

Computer Architecture

A Generic CPU - 4

Dr. Masood Mir

Week 7

The Control Word

- Lets continue from the last diagram we discussed and see how the control variables select the microoperations for the datapath.
- Figure 8-10 shows a generic datapath unit. The selection variables control the addresses for the data read from the register file, the function performed by the function unit, and the data loaded into the register file, as well as the selection of external data.
- A block diagram of a datapath that is a specific version of the datapath in Figure 8-10 is shown in next slide.
- It has a register file with eight registers, R0 through R7.
- The register file provides the inputs to the function unit through Bus A and Bus B.
- MUX B selects between constant values on Constant in and register values on B data.

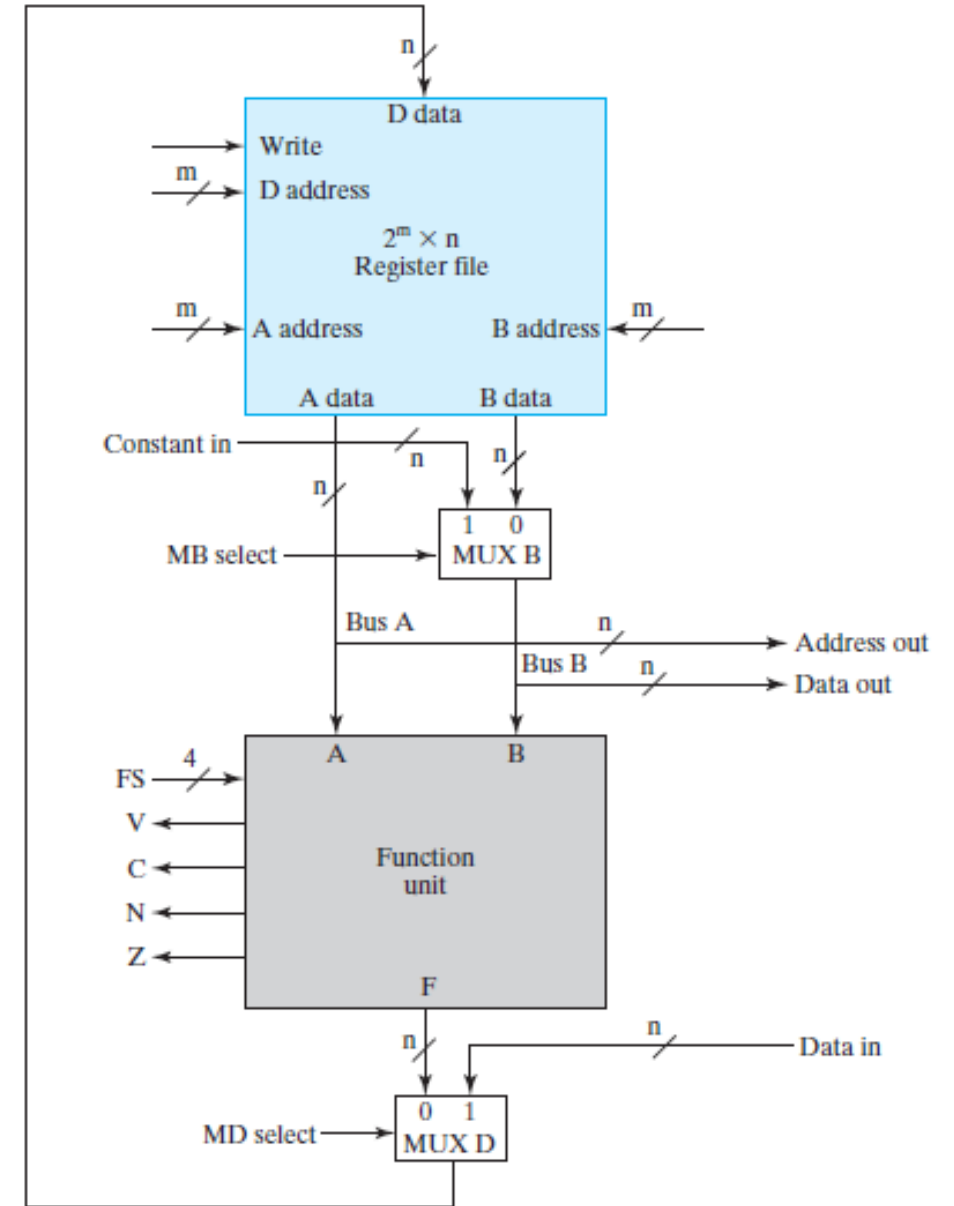
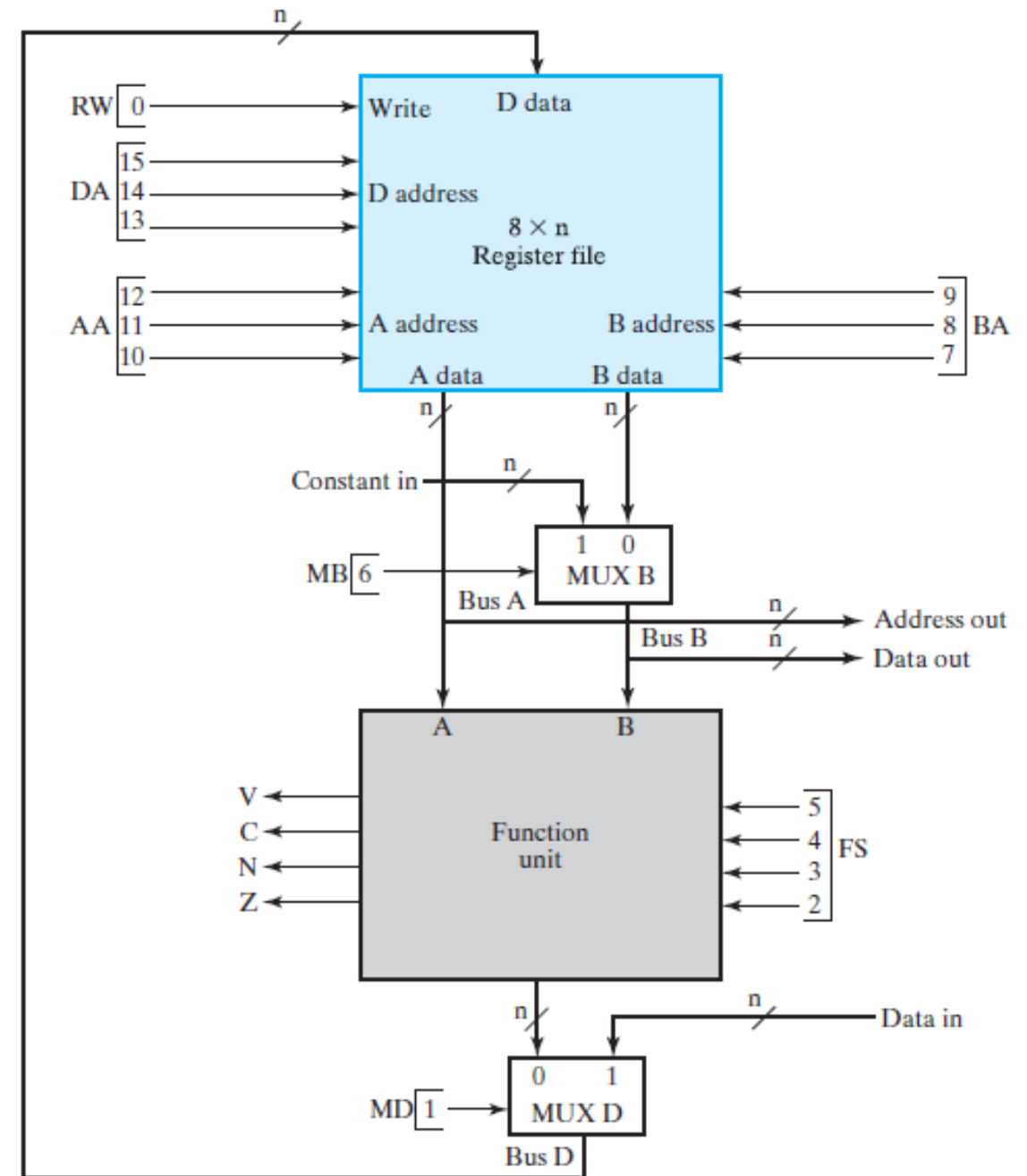


