CSE 103 Assignment from the book

Chapter: 1, Section: 2, Exercise No: 12

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Problem 12: Are these system specifications consistent? “If the file system is not locked, then new messages will be queued.

If the file system is not locked, then the system is functioning normally, and conversely. If new messages are not queued, then they will be sent to the message buffer. If the file system is not locked, then new messages will be sent to the message buffer. New messages will not be sent to the message buffer.”

Solution: If the file system is not locked, then

(a) New messages will be queued.

(b) New messages will be sent to the messages buffer.

(c) The system is functioning normally, and conversely, if the system is functioning normally, then the file system is not locked.

2. If new messages are not queued, then they will be sent to the messages buffer.

3. New messages will not be sent to the message buffer.

(a) Begin by translating the parts of the specification into propositional formulas using four propositional variables:

L ::= file system locked,

Q ::= new messages are queued,

B ::= new messages are sent to the message buffer,

N ::= system functioning normally.

The translations of the specifications are:

$\neg L \rightarrow Q$

$\neg L \rightarrow B$

$\neg L \leftrightarrow N$

$\neg Q \rightarrow B$

$\neg B$

The specification is consistent if there is a single choice of truth values for the variables L, Q, B, N, so that every propositional formulas are true.

We can avoid the full truth table calculation if we reason by cases.

Case 1 (B is true): Then the last formula is false, and the whole specification is false.

Case 2 (B is false): Now (Spec. 2.) and (Spec. 1. (b)) can be true only if Q and L are true. Since

Case 2 (B is False): Now (Spec. 2.) and (Spec. 1. (b)) can be true only if Q and L are true. Since

L is true, (Spec. 1. (c)) can be true only if N is false. Thus, we have deduced that in order to be consistent, we must have,

L = True
N = False
Q = True
B = False.

From the way this assignment was constructed, we know it ensures that formulas from (Spec. 1. (b)) on are true. So all that remains is to check formula (Spec. 1. (a)), and indeed it is also true under this assignment.

So the system is consistent, and this is the only assignment that will satisfy it.