From Concentration to Regulation. Possible Approaches for Reconstructing Genetic Networks.

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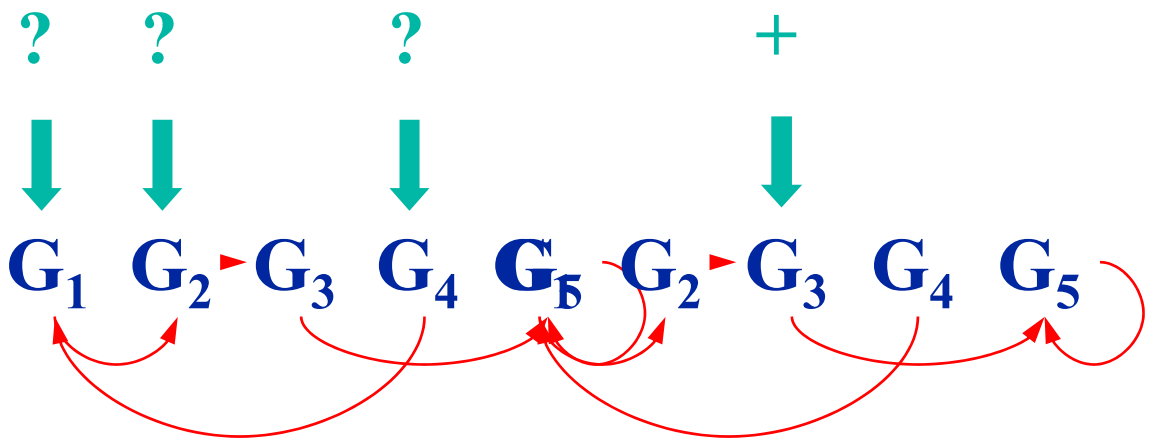
Culture Conditions ⇔ Expression Patterns

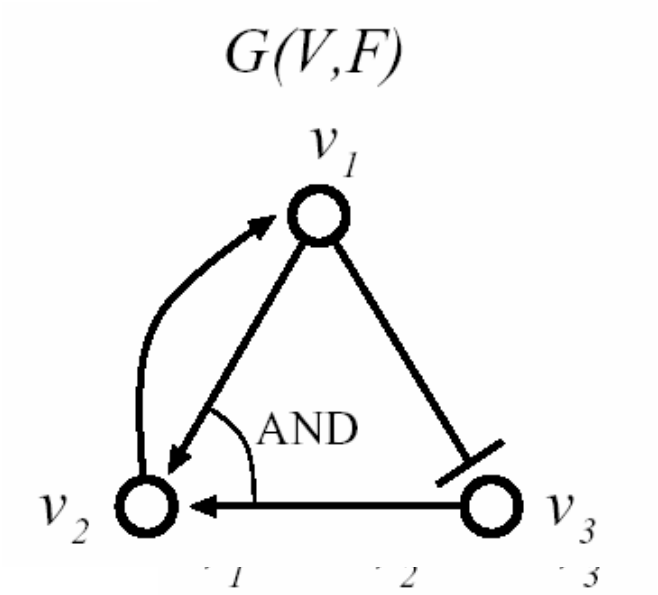


Different Culture Conditions RNAi Experiment

Approaches

- Boolean Nets
  - Popular approach
  - Mathematically accessible
  - Produced several proofs
  - Lacking biological realism
- Genetic Programming
  - Rarely used
  - Kind of black box
  - Can deal with realistic scenarios.

Boolean Nets



INPUT			OUTPUT		
v_1	v_2	v_3	v_1'	v_2'	v_3'
0	0	0	0	0	1
0	0	1	0	0	1
0	1	0	1	0	1
0	1	1	1	0	1
1	0	0	0	0	0
1	0	1	0	1	0
1	1	0	1	0	0
1	1	1	1	1	0

$v_1' = v_2$ $\quad$ $v_2' = v_1$ AND v_3 $\quad$ $v_3' =$ NOT v_1

Solutions

Examples

	v_1	v_2	v_3	v_1'	v_2'	v_3'	
I_1	1	0	0	0	0	1	O_1
I_2	0	1	0	0	1	1	O_2
I_3	0	1	1	1	0	0	O_3