FIGURE 8-10
Block Diagram of Datapath Using the Register File and Function Unit

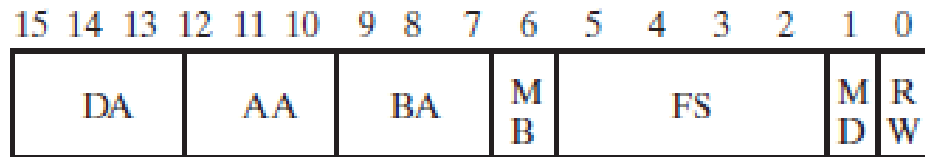
The Control Word

- The ALU and zero-detection logic within the function unit generate the binary data for the four status bits: V (overflow), C (carry), N (sign), and Z (zero).
- MUX D selects the function unit output or the data on Data in as input for the register file.
- There are 16 binary control inputs. Their combined values specify a control word.
- The Control Word consists of seven parts called fields, each designated by a pair of letters.
- The three register fields are three bits each.
- The three bits of DA select one of eight destination registers for the result of the microoperation.
- The three bits of AA select one of eight source registers for the Bus A input to the ALU.
- The three bits of BA select a source register for the 0 input of the MUX B.

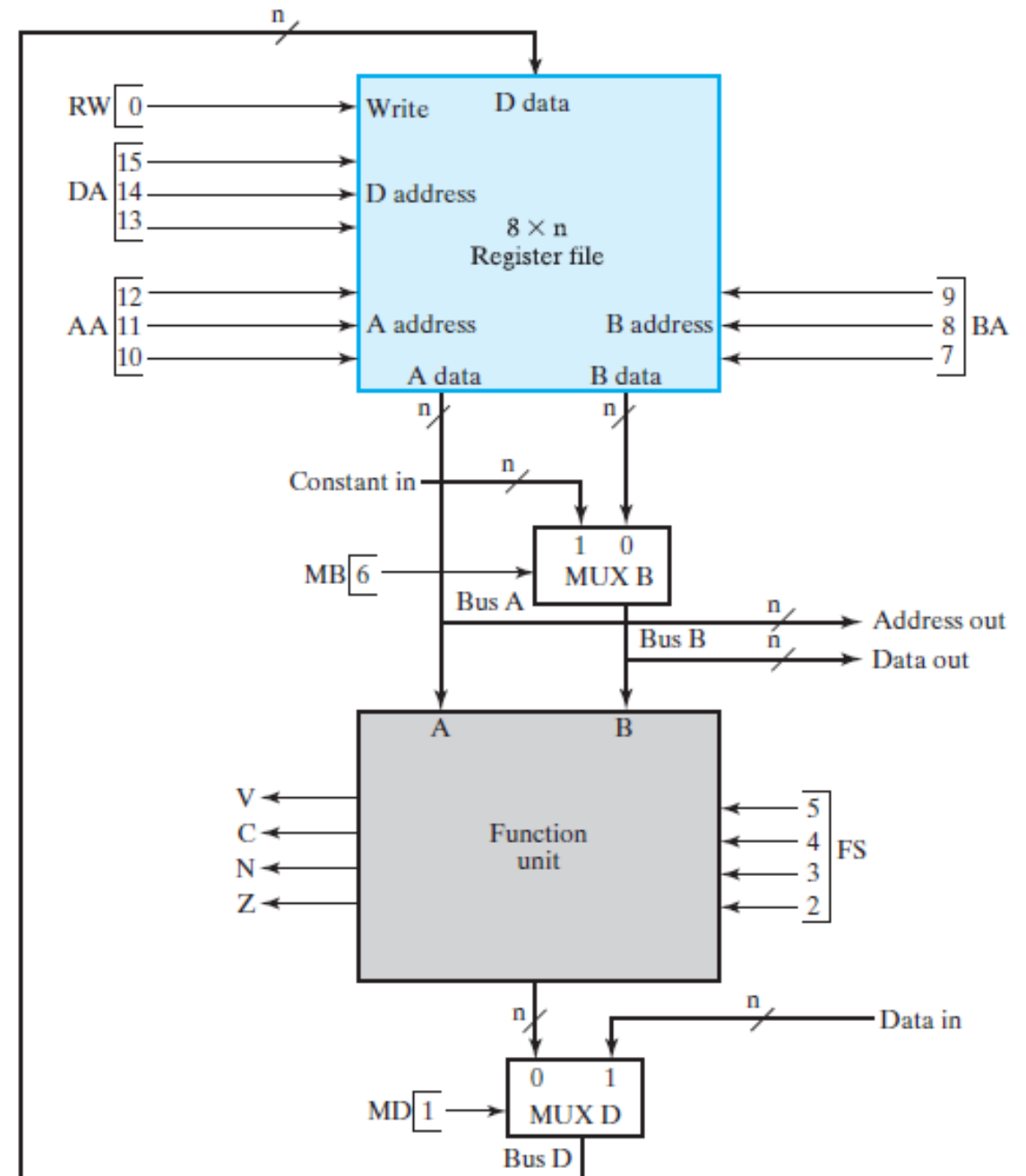


The Control Word

- The single MB bit determines whether Bus B carries the contents of the selected source register or a constant value.
- The 4-bit FS field controls the operation of the function unit. The FS field contains one of the 15 codes from Table 8-4.
- The single bit of MD selects the function unit output or the data on Data in as the input to Bus D.
- The final field, RW, determines whether a register is written or not.
- When applied to the control inputs, the 16-bit control word specifies a particular microoperation.

