Problem 3.1

- A) Consider the following proposition:
 - Let L(f) be the number of literals for function f. The number of NAND2 gates required to implement f is L(f) 1.
 - Prove this proposition assuming f is a two-level logic.
 - Prove this proposition assuming f is a multi-level logic.
- B) Prove the propositions 3 and 4 on the cube-literal matrix described in the slide "Cube-Literal Matrix (3)"
- C) Compute all kernels for the function

F = abde + cde + bcdf + aef

Problem 3.2

- A) Consider the below three functions :
 - F = abde + cde + bcd + ace
 - G = abd + bce
 - H = abe + acd
 - i. Construct the cube-literal matrix
 - ii. Identify all common cubes (rectangle with $|C| \ge 2$ and $|R| \ge 2$) in the matrix
 - iii. For each extracted common cubes, compute the # of gates saved when algebraic division is applied.
 - iv. Select the common cube with the largest gate savings and apply algebraic division on the corresponding functions.
 - v. Continue the process of iii and iv until no gate savings is possible.

Problem 3.2

B) Consider the following three functions :

$$F = ad + ac + bed + bef + cf$$

$$G = ac + bce + bd + bf$$

- i. Construct the cokernel-cube matrix (use the cube indices as indicated above).
- ii. Identify all non-trivial kernel intersections (rectangle with $|C| \ge 2$ and $|R| \ge 2$) in the matrix
- iii. For each non-trivial kernel intersections, compute the # of gates saved when algebraic division is applied.
- iv. Select the non-trivial kernel intersection with the largest gate savings and apply algebraic division on the corresponding functions.
- v. Continue the process of iii and iv until no gate savings is possible.

Problem 3.3 (extra-credit)

Write a program which computes all kernels for a given function

- i. Input function is to be given as a set of cubes in cube-literal matrix.
- ii. Input functions are to be given as a set of cubes in cube-literal matrix.
- iii. Display the kernels in the form of cube-literal matrices. Also, if possible, display the input function and its kernels in equation form (Each literal corresponding to the column of the cube-literal matrix could be merely labeled as a, b, c, d, ...)