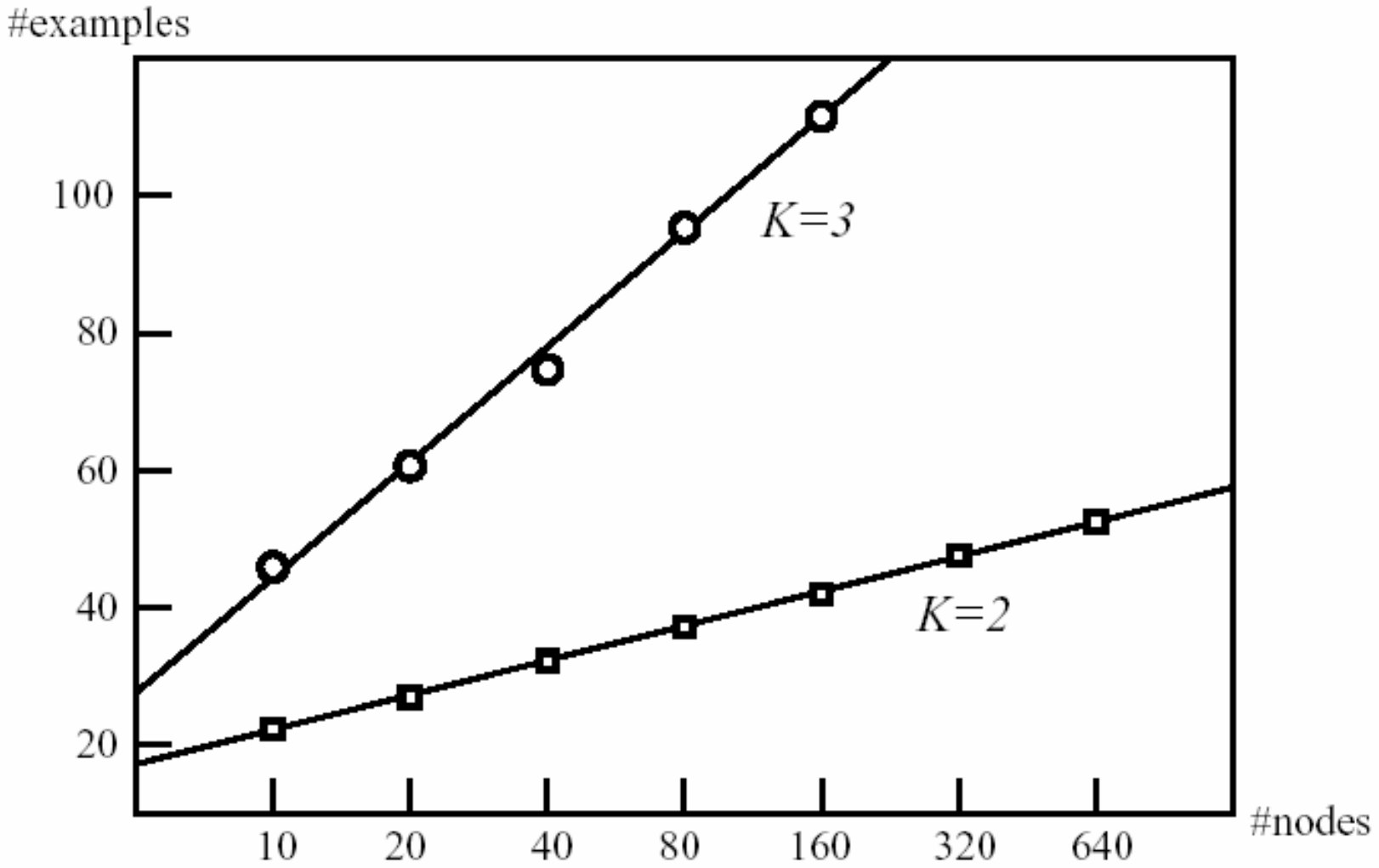
G_1

$$v_1' = v_3$$
$$v_2' = v_2 \text{ AND } (\text{NOT } v_3)$$
$$v_3' = \text{NOT } v_3$$

