

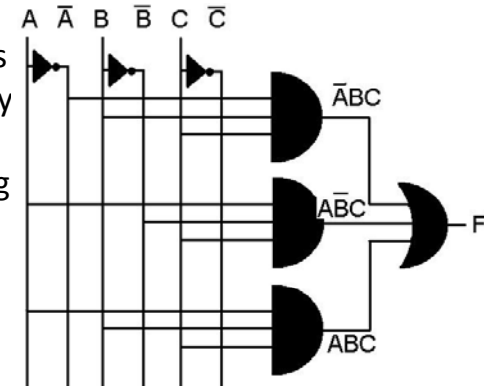
# Logic Arrays

COMP370

Intro to Computer Architecture

## Normal Structure

- A sum of products equation is usually implemented by AND gates feeding into OR gates.

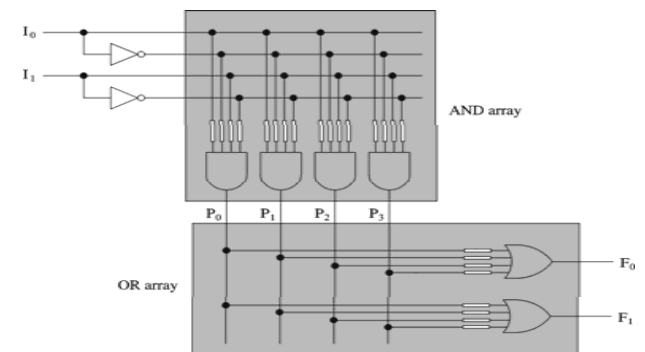


## Programmable Logic Array

- A Programmable Logic Array (PLA) consists of an array of AND gates and an array of OR gates.
- The inputs connect to the AND gates.
- The output of the AND gates connect to the inputs of the OR gates.
- Designers can use a PLA instead of many separate AND and OR gates.

## Programmable Logic Array

- Two input, two output PLA



## Programming

- Many PLAs are One Time Programmable (OTP)
- Each input to the AND gates goes through a “fuse” that can be permanently broken or blown.
- If the fuse is broken, that input value does not go to that AND gate.
- The OR gate inputs also go through a set of fuses.

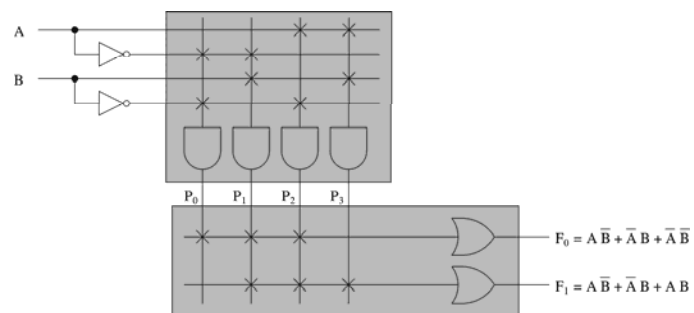
## PLA unit



- Manufacturers can build PLA devices that designers can use instead of building from simple gates.
- A PLA programming device can permanently break fuses to implement the desired logic circuit.

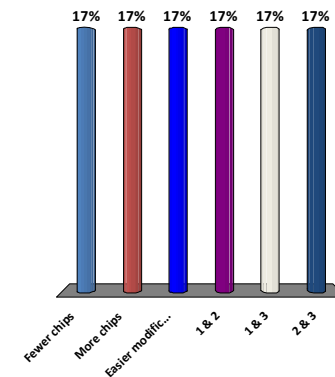
## Example Problem

- Consider the gates to implement
- $F_0 = AB' + A'B + A'B'$
- $F_1 = AB' + A'B + AB$



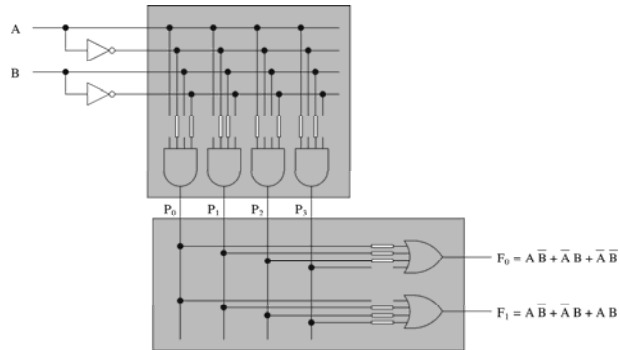
## Advantages of using PLAs are

1. Fewer chips
2. More chips
3. Easier modification
4. 1 & 2
5. 1 & 3
6. 2 & 3



## Example Implementation

- Breaking the appropriate fuses implements the circuits.



