VIT-AP UNIVERSITY

ECE-2002 Computer Organization and Architecture

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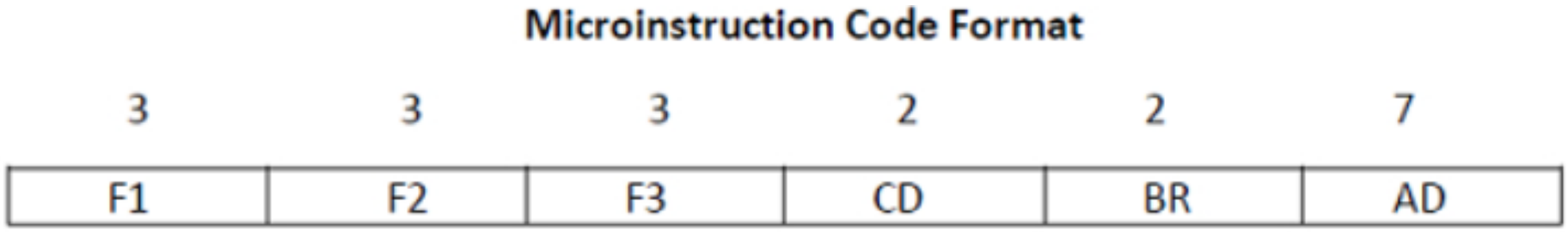
Micro Program

- A program is a set of instructions. An instruction requires a set of micro-operations.
- Micro-operations are performed using control signals.
- Instead of generating the control signals by hardware, here, these control signals are generated using micro-instructions.
- This means every instruction requires a set of micro-instructions
- A set of micro-instructions are called micro-program.
- Microprograms for all instructions are stored in a small memory called control memory.
- The control memory is present inside the processor.

Micro-Instructions

- A microinstruction format includes 20 bits in total.

