

## Programmable Logic Devices

- Most of the circuits presented so far are available on a TTL IC chip. Circuits can be constructed using these chips and wiring them together
- An alternative to this method would be to program all the components into a single chip, saving wiring, space and power
- One type of such device is PLA (Programmable Logic Array) that contains one or more and/or arrays.

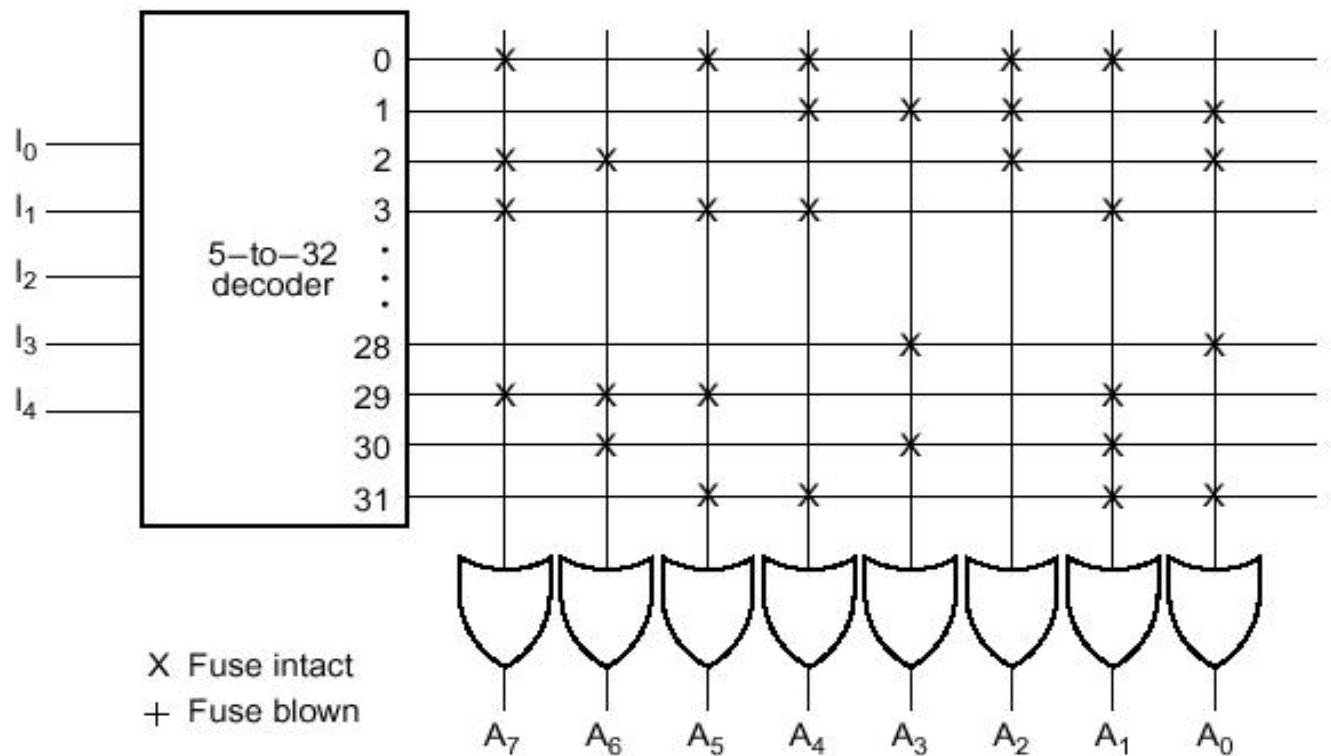
## Programmable Logic Devices (PLDs)

- **Standard** logic devices that can be **programmed** to implement any combinational logic circuit.
- **Standard** à of regular structure
- **Programmed** à refers to a hardware process used to specify the logic that a PLD implements

## Types of PLDs

DEVICE	AND-ARRAY	OR-ARRAY
PROM	Fixed	Programmabl
PLA	Programmabl	Programmabl
PAL	Programmabl	Fixed

## Programming the ROM



Example: Let  $I_0I_1I_3I_4 = 00010$  (address 2). Then, output 2 of the decoder will be 1, the remaining outputs will be 0, and ROM output becomes  $A_7A_6A_5A_4A_3A_2A_1A_0 = 11000101$ .