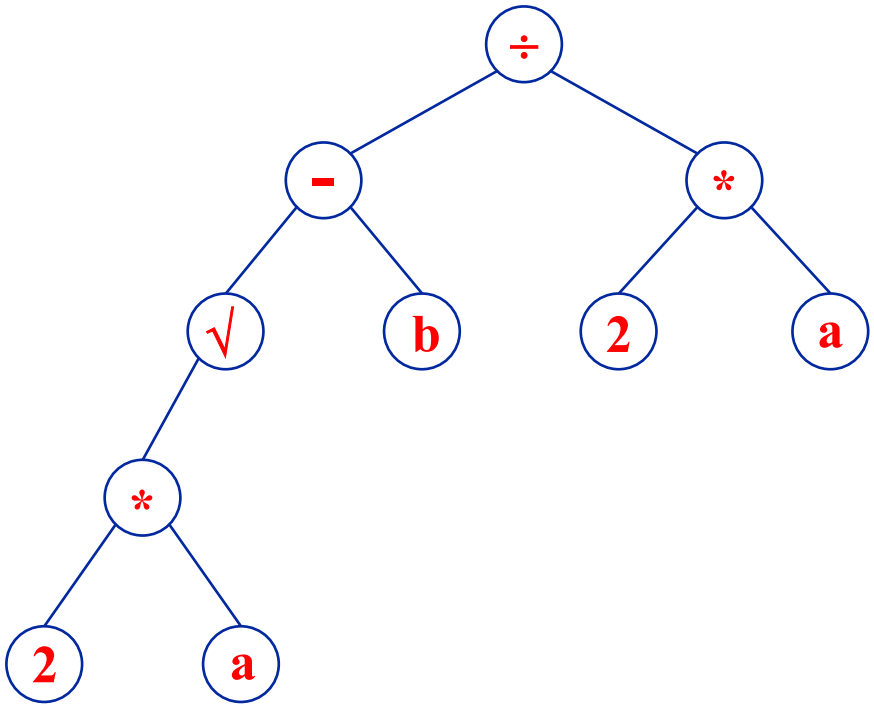
G_2

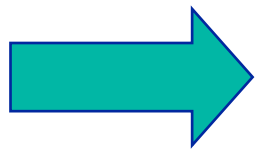
$$v_1' = v_3$$
$$v_2' = v_2 \text{ XOR } v_3$$
$$v_3' = \text{NOT } v_3$$

Necessary Examples



What is Genetic Programming ?