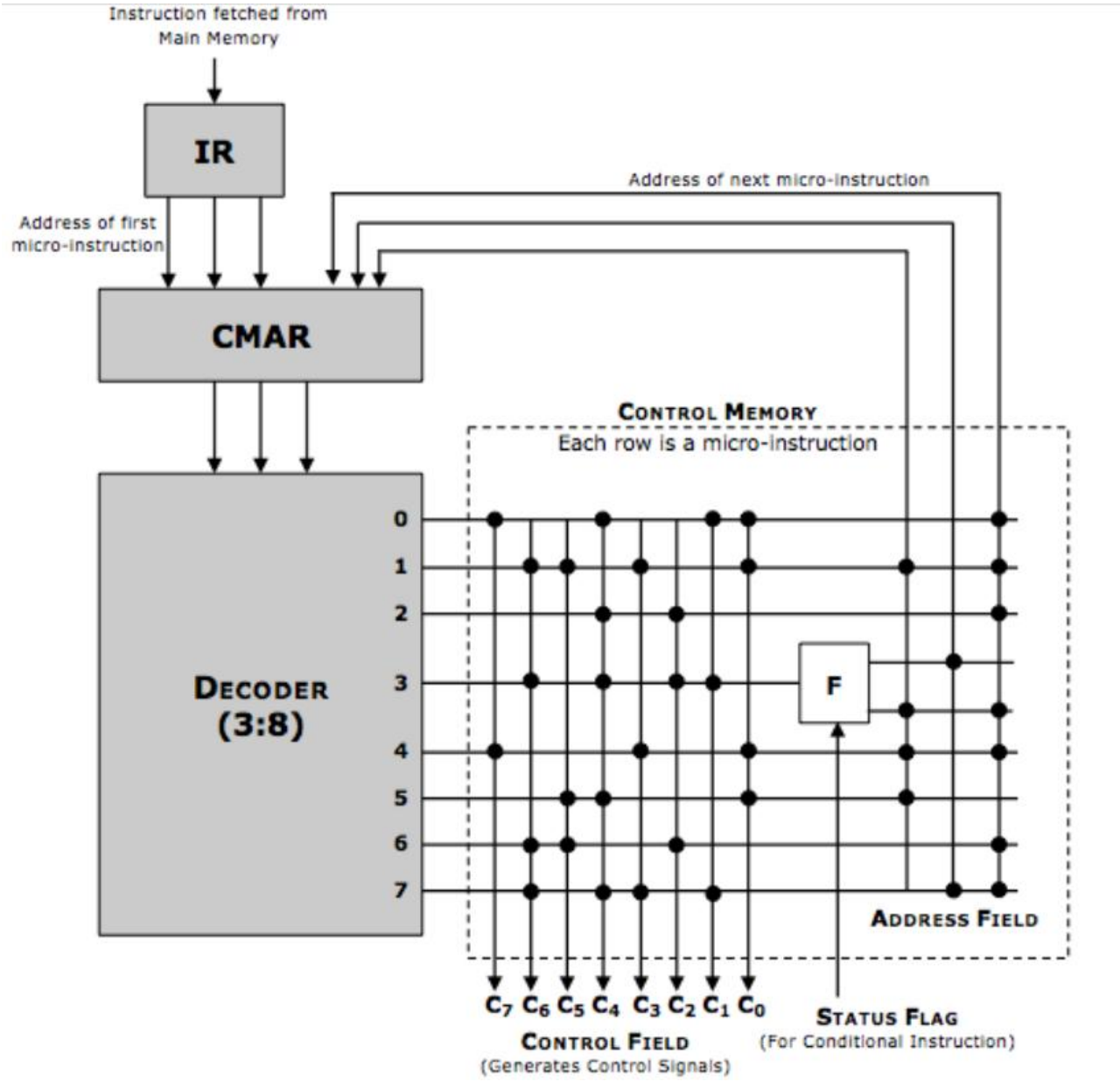


- F1, F2, F3 are the micro-operation fields. They determine micro-operations for the computer.
- CD is the condition for branching. They choose the status bit conditions.
- BR is the branch field. It determines the type of branch.
- AD is the address field. It includes the address field whose length is 7 bits.

*Each microinstruction can have only three micro-operations, one from each field.

