Stochastic Boolean Networks: An Efficient Approach to Modeling Gene Regulatory Networks

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Additional file 2.

Truth Table of the PBN Inferred from the T Cell Microarray Time Series Data

Based on the activation and inhibition relationships in the T cell network in Fig. 9 [1], the following single-input Boolean functions are obtained using the proposed SBN rules:

$$\mathbf{g_1} = not(\mathbf{g_6}),$$

$$\mathbf{g_3} = \mathbf{g_2},$$

$$\mathbf{g_4} = not(\mathbf{g_2}),$$

$$\mathbf{g_5} = not(\mathbf{g_3}),$$

$$\mathbf{g_7} = \mathbf{g_3},$$

$$\mathbf{g_8} = not(\mathbf{g_5}),$$

$$\mathbf{g_{10}} = \mathbf{g_{11}},$$

$$\mathbf{g_{12}} = not(\mathbf{g_8}).$$

For $\mathbf{g_2}$, $\mathbf{g_6}$, $\mathbf{g_9}$ and $\mathbf{g_{11}}$, their Boolean functions are determined by multiple inputs, as shown as follows.

1. The state of g_2 is determined by the states of three genes: g_2, g_3 and g_6.

Truth Table for g_2: $f_1^{(2)} = \mathrm{or}(g_2, g_6)$, $f_2^{(2)} = \mathrm{or}(g_3, g_6)$.

$g_2 g_3 g_6$	$f_1^{(2)}$	$f_2^{(2)}$
000	0	0
001	1	1
010	0	1
011	1	1
100	1	0
101	1	1
110	1	1
111	1	1
$c_j^{(i)}$	0.5	0.5

2. The state of g_6 is determined by five genes: g_1, g_9, g_{11}, g_{12} and g_{10}.

Truth Table for g_6: $f_1^{(6)} = \text{and}(\text{or}(g_1, g_9, g_{11}, g_{12}), \text{not}(g_{10}))$, $f_2^{(6)} = \text{not}(g_{10})$.

$g_{10}g_1g_9g_{11}g_{12}$	$f_1^{(6)}$	$f_2^{(6)}$
00000	0	1
00001	1	1
00010	1	1
00011	1	1
00100	1	1
00101	1	1
00110	1	1
00111	1	1
01000	1	1
01001	1	1
01010	1	1
01011	1	1
01100	1	1
01101	1	1
01110	1	1
01111	1	1
10000	0	0
10001	0	0
10010	0	0
10011	0	0
10100	0	0
10101	0	0
10110	0	0
10111	0	0
11000	0	0
11001	0	0
11010	0	0
11011	0	0
11100	0	0
11101	0	0
11110	0	0
11111	0	0
$c_j^{(i)}$	0.8	0.2

3. The state of g_9 is determined by the states of three genes: g_4, g_5 and g_{12}.

Truth table for g_9: $f_1^{(9)} = \text{or}(g_4, g_{12})$, $f_2^{(9)} = \text{or}(g_5, g_{12})$.

$g_4 g_5 g_{12}$	$f_1^{(9)}$	$f_2^{(9)}$
000	0	0
001	1	1
010	0	1
011	1	1
100	1	0
101	1	1
110	1	1
111	1	1
$c_j^{(i)}$	0.5	0.5

4. The state of g_{11} is determined by the states of four genes, g_6, g_4, g_5 and g_7.

Truth table for g_{11}: $f_1^{(11)} = \text{and}(\text{or}(g_7, \text{nor}(g_4, g_5)), \text{not}(g_6))$,

$f_2^{(11)} = \text{and}(\text{nor}(g_4, g_5), \text{not}(g_6))$,

$f_3^{(11)} = \text{and}(g_7, \text{not}(g_6))$, $f_4^{(11)} = \text{not}(g_6)$.

$g_6g_4g_5g_7$	$f_1^{(11)}$	$f_2^{(11)}$	$f_3^{(11)}$	$f_4^{(11)}$
0000	1	1	0	1
0001	1	1	1	1
0010	0	0	0	1
0011	1	0	1	1
0100	0	0	0	1
0101	1	0	1	1
0110	0	0	0	1
0111	1	0	1	1
1000	0	0	0	0
1001	0	0	0	0
1010	0	0	0	0
1011	0	0	0	0
1100	0	0	0	0
1101	0	0	0	0
1110	0	0	0	0
1111	0	0	0	0
$c_j^{(i)}$	0.185	0.37	0.148	0.297

References

1. Martin, S., Zhang, Z., Martino, A. and Faulon, J-L.: **Boolean dynamics of genetic regulatory networks inferred from microarray time series data.** *Bioinformatics*, 2007, 23(7): 866-874.