Lab 2a

f=1 represents the door opening.
p=1 represents a person being detected.
h=1 represents the switch being set to hold the door open.
c=1 represents the door being closed/locked.

Case 1:

Door: Unlocked
Switch: Off
Person: Undetected
Outcome: The door remains closed.

```
(%i1)

f:(h and not c) or (p and not c);
(%o1) h∧¬c∨p∧¬c

(%i2)

f,h=false,c=false,p=false;
(%o2)  false
```

Case 2:

Door: Unlocked
Switch: On
Person: Undetected
Outcome: The door opens due to the switch.

```
(%i1)

f:(h and not c) or (p and not c);
(%o3) h∧¬c∨p∧¬c

(%i2)

f,h=true,c=false,p=false;
(%o4)  true
```

Case 3:

Door: Unlocked
Switch: Off
Person: Detected
Outcome: The door opens due to person detection.

```
(%i1)

f:(h and not c) or (p and not c);
(%o5) h∧¬c∨p∧¬c

(%i2)

f,h=false,c=false,p=true;
(%o6)  true
```

Case 4:

Door: Unlocked
Switch: On
Person: Detected
Outcome: The door opens due to both the switch and person detection.

```
(%i1)

f:(h and not c) or (p and not c);
(%o7) h∧¬c∨p∧¬c

(%i2)

f,h=true,c=false,p=true;
(%o8)  true
```

Case 5:

Door: Locked
Switch: Off
Person: Undetected
Outcome: The door remains closed.

```
(%i1)

f:(h and not c) or (p and not c);
(%o9) h∧¬c∨p∧¬c

(%i2)

f,h=false,c=true,p=false;
(%o10)       false
```

Case 6:

Door: Locked
Switch: On
Person: Undetected
Outcome: The door remains closed despite the switch being on because the door is locked

```
(%i1)

f:(h and not c) or (p and not c);
(%o11)      h∧¬c∨p∧¬c

(%i2)

f,h=true,c=true,p=false;
(%o12)       false
```

Case 7:

Door: Locked
Switch: Off
Person: Detected
Outcome: The door remains closed despite person detection because the door is locked

```
(%i1)

f:(h and not c) or (p and not c);
(%o13)      h∧¬c∨p∧¬c

(%i2)

f,h=false,c=true,p=true;
(%o14)       false
```

Case 8:

Door: Locked
Switch: On
Person: Detected
Outcome: The door remains closed even though the switch is on and a person is detected because the door is locked.

```
(%i1)

f:(h and not c) or (p and not c);
(%o15)      h∧¬c∨p∧¬c

(%i2)

f,h=true,c=true,p=true;
(%o16)       false
```

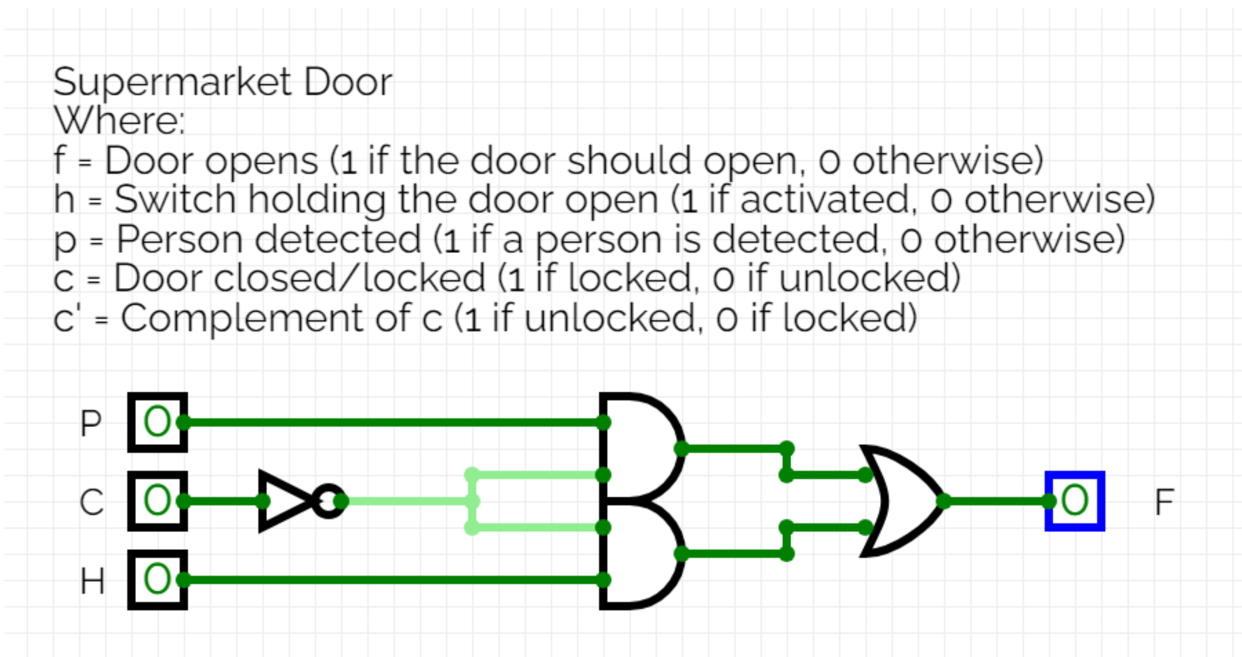
To conclude, the primary utility of Maxima in this scenario was to validate the logic function for different input states and ensure the function behaves as expected. Given the inputs and the logical equation, Maxima would output whether the door should open (true) or remain closed (false) for each possible scenario. All 8 combinations follow the truth table for this function