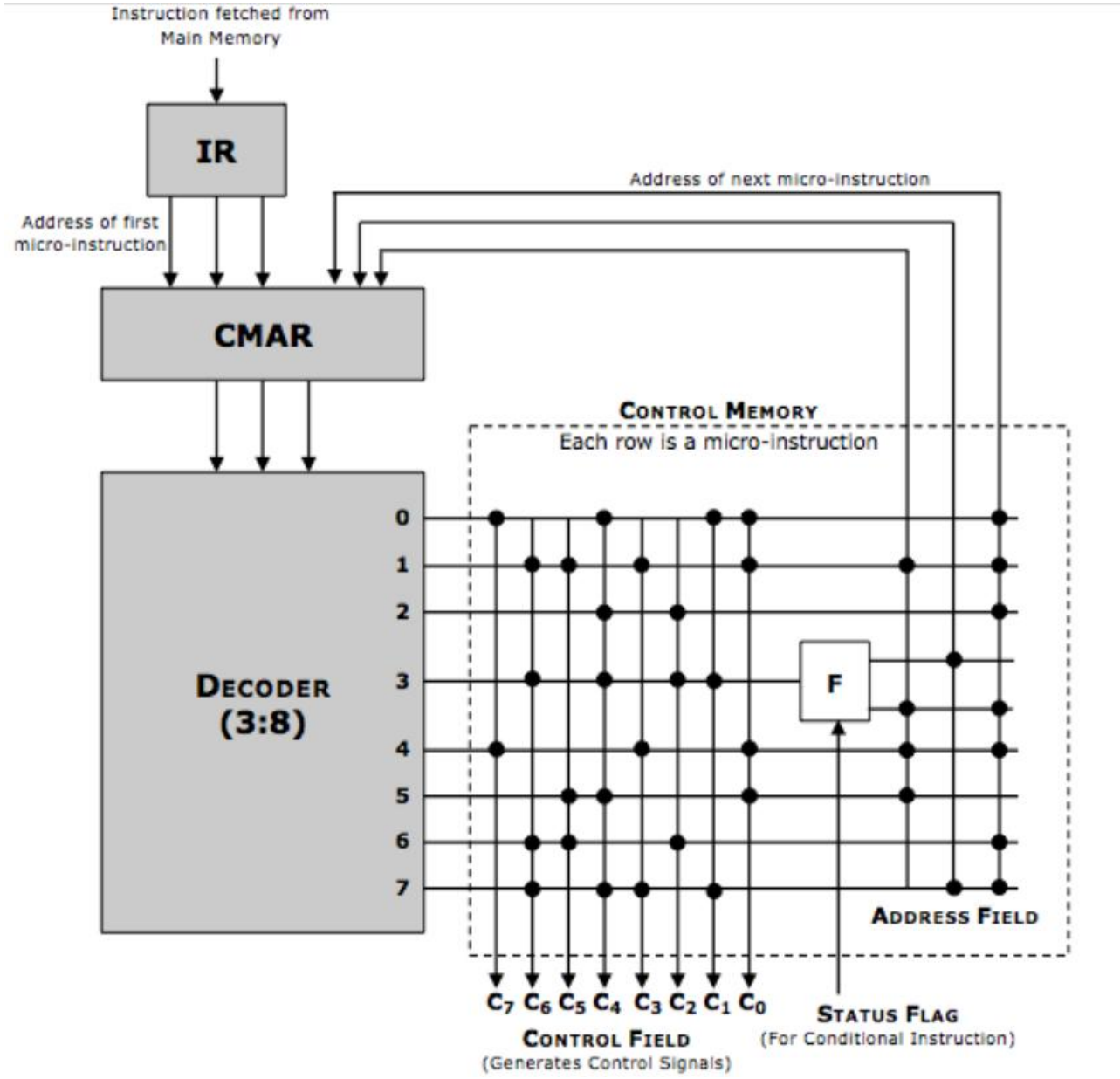
Wilkes' Design for Micro programmed Control Unit

- Consider an instruction fetched from the main memory into the Instruction Register (IR).
- The processor uses opcode to identify the address of the first micro-instruction.
- That address is loaded into CMAR (Control Memory Address Register).
- CMAR passes the address to decoder.



