

Chapter 05: Basic Processing Units ...

Control Unit Design Organization

Lesson 14:

Microprogrammed Control

Objective

- Understand the design of microprogrammed control unit to generate all sequences of the control signals using a control memory
- Learn how the control memory stores at successive addresses the data for generating the control signal values 0 or 1 stored at each address and generates the sequences by address changes from the start address to end address
- Learn how the start address for generating the control signals depend on the instruction at ID

Microprogram concept

Microprogram concept

- Hardware, with a large number of logic gates, does not directly execute an instruction
- Instead, the hardware executes very simple set of micro-operations called microinstructions
- Each instruction specifies a sequence of micro-operations that are used to implement the instruction

Microprogram concept

- Each instruction translated into a short program of microinstructions by the hardware; similar to the way a compiler translates each instruction in a high-level language program into a sequence of assembly-language instructions

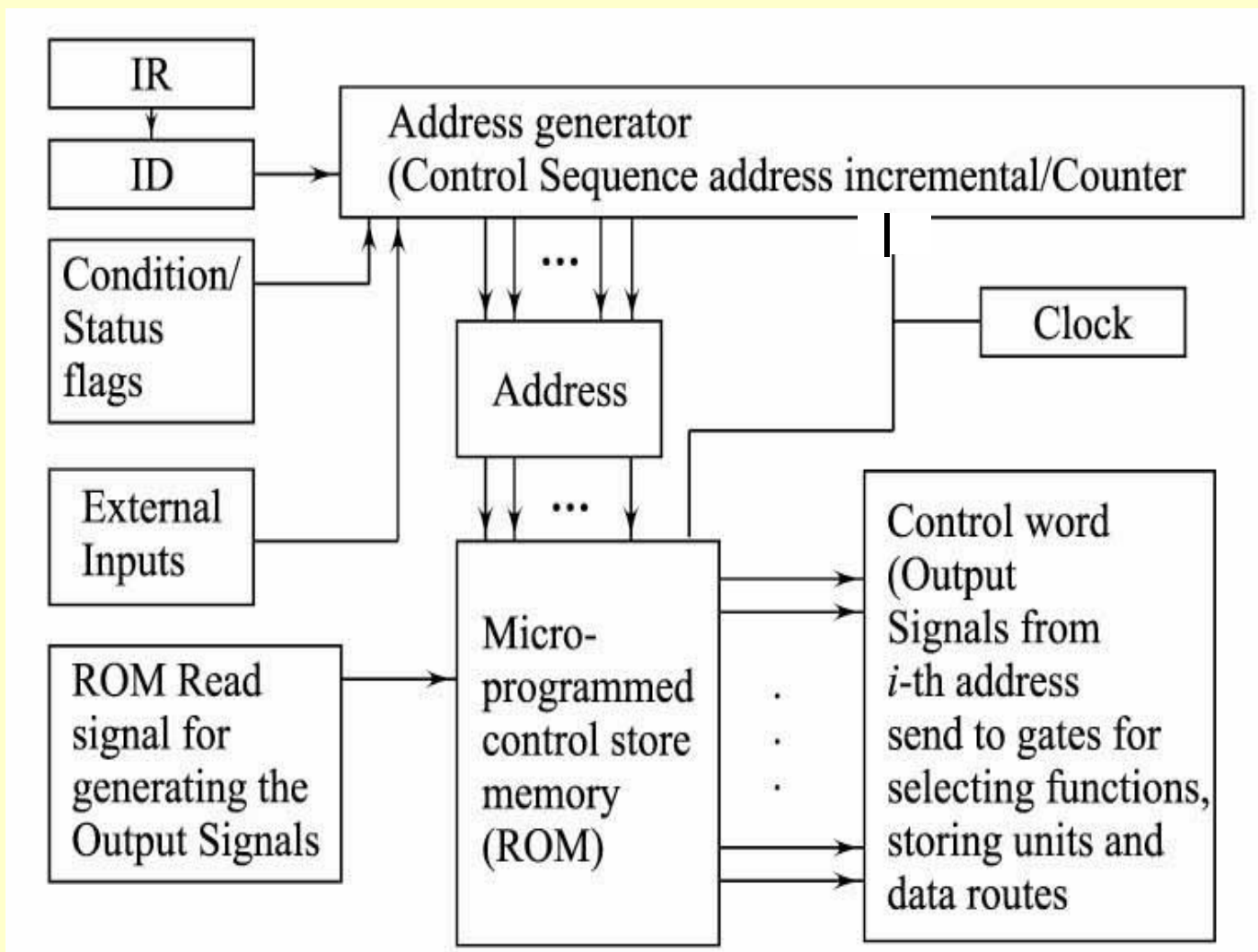
Microprogrammed control execution

- Microprogrammed control memory generates a set of outputs for a given set of microinstructions (set of control-Signal sequences) stored in that

