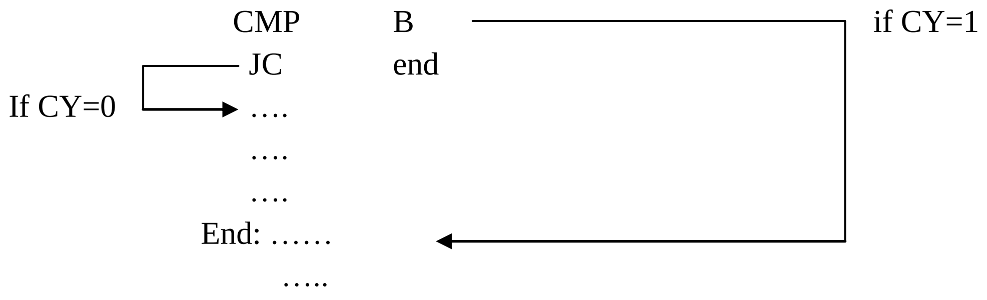
(1) Explain Decision making programming technique.

- Decision making in 8085 is same as doing if else in higher level programming language as

```
If (condition)
        Block1
else
        block2
```

- In above case if condition is true, then statements in block 1 are performed and if condition is false, then statements in block 2 are performed.
- Following examples show how decision making is done in 8085 using compare and branch instructions.



```
            CMP     B                       if CY=1
             JC     end
If CY=0      ….
             ….
             ….
         End: ……
               …..
```

- In above example CMP B compares contents of register A and Band sets the flags.
- If A<B than CY=1 and JC transfers control to end.
- If A>=B than CY=0 and JC is false so next instruction will be executed.

(2) Describe the looping and counting techniques. OR Explain looping, counting & indexing with an example.

Looping: repeat the sequence of instructions for a particular number of times. This process is accomplished by using jump instructions.

Counting: to count how many times the instructions are executed.

Indexing: to point or refer the data stored in the sequential memory locations one by one.

- A loop can be classified into two groups:
    - Continuous loop- repeats a task continuously
    - Conditional loop-repeats a task until certain data condition are met

Continuous loop (infinite loop)

- A continuous loop is set up by using the unconditional jump Instruction shown in the flowchart.
- A program with Continuous loop does not stop repeating the tasks until the system is reset.

Conditional Loop

- A Conditional loop is setup by the conditional jump instructions.
- These instructions Check flags (zero, carry, etc.) and repeat the specified task if the conditions are satisfied.
- These loops usually include counting and indexing. Conditional loop is shown by the Flowchart as follow.

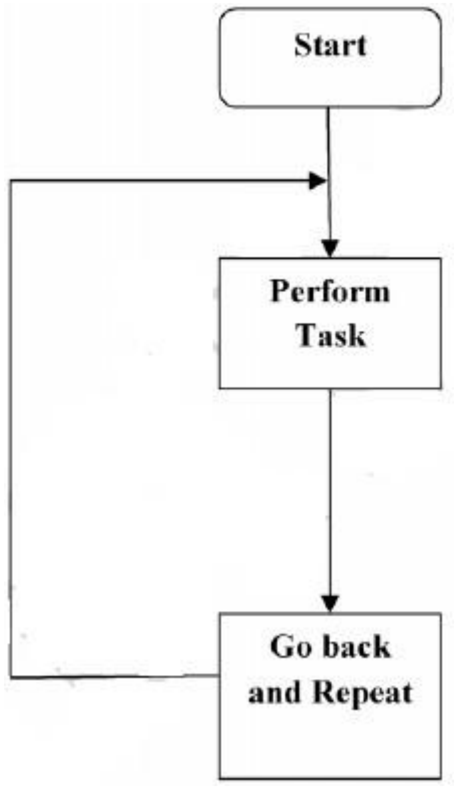


Fig: - Continuous Loop

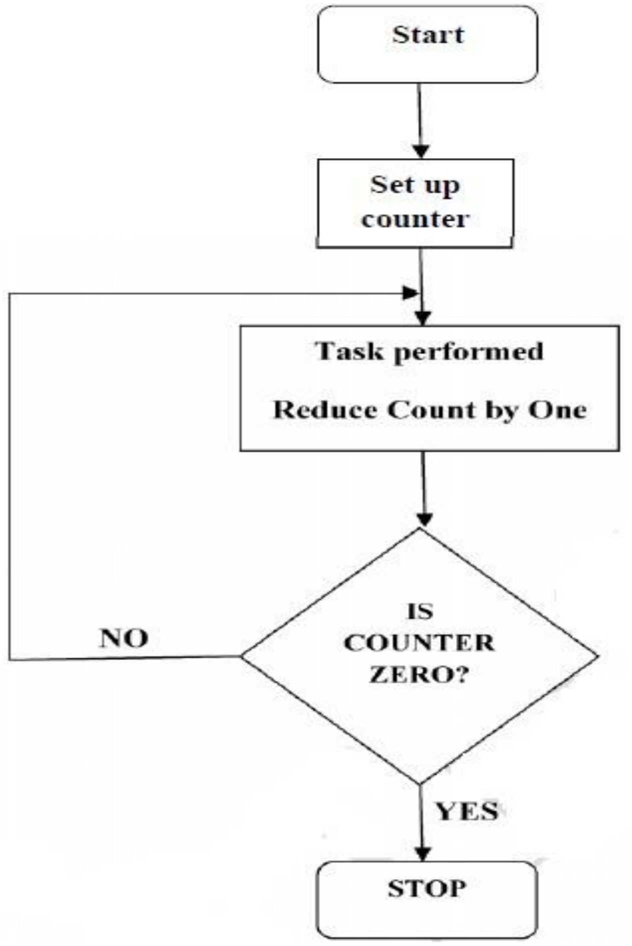


Fig: - Conditional Loop

The Flowchart is translated into the program as follows:

1. Counter is setup by loading an appropriate count in a register.
2. Counting is performed by either incrementing or decrementing the counter.
3. Loop is set up by a conditional jump instruction.
4. End of counting is indicated by a flag.

