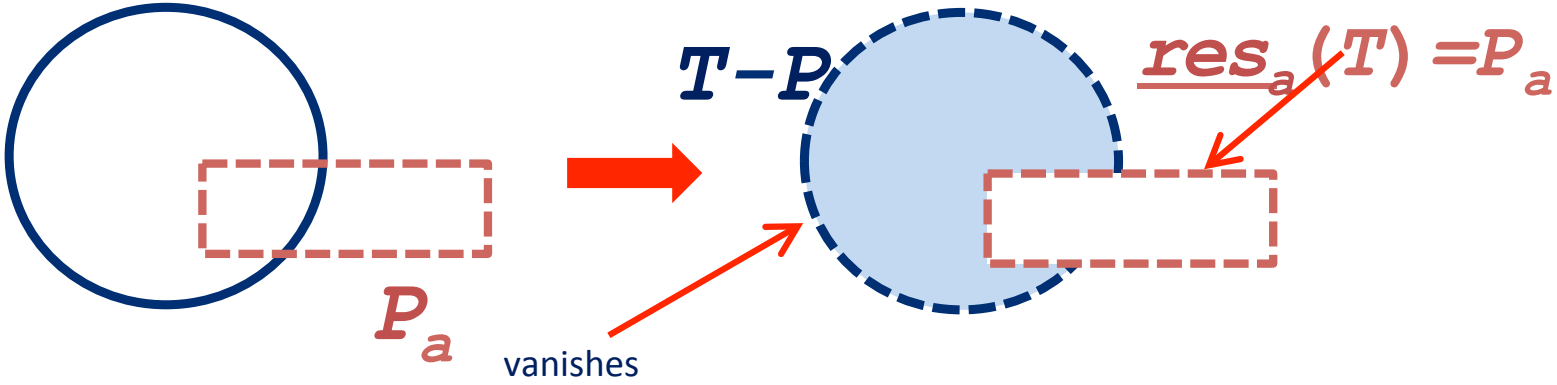
Jetty Kleijn

(back in June)

'A Natural Computing Approach to the Functioning of Living Cells'

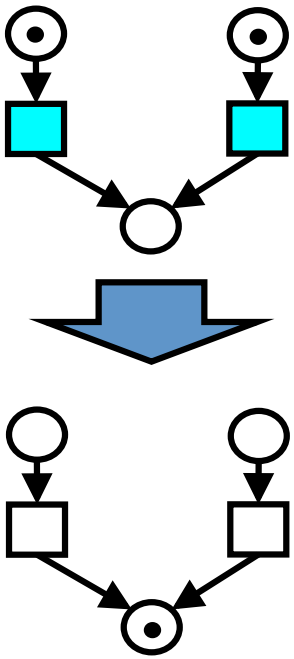
Computational understanding of the functioning of living cells

Investigation of processes carried out by biochemical reactions



Abstract, formal framework: Model of Computation

- ✓ Networks of reactions systems
- ✓ Context
- ✓ Tool: visualisation and simulation



Set Nets

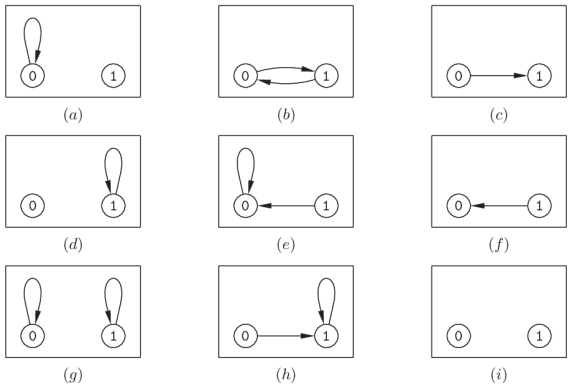
Jetty Kleijn

(back in June)

'(Petri) Nets that do not count'

set arithmetic rather than multisets

belong to the family of 'Boolean Nets'



- ✓ Causality, dependency
- ✓ Structural properties
- ✓ Set nets and reaction systems
- ✓ Tool
- ✓ …