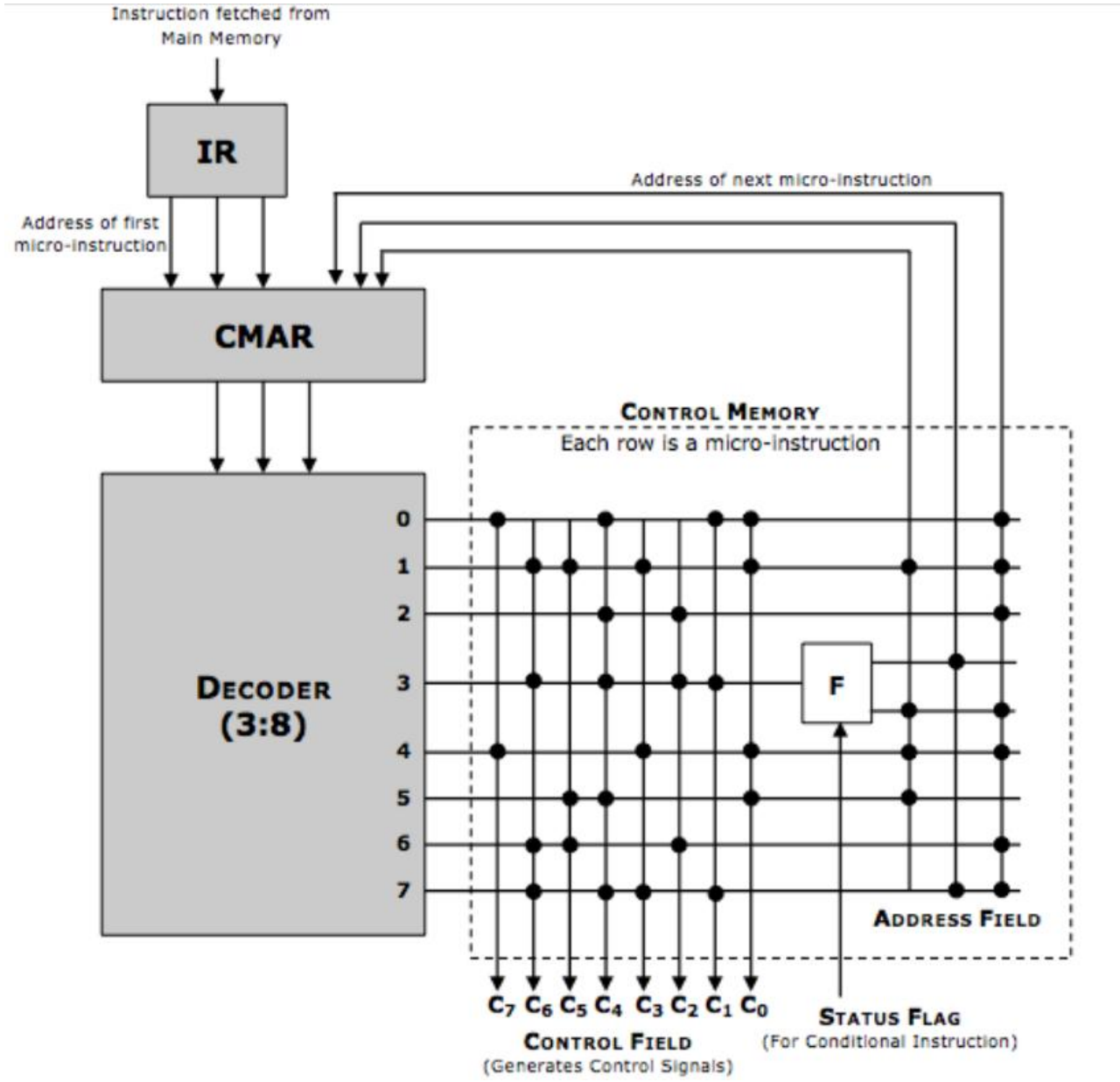
Wilkes' Design for Micro programmed Control Unit

- The decoder identifies the corresponding microinstruction from the control memory.
- A microinstruction has two fields: Control field and Address field.
- Control field: indicates the control signal to be generated.
- Address field: indicates the address of the next microinstruction
- This address is further loaded into CMAR to fetch the next instruction.



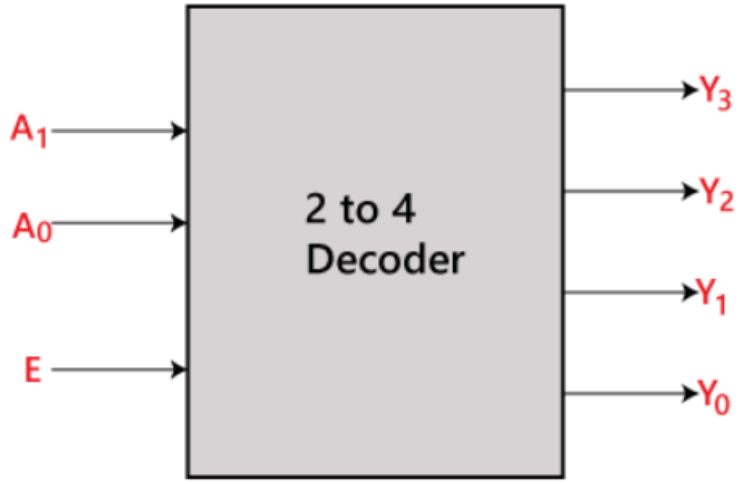
Wilkes' Design for Micro programmed Control Unit

- For a conditional microinstruction, there are two address fields, as the address of the next microinstruction depends on the condition (true or false).



