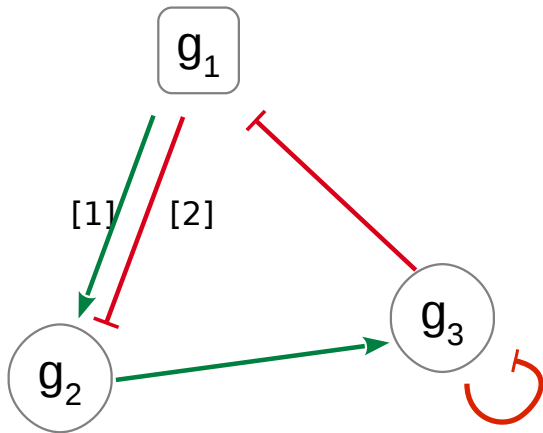


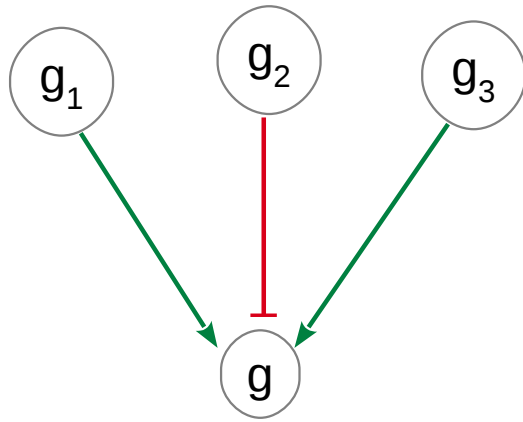
A glance at software tools for Logical modelling

Logical modeling



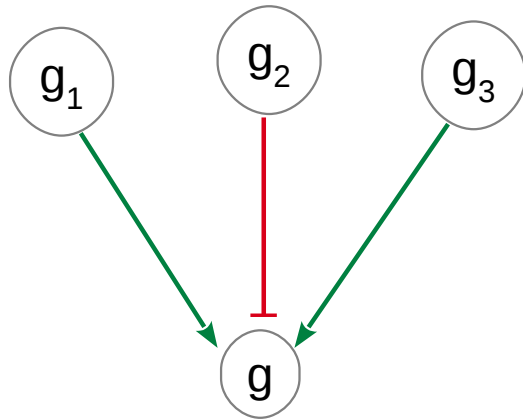
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Discrete modeling methods



$(g_1 \mid g_3) \& !g_2$

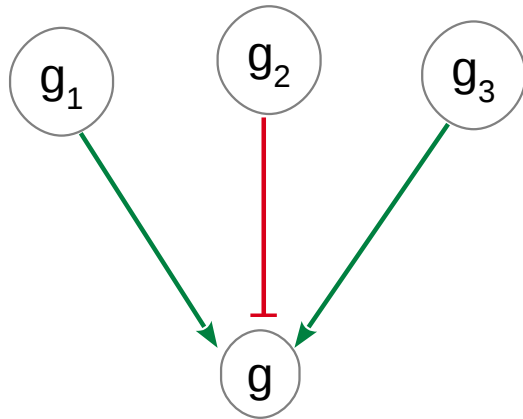
Discrete modeling methods



$$(g_1 \mid g_3) \& !g_2$$

g1	g2	g3	g
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

Discrete modeling methods

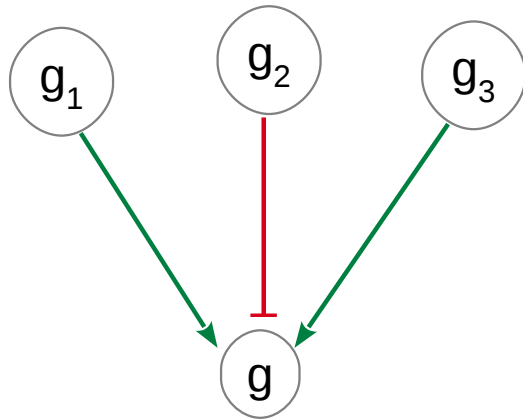


$$(g_1 \vee g_3) \wedge \neg g_2$$

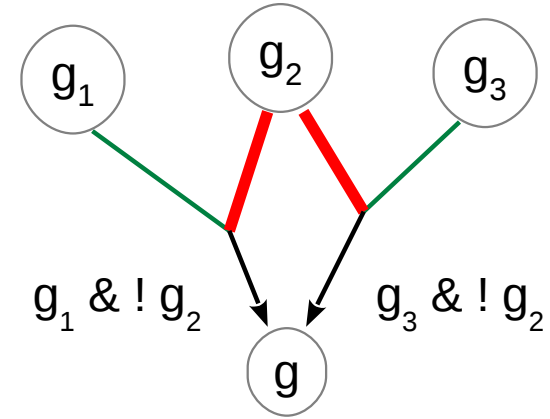
g1	g2	g3	g
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

Logical parameters
\emptyset (basal value)
g3
g2
g2,g3
g1
g1,g3
g1,g2
g1,g2,g3

Discrete modeling methods



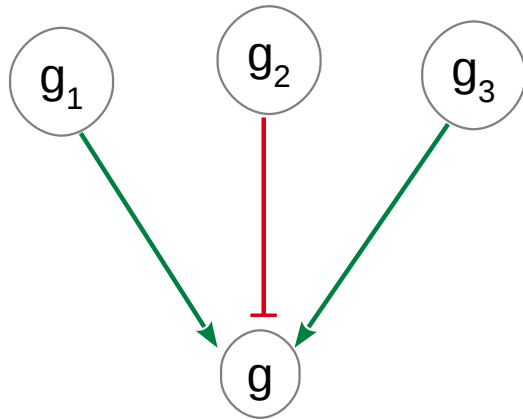
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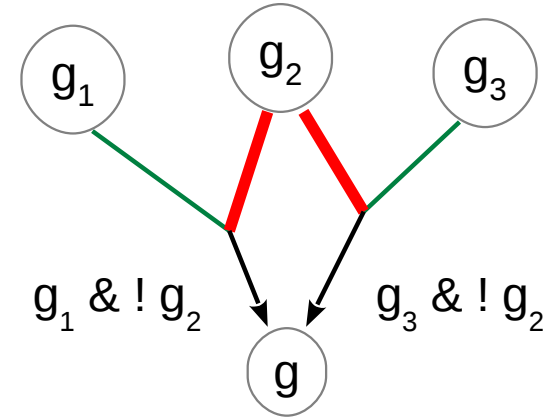
g1	g2	g3	g
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

