CS 2110 Lab 6
Karnaugh maps

Your TAs :)

Fall 2018

1 Recitation Outline

1. K-maps
   (a) Setting up the K-Maps
   (b) General rules for creating groups using K-Maps
   (c) The don't cares in K-Maps
2. Example

2 K-Maps

Karnaugh maps are an easy way to take a truth table and convert it to a circuit using the least number of gates.

2.1 Set-up for a Karnaugh Map

- Karnaugh Maps are set up via gray-code, which means that only one variable changes between two adjacent cells.

	AB	AB'	A'B'	A'B
C				
C'				

	AB	A'B'	AB'	A'B
C				
C'				

2.2 General rules for K-Maps

1. We want the biggest groups with the size being a power of 2
2. We want the least number of groups
3. We can build groups with adjacent cells, including wrapping around corners. Below are two examples of groupings.

	AB	AB'	A'B'	A'B
C	1	0	0	1
C'	0	1	1	0

	AB	AB'	A'B'	A'B
C	1	0	0	1
C'	0	1	1	0

2.3 Don't Cares

- Don't cares are represented by an 'X' in the truth table. These values can either signify a '0' or a '1' whichever is most helpful in translating from k-map to boolean expression

3 Example

Suppose we wanted to build a circuit with the following truth table:

A	B	C	O
0	0	0	X
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

1. We first translate this truth table into a Karnaugh Map. Remember the Gray-Code format of K-maps!

	AB	AB'	A'B'	A'B
C	1	1	0	1
C'	0	1	X	0

2. Next, we group the 1's in groups the size of a power of 2. We can include the don't care if is helpful in creating groups.

	AB	AB'	A'B'	A'B
C	1	1	0	1
C'	0	1	X	0

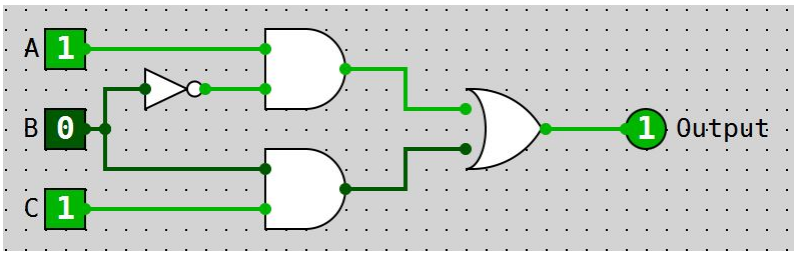
3. Now that we have outlined all of the possible groupings, we pick the biggest and least amount of groups to represent all of the ones. We can include the group with the don't care (X) if it is helpful towards this goal.

	AB	AB'	A'B'	A'B
C	1	1	0	1
C'	0	1	X	0

4. We can easily convert these groupings into a boolean expression by picking which inputs do not change in the group.

```
AB' + BC
```

5. Finally, we take this expression and convert it to a circuit.



4 Final Thought

A truth table, boolean expression, and circuitry all represent the same logical expression, just in different forms. Karnaugh maps are an easy way to convert from truth table to a boolean expression in its simplified form.