

Microprocessor & Interfacing

Lecture 17

Instructions of 8086



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Introduction



- Instruction is the way in which data are used by the microprocessor. Basically instruction has the two parts opcode and the operand opcode means operation code and operand means the the data where operation will be carried out.

Data Transfer Instructions



- MOV :Move byte or word to register or memory IN, OUT: Input byte or word from port, output word to port
- LEA: Load effective address
- LDS, LES Load pointer using data segment, extra segment
- PUSH, POP: Push word onto stack, pop word off stack
- XCHG: Exchange byte or word
- XLAT: Translate byte using look-up table

Logical Instructions



- NOT : Logical NOT of byte or word (one's complement)
- AND: Logical AND of byte or word
- OR: Logical OR of byte or word
- XOR: Logical exclusive-OR of byte or word
- TEST: Test byte or word (AND without storing)

Shift and Rotate Instructions



- SHL, SHR Logical shift left, right byte or word? by 1 or CL
- SAL, SAR Arithmetic shift left, right byte or word? by 1 or CL
- ROL, ROR Rotate left, right byte or word? by 1 or CL
- RCL, RCR Rotate left, right through carry byte or word? by 1 or CL

Arithmetic Instructions



- ADD, SUB: Add, subtract byte or word
- ADC, SBB :Add, subtract byte or word and carry (borrow)
- INC, DEC: Increment, decrement byte or word
- NEG: Negate byte or word (two's complement)
- CMP: Compare byte or word (subtract without storing)
- MUL, DIV: Multiply, divide byte or word (unsigned)
- IMUL, IDIV: Integer multiply, divide byte or word (signed)
- CBW, CWD: Convert byte to word, word to double word (useful before multiply/divide)
- AAA, AAS, AAM,AAD: ASCII adjust for addition, subtraction, multiplication, division (ASCII codes 30-39) □ DAA, DAS: Decimal adjust for addition, subtraction (binary coded decimal numbers)

Transfer Instructions



- **JMP: Unconditional jump** (short :127/8, near :32K, far between segments)

Conditional jumps



- JA (JNBE): Jump if above (not below or equal)? +127, -128 range only
- JAE (JNB): Jump if above or equal(not below)? +127, -128 range only
- JB (JNAE): Jump if below (not above or equal)? +127, -128 range only
- JBE (JNA): Jump if below or equal (not above)? +127, -128 range only
- JE (JZ): Jump if equal (zero)? +127, -128 range only
- JG (JNLE): Jump if greater (not less or equal)? +127, -128 range only
- JGE (JNL): Jump if greater or equal (not less)? +127, -128 range only
- JL (JNGE): Jump if less (not greater nor equal)? +127, -128 range only

Continue



- JLE (JNG): Jump if less or equal (not greater)? +127, -128 range only
- JC, JNC: Jump if carry set, carry not set? +127, -128 range only
- JO, JNO: Jump if overflow, no overflow? +127, -128 range only
- JS, JNS: Jump if sign, no sign? +127, -128 range only
- JNP (JPO): Jump if no parity (parity odd)? +127, -128 range only
- JP (JPE): Jump if parity (parity even)? +127, -128 range only

Loop Control



- **LOOP:** Loop unconditional, count in **CX**, short jump to target address
- **LOOPE (LOOPZ):** Loop if equal (zero), count in **CX**, short jump to target address
- **LOOPNE (LOOPNZ):** Loop if not equal (not zero), count in **CX**, short jump to target address
- **JCXZ:** Jump if **CX** equals zero (used to skip code in loop)

Subroutine and Interrupt Instructions



- CALL, RET: Call, return from procedure (inside or outside current segment)
- INT, INTO: Software interrupt, interrupt if overflow
- IRET: Return from interrupt

String Instructions



- **MOVS**: Move byte or word string
- **MOVSB, MOVSW**: Move byte, word string
- **CMPS**: Compare byte or word string
- **SCAS S**: scan byte or word string (comparing to A or AX)
- **LODS, STOS**: Load, store byte or word string to AL or AX

Cont..



- Repeat instructions (placed in front of other string operations):
- REP: Repeat
- REPE, REPZ: Repeat while equal, zero
- REPNE, REPNZ: Repeat while not equal (zero)

Processor Control Instructions



- Flag manipulation:
- STC, CLC, CMC: Set, clear, complement carry flag
- STD, CLD: Set, clear direction flag
- STI, CLI: Set, clear interrupt enable flag
- LAHF, SAHF: Load AH from flags, store AH into flags
- PUSHF, POPF: Push flags onto stack, pop flags off stack

Cont..



- Coprocessor, multiprocessor interface:
- ESC Escape to external processor interface
- LOCK Lock bus during next instruction
- Inactive states:
- NOP No operation
- WAIT Wait for TEST pin activity
- HLT Halt processor

Instruction types



- Zero Operand instruction
- One operand instruction
- Two operand instruction
- Three operand instruction

Scope of research



- We can design the new instruction which will be more efficient than the existing instruction in the form of speed, time and space.