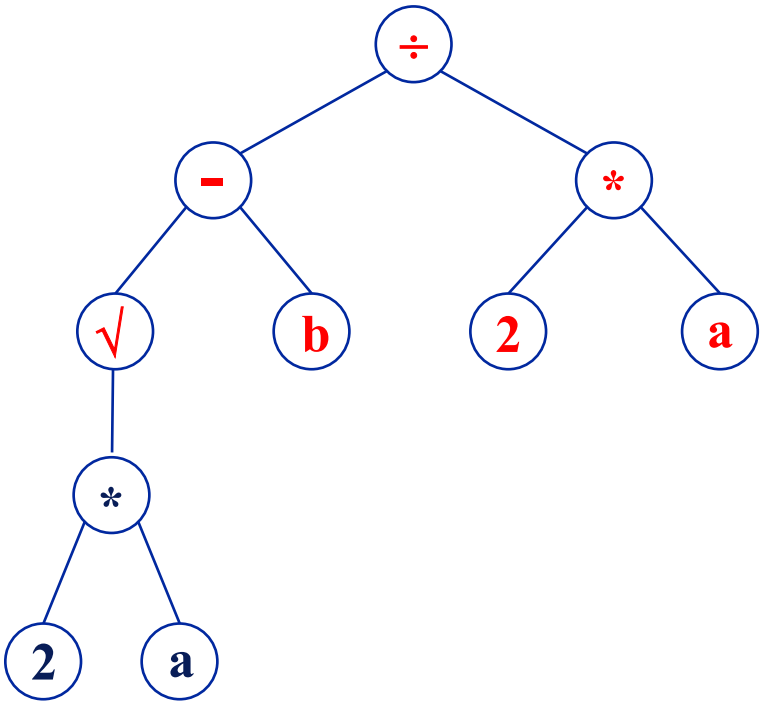




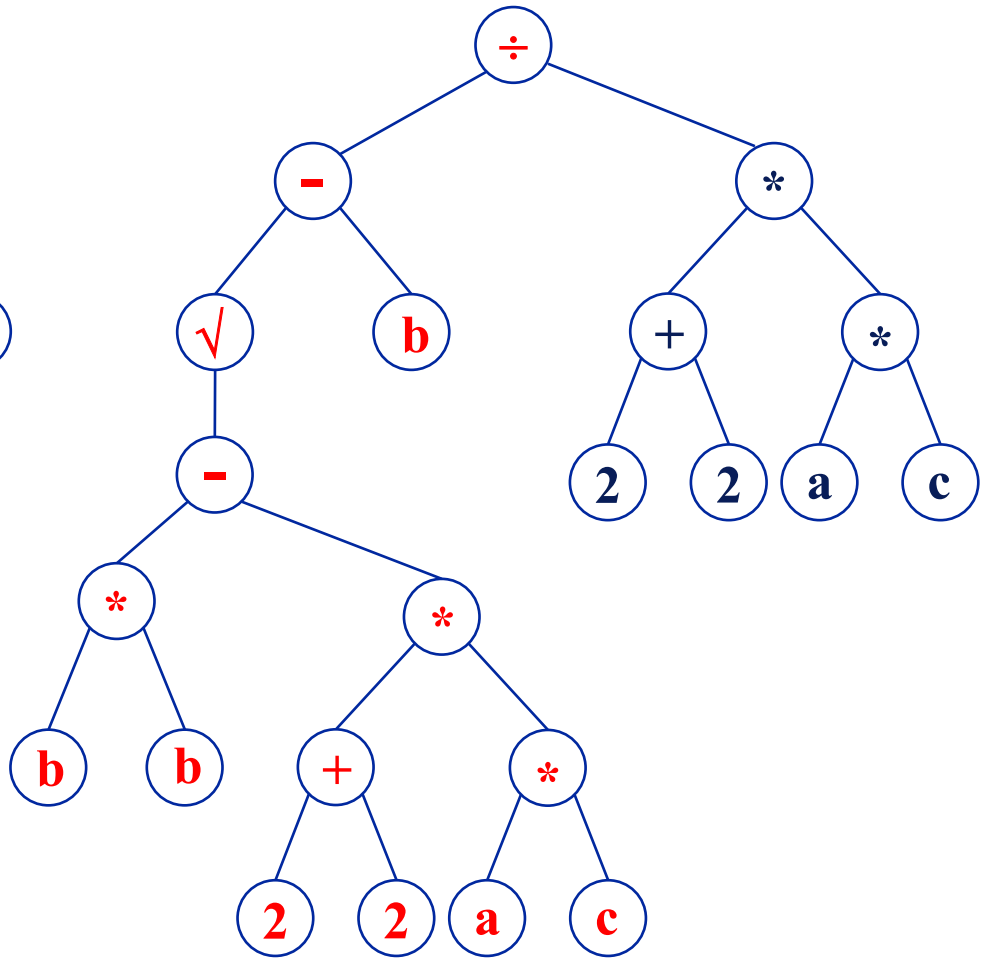
$$\frac{\sqrt{2 \cdot a} - b}{2 \cdot a}$$

Crossing Over

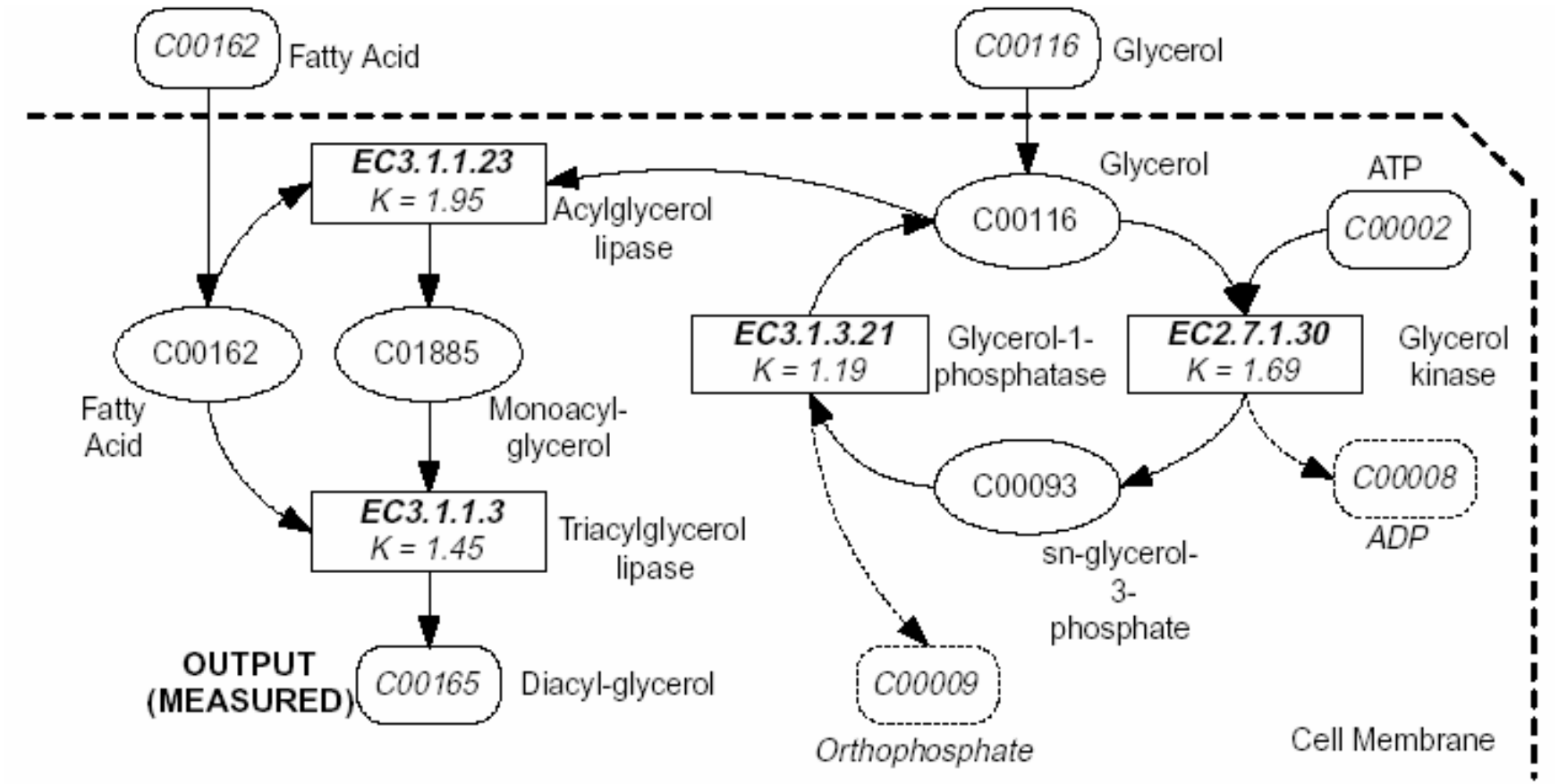
$$\frac{\sqrt{(2 \cdot a \cdot b \cdot c) - b}}{2 \cdot a}$$



