PRACTICAL 3A: COMBINATIONAL CIRCUITSRonak Mehta (MHTRON001)

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and declare that this is my own work.

02-05-2018  
Signature Date

Solutions

a) Truth Table for 1-bit Half Adder

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **S** | **COUT** |
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |

b) S = (A.) + (.B)

**S = A ⊕ B**

**COUT = A.B**

c) Truth Table for 1-bit Full Adder

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CIN** | **A** | **B** | **S** | **COUT** |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

d)

S = () + (A . ) + ( . . Cin) + (A .B .Cin)

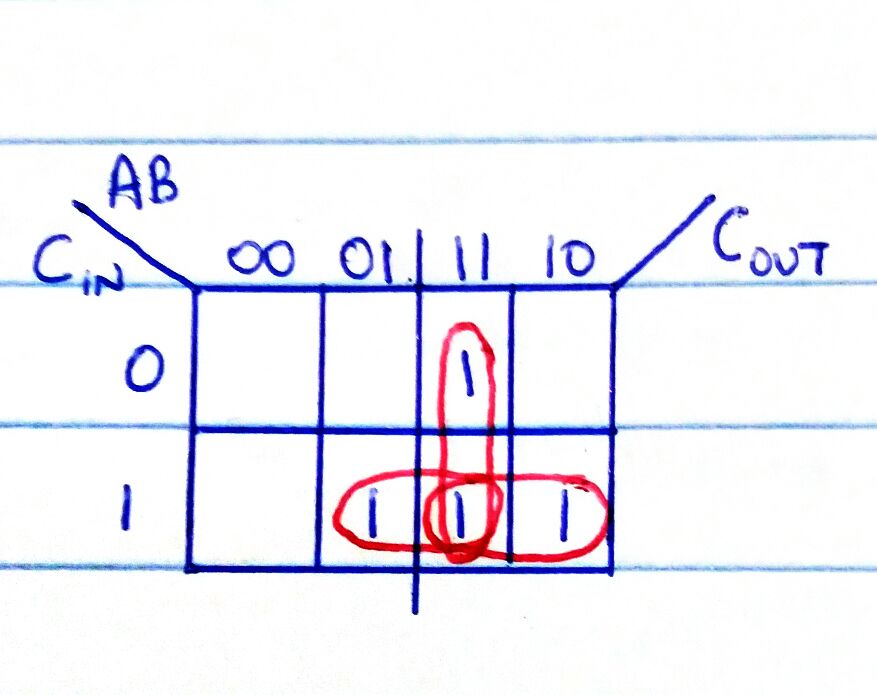
S =

Let X = = A ⊕ B

Then,

Thus, S = = CIN ⊕ X

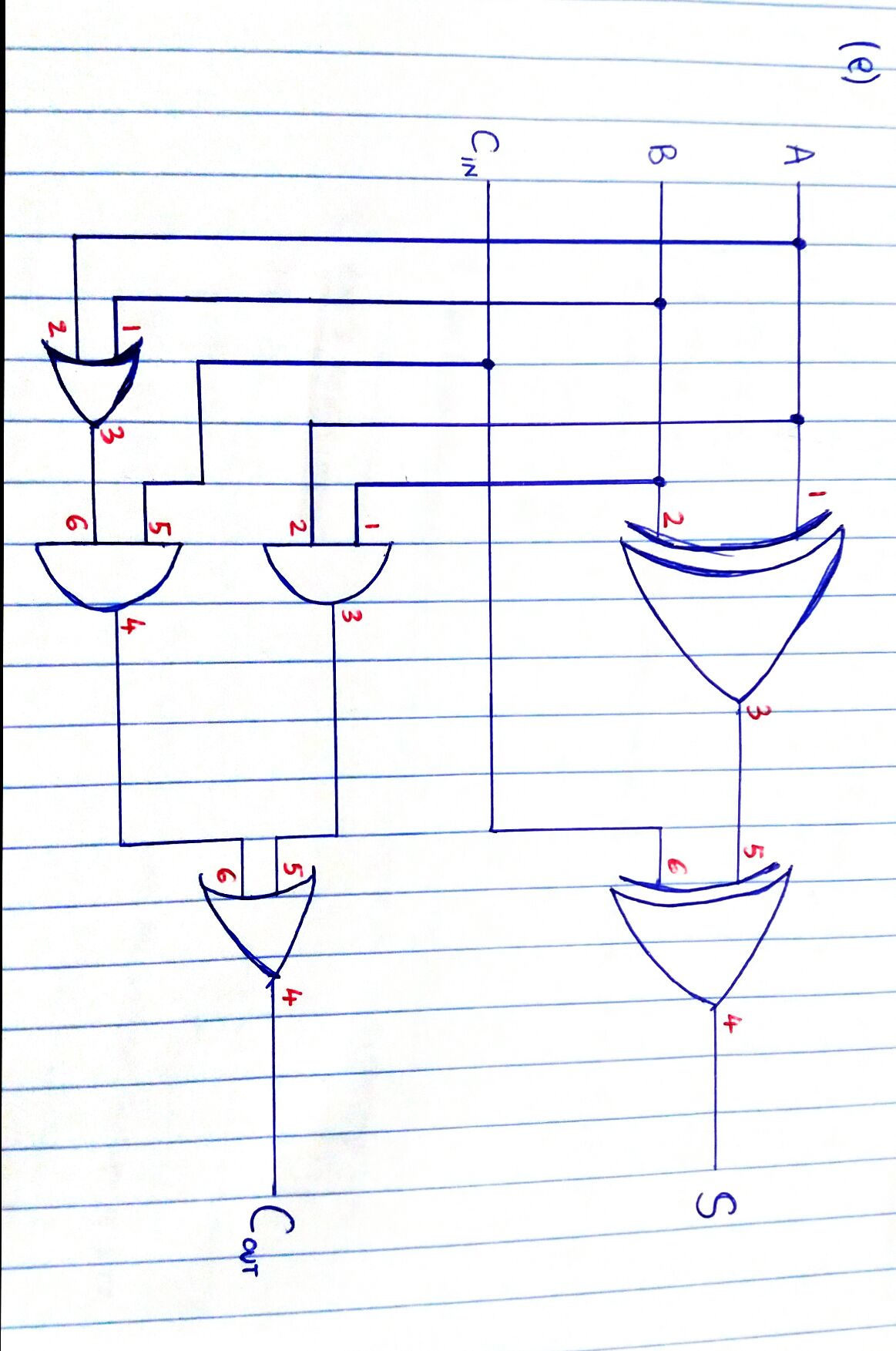
**S = CIN ⊕ A ⊕ B**



COUT = (CIN.B) + (CIN.A) + (A.B)

**COUT = CIN(A+B) + (A.B)**

e)



f) Truth Table for 1-bit Full Subtractor

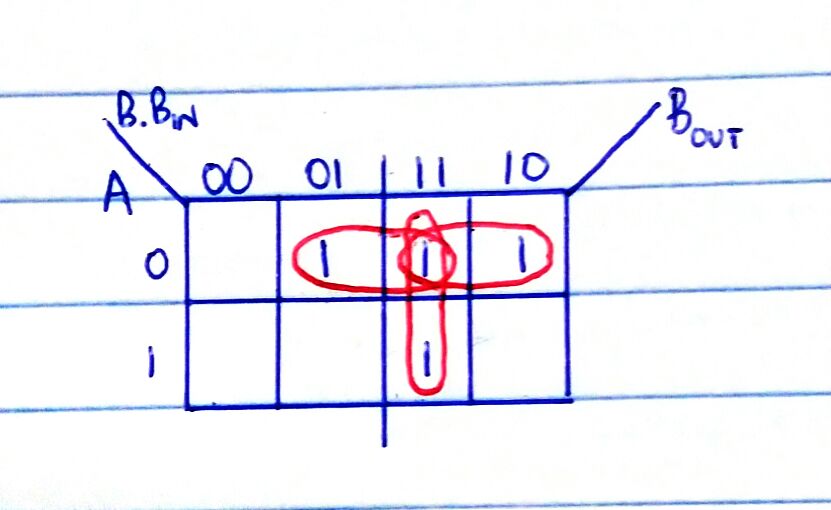
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A** | **B** | **BIN** | **D** | **BOUT** |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

g)

D = () + () + (A . ) + (A . B . Bin)

