Computer Architecture
Dont Cares in Digital Circiuts
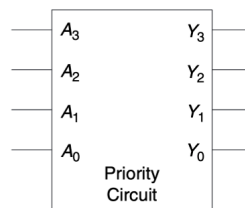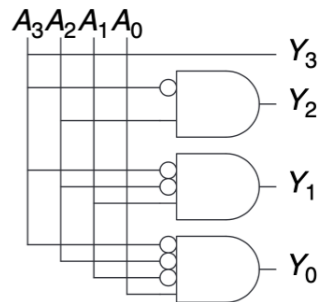
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Dont Cares

Many circuits have multiple outputs, each of which computes a separate Boolean function of the inputs When there are strong correlation among the outputs, the truth table can often be simplified with "don't care" as certain input values don't matter in some cases

Don't Care example: Priority Circuit

A_3	A_2	A_1	A_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	0
0	0	1	1	0	0	1	0
0	1	0	0	0	1	0	0
0	1	0	1	0	1	0	0
0	1	1	0	0	1	0	0
0	1	1	1	0	1	0	0
1	0	0	0	1	0	0	0
1	0	0	1	1	0	0	0
1	0	1	0	1	0	0	0
1	0	1	1	1	0	0	0
1	1	0	0	1	0	0	0
1	1	0	1	1	0	0	0
1	1	1	0	1	0	0	0
1	1	1	1	1	0	0	0

A_3	A_2	A_1	A_0	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	X	0	0	1	0
0	1	X	X	0	1	0	0
1	X	X	X	1	0	0	0

Karnaugh Map

A karnagh map is a way of simplifying boolean expressions. it was developed by Maurice Karnaugh of Bell Labs in the 1950's. the idea of the k-map is that by arranging the minterms on a grid, it makes combinable terms easier to recognize. Take another example. Note, the C, AB represent true or false

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

Y \ AB	00	01	11	10
C 0	1	0	0	0
1	1	0	0	0

Y \ AB	00	01	11	10
C 0	$\overline{A}\overline{B}\overline{C}$	$\overline{A}B\overline{C}$	$AB\overline{C}$	$A\overline{B}\overline{C}$
1	$\overline{A}\overline{B}C$	$\overline{A}BC$	ABC	$A\overline{B}C$

Y \ AB	00	01	11	10
C 0	1	0	0	0
1	1	0	0	0

values of variables, one has to fill in the karnaugh map with the corresponding boolean values. We can also use up to 4 variables from a boolean equation

Y \ AB	00	01	11	10
C 0	1	0	1	1
1	1	0	0	1

$A\overline{C}$

$Y = A\overline{C} + \overline{B}$

$\overline{B}$

Also, note that the table is 'connected' such that the going past the top goes to the bottom, and going too far left puts you as far right.
Areas that are able to be simplified are ones that are consecutive and have the same bit (dont cares are counted as 1, also, they are represented as x) Note, when combining variables in the boxes, the variables that are kept from the simplification are the ones that stay the same within the box.