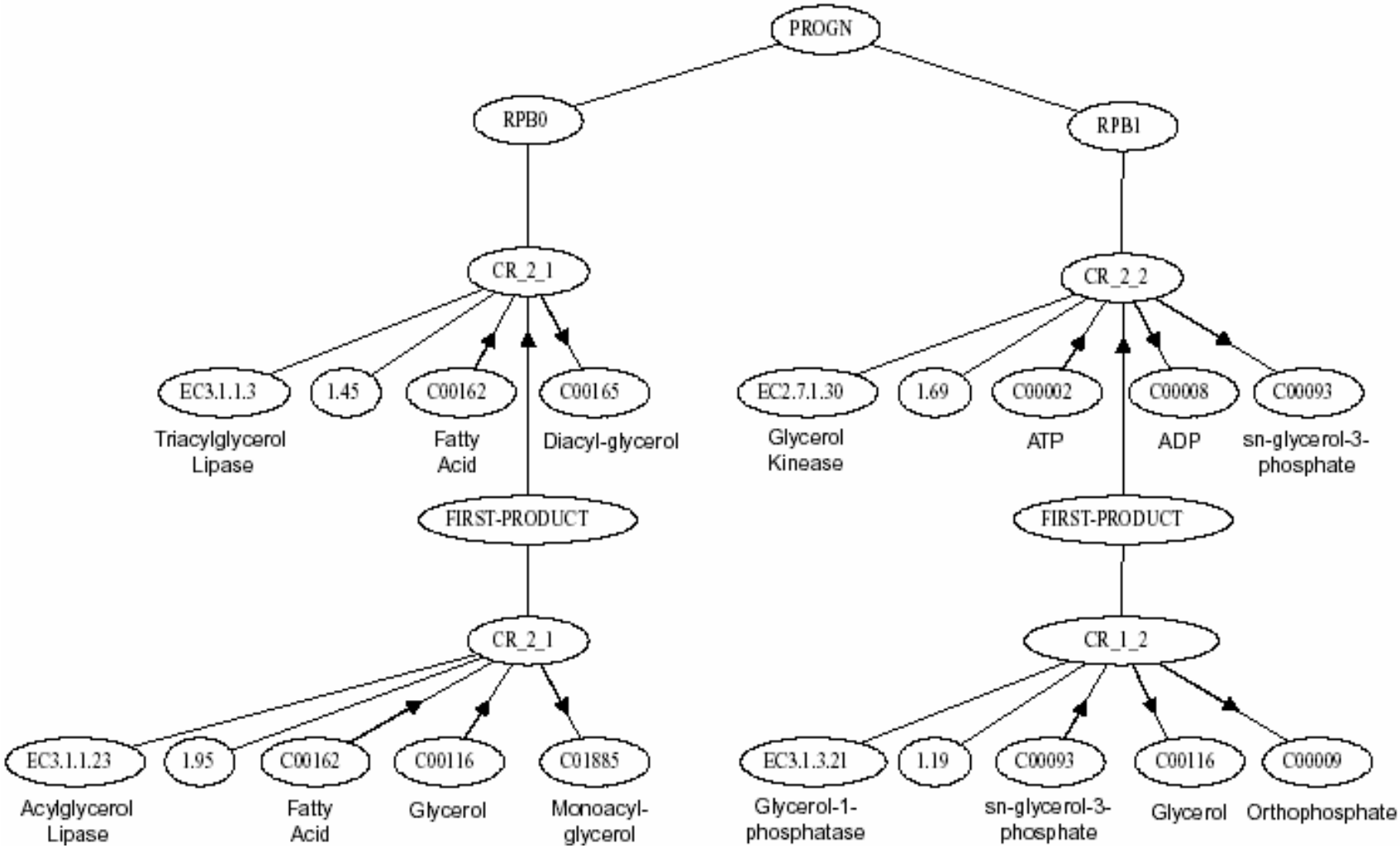
$$\frac{\sqrt{b \cdot b = (2 + 2) \cdot a \cdot c = b}}{(2 + 2) \cdot a \cdot c}$$