## PLA Program

- Using the PLA worksheet, show the fuses that would have to be broken to implement

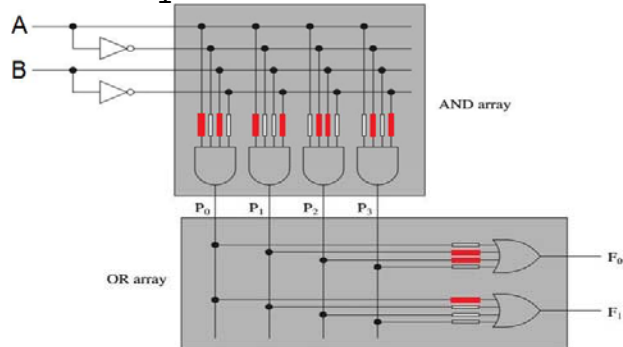
$$F^0 = AB + A'B'$$

$$F_1 = A'B + AB + AB'$$

## PLA Program

$$F^0 = AB + A'B'$$

$$F_1 = A'B + AB + AB'$$



## PLA Program

- Using the PLA worksheet, show the fuses that would have to be broken to implement

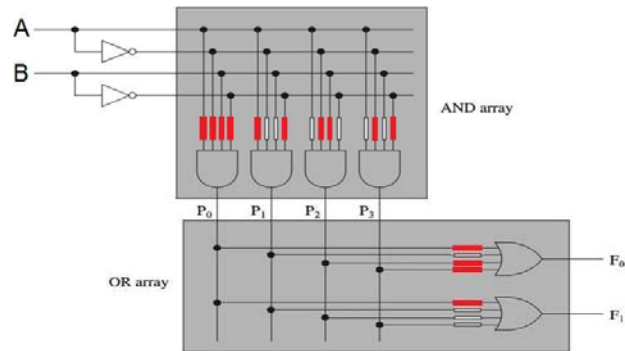
$$F^0 = AB'$$

$$F_1 = A'B + AB + AB'$$

## PLA Program

$$F_0 = AB'$$

$$F_1 = A'B + AB + AB'$$



## PLA Program

- Using the PLA worksheet, show the fuses that would have to be broken to implement

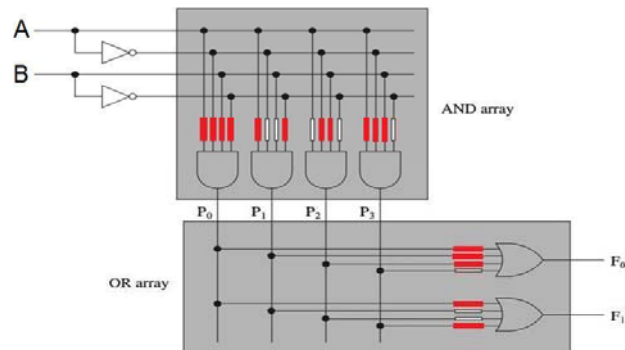
$$F_0 = B'$$

$$F_1 = A'B + AB'$$

## PLA Program

$$F_0 = B'$$

$$F_1 = A'B + AB'$$

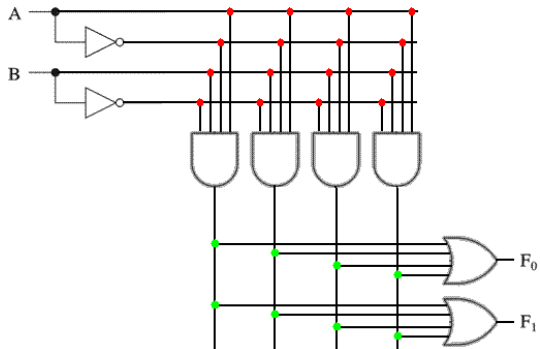


## Field Programmable

- A PLA with fuses can be programmed only once.
- Instead of using fuses as a permanent switch, a transistor can be used.
- The input to the transistor gate can come from an array of memory.
- Setting the memory controls the function being implemented by the gates.

## Field Programmable Gate Array

- Each switch (red and green dots) could be connected to a memory controlling the switch.



## Fire Alarm

- Consider a fire alarm system with 5 sensors.
- Each sensor sends a “true” or 1 signal if it detects a fire. Otherwise it is “false” or 0.
- An alarm sounds if its input is “true” or 1.
- A silence toggle switch output is true or false.
- The alarm must sound if any sensor detects a fire unless the silence button is set.
- Draw a logic circuit for the fire alarm.