Logical parameters
\emptyset (basal value)
g3
g2
g2,g3
g1
g1,g3
g1,g2
g1,g2,g3

Discrete modeling methods

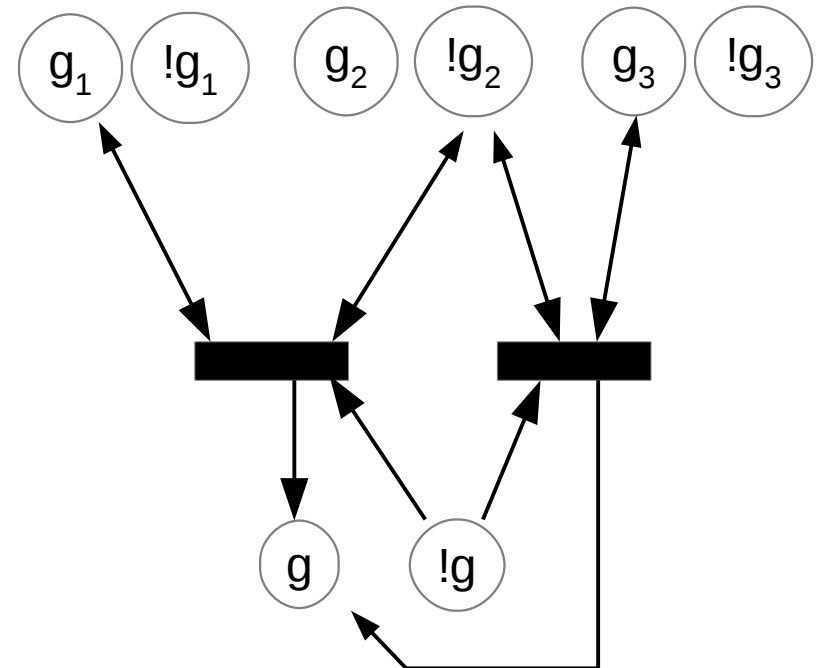


$$(g_1 \vee g_3) \wedge \neg g_2$$

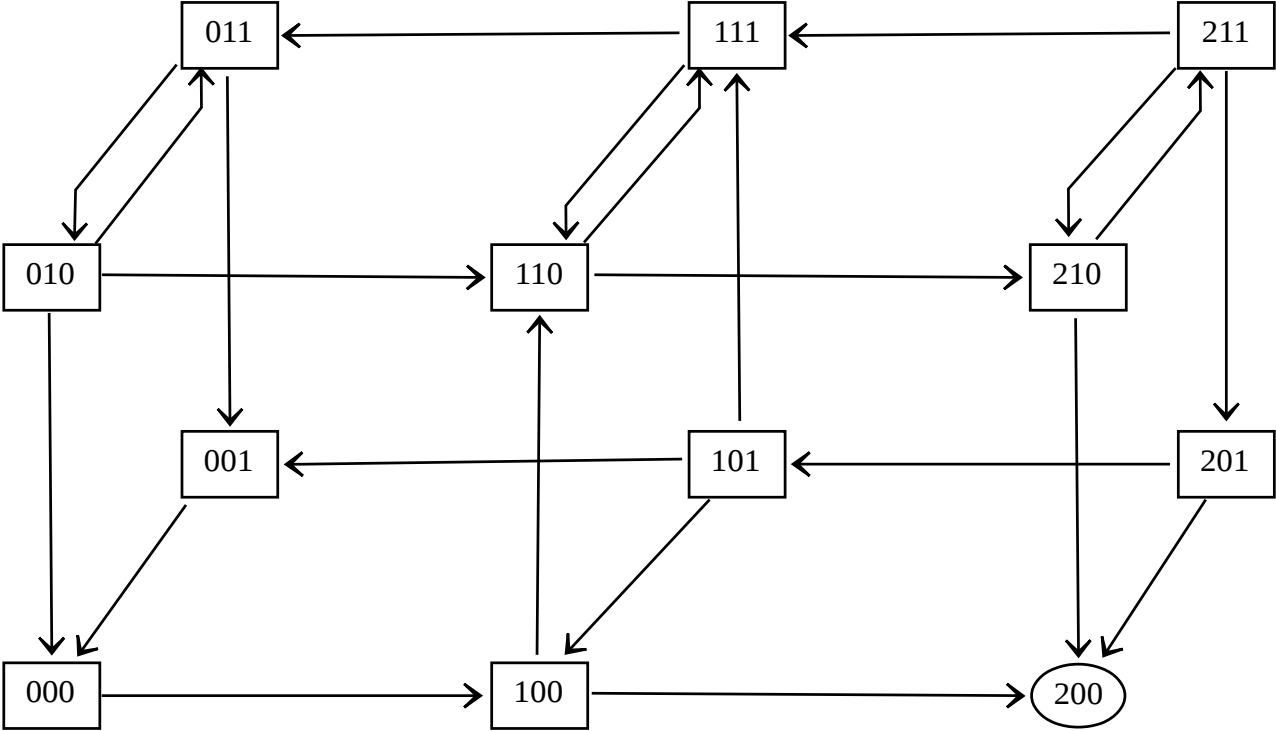


g1	g2	g3	g
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

