Don’t care values result when certain assignments of values to variables never occur. For example,

The designer can expect that the assignments $ABCD = 1010, 1011, \ldots, 1111$ will never occur. Thus, $S_1, S_2, \ldots, \text{and } S_7$ take on don’t care values for these assignments.
Minimizing an Expression with Don’t Cares

Two Approaches

1. Find the minimal circuit for each assignment of values to the don’t cares (choose each don’t care as 0 or 1). If there are \( k \) don’t cares, there are \( 2^k \) functions (not practical for large \( d \)).

2. Enter don’t cares into Karnaugh Map and select the fewest largest circles.
Example of Approach #2

This solution “chooses” these don’t care values as 0 and these don’t care values as 1.

\[ f(A, B, C, D) = \overline{A} \overline{C} + BD \]
Two Problems

1. Minimize number of product terms
2. Minimize number of dependent variables.
Minimize number of product terms

\[ f(A, B, C, D) = B \overline{C} + AD \]
Minimize number of dependent variables

\[ f(A, B, C, D) = \overline{AB} + \overline{BD} + \overline{AD} \]

Independent of C.
Minimizing a Circuit with Don’t Cares

Two Problems

1. Minimizing the number of product terms allows for smaller AND-OR circuits. Our example minimized to 4 variables and 2 product terms. It is useful in ordinary circuits.

2. Minimizing the number of dependent variables allows for smaller memory. Our example minimized to 3 variables, so that it is useful for FPGA design.