## Programmable Logic Arrays (PLAs)

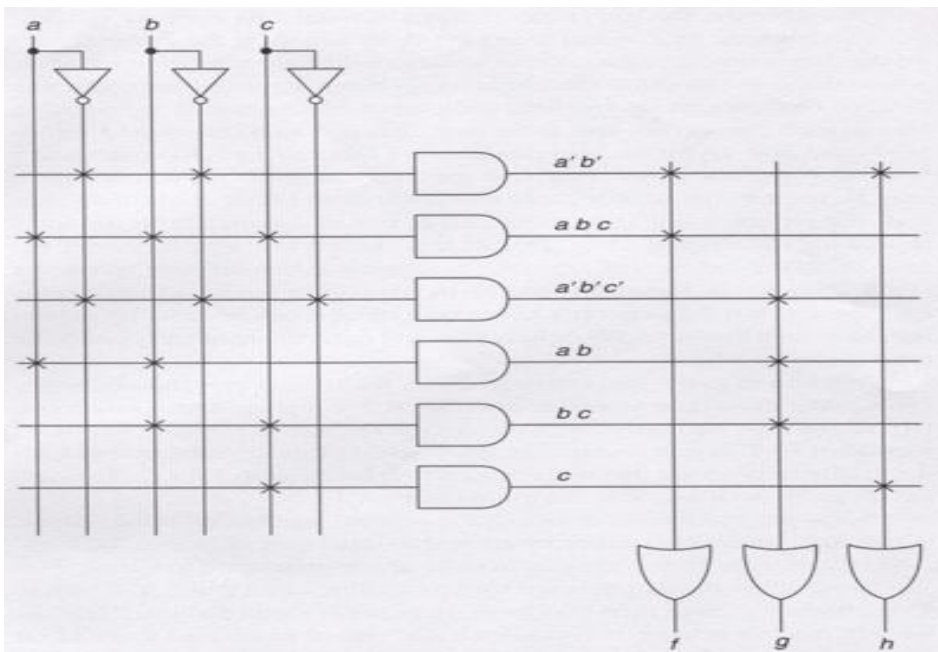
- Similar concept as in PROM, except that a PLA does not necessarily generate all possible minterms (ie. the decoder is not used).

- More precisely, in PLAs both the AND and OR arrays can be programmed (in PROM, the AND array is fixed – the decoder – and only the OR array can be programmed).

## PLA Example

- $f(a,b,c) = a'b' + abc$
- $g(a,b,c) = a'b'c' + ab + bc$
- $h(a,b,c) = c$

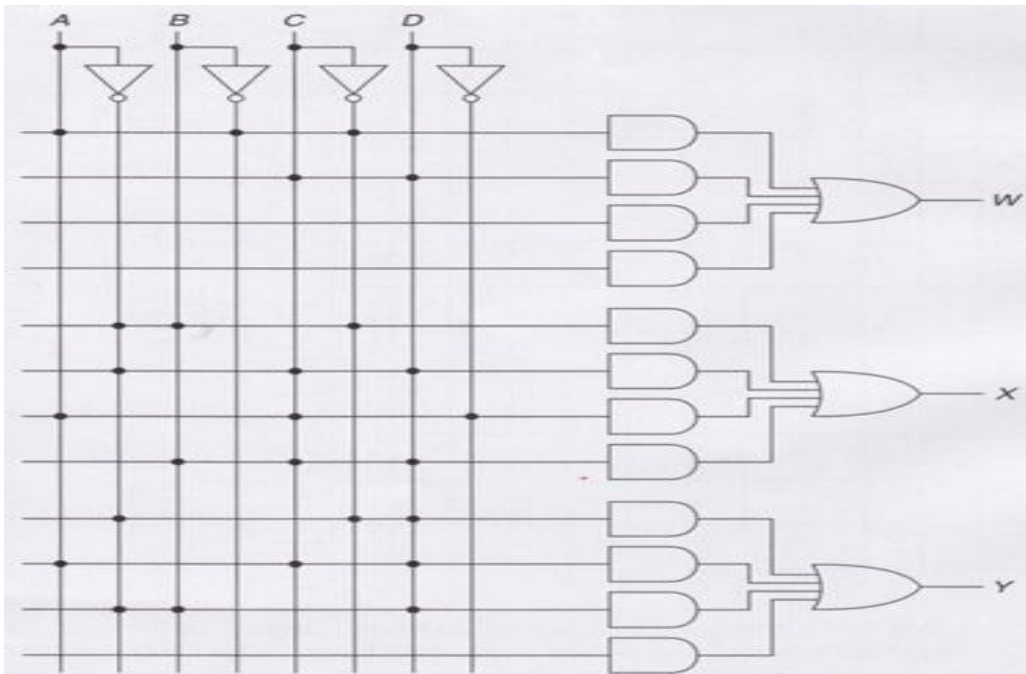
PLAs can be more compact implementations than ROMs, since they can benefit from minimizing the number of products required to implement a function



## Programmable Array Logic (PAL)

- OR plane (array) is fixed, AND plane can be programmed
- Less flexible than PLA
- Number of product terms available per function (OR outputs) is limited

### PAL-based circuit implementation



$$W = AB'C' + CD$$

$$X = A'BC' + A'CD + ACD' + BCD$$

$$Y = A'C'D' + ACD + A'BD$$