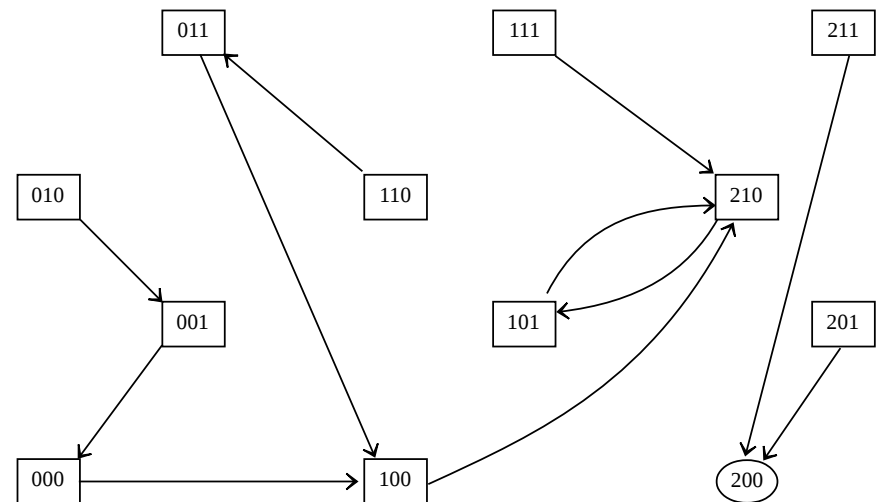
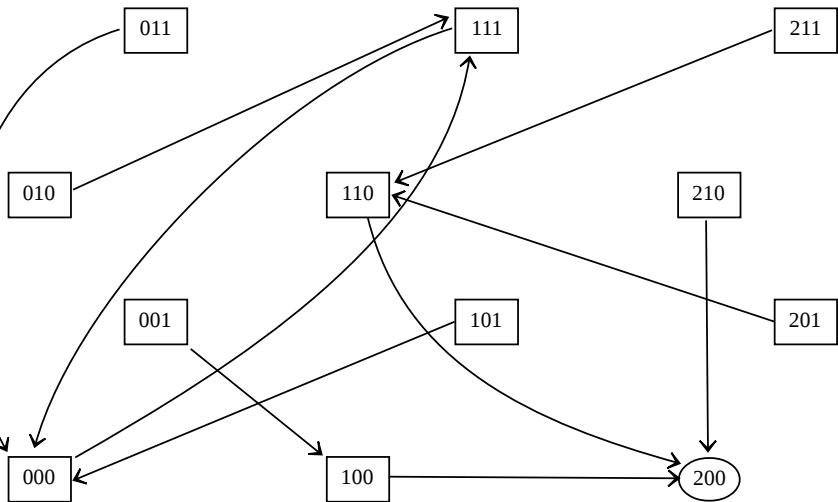
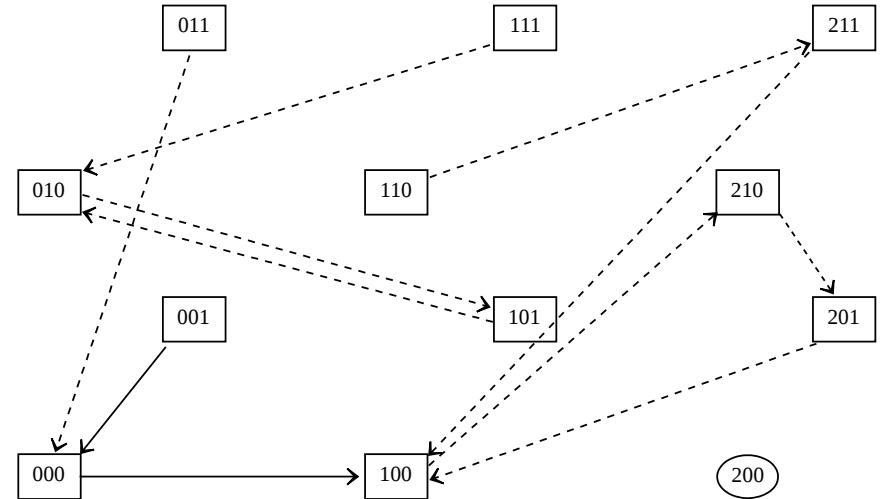
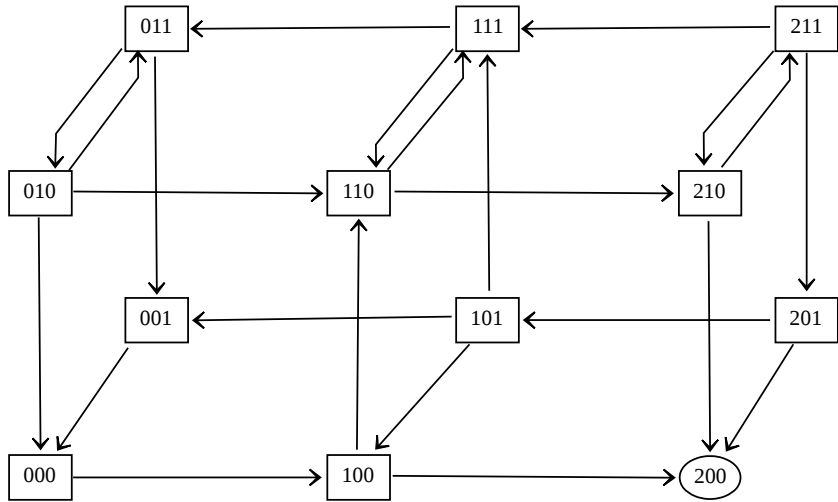
Logical parameters
\emptyset (basal value)
g3
g2
g2,g3
g1
g1,g3
g1,g2
g1,g2,g3



