Chapter 1

Combinational Circuits as Basic Building Blocks for AI

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1.   INTRODUCTION

Overall Digital systems are categorized into two types of logic circuits:

(1)   Combinational logic circuits.

(2)   Sequential logic circuits.

When output depends upon the present state of inputs then it is known as combinational circuits. Logic gates (AOI i.e., AND, OR, NOT/INVERTER) are the basic building blocks to design different combinational circuits and for AI hardware they act as fundamental building blocks. AI accelerators such as GPUs and TPUs are used for deep learning in order to perform core AI tasks. Examples of Combinational circuits are adders and subtractors (Arithmetic circuits), multiplexers (MUX) and demultiplexers (DEMUX) (for data selection and distribution), magnitude comparator etc. For complex AI models the design of a combinational circuit depends on the type of circuit to be designed with specified inputs and outputs. Thus, different IC's are used for more complex combinational circuits. Block diagram representation of a typical combinational circuit is as shown
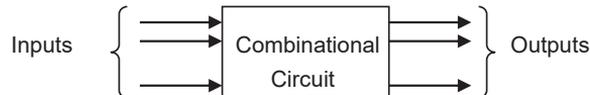

Fig. 1. Typical Combinational Circuit.

The binary bits are used as inputs and each output is expressed by different Boolean expressions.

2.   DESIGNING STEPS FOR TYPICAL COMBINATIONAL LOGIC CIRCUIT

1. Following steps are required for the designing of a typical combinational logic circuit
2. Write the statement of the problem for which circuit to be designed.
3. Identify the input and output variables for the logic design/circuit to be implemented.
4. To Calculate the relationship between input and output variables.
5. Write the truth table for the circuit to be designed.
6. For design logic find out the output variables with Boolean expression of each input variables.
7. Find out the minimized expressions using any of the minimization technique.