D = + A(()+(B . Bin))

**D = A ⊕ B ⊕ BIN**

****

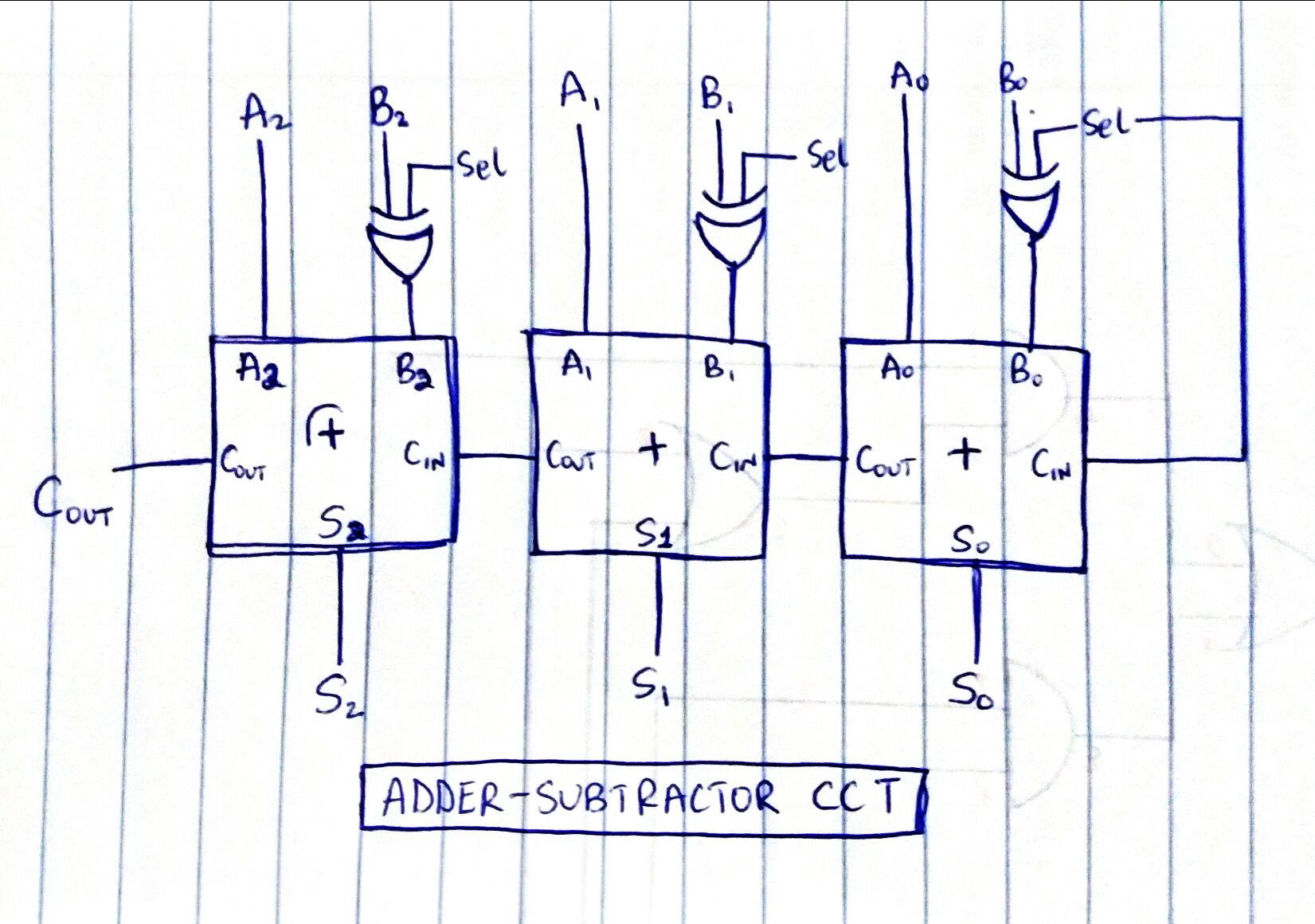
BOUT = (B. BIN) + ( BIN) + ( . B)