State Transition Graph



Updating method



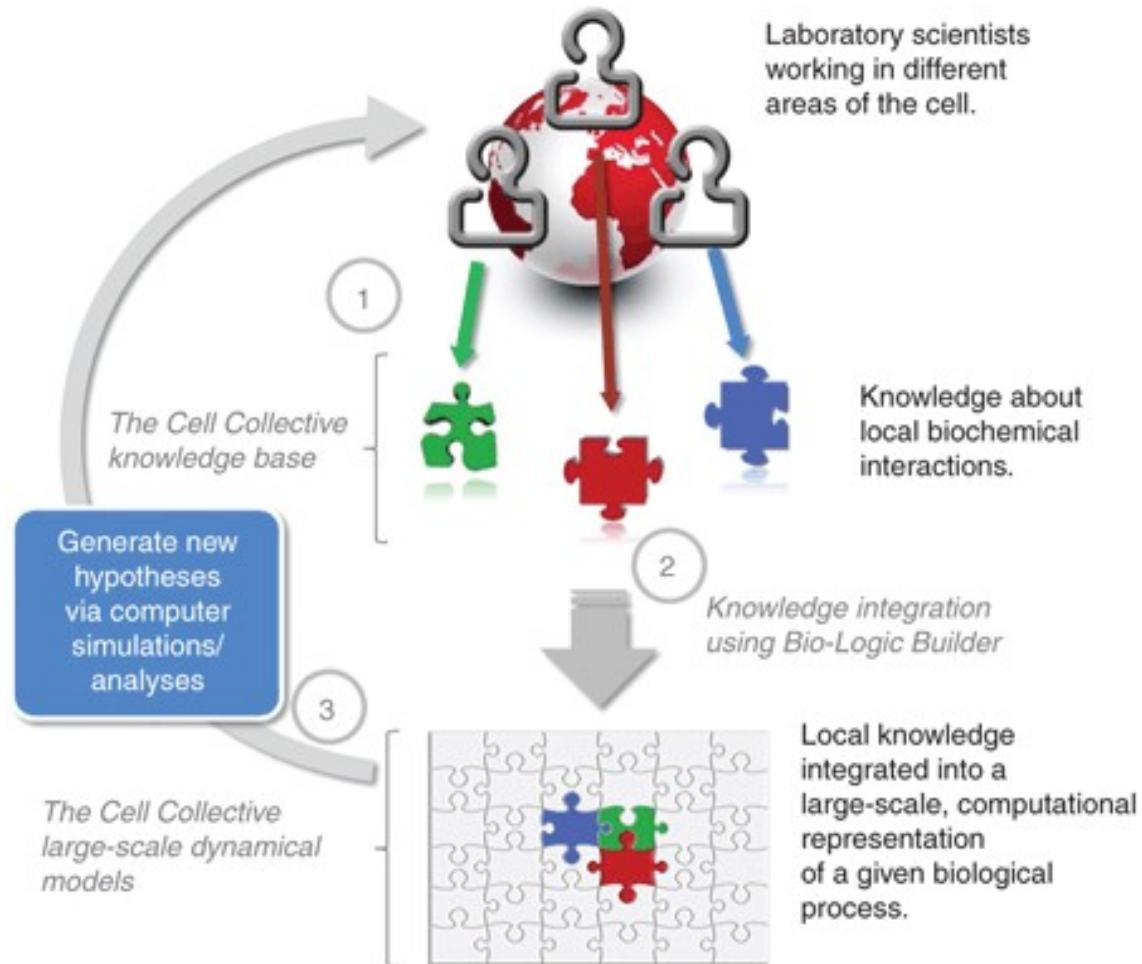
Some tools

- **GINsim**
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- **SQUAD** & boolsim
 - Attractor identification and “continuous” dynamics
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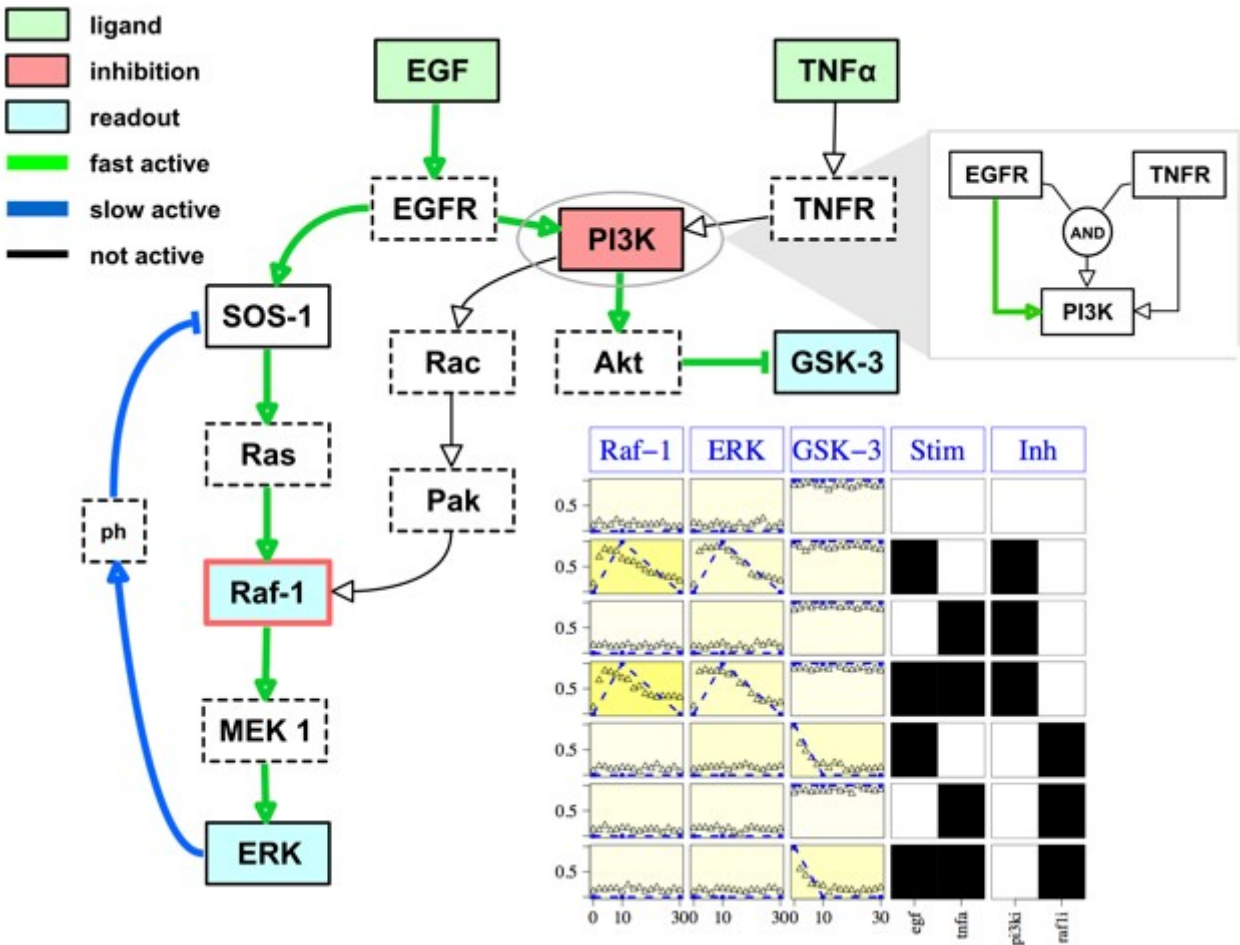
Software Tools