Lab 2b

Supermarket Door
f = Door opens (1 if the door should open, 0 otherwise)
h = Switch holding the door open (1 if activated, 0 otherwise)
p = Person detected (1 if a person is detected, 0 otherwise)
c = Door closed/locked (1 if locked, 0 if unlocked)
c' = Complement of c (1 if unlocked, 0 if locked)

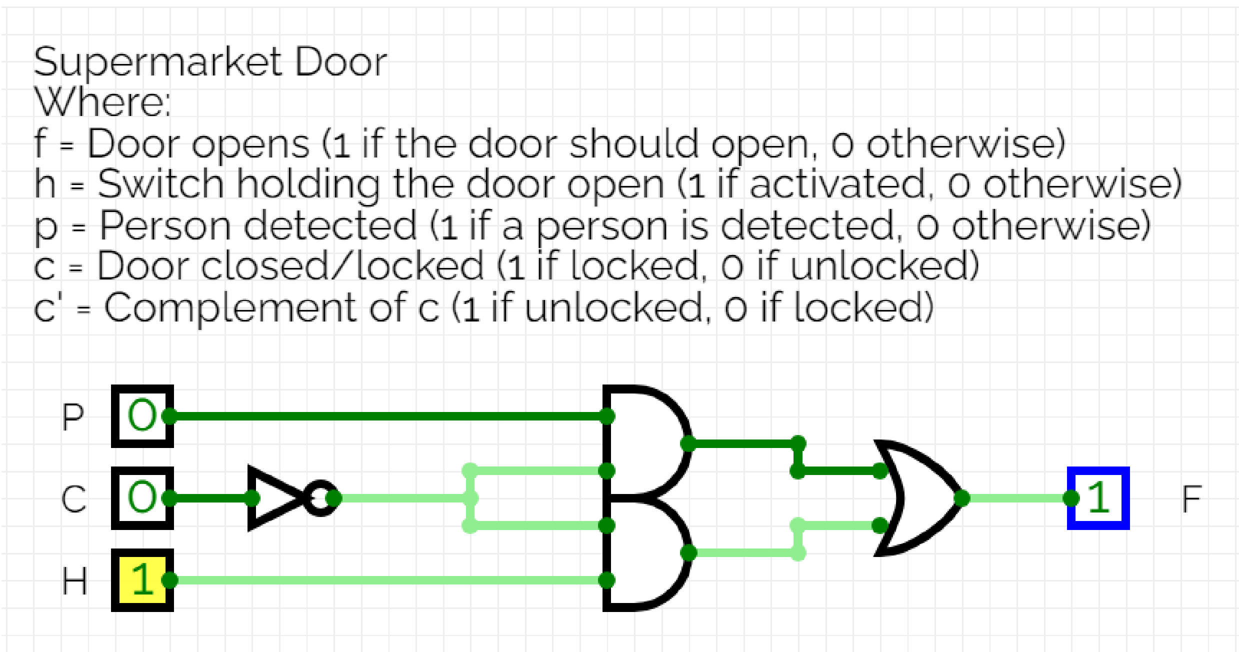
Case 1:

Door: Unlocked
Switch: Off
Person: Undetected
Outcome: The door remains closed.