Decoder

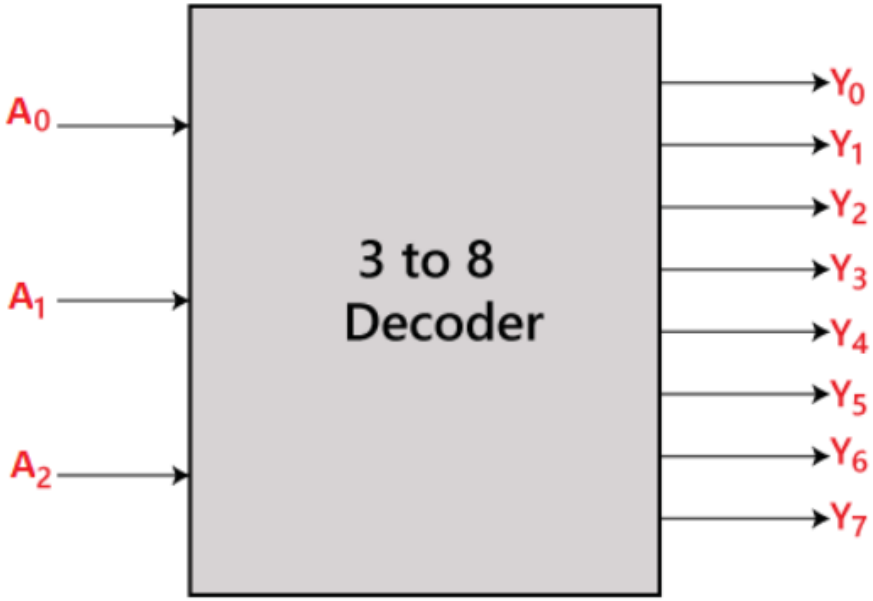
- Decoder: n binary inputs and 2^n binary outputs
- In the 2 to 4 line decoder, there is a total of three inputs, i.e., A_0, and A_1 and E and four outputs, i.e., Y_0, Y_1, Y_2, and Y_3. For each combination of inputs, when the enable 'E' is set to 1, one of these four outputs will be 1.



Enable	INPUTS		OUTPUTS			
E	A_1	A_0	Y_3	Y_2	Y_1	Y_0
0	X	X	0	0	0	0
1	0	0	0	0	0	1
1	0	1	0	0	1	0
1	1	0	0	1	0	0
1	1	1	1	0	0	0

Decoder

- In a 3 to 8 line decoder, there is a total of eight outputs, i.e., Y0, Y1, Y2, Y3, Y4, Y5, Y6, and Y7 and three inputs, i.e., A0, A1, and A2.