Tool	M/B	Updating	Special touch
BooleanNet	B		PLDE, Stable motifs
BoolNet	B	A/Sync, stoch	RBN generation
Boolsim/SQUAD	B	A/Sync	Find attractors, ODE
<u>The Cell Collective</u>	B	Sync	Shared online models, varying inputs
CellNetAnalyzer	M		Structural Analysis
CellNOpt	B		Model training
GINsim	M	A/Sync	Stable states, reduction
MaBoSS	B	Stochastic	Markov process

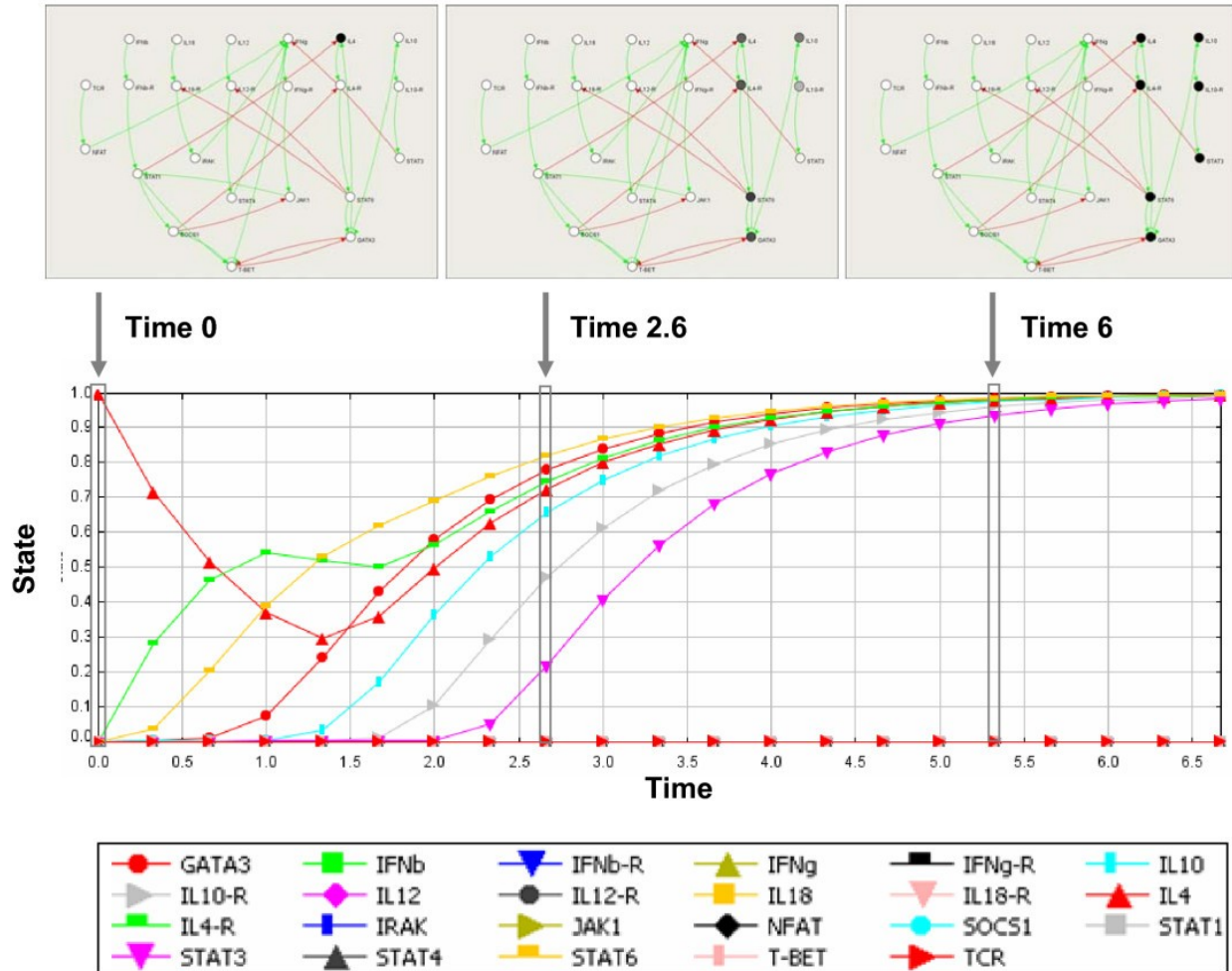
The Cell Collective



CellNOpt



SQUAD



Hyperarcs (normalised functions)
 Continuous view (synchronous with speeds)

GINsim

The screenshot displays the GINsim software interface for a model named 'phageLambda4'. The main window shows a state transition graph with four nodes: CI, Cro, N, and CII. Red arrows represent inhibitory interactions, and green arrows represent activating interactions. The configuration panel at the bottom is divided into 'Modelling Attributes' and 'Style' tabs. The 'Modelling Attributes' tab is active, showing the 'Id' field set to 'Cro'. A red box labeled '1' highlights the 'Id', 'Name', 'Input', and 'Max' fields. The 'Style' tab shows a table of 'Active Interactions' and a text area containing the interaction rules: 'CI:2 [2,max] ; negative' and 'Cro:3 [3,max] ; negative'. A blue box labeled '2' highlights the 'Active Interactions' table and the text area.

