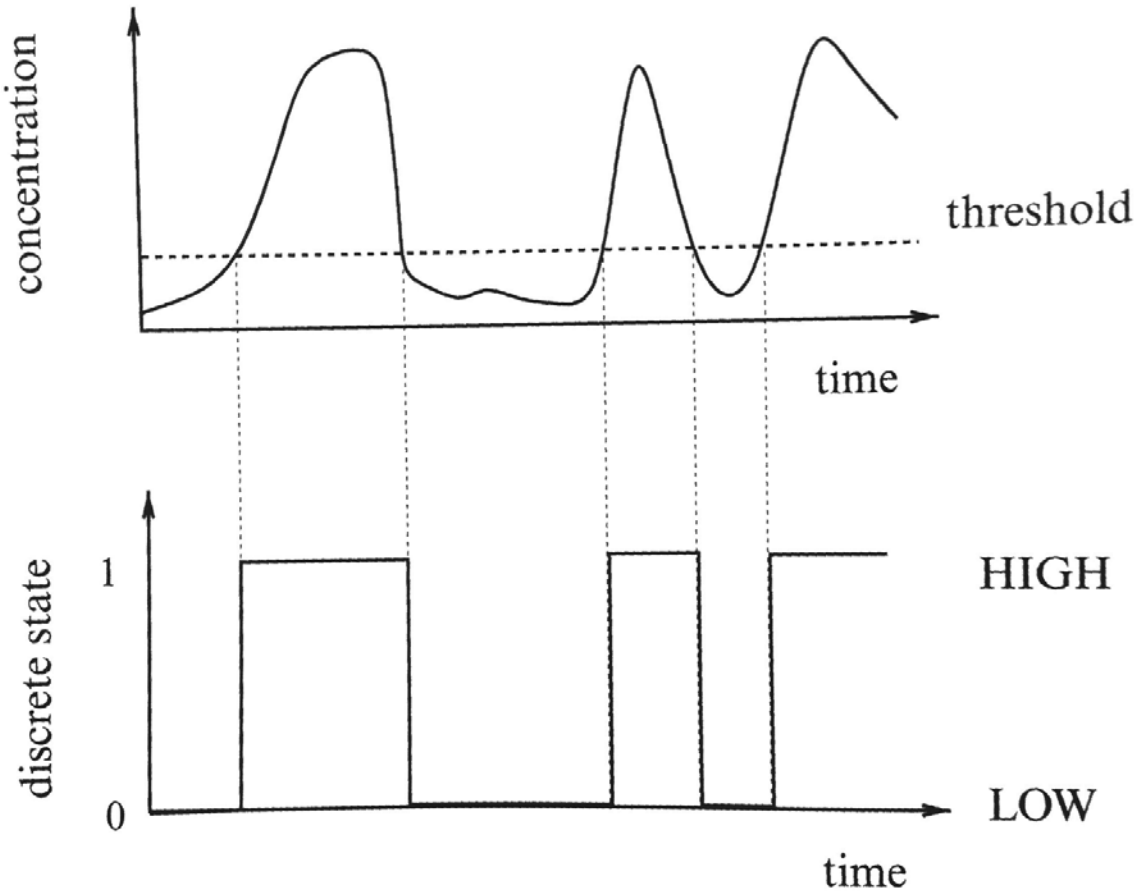
BME 5742

Genetic Logic Circuits

Analogy between Gene Circuits and Logic Gates Electronic Circuits

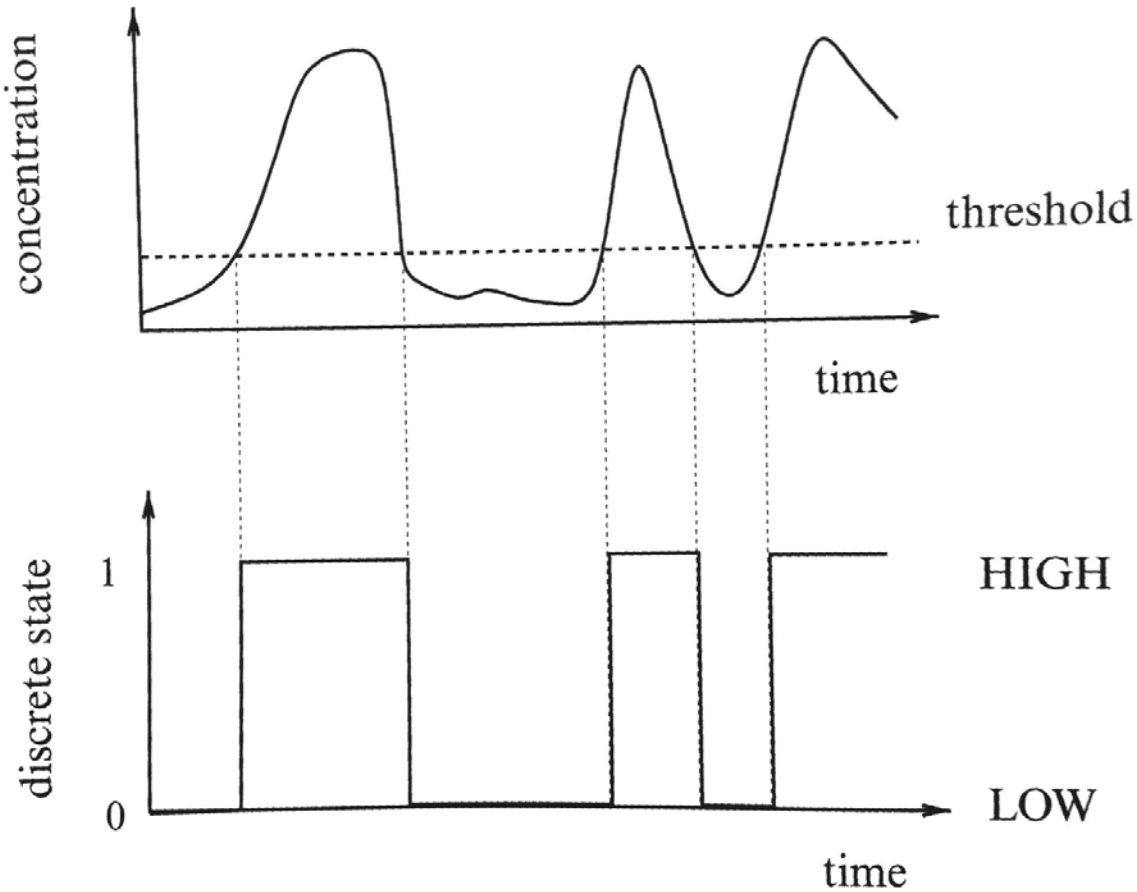
- Promoter - transcription factor interactions are building blocks of gene networks
- Logic gates are building blocks of computational digital electronic circuits

