Problem 1: Boolean Algebra

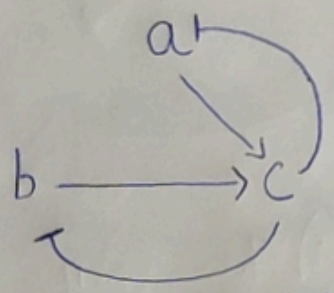
Ans:

gene a => repressed by Protein C

gene b => repressed by Protein C

gene c => activated by both Protein A and B

Network:



→ - activate

⊣ - supress

Initially, when all are activated,

a = 1 b = 1 c = 1

Transfer functions are,

$a^* = (\text{NOT } c)$

$b^* = (\text{NOT } c)$

$c^* = a \text{ AND } b$

at, a b c
1 1 1

a = 0 b = 0 c = 1

at, a b c
0 0 1

a = 0 b = 0 c = 0

at, a b c
0 0 0

a = 1 b = 1 c = 0

at, a b c
1 1 0

a = 1 b = 1 c = 1

So, initially at all active state,

The transition states are,

a	b	c
1	1	1
0	0	1
0	0	0
1	1	0
1	1	1

A cyclic attractor with size 4 is observed.

According to this cyclic attractor, when all the genes are active, it moves to a transient state, where all genes are switched off. Then, genes a and b are activated, subsequently, activating gene c in next state. Thus, forming a cycle.