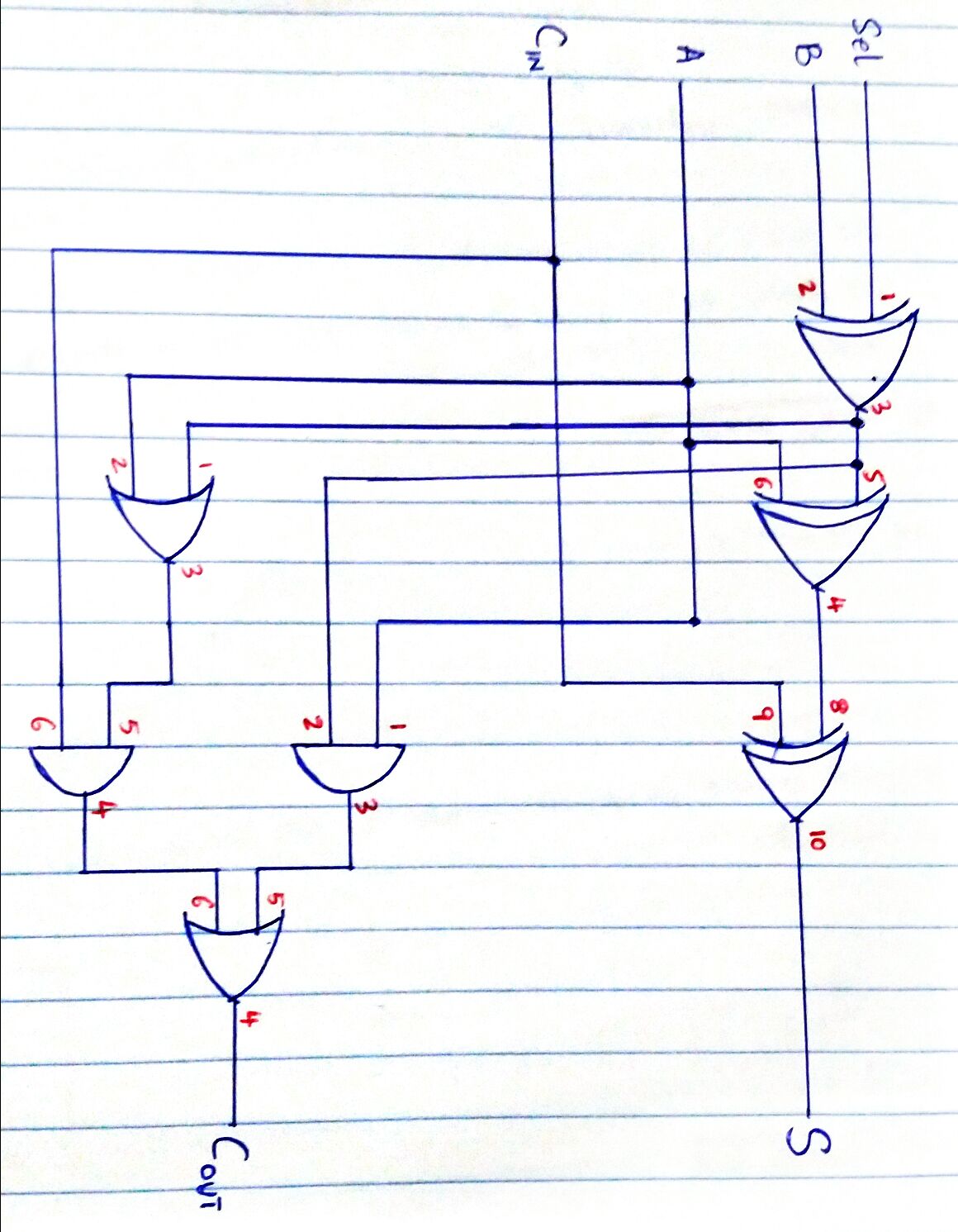
**BOUT = BIN ( + B) + ( . B)**

h)

A full Adder can be used as a Full Subtractor by connecting a NOT gate on one of the inputs and connecting the CIN input to a HIGH. By connecting the NOT gate, we are converting the input to its 2’s compliment. We can also do this by adding an XOR gate to one of the inputs.

i)





k)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CIN** | **A** | **B** | **Sel** | **S** | **COUT** | **VERIFIED the S variable** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 |