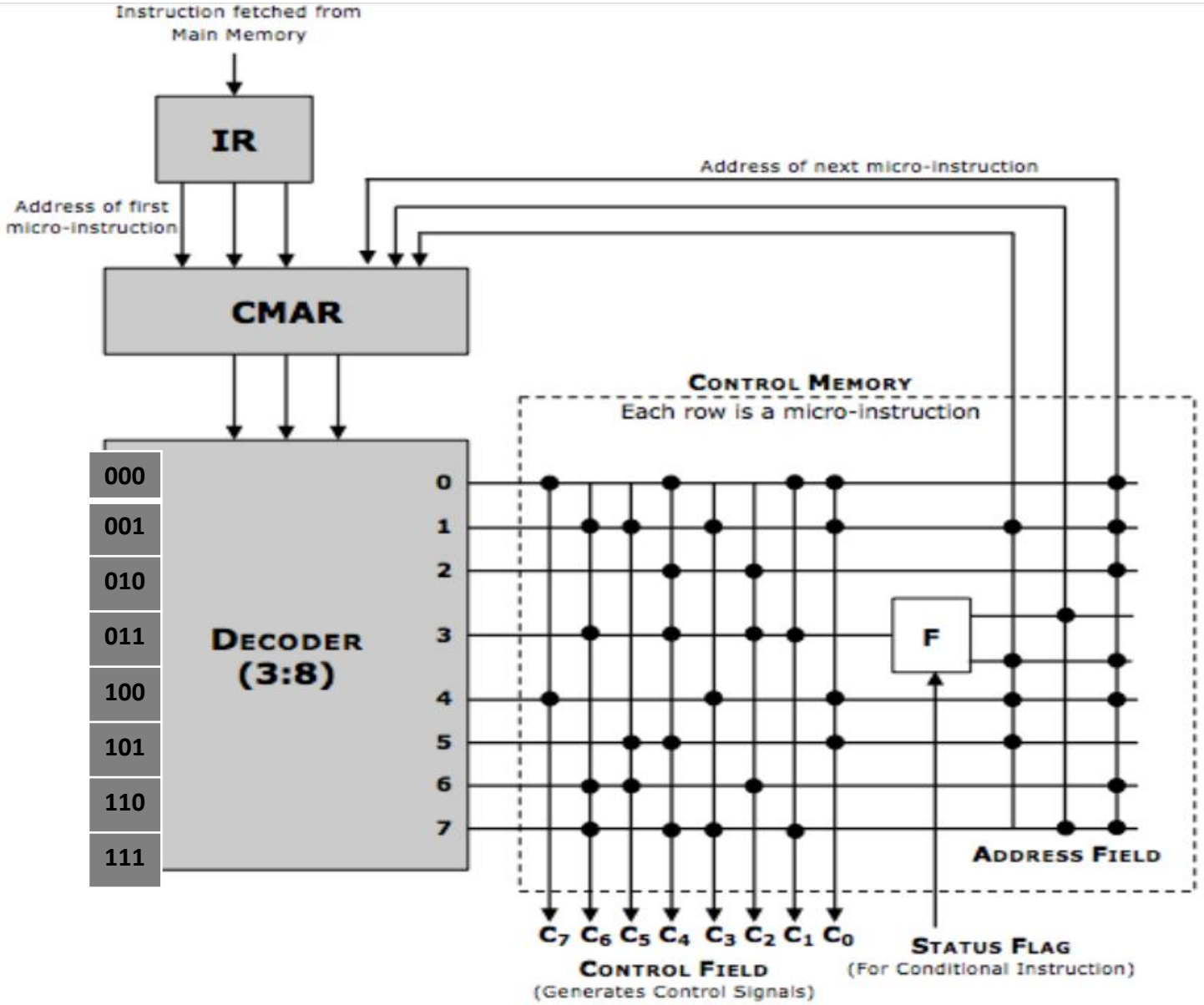
Enable	INPUTS			Outputs							
E	A_2	A_1	A_0	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
0	x	x	x	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0	0	0	1	0
1	0	1	0	0	0	0	0	0	1	0	0
1	0	1	1	0	0	0	0	1	0	0	0
1	1	0	0	0	0	0	1	0	0	0	0
1	1	0	1	0	0	1	0	0	0	0	0
1	1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	1	0	0	0	0	0	0	0

Decoder

- In the 4 to 16 line decoder, there is a total of 16 outputs, i.e., Y_0, Y_1, Y_2,……, Y_{16} and four inputs, i.e., A_0, A1, A_2, and A_3.