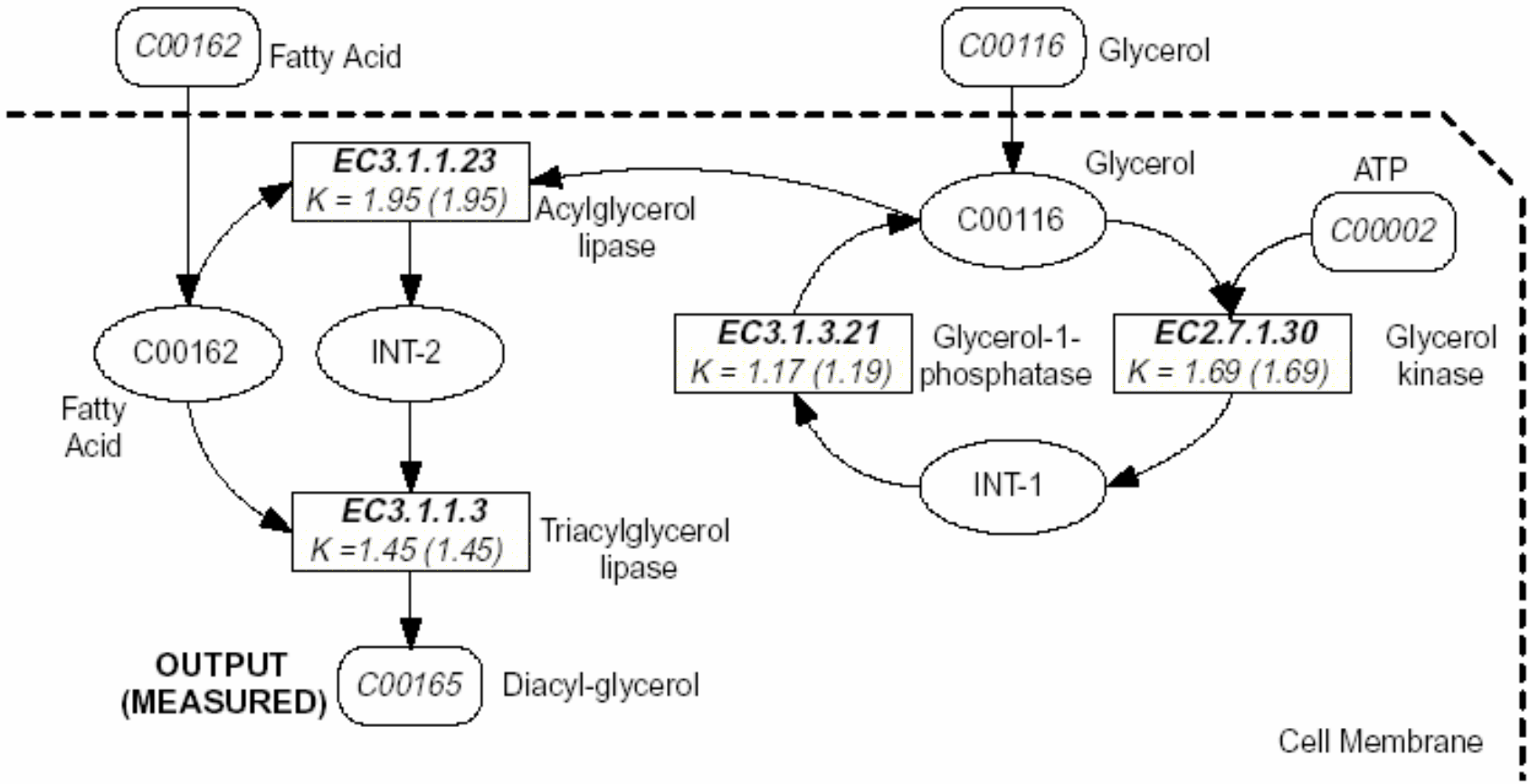
GP Representation of Biochemical Reaction Nets - I