Digitizing a Signal



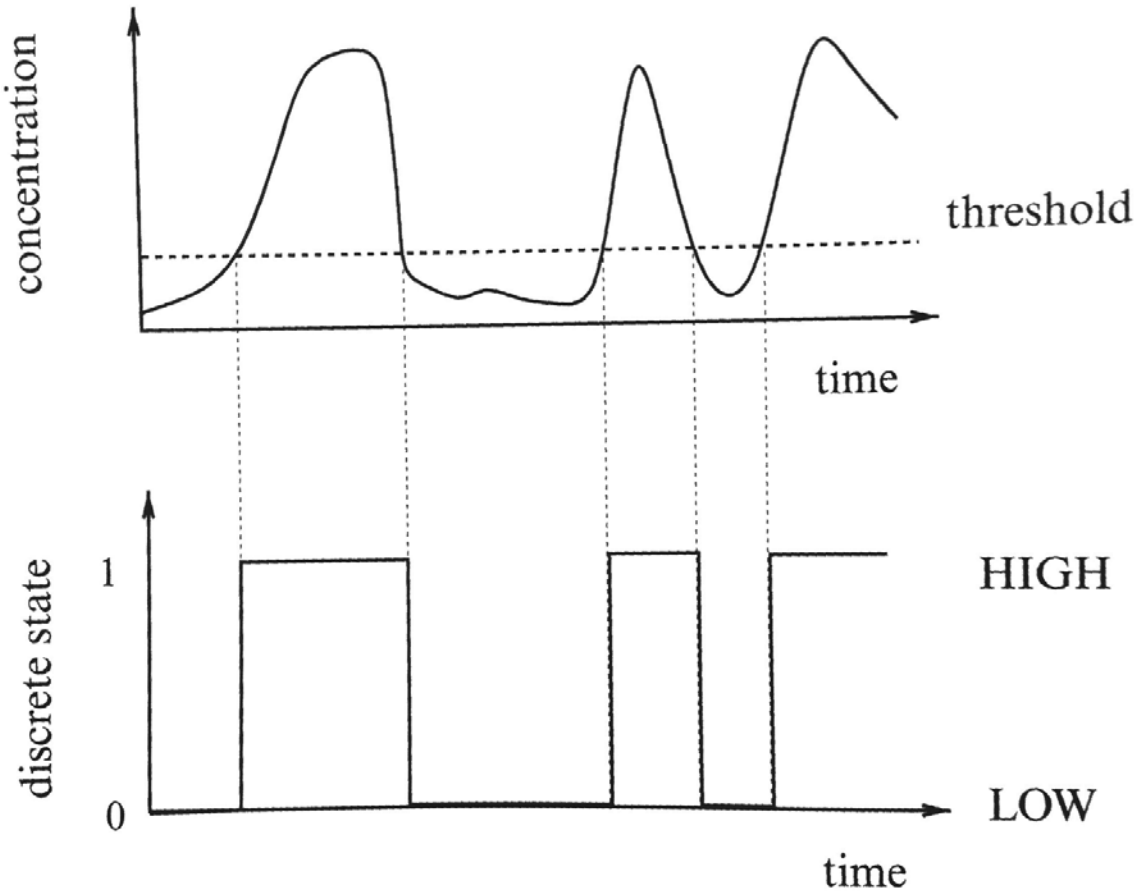
In digital electronics a voltage is mapped into one of two categories: HIGH or LOW, depending on voltage magnitude with respect to some threshold