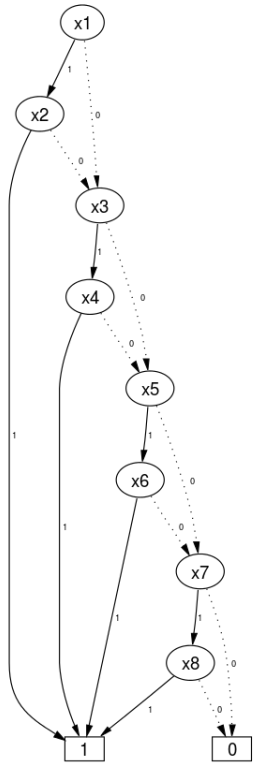
Program correctness and model checking with Alfons Laarman

BDDs, or Binary **Decision diagrams,** are complicated structures
(*used in model checking, theorem proving, AI Planning, …*)

x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	#
1	1	*	*	*	*	*	*	2^6
*	*	1	1	*	*	*	*	2^6
*	*	*	*	1	1	*	*	2^6
*	*	*	*	*	*	1	1	2^6

$f(x_1, .., x_8)$ & $g(x_1, .., x_8)$
$f(x_1, .., x_8)$ | $g(x_1, .., x_8)$
.....

Use automated testing to find bugs in existing BDD packages (Sylvan, CUDD)

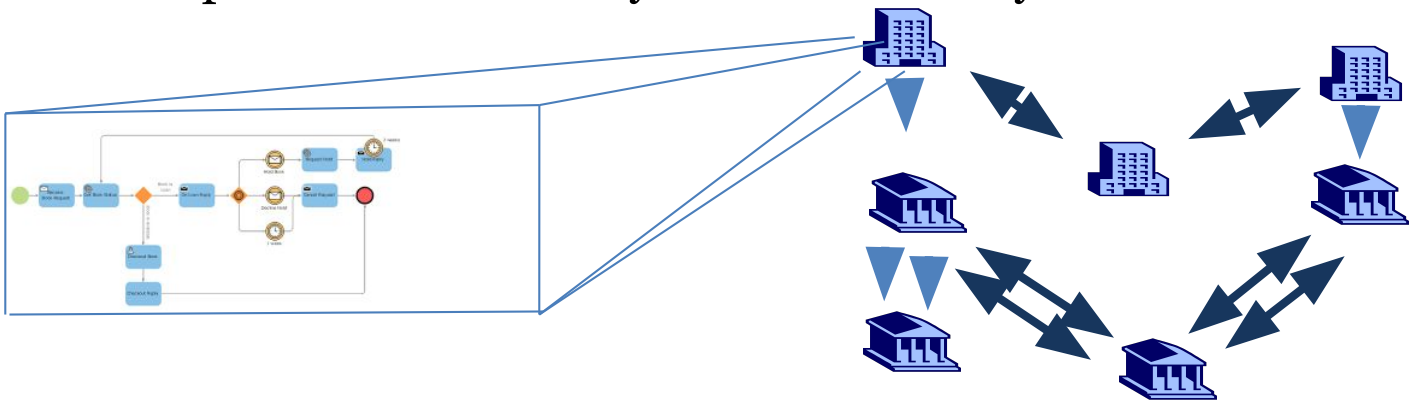


$$f(x_1, \ldots, x_8) = x_1x_2 + x_3x_4 + x_5x_6 + x_7x_8$$

Modelling, analysis and synthesis of business processes and systems

Pieter Kwantes

- **<u>Problem</u> :** how to specify/implement global requirements for business-to-business protocols and local requirements for internal operations and verify their consistency



- **<u>Overall goal</u>** is to design and build an integrated framework for domain-specific modelling, analysis and synthesis of inter-organizational business processes and systems to solve that problem

- Related courses: **Programming, Theory of Concurrency, Programming and correctness**

QUANTUM RL & OPTIMIZATION FOR NEAR-TERM QUANTUM COMPUTERS

1. Quantum k-SAT-solving algorithms
2. Quantum music
3. RL with parameterised quantum circuits
4. Quantum topological data analysis

Charles Moussa Mathys Rennela Casper Gyurik Vedran Dunjko