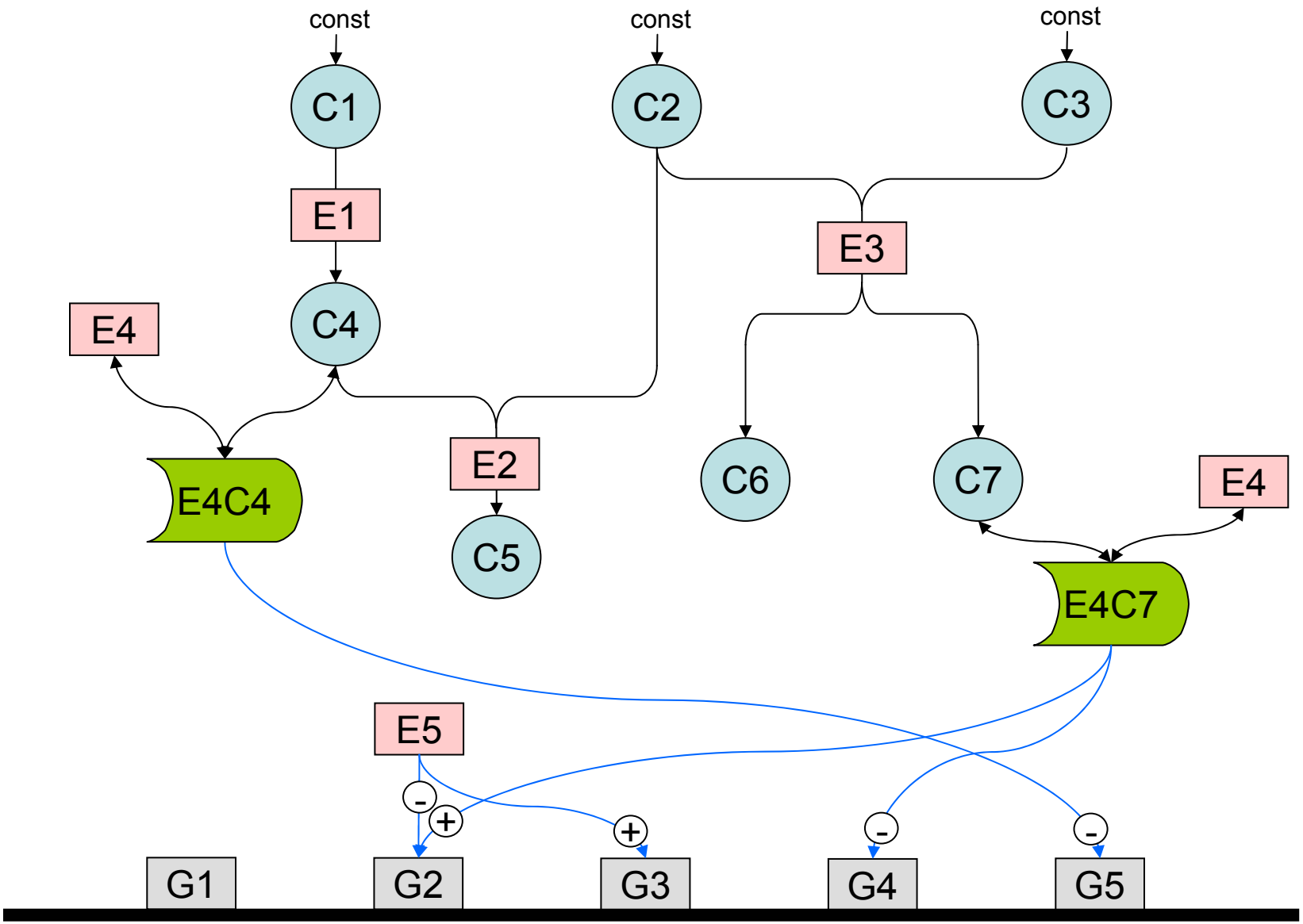
GP Representation of Biochemical Reaction Nets - II