Digitizing a Signal



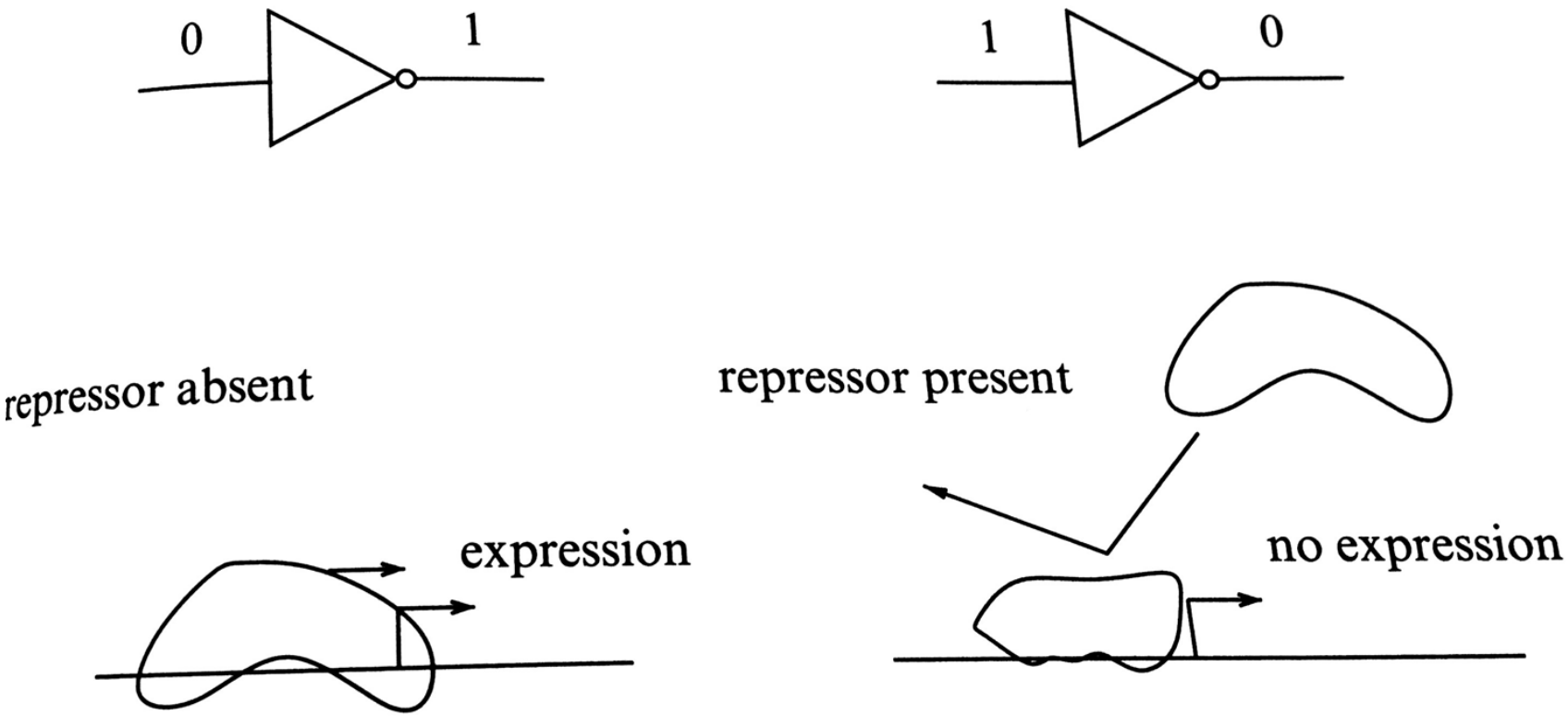
The continuously varying concentration levels of a transcription factor may be viewed as the analog signal that needs to be discretized