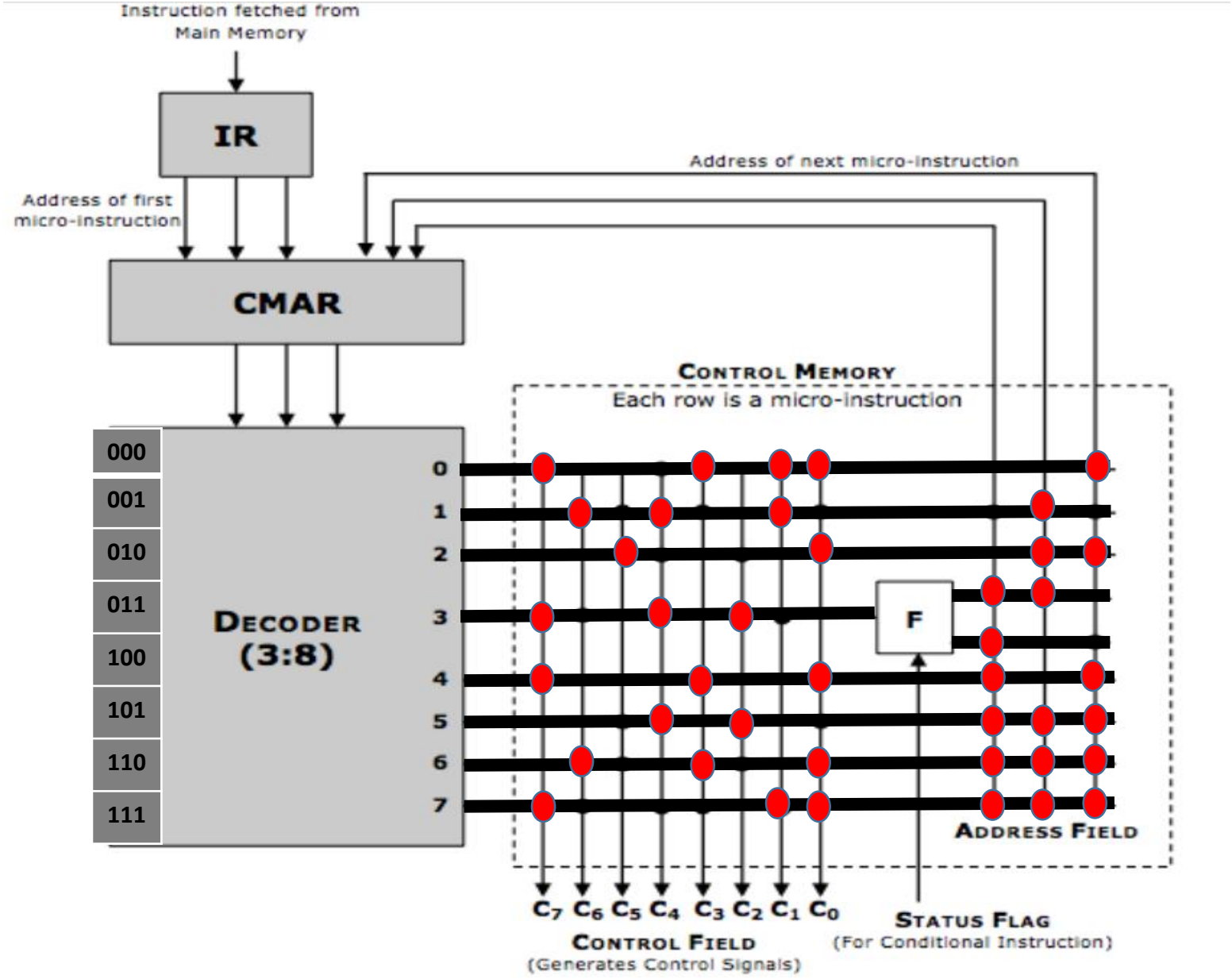
INPUTS				OUTPUTS															
A_3	A_2	A_1	A_0	Y_{15}	Y_{14}	Y_{13}	Y_{12}	Y_{11}	Y_{10}	Y_9	Y_8	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Wilkes' Design for Micro programmed Control Unit



Address of current instruction	Control signal	Address of next instruction
000	C0, C1, C4, C7	001
001	C0, C3, C5, C6	101
010	C2, C4	001
011	C1, C2, C4, C6	010/101
100	C0, C3, C7	101
101	C0, C4, C5	100
110	C2, C5, C6	001
111	C1, C3, C4, C6	011

Wilkes' Design for Micro programmed Control Unit



Address of current instruction	Control signal	Address of next instruction
000		
001		
010		
011		
100		
101		
110		
111		