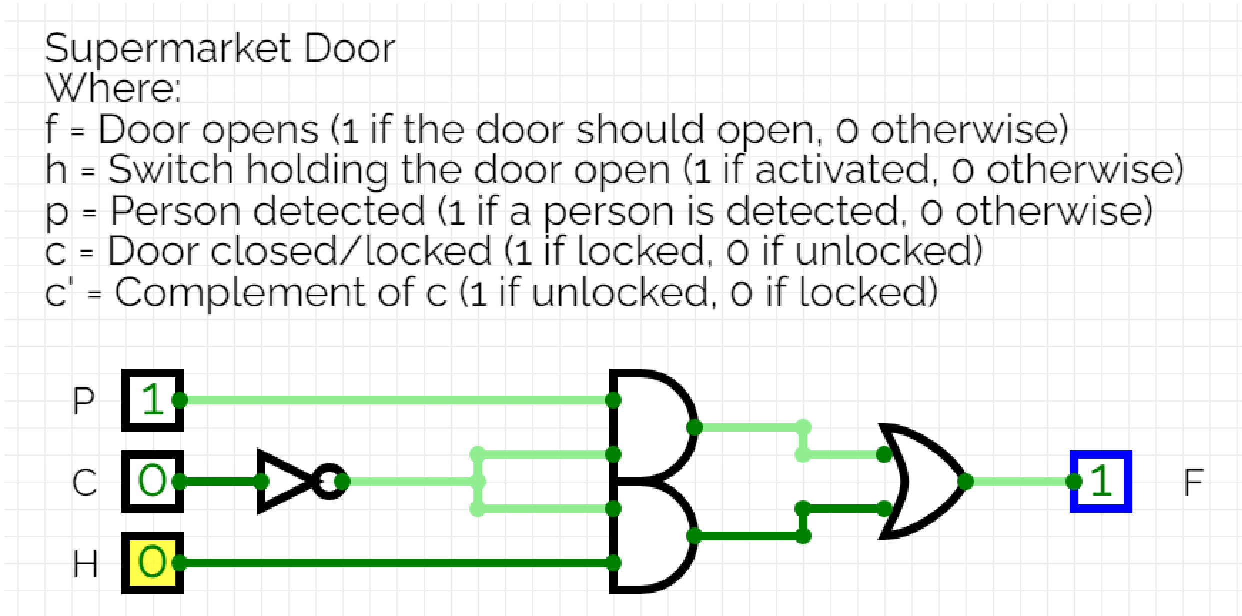
Case 2:

Door: Unlocked
Switch: On
Person: Undetected
Outcome: The door opens due to the switch.



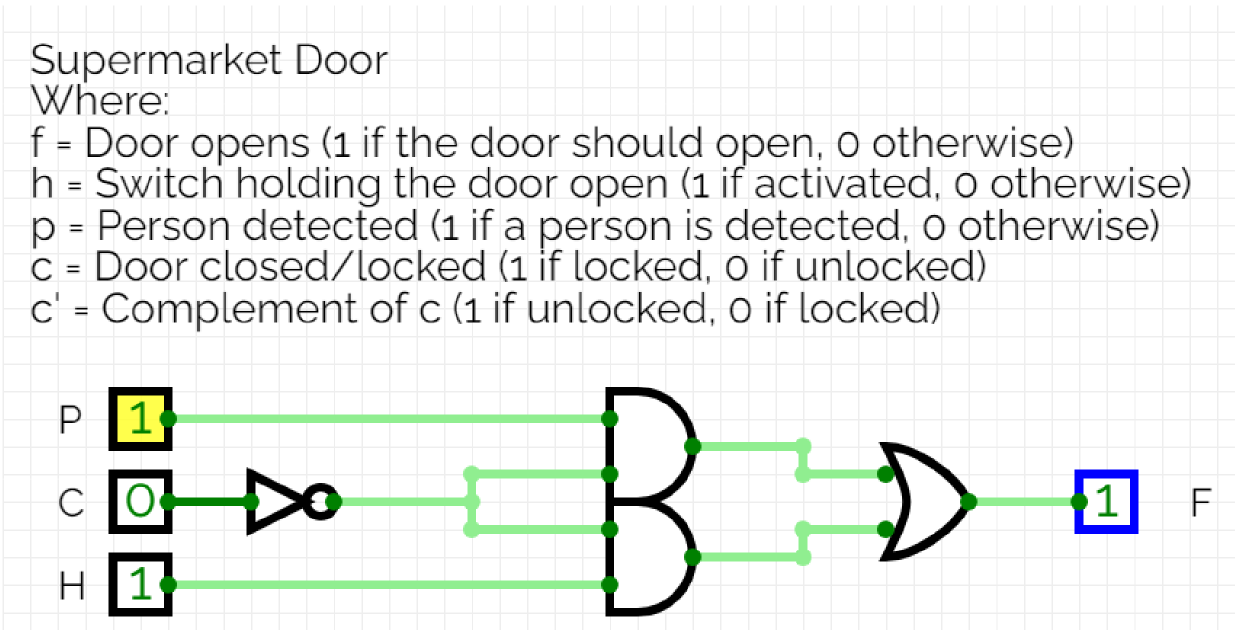
Case 3:

Door: Unlocked
Switch: Off
Person: Detected
Outcome: The door opens due to person detection.



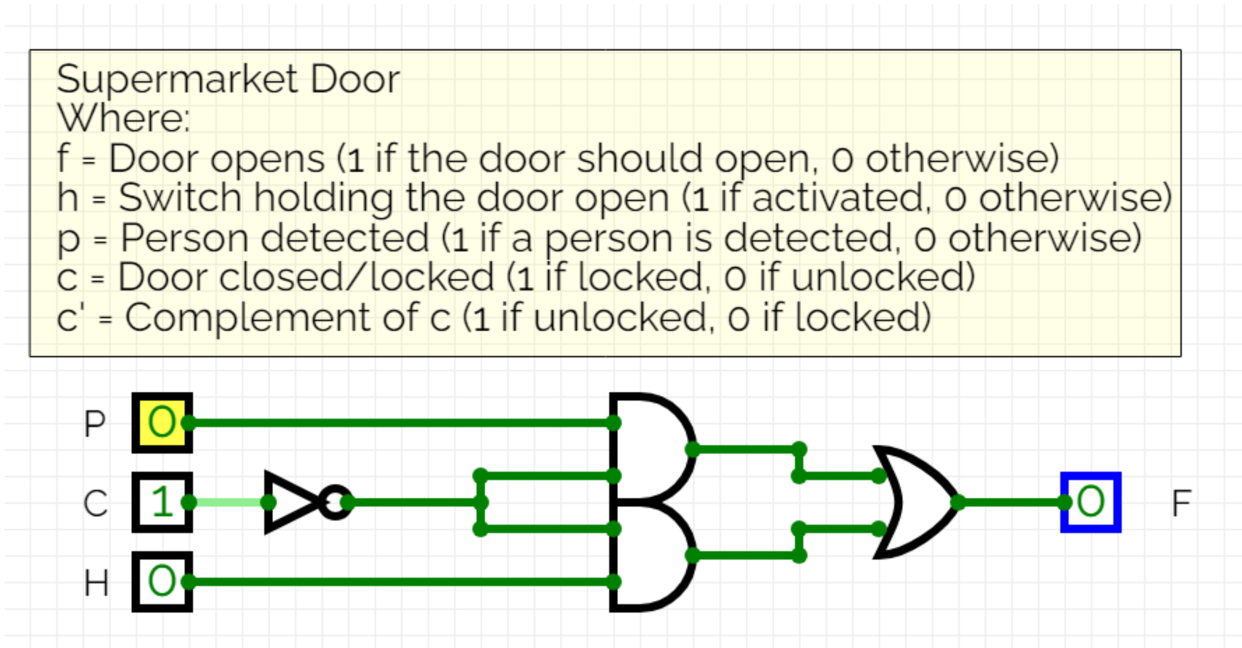
Case 4:

Door: Unlocked
Switch: On
Person: Detected
Outcome: The door opens due to both the switch and person detection.



