Logic Arrays

COMP370
Intro to Computer Architecture

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.

Normal Structure

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

\[ F_0 = AB' \]
\[ F_1 = A'B + AB + AB' \]

PLA Program

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

\[ F_0 = B' \]
\[ F_1 = A'B + AB' \]

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.