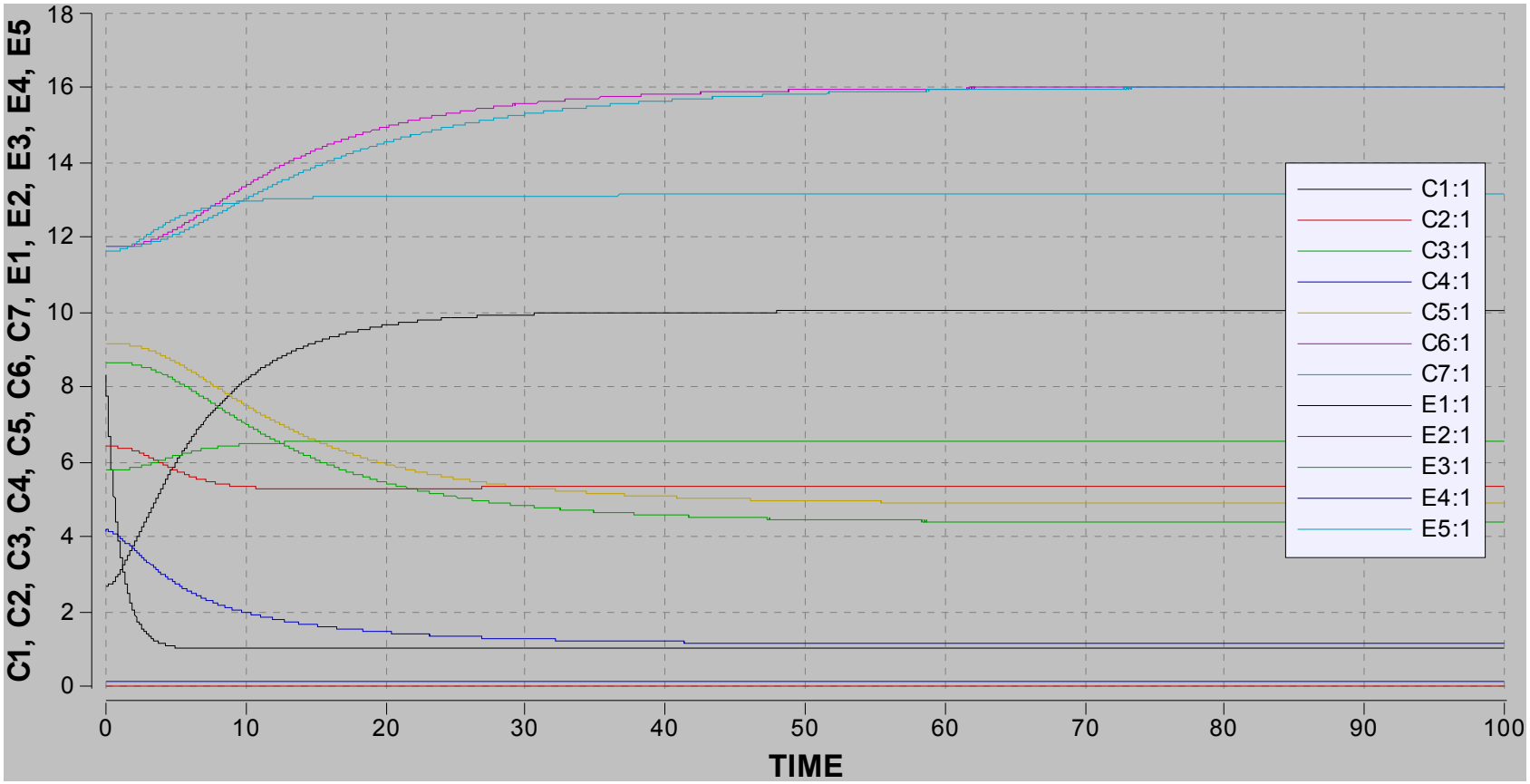
Result after 225 Generations



Test Network



In silico RNAi



Knock down of enzyme 1

EXTRA

Best of Generation 10