Instruction Set Architecture:

Machine instructions or computer instructions - operation of a processor is determined by the instructions it executes.

Instruction Set - Collection of different instructions that a processor can execute.

Elements of Machine Instruction:

* Operation code – specifies operation to be perform, opcode
* Source operand reference – input for the operation
* Result operand reference – encompasses result of operation
* Next instruction reference – where processor should fetch next instruction

Instruction Category:

* **For data processing -** The arithmetic and logic instructions
* **For data storage -** The entry or exit of data into registers and memory locations
* **For data movement -** The input and output instructions
* **For control -** The test and branch instructions

Data Transfer:

Fundamental type of machine instruction –

* Location of source operand
* Destination of the operand
* Length of data to be transferred
* Addressing mode for each operand

Common x86 Data Transfer Instructions:

MOV Dest, Source – move data between register or register and memory

XCHG Op1, Op2 – swaps the contents between two register

PUSH Source – decrement esp and copies source operand to stacktop

POP Dest – copies stack top to destination

* L: Load – memory to register
* LH: Load Halfword – memory to register
* LR: Load – register to register
* LER: Load Short – float point register to float point register
* LD: Load Long – memory to floating point regster
* ST: Store -register to memory
* STH: Store Halfword -register to memory
* STC: Store Character – register to memory
* STE: Store short – floating point register to memory

**Processor Actions in Data Transfer**

When moving data, the CPU may need to:

* calculate the memory address using the addressing mode.
* Translate virtual memory addresses to physical addresses.
* determine if the data is in cache
* Communicate with the memory module if the data is not in cache.

Data Manipulation:

Conversion Instructions – Instruction that changes the format or operate on the format of data.

IBMS ESA/390 Translate (TR) - instruction that can be used to convert one 8-bit code to another

**TR R1 (L), R2**

**R2** contains the address of the start

**L** represents the number of bytes

specified address in **R1**

**Input/Output (I/O) instructions *-*** operation of transferring external data into the memory and vice versa.

The following are the three (3) possible approaches in dealing with I/O operations:

1. Programmed I/O: Processor executes program, direct controls I/O operations
2. Interrupt-Driven I/O: Processor issue command, continue execute other instructions. Interrupted by I/O once completed.
3. Direct Memory Access (DMA): I/O Module and main memory exchange data directly.

Common x86 instructions for input/output:

IN Dest, Source: Copies data from I/O Specified by src operand to destination, which is register location

INS Dest, Source: Copies data from I/O Specified by src operand to destination, which is memory location

OUT Dest, Source: Copies byte, word, doubleword from src register to I/O port by destination operand

OUTS Dest, Source: Copies byte, word, doubleword from src operand, memory location to I/O port by destination operand