COL215 : Assignment 1 Report

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1   Problem Description

For a K-map with 4 variables, the rows of the K-map are labelled with ab values, and columns are labelled with cd values. Note the sequence of values [00, 01, 11, 10]. This is a K-map property (adjacent cells have only one variable changing values). A REGION in the K-map is identified by two co-ordinates: the top-left corner, and bottom-right corner (note that the regions can wrap around the edges). Regions correspond to TERMS *(e.g., $ab'c$)*, which are the product of LITERALS. Literals can be a boolean variable or its complement *(e.g., a or b')*. Here is the way to find the region corresponding to a term.

- If a variable a appears in *uncomplemented* form (e.g., ab), then the region has $a = 1$ in all its cells.

- If a variable a appears in *complemented* form (e.g., ab), then the region has $a = 0$ in all its cells.

- If a variable k does not appear in the term, then the region has both cells with $k = 0$ and cells with $k = 1$.

Given a function and a term, write a program to:

- Highlight the corresponding K-map region, and

- Report whether the region is LEGAL. A legal region can consist of $1s$ and $x's$, but cannot contain any $0s$.

2   Approach

We know that for a given term, the K-map region corresponding to it will always be a rectangle with sides whose lengths are equal to some power of 2.
So we will implement the following Algorithm-

- Corresponding to the term, find out the region in which the K-map is supposed to have $1s$

- Then in the found region, check that each cell doesn't have $0s$, as $1s$ and $x's$ are valid entries

We note that there are valid regions that wrap around the grid. In such cases, we note that the *top-left* cell is not necessarily what appears to be the *top-left* visually.

To get around this, we iterate over each cell of the grid to find out the cell containing 1 that will have the largest valid region containing $1s$ for a corresponding term. We note that this is going to be a unique cell.

To check the validity of the region in the K-map, given that we have found out the largest region containing $1s$ for a given Term, we iterate over each cell in that region to make sure no cell has $0s$ in the K-map.

For example, consider a 4 variable K-map with the term as $b'd$. The 4 possible valid regions for this term are $[(1,0),(2,0)],[(1,3),(2,0)],[(2,0),(2,0)],[(2,3),(2,0)]$ as all of them will contain $1s$. Amongst these, $[(1,3),(2,0)]$ is the one having the largest area. So over this region we check that the K-map doesn't have $0s$.
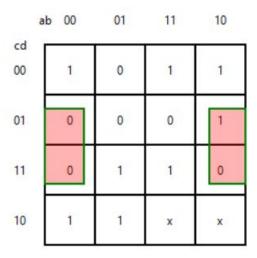

Figure 1: K-map for $b'd$

In the example above we can se that for $b'd$ the K-map is invalid as it contains $0s$ in the region $[(1,3),(2,0)]$
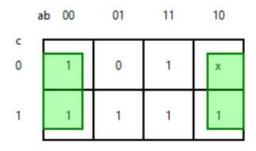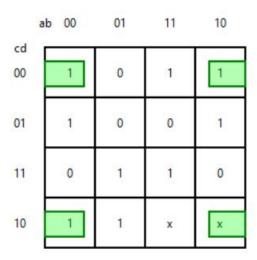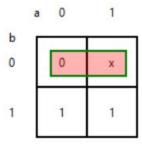
3   Test Cases

Figure 2: K-map for b'

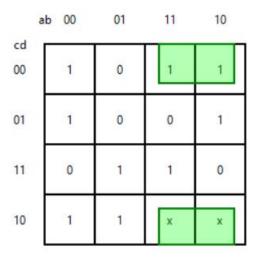Figure 3: K-map for $b'd'$

Figure 4: K-map for b'

Figure 5: K-map for ad'

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