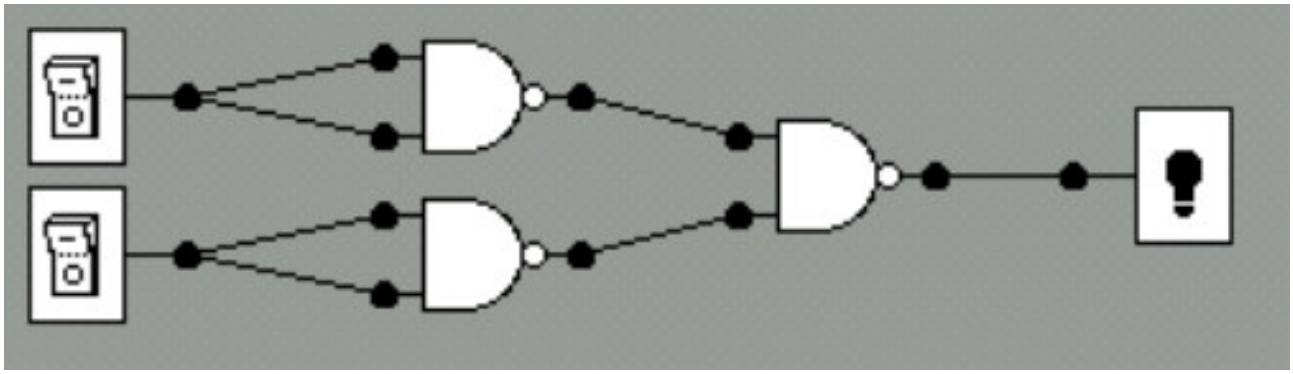


(1) The circuit above contains 3 NAND gates.

(a) Use the circuit emulator to create this circuit.

(b) Fill in this Truth Table as you PREDICT
the circuit will behave. Then use the emulator
to check your prediction, making corrections as necessary

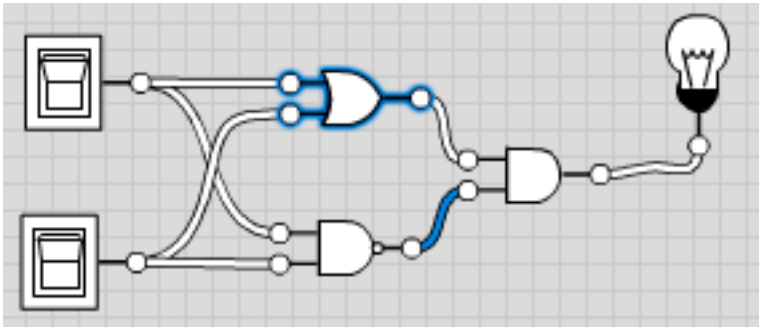
A	B	A nand A = C	B nand B = D	C nand D = output

.

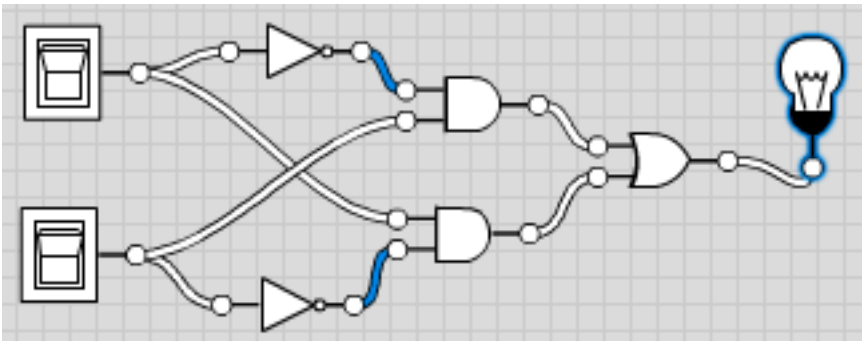
(c) State the single logic gate that performs the same function as this circuit.

---

(2) Repeat (a), (b), and (c) for the following circuit.
You need to create a new Truth Table with appropriate columns.



(3) Repeat (a),(b), and (c) for the following circuit.
You need to create a new Truth Table with appropriate columns.



(4) Consider this Boolean Algebra Expression:

A . B + ~A . B (in Java, A && B || (!A) && B)

(a) Write a Truth Table for the expression,
PREDICTING the truth values that it produces for various inputs.

(b) In the emulator, create an equivalent circuit and check your predictions from (a).

(c) State a simpler Boolearn Expression that produces the same outputs.

---

(5) State whether each equivalence is ALWAYS valid:

(a) A . (B + C) === A.B + A.C

(b) ~ (A + B) === ~ A + ~ B

(c) (A + B) . (~A + ~B) === ~A . B + A . ~B

(d) A . B + ~A . B + A . ~B === A + B

(e) A . ~A + A . B === B

---

(6)

An optical sensor is attached to a door, registering the door as CLOSED (1) or OPEN (0) .
A thermal sensor measures the heat of the room, registering TOO HOT (1) or OKAY (0) .
An audio sensor measures noise in the room, registering NOISE (1) or QUIET (0) .

A switch is available for the occupant to switch on the air conditioning (cooling).
- When the switch is ON (1), the air-conditioning will be on
if the TOO HOT (1) sensor is on and the door is CLOSED (1).

- The air conditioner cannot be turned on when the door is OPEN(0) or the temperature is OKAY (0).

Which of the following programming expressions correctly express the logic of this system?
(there may be more than one correct)

(6a) If (DOOR = OPEN) or (TEMPERATURE = OKAY) or (SWITCH = OFF)
then TurnOffCooler
else TurnOnCooler
end if

(6b) COOLER = ((DOOR NOR TEMPERATURE) NOR SWITCH)

(6c) COOLER = DOOR and SWITCH and TEMPERATURE

(6d) Construct a circuit to correctly control the air conditioner, using only NAND gates.