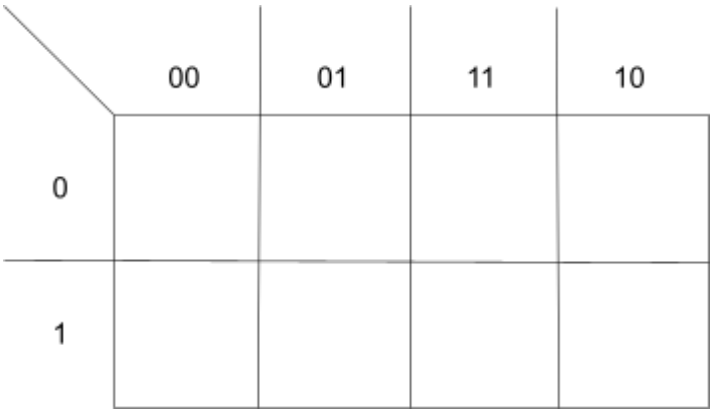
Traffic Light Truth Table

A traffic light controller is used to control the changing of colours on traffic lights. Below is a truth table showing how the next colour for the traffic light is determined from the current colour.

Complete the table.

Current colour			Next colour		
R	A	G	R’	A’	G’
1	0	0	1	1	0
1	1	0	0	0	1
0	0	1			
0	1	0			

Fill in the Karnaugh map to work out the simplified logic for R’ based on R, A and G.



1. **What is the simplified expression for R’.**

2. **Work out the simplified expressions for both A’ and G’ using Karnaugh maps.**

Guidance for supervisors:

a) Truth Table

Current colour			Next colour		
R	A	G	R’	A’	G’
1	0	0	1	1	0
1	1	0	0	0	1
0	0	1	0	1	0
0	1	0	1	0	0

b) Karnaugh Maps

1. K-map for R':

```
      AG
R     00   01   10   11
0     1    0    0    X
1     1    0    X    X
```

Grouping the 1s: We can group the two 1s in the left column.

Simplified expression for R': R' = $\bar{G}$ (NOT G) or R' = $\bar{G}$

2. K-map for A':

```
      AG
R     00   01   10   11
0     0    1    0    X
1     1    0    X    X
```

Grouping: Group the (R=1,A=0,G=0) and (R=0,A=0,G=1) - these give us A' = $\bar{R}$G + R$\bar{A}\bar{G}$

Or more simply: A' = R ⊕ G (R XOR G)

Or written out: A' = R̄G + RḠ

3. K-map for G':

	AG			
R	00	01	10	11
0	0	0	0	X
1	0	1	X	X

Simplified expression for G': G' = RA (R AND A)

Summary of Simplified Expressions:

1. **R' = Ḡ** (NOT G)
2. **A' = R̄G + RḠ** (can also be written as R ⊕ G)
3. **G' = RA** (R AND A)

These make logical sense:

- Red comes on when NOT Green
- Amber comes on when we're transitioning (either Red→Green or Green→Red)
- Green comes on only from Red+Amber state