Programming Assignment 3-2:
Two-Level Logic Minimization

Problem Descriptions:

Implement the step 2 of two-level logic minimization. Our goal is to find the **minimum** (exact minimum) sum-of-products expression for a given function.

Two-Level Logic Minimization

Step 1. Generate all prime implicants.

- Use the results from Quine-McCluskey method. (HW 3-1)

Step 2. Extract the ***minimum*** *sum-of-products* expression.

- A **minimum** sum-of-products expression is a sum of product terms which (a) has a minimum number of terms, and (b) of all those expressions with the same minimum number of terms, has a minimum number of literals.
- Use the **branch-and-bound** method.
  cost = (#term, #literal), where #term refers to the number of terms and #literal refers to the number of literals. If an expression has the minimum cost, then its cost is *lexicographically* less than or equal to the cost of any other expression, e.g., (2, 6) ≤ (3, 5).
  Search from a must (a prime is essential) to reduce the search space.

Input format:

You should allow input from a file that is generated from HW 3-1 as shown below.

$f(A,B,C,D) = \sum m(4,5,6,8,9,10,13) + \sum d(0,7,5)$.

```
.i 4            /* the function f has 4 input variables: A,B,C,D. */
.m              /* on set */
4 5 6 8 9 10 13
.d              /* don't care set */
0 7 15
.p 7            /* there are 7 prime implicants */
0-00            /* A'C'D' */
-000            /* B'C'D' */
100-            /* AB'C' */
10-0            /* AB'D'*/
01--            /* A'B */
1-01            /* AC'D */
-1-1            /* BD */
.end
```

Output format:

```
10-0            /* AB'D'*/
1-01            /* AC'D */
01--            /* A'B */
cost=(3,8)
```

Grading:

Your grade depends on the correctness, runtime, and the pruning strategy of your program. You may first compress all of the source code and execution file and then email your homework to TA before the deadline (please specify your student ID in the subject). The implementation details and your comments about this homework should be written in a simple **report** and mailed to TA together.