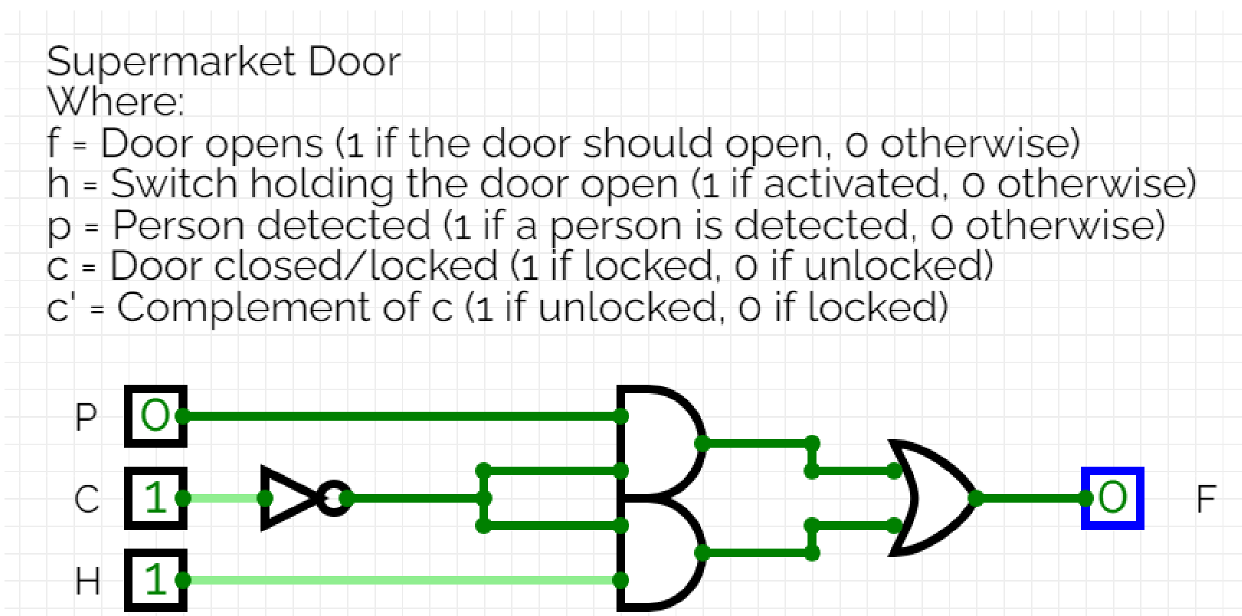
Case 5:

Door: Locked
Switch: Off
Person: Undetected
Outcome: The door remains closed.



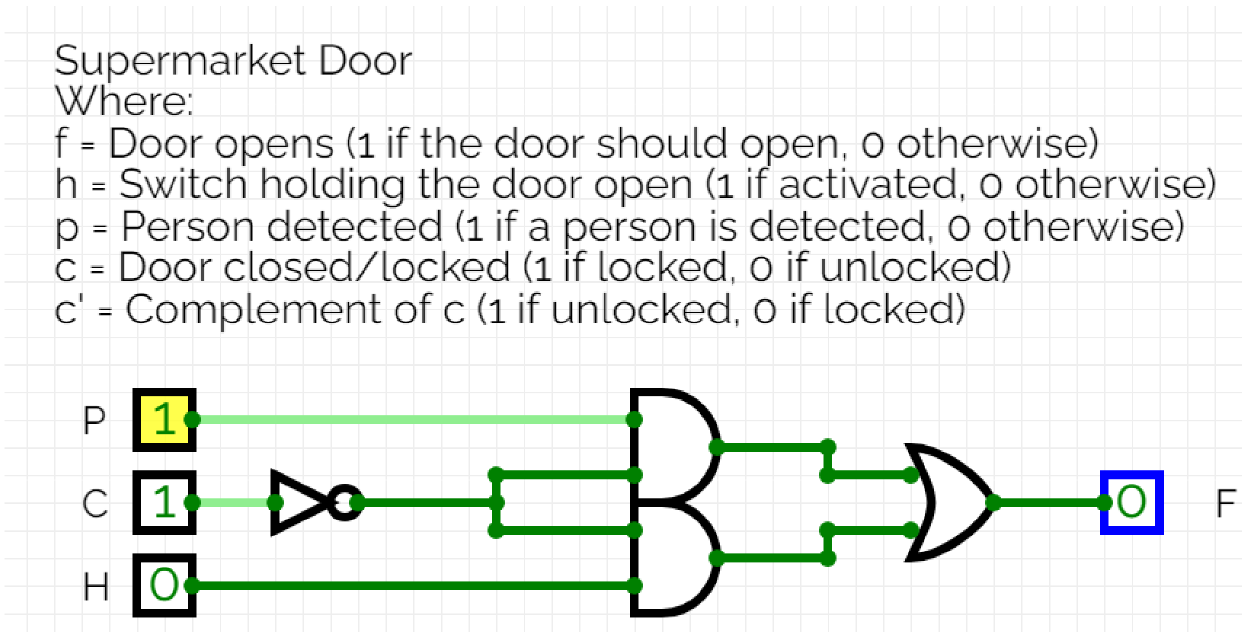
Case 6:

