COMPUTER ARCHITECTURE & ASSEMBLY LANGUAGE
BACHELOR OF COMPUTER APPLICATIONS (B.C.A)
II YEAR

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BASIC COMPUTER ORGANISATION AND DESIGN

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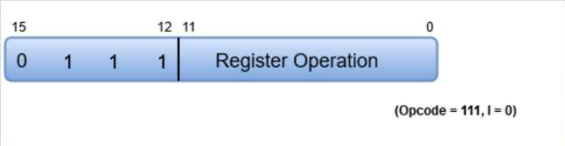
- Computer organization refers to the operational unit and their interconnection that realise the architectural specification.
- Computer organization deals with how different part of a computer are organised and how various operations are performed between different part to do a specific task.
- The organization of the computer is defined by its internal registers ,timing and control structure ,and set of instruction that is uses.

INSTRUCTION

- Computer instructions are a set of machine language instructions that a particular processor understands and executes. A computer performs tasks on the basis of the instruction provided.
- An instruction comprises of groups called fields. These fields include:
- The Operation code (Opcode) field which specifies the operation to be performed.
- The Address field which contains the location of the operand, i.e., register or memory location.
- The Mode field which specifies how the operand will be located.

INSTRUCTION & INSTRUCTION CODES

- A basic computer has three instruction code formats which are:
  - Memory – reference instruction
  - Register – reference instruction
  - Input-Output instruction
- Memory – reference instruction
  - In Memory-reference instruction, 12 bits of memory is used to specify an address and one bit to specify the addressing mode 'I'.
- Register – reference instruction
  - The Register-reference instructions are represented by the Opcode 111 with a 0 in the leftmost bit (bit 15) of the instruction
- Input-Output instruction
  - Just like the Register-reference instruction, an Input-Output instruction does not need a reference to memory and is recognized by the operation code 111 with a 1 in the leftmost bit of the instruction. The remaining 12 bits are used to specify the type of the input-output operation or test performed.



INSTRUCTION SET COMPLETENESS

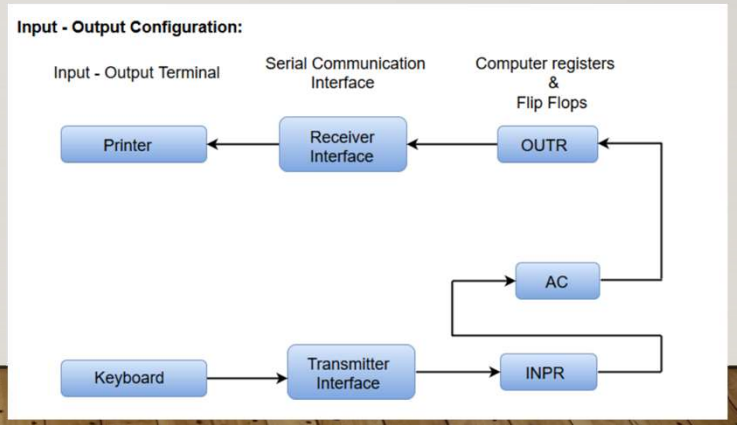
- A set of instructions is said to be complete if the computer includes a sufficient number of instructions in each of the following categories:
- Arithmetic, logical and shift instructions
- A set of instructions for moving information to and from memory and processor registers.
- Instructions which controls the program together with instructions that check status conditions.
- Input and Output instructions
- Arithmetic, logic and shift instructions provide computational capabilities for processing the type of data the user may wish to employ.
- A huge amount of binary information is stored in the memory unit, but all computations are done in processor registers. Therefore, one must possess the capability of moving information between these two units.
- Program control instructions such as branch instructions are used change the sequence in which the program is executed.
- Input and Output instructions act as an interface between the computer and the user. Programs and data must be transferred into memory, and the results of computations must be transferred back to the user.

INSTRUCTION CYCLE

- A program residing in the memory unit of a computer consists of a sequence of instructions. These instructions are executed by the processor by going through a cycle for each instruction.
- In a basic computer, each instruction cycle consists of the following phases:
- Fetch instruction from memory.
- Decode the instruction.
- Read the effective address from memory.
- Execute the instruction.

INPUT OUTPUT CONFIGURATION

- In computer architecture, input-output devices act as an interface between the machine and the user.
- Instructions and data stored in the memory must come from some input device. The results are displayed to the user through some output device.
- The following block diagram shows the input-output configuration for a basic computer.



DESIGN OF A BASIC COMPUTER

- A basic computer consists of the following hardware components.
- A memory unit with 4096 words of 16 bits each
- Registers: AC (Accumulator), DR (Data register), AR (Address register), IR (Instruction register), PC (Program counter), TR (Temporary register), SC (Sequence Counter), INPR (Input register), and OUTR (Output register).
- Flip-Flops: I, S, E, R, IEN, FGI and FGO

EXCERCISES

- The content of AC in the basic computer is hexadecimal A937 and the initial value of E is 1. Determine the contents of AC, E, PC, AR, and IR in hexadecimal after the execution of the CLA instruction. Repeat 11 more times, starting from each one of the register-reference instructions. The initial value of PC is hexadecimal 021
- An instruction at address 021 in the basic computer has I = 0, an operation code of the AND instruction, and an address part equal to 083 (all numbers are in hexadecimal The memory word at address 083 contains the operand B8F2 and the content of AC is A937. Go over the instruction cycle and determine the contents of the following registers at the end of the execute phase: PC, AR, DR, AC, and IR. Repeat the problem six more times starting with an operation code of another memory-reference instruction
- The content of PC in the basic computer is 3AF (all numbers are in hexadecimal). The content of AC is 7EC3. The content of memory at address 3AF is 932E. The content of memory at address 32E is 09AC. The content of memory at address 9AC is 8B9F.
  - a. What is the instruction that will be fetched and executed next?
  - b. Show the binary operation that will be performed in the AC when the instruction is executed

EXCERCISES

- A digital computer has a memory unit with a capacity of 16,384 words, 40 bits per word. The instruction code format consists of six bits for the operation part and 14 bits for the address part (no indirect mode bit). Two instructions are packed in one memory word and a 40-bit instruction register IR is available in the control unit. Formulate a procedure for fetching and executing instructions for this computer
- Show the complete logic of the interrupt flip-flops R in the basic computer. Use a JK fllp-'flop and minimize the number of gates.

REFERENCE

- Reference Books:
- 1. Leventhal, L.A, “Introduction to Microprocessors”, Prentice Hall of India
- 2. Mathur, A.P., “Introduction to Microprocessors”, Tata McGraw Hill
- 3. Rao, P.V.S., “Prospective in Computer Architecture” , Prentice Hall of India

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THANK YOU!!!