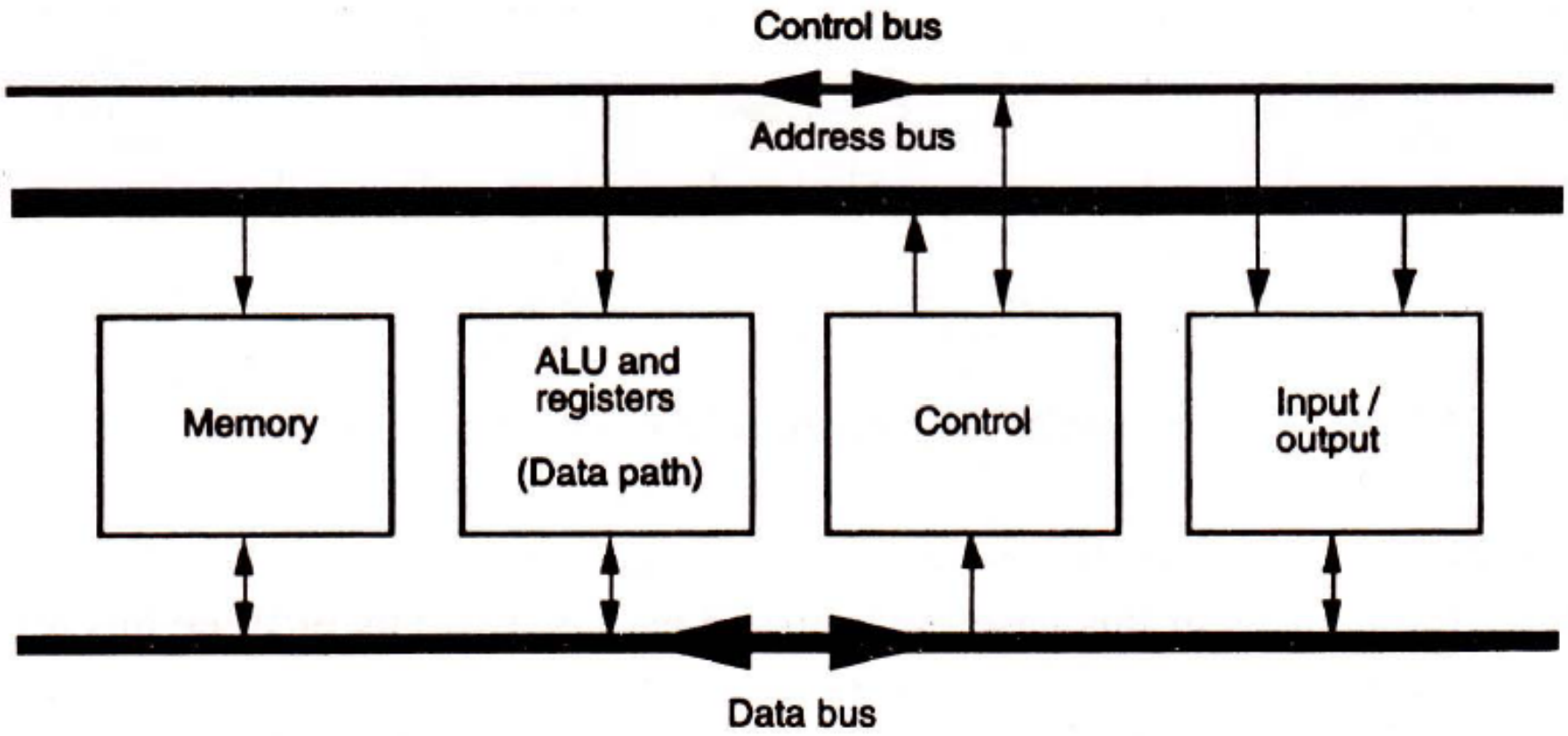
Design Example

4-bft Arithmetic Processor

- The 4-bit microprocessor has been chosen as a design example because it is particularly suitable for illustrating the design and interconnection of common architectural blocks.


Control bus
Address bus
Memory
ALU and registers
(Data path)
Control
Input / output
Data bus

- Metal can cross polysilicon or diffusion without any significant effect
- Wherever polysilicon crosses diffusion a transistor will be formed. This includes the second polysilicon layer for processes that have two.
- Wherever lines touch on the same level an interconnection is formed.
- Simple contacts can be used to join diffusion or polysilicon to metal.
- To join diffusion and polysilicon we must use either a buried contact or a butting contact (in which case all three layers are joined together at the contact) or two contacts, diffusion to metal then metal to polysilicon.
- In some processes, a second metal layer is available. This can cross over any other layers and is conveniently employed for power rails.
- First and second metal layers may be joined using a *via.*
- Each layer has particular electrical properties which must be taken into account.
- For CMOS layouts, p- and n-diffusion wires must not directly join each other, nor may they cross either a p-well or an n-well boundary.

Carry look ahead adder

- We have considered some other methods of improving adder throughput time and may now turn to algebra to seek a general solution to this problem. This is to be found in rearranging the expressions for the adder

$$C_k = A_k B_k + H_k . C_{k-1}$$

$$C_k = A_k . B_k + (A_k + B_k) . C_{k-1}$$

$$c_k = g_k + p_k \cdot g_{k-1} + p_k \cdot p_{k-1} g_{k-2} + \ldots\ldots + p_k \ldots\ldots p_1 \cdot g_0 + p_k \ldots\ldots p_0 \cdot c_{in}$$

$$c_0 = g_0 + p_0 \cdot c_{in}$$

$$c_1 = g_1 + p_1 \cdot g_0 + p_1 \cdot p_0 \cdot c_{in}$$

$$c_2 = g_2 + p_2 \cdot g_1 + p_2 \cdot p_1 \cdot g_0 + p_2 \cdot p_1 \cdot p_0 \cdot c_{in}$$

$$c_3 = g_3 + p_3 \cdot g_2 + p_3 \cdot p_2 \cdot g_1 + p_3 \cdot p_2 \cdot p_1 \cdot g_0 + p_3 \cdot p_2 \cdot p_1 \cdot p_0 \cdot c_{in}$$