Door: Locked
Switch: On
Person: Undetected
Outcome: The door remains closed despite the switch being on because the door is locked



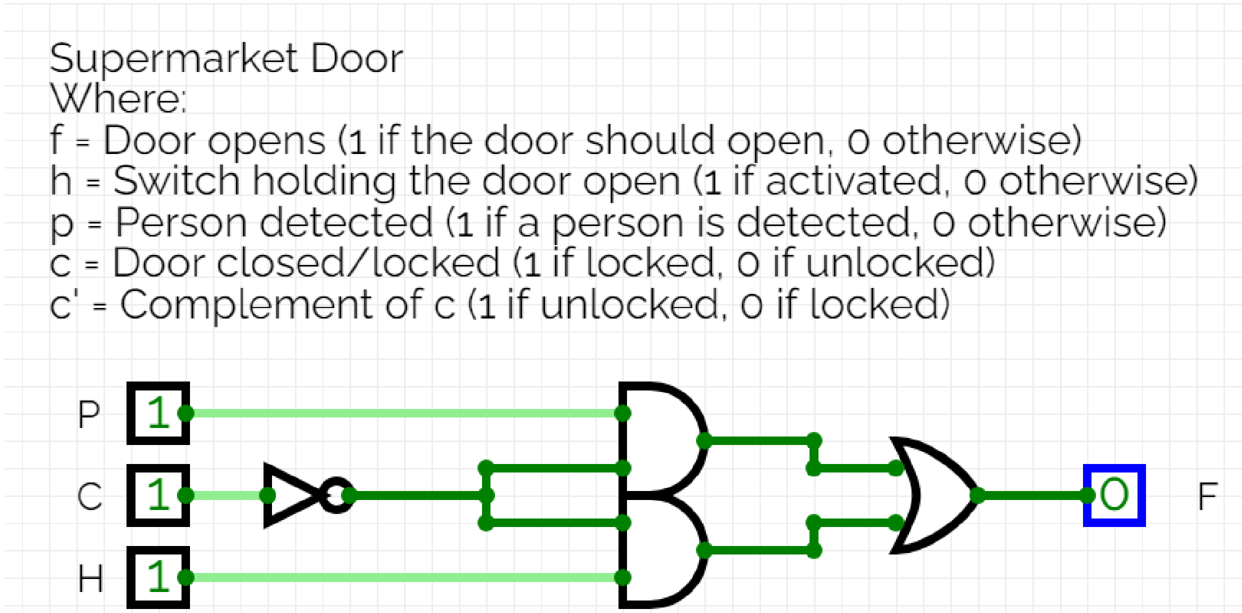
Case 7:

Door: Locked
Switch: Off
Person: Detected
Outcome: The door remains closed despite person detection because the door is locked



Case 8:

Door: Locked
Switch: On
Person: Detected
Outcome: The door remains closed even though the switch is on and a person is detected because the door is locked.



Circuit Description:

NOT Gate (Inverter):
This gate was used to invert the c-prime signal. The purpose of this gate is to have a logic high (1) output when the door is unlocked and a logic low (0) output when it is locked.

AND Gates:
Two AND gates were used to handle two conditions under which the door should open:
First, when the door is unlocked and the switch is activated.
Second, when the door is unlocked and a person is detected.

OR Gate:
The OR gate takes the outputs from the two AND gates. If either (or both) of the AND gates have a high output (indicating one of the conditions to open the door is met), the OR gate will produce a high output, signaling the door to open.

In conclusion, the described circuit will trigger the door to open if a person is detected walking through OR if the hold switch is pressed, but ONLY if the door is unlocked. If the door is locked (c=1), the NOT gate will produce a low output, and both AND gates will also produce low outputs, ensuring the door remains closed.