

Chapter 02: Computer Organization

Lesson 05:

Functional units and components in a computer organization Part 4— ALU

Objective:

- Understand the operations in the Arithmetic Logic Unit

ALU for Program instructions

- The arithmetic and logic unit (ALU) performs the instructed operation on the operands
- The instruction set of a processor contains the instructions that a given processor ALU can execute

Operands in a Program instruction

- Source Operands
- Destination Operand
- Implied Accumulator as one of the source and the destination operands (accumulate the result of arithmetic or logic operation)

Operands Load and Store architecture

- Most often, the required operands are *loaded* in the register from the memory *before* the arithmetic or logic operation instruction
- Most often, the operands are *stored* from the register to the memory address *after* the arithmetic or logic operation instruction

ALU arithmetic operations on two operands

- a) Addition
- b) Addition with previous operation carry
- c) Subtract
- d) Subtract with previous operation borrow
- e) Multiply integers without sign considerations
- f) Multiply integers with sign considerations

ALU arithmetic operations on two operands

- g) divide integers without sign considerations
- h) Divide integers with sign considerations
- i) Compare (hypothetical subtraction and set flags as per result of comparing - equal or greater or less)

ALU arithmetic operations on an operand

- (i) Increment
- (ii) decrement
- (iii) negate (multiply by -1]

ALU Logic Operations on two operands

- a) AND
- b) OR
- c) XOR
- d) Test (hypothetical AND, and set flags as per result of ANDing)

ALU bit manipulation operations on an operand

- a) NOT (complement operation)
- b) Left shift by one or specified number of bits,
- c) Right shift by one or specified number of bits,
- d) Arithmetic shift-right by one or specified number of bits
- e) Rotate left by one or specified number of bits, and
- f) Rotate right by one or specified number of bits

Example: The processor 8086 ALU

- Executes most of the arithmetic and logic instructions and also provides a number of addressing modes for one of the source operands

Example ARM processor ALU—MLA instruction

- Multiply one register by another and add the result into the first register
- ALU adds one register operand by other operand after the left-shift by n bits
- Left shift by 2— equivalent to multiply by 2^2 and thus the operation is $A + 4 \times B$

Summary

We learnt

- ALU using the addressing mode provided in an instruction does all the arithmetic and logic operations which the instruction-set provides

End of Lesson 5 on
**Functional units and components in a
computer organization Part 4—
ALU**