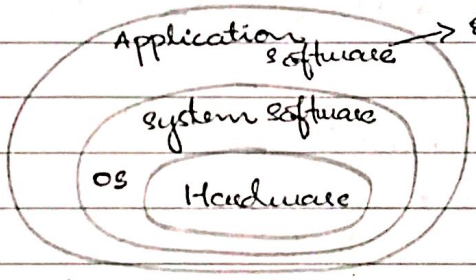
Page No.
Date:

Book: System Software - An Introduction to system Programming - Leyland.

MODULE-1

* Software - set of programs to perform a particular task.



System software → set of instructions connecting hardware and the application.

e.g: OS.

→ Type of computer pgm that is designed to run a computer's hardware.

* Translators:

- Converts a computer pgms from one language to another

- Types → Assemblers
→ compilers
→ Interpreters

- Source code to machine code.

Machine code
Assembly code
HLL code.

compiles
Interpreted

- Assembler → low level language to machine code.
- Compiler } high level language to machine code.
- Interpreter } line by line.

* Different types of system software:
- Assembler
- Linker → link obj file to executable form.
- Loader
- Macro Processor → replacement
- Text editor
- Debuggers.
- Device drivers.
- Compiler
- Interpreter.
- Operating System. → Interface b/w user and computer.

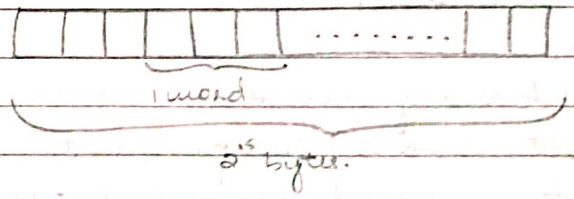
imp Diff. b/w system software and application software

19-8-20

Simplified Instructional computer (SIC)

- A hypothetical computer (includes) — has/does not have features.
- Upward compatible → can work on any computer.
- SIC standard model
- 2 version { SIC/XE (extra equipment.)

- Memory: (in bytes).
  - less memory.
  - byte addressable.
  - 8-bit bytes.
  - 3 consecutive bytes forms a word.
  - 2^{15} (32768) bytes in the computer memory.

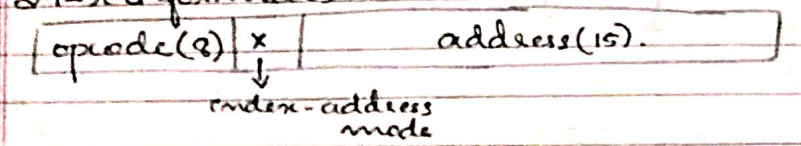


- Registers:
  - for easy storage & transfer.
  - 5 registers / each 24 bit.

Mnemonic	Number	Special use.
A	0	Accumulator; used for arithmetic operations
X	1	Index register; for addressing mode
L	2	Linkage register; the jump to subroutine (JSUB) instruction stores the return address in this register.
PC	8	Program counter
SW	9	status Word; contain condition code. (CC)

- Data formats:
  - characters:
    - 8-bit ASCII codes.
  - Integers:
    - 24-bit binary numbers.
    - '-ve' values → 2's compliment.
  - No floating point numbers exist in SIC/XE.

- Instruction formats:
  - 24 bits formats



- Addressing mode.

Mode	Indication	Target address calculation
Direct	x = 0	TA = address
Indirect	x = 1	TA = address + (X).

- Instruction set:
  - Load and store instruction
    LDA, LDX, STA, STX.
    (Load to accumulator, store to index register)

    Eg: LDA ALPHA ⇔ (A) ← ALPHA.
    STA ALPHA ⇔ (ALPHA) ← A.

  - Arithmetic instruction:
    ADD, SUB, MUL, DIV, INCR
    Eg: ADD ALPHA ⇔ (A) ← (A) + ALPHA.

  - Comparison instruction:
    COMP
  - Conditional jump instruction:
    (jump Less than, equal, greater than.)
    JLT, JEQ, JGT.
  - Subroutine linkage instruction:
    JSUB, RSUB. → returns to the address in L.
    (jumps to and places the return address in register L.)

Page No.
Date:

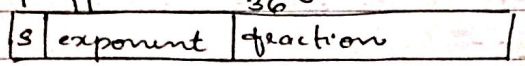
- Input and output:
  - Read Data → RD
  - Write Data → WD.
  - Test Device → TD. = whether device is ready to send or receive.
    - cc: < → ready
    - cc: = → busy.

25-8-2020. SIC/XE Architecture

- Maximum memory available = 2^{20} bytes = 1MB.
- Additional 5 more registers.

Mnemonic	Number	Purpose
B	3	Base register.
S	4	general purpose register (only for storing purpose)
T	5	"
F	6	floating-point accumulator.

- Data formats.
  - 48-bit floating point datatype.



Page No.
Date:

- Instruction format.

Format 1 (1 byte) | op(8) |

Format 2 (2 byte) | op(8) | r1(4) | r2(4) |

Format 3 (3 byte) | op(6) | n | i | x | b | p | e | disp(12) |

Format 4 (4 byte) | op(6) | n | i | x | b | p | e | add(20) |

flags

e=0: format 3
e=1: format 4.

- If b=p=0, direct addressing

n → indirect addressing mode
i → immediate addressing mode.
x → indexed addressing
b → base addressing relative mode.
p → program counter relative
e → to understand format

- Instruction set:
  - Load and store registers (B, S, T, F).
    LDB, STB
  - floating-point arithmetic operations
    ADDF, SUBF, MULF, DIVF.
  - Register-register arithmetic operations.
    ADDR, SUBR, MULR, DIVR

ADDR S,B → B ← S+B.

- Register move operations (RMO).

RMO S,B ⇒ B ← S.

- Supervisor call (SVC).

generates an interrupt for OS.

- Input/Output:

- SIO, TIO, HIO : start, test, halt the operations of I/O devices.

Imp: Address calculation

Consider 000000 → LOADA.

	op	n	i	x	b	p	e	disp/address	address	A.
① 003600	000000	1	1	0	0	1	0	0110 00000000	3600	103000
② 05C300	000000	1	1	1	1	0	0	0011 00000000	C390	00C303
③ 000030	000000	0	1	0	0	0	0	0000 0011 0000	30	000030
④ 003600	000000	0	0	0	0	1	1	0110 0000 0000	3600	103000

(B) = 006000

(PC) = 003000

B=0

(X) = 000090

① . n=1, i=1, p=1, e=0

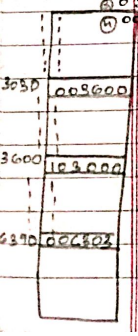
e=0, 3rd format

B=0, p=1, PC relative addressing mode.

∴ TA = (PC) + address

= 003000 + 600 = 003600.

∴ A = 103000



⑤ . n=1, i=1, x=1, B=1, P=0, e=0.

e=0 ⇒ 3rd format.

x=1 → Indexed mode.

B=1, P=0 → Base relative indexed addressing mode.

∴ TA = (B) + (x) + address

= 006000 + 000090 + 300

= 006390.

A = 00C303

② . n=0, i=1, x=0, B=0, P=0, e=0.

B=0, P=0, i=1 ⇒ immediate addressing mode.

∴ Value in A = TA = address

= 000030

④ . n=0, i=0, x=0, P=1, e=1.

e=1 ⇒ 4th format.

B=0, P=1 ⇒ PC relative mode.

∴ TA = (PC) + address

= 003000 + 600 = 003600.

∴ A = 103000