We can form a loop in 8085 as follows.

(1) by decrementing counter

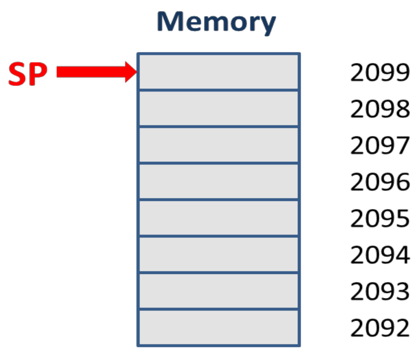
```
            MVI C, 05H
Next:
            …….
            ……
            ……
            DCR C
            JNZ Next
```

(2) By incrementing counter

```
            MVI C, 00H
Next:
            …….
            ……
            ……
            INC C
            MOV A, C
            CPI 05H
            JNZ Next
```

(3) What is stack? Explain stack related instruction with example OR Give function of stack. OR What is stack? Explain the stack operations using examples.

- The stack is a group of memory location in the R/W memory (RAM) that is used for temporary storage of data during the execution of a program.
- Address of the stack is stored into the stack pointer register.



- The 8085 provide two instructions PUSH & POP for storing information on the stack and reading it back.
- Data in the register pairs stored on the stack by using the instruction PUSH.

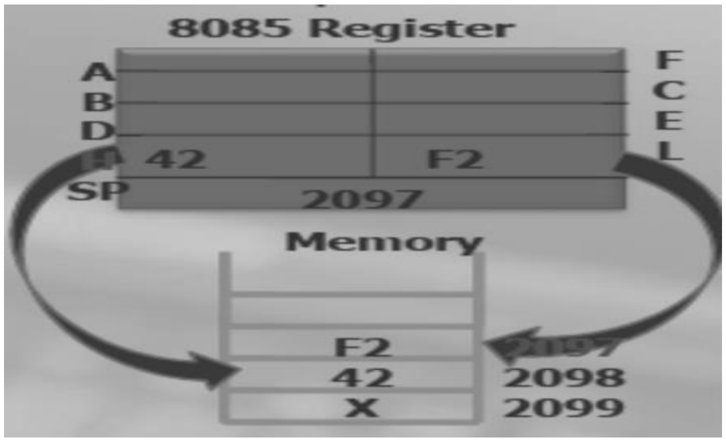
- Data is read from the stack by using the instruction POP.
- PUSH & POP both instruction works with register pairs only.
- The storage and retrieval of the content of registers on the stack fallows the LIFO (Last- In-First-Out) sequence.

Operation of the stack by PUSH and POP Instruction

```
2000    LXI SP, 2099H        ; this instruction define stack
2003    LXI H, 42F2H         ; this instruction store 42F2 in to the HL pair
2006    PUSH H               ; store HL pair on to the stack
2010    POP H                ; store data from top of the stack to HL pair
```

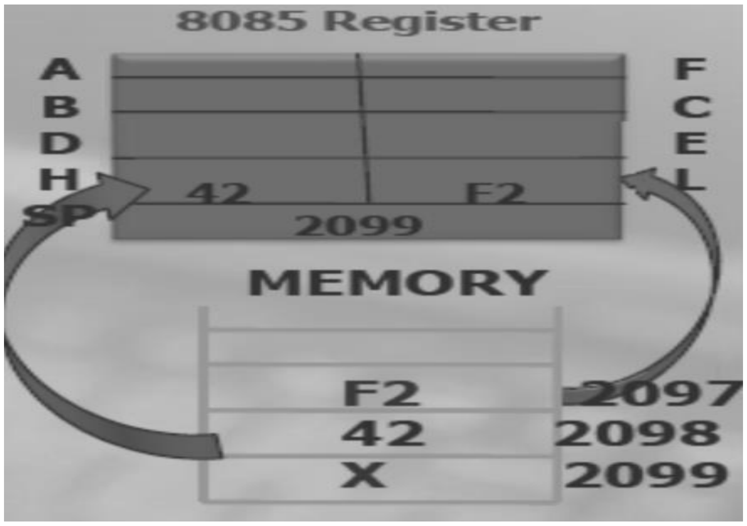
For PUSH H

- The stack pointer is decremented by one to 2098H, and the contents of the h register are copied to memory location 2098H.
- The stack pointer register is again decremented by one to 2097H,and the contents of the L register are copied to memory location 2097H.The contents of the register pair HL are not destroyed.



For POP H

- The contents of the top of the stack location shown by the stack pointer are copied in the L register and the stack pointer register is incremented by one to 2098 H.
- The contents of the top of the stack (now it is 2098H) are copied in the H register, and the stack pointer is incremented by one.
- The contents of memory location 2097H and 2098 are not destroyed until some other data bytes are stored in these location.