Microprogrammed control execution

- Using microprogramming, architects could build simple hardware and then microprogram that hardware to execute complex instructions
- Requirement of limited the amount of hardware that could be built into the processor
- Enables design of instruction sets with complex instructions at the reduced total number of microinstructions required to implement a program

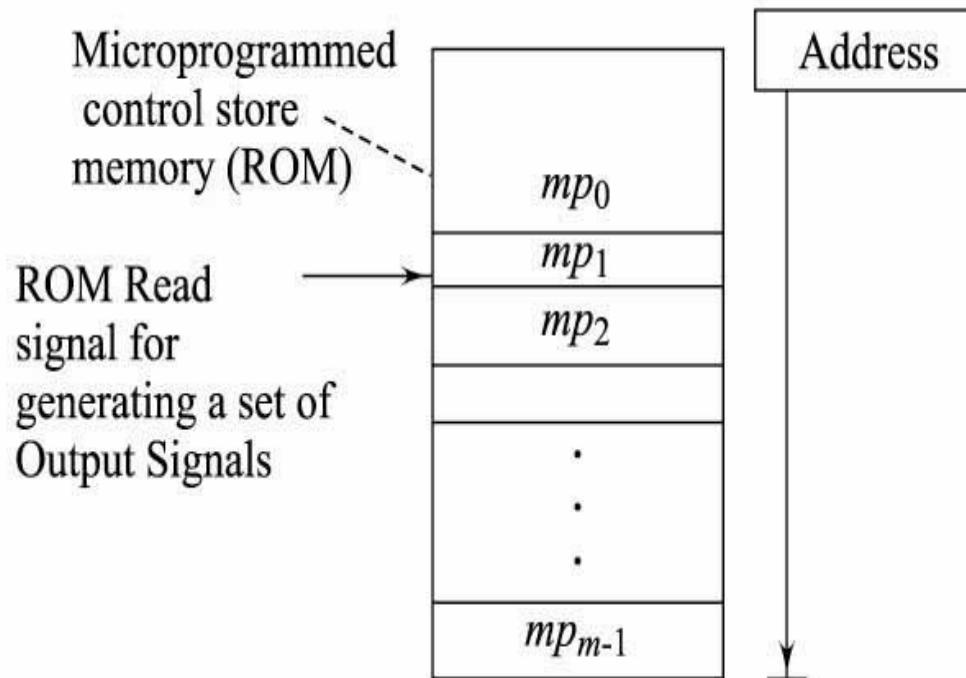
Microprogrammed Control Unit organization



Organization of control store memory

- m -distinct instructions from I_0 to I_{m-1} , there are m -distinct microprograms stored in memory mp_0 to mp_{m-1} , each having a distinct start address
- To execute an instruction, a microprogrammed processor accesses this memory to locate the set of microinstructions required to implement the instruction, I_i at the ID and then execute the microinstructions mp_i for I_i in a sequence of addresses from the start address

m -instruction processor having m -sets of inputs and m -microprograms stored at control ROM distinct start addresses



Use of Control memory in place of hardwired control

- Hardware, with a large number of logic gates, does not directly execute an instruction
- Instead, the hardware executes very simple micro-operations
- Each instruction specifies a sequence of micro-operations that are used to implement the instruction
- Each instruction translated into a short program of microinstructions by the hardware; similar to the way a compiler translates each instruction in a high-level language program into a sequence of assembly-language instructions

Use of Control memory in place of hardwired control

- Hardware, with a large number of logic gates, does not directly execute an instruction
- Instead, the hardware executes very simple micro-operations
- Each instruction specifies a sequence of micro-operations that are used to implement the instruction
- Each instruction translated into a short program of microinstructions by the hardware; similar to the way a compiler translates each instruction in a high-level language program into a sequence of assembly-language instructions

Summary

We Learnt

- Micro-programmed control using control memory
- Starting address of a microprogram as per ID output
- m -distinct instructions from I_0 to I_{m-1} , there are m -distinct microprograms stored in memory mp_0 to mp_{m-1} , each having a distinct start address

We Learnt

- Steps implement by outputs of control ROM from a microprogram start address to end address
- Requires simpler hardware to implement a complex instruction set

End of Lesson 14 on
Microprogrammed Control