Two Gene States

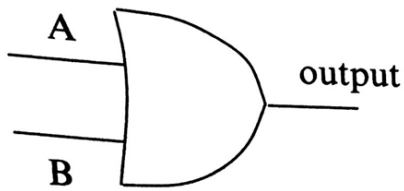


Each gene is either ON (expressing above threshold) or OFF (expressing below threshold). We may assign “1” to HIGH and “0” to LOW

Implementation of a Gene Inverter (a NOT Gate)

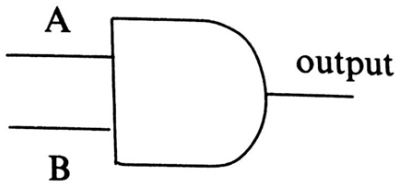


Truth Tables of OR and AND Gates



OR gate		
inputs		output
A	B	
0	0	0
1	0	1
0	1	1
1	1	1

B

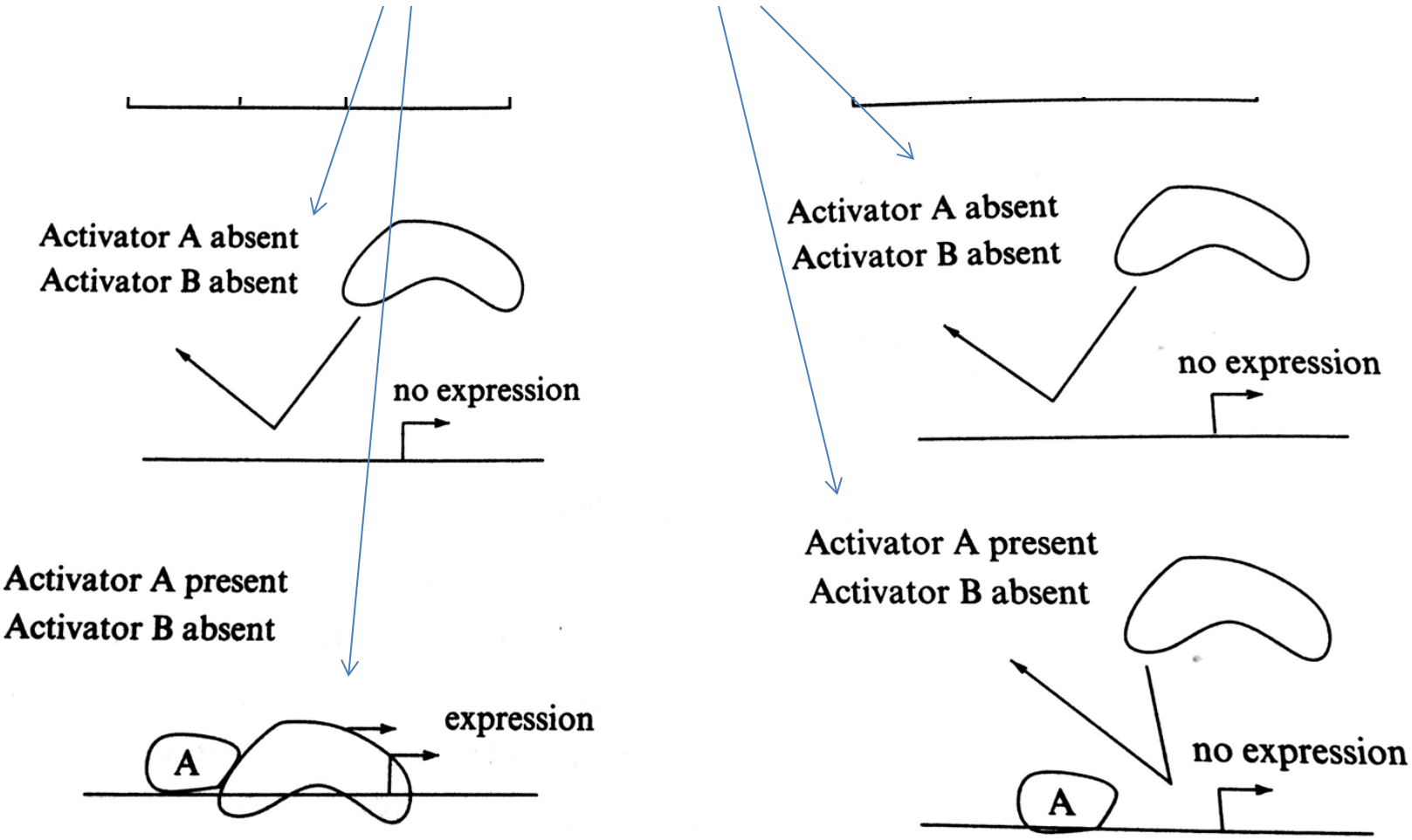


AND gate		
inputs		output
A	B	
0	0	0
1	0	0
0	1	0
1	1	1

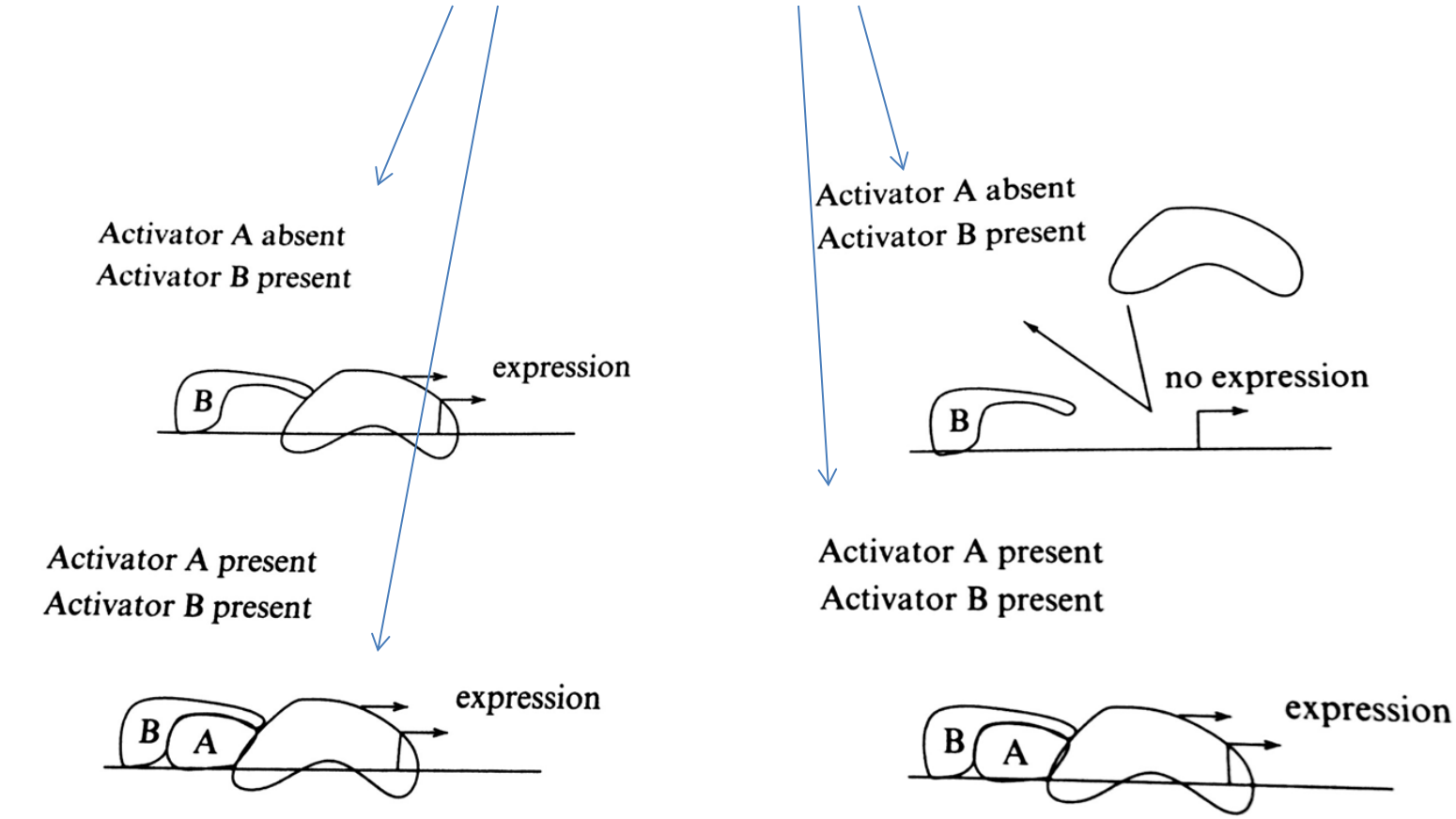