GINsim - phageLambda4 [/home/aurelien/lambda.zginml]

File Edit View Graph Tools Help

E

CI Cro N CII

Modelling Attributes Style

Id Cro

Name

Input

Max 3

1

Value	Active Interactions
3	(basal value)
2	Cro:3

2

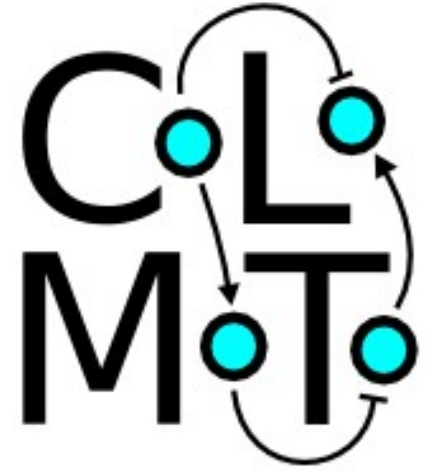
CI:2 [2,max] ; negative
Cro:3 [3,max] ; negative

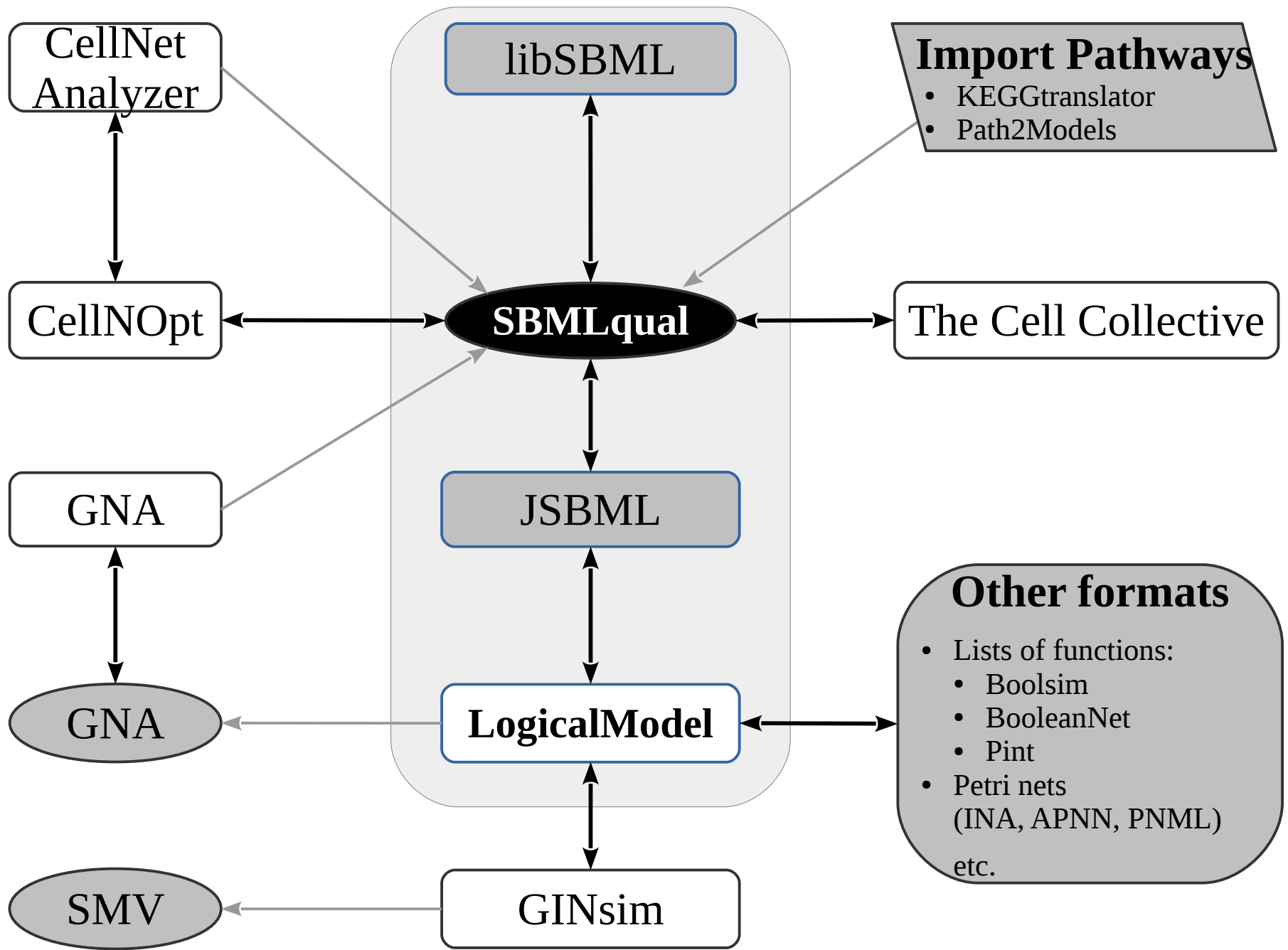
Logical parameters or functions

State transition graphs: (a)synchronous, with priorities

Improving interoperability

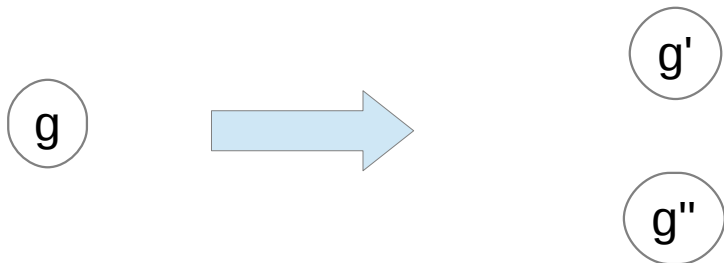
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From multivalued to Boolean

- Some tools support only Boolean models
- Multivalued models getting more common
- “Booleanize” a multivalued model when needed:
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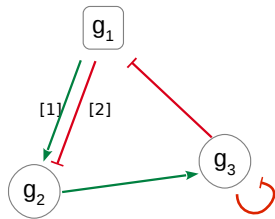
g'	g''	g'''	g''''	g
0	0	0	0	0
1	0	0	0	1
1	1	0	0	2
1	1	1	0	3
1	1	1	1	4

