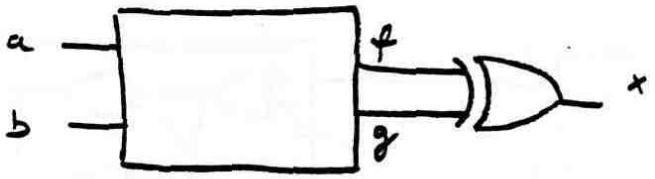
PH.D. QUALIFYING EXAMINATION 1994 / SOLUTIONS

Topic: Logic design and Boolean algebra

NOTE: We are dealing with combinational circuits only.

1) An engineer claims correctly that he can replace the XOR gate in the circuit below by a NAND gate.
Can you give an example of a circuit that can fit in the box?



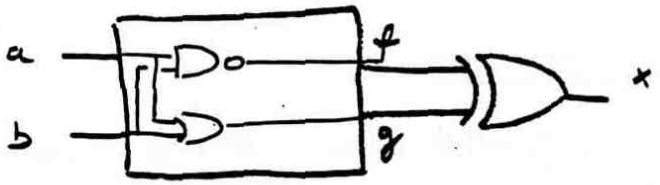
Compare XOR to NAND

a	b	XOR	NAND
0	0	0	1
0	1	1	1
1	0	1	1
1	1	0	0

XOR differs from NAND on input pattern 00

The network in the box should not yield 00

Example



2) Is the circuit in the box unique?
How can you characterize the class of circuits that fit the box?
Hint: consider functions f(a,b) and g(a,b).

$$f + g = 1$$