Comment about Multi-Input Gates

- Promoters that are regulated by multiple transcription factors can be part of a multi-input genetic logic gate.

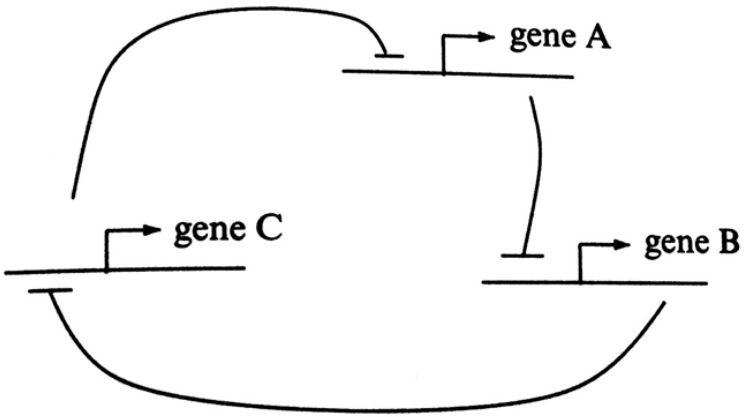
Genetic OR and AND Gates – part 1

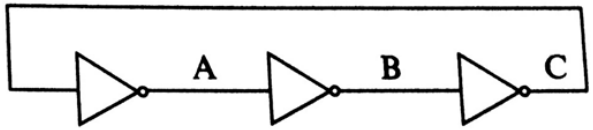


Genetic OR and AND Gates – part 2



Repressilator Oscillator Revisited





Here we see the origin of the repressilator idea: Odd number of consecutive NOT gates, creates an oscillation. It works only because each NOT inversion takes some finite time.