A glance at software tools for Logical modelling

Aurélien Naldi

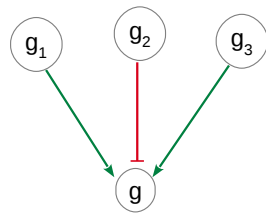
BC2: Logical modeling tutorial
June 09, 2015

Logical modeling



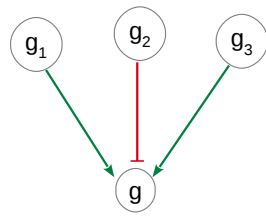
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Activity level (Boolean, MV)
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 $\text{next}(G3) = G2 \text{ and not } G3$

Discrete modeling methods



$(g_1 \mid g_3) \& ! g_2$

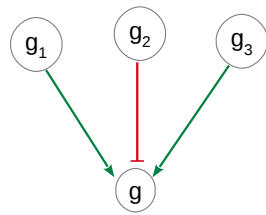
Discrete modeling methods



$(g_1 | g_3) \& !g_2$

g1	g2	g3	g
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

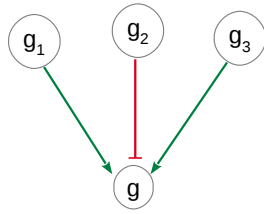
Discrete modeling methods



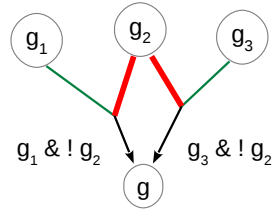
$$(g_1 \mid g_3) \& !g_2$$

g1	g2	g3	g	Logical parameters
0	0	0	0	\emptyset (basal value)
0	0	1	1	g3
0	1	0	0	g2
0	1	1	0	g2,g3
1	0	0	1	g1
1	0	1	1	g1,g3
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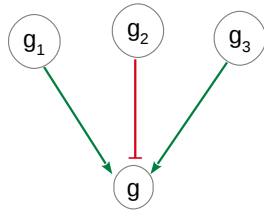


$$(g_1 \mid g_3) \& !g_2$$

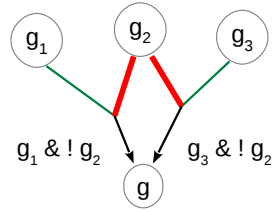


g1	g2	g3	g	Logical parameters
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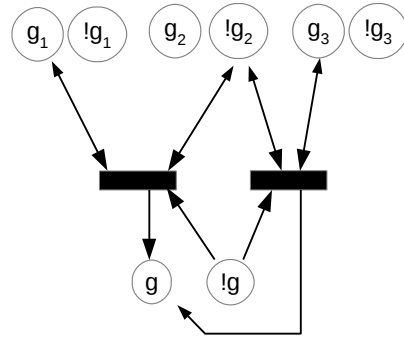
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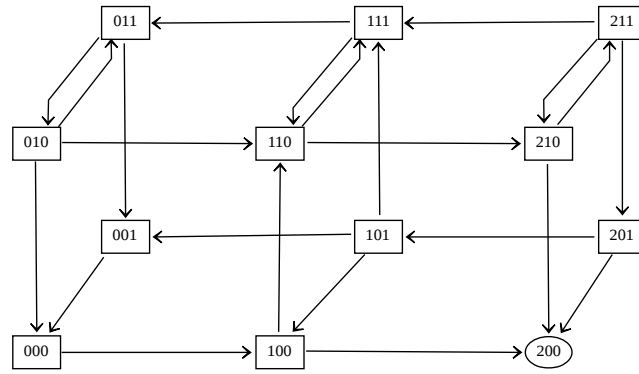
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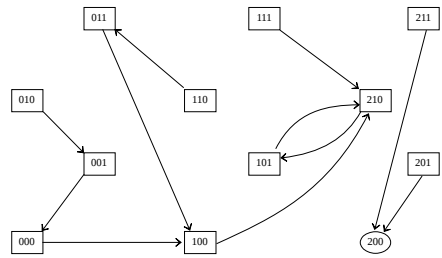
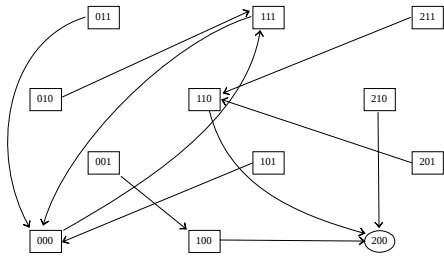
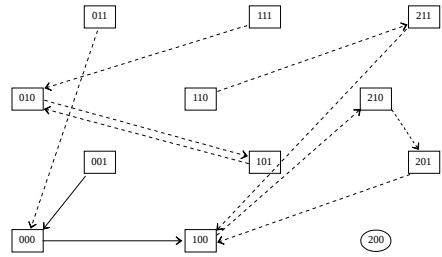
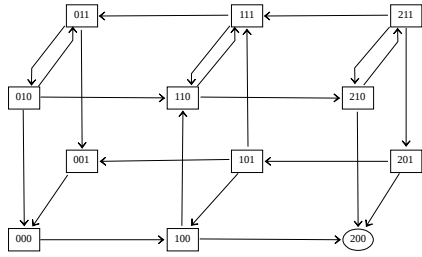
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0	1	0	0	g2
0	1	1	0	g2,g3
1	0	0	1	g1
1	0	1	1	g1,g3
1	1	0	0	g1,g2
1	1	1	0	g1,g2,g3