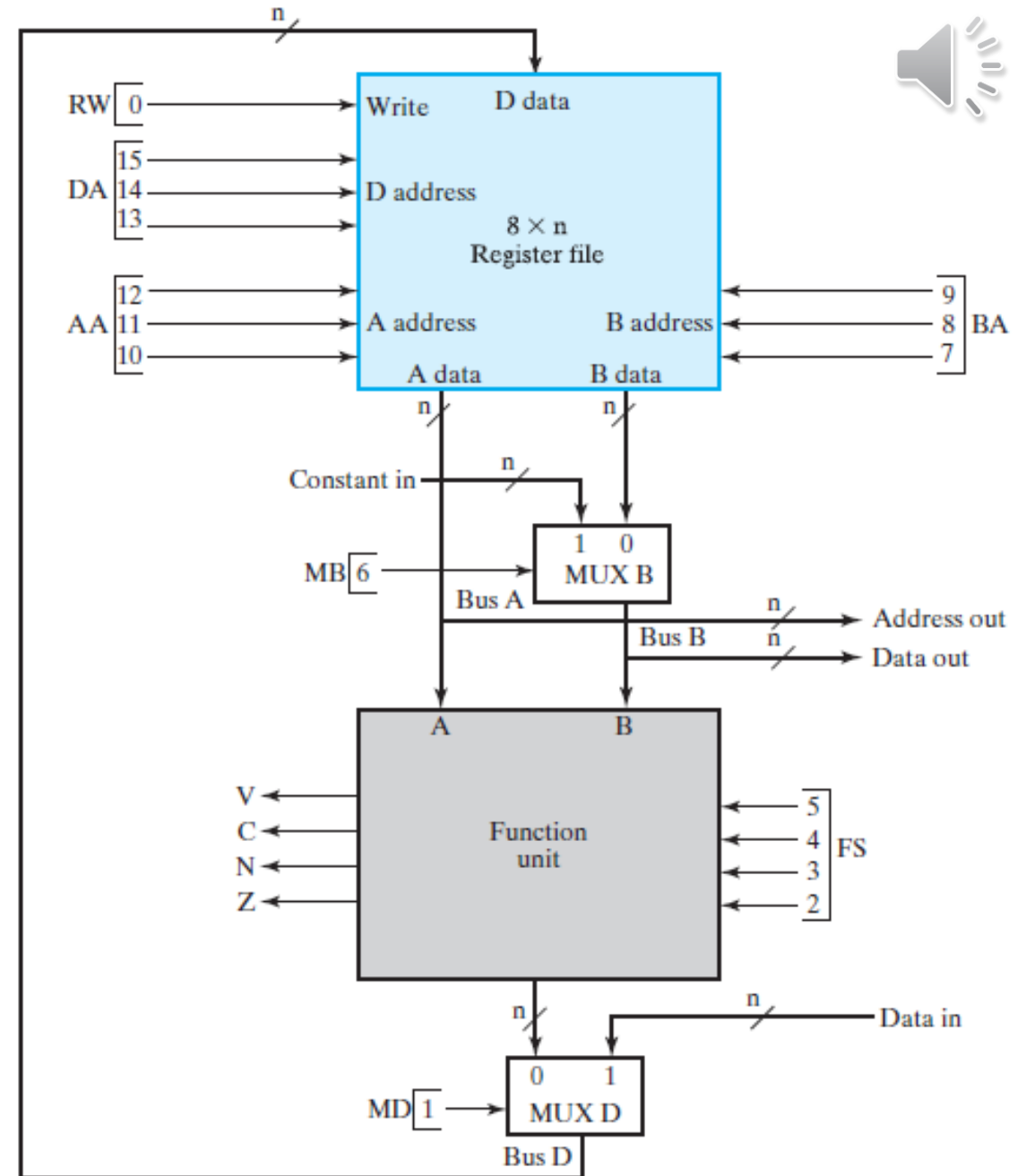


(b) Control word



The Control Word

- The functions of all meaningful control codes are specified in Table 8-5. For each field a binary code for each function is given.
- The register selected by each of the address fields DA, AA, and BA is the one with the decimal equivalent equal to the binary number for the code.
- MB selects either the register selected by the BA field or a constant from outside the datapath on Constant in. The ALU operations, the shifter operations, and the selection of the ALU or shifter outputs are all specified by the FS field.



The Control Word

- The field MD controls the information to be loaded into the.

Encoding of Control Word for the Datapath

DA, AA, BA		MB		FS		MD		RW	
Function	Code	Function	Code	Function	Code	Function	Code	Function	Code
R0	000	Register 0		$F = A$	0000	Function 0		No Write 0	
R1	001	Constant 1		$F = A + 1$	0001	Data in 1		Write 1	
R2	010			$F = A + B$	0010				
R3	011			$F = A + B + 1$	0011				
R4	100			$F = A + \overline{B}$	0100				
R5	101			$F = A + \overline{B} + 1$	0101				
R6	110			$F = A - 1$	0110				
R7	111			$F = A$	0111				
				$F = A \wedge B$	1000				
				$F = A \vee B$	1001				
				$F = A \oplus B$	1010				
				$F = \overline{A}$	1011				
				$F = B$	1100				
				$F = sr B$	1101				
				$F = sl B$	1110				