State Transition Graph



Updating method



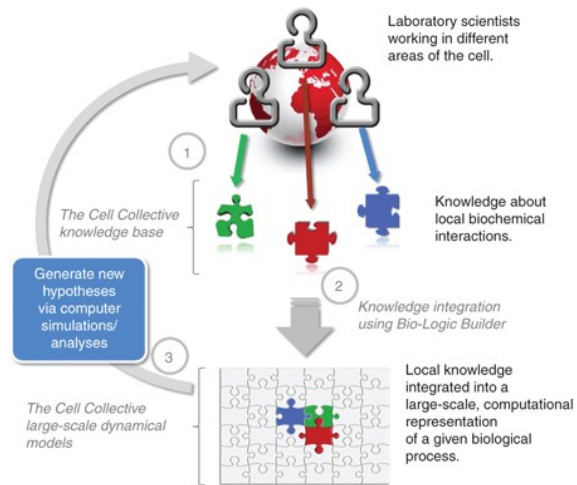
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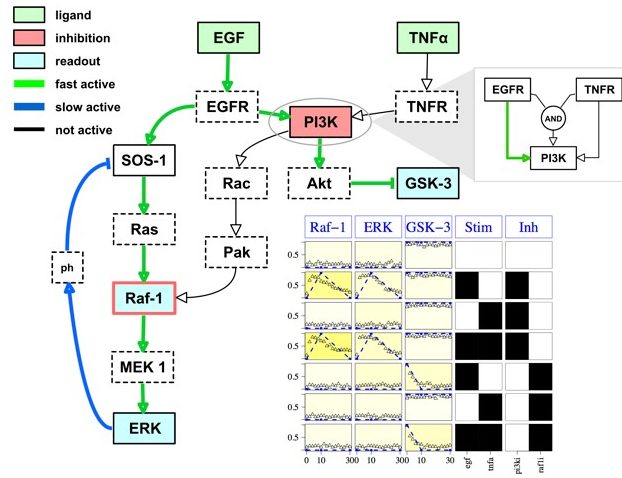
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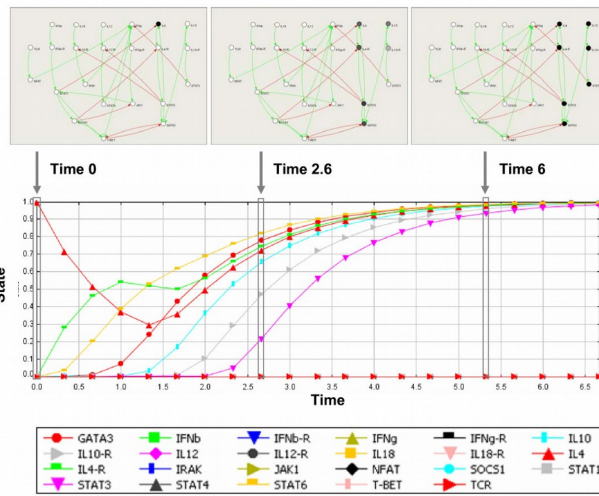
T Helikar et al. Clinical Pharmacology & Therapeutics (2013)

CellNOpt



C Terfve et al. BMC Syst. Biol. (2012)

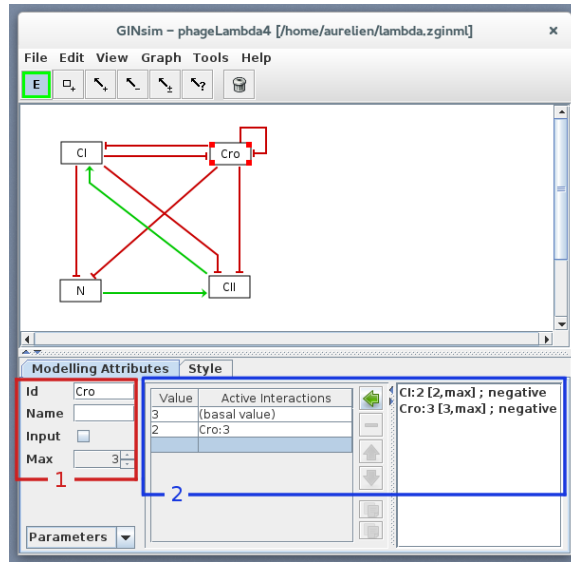
SQUAD



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A Di Cara et al. BMC Bioinformatics (2007)

GINsim

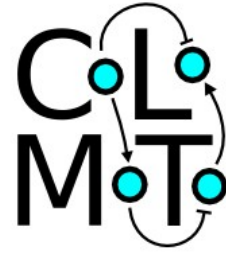


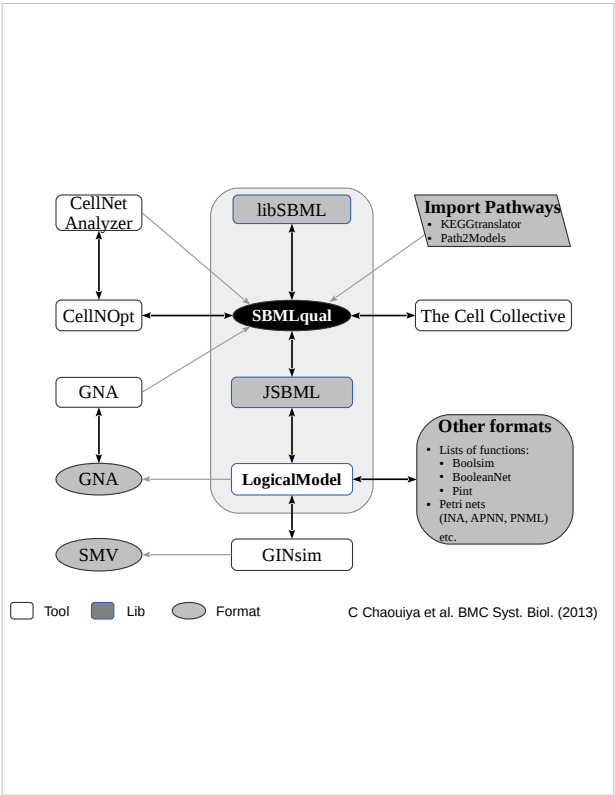
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A Naldi et al. Bio Systems (2009)

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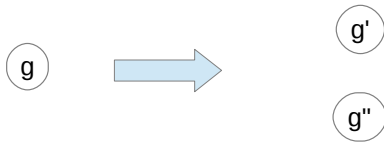
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1	0	0	0	1
1	1	0	0	2
1	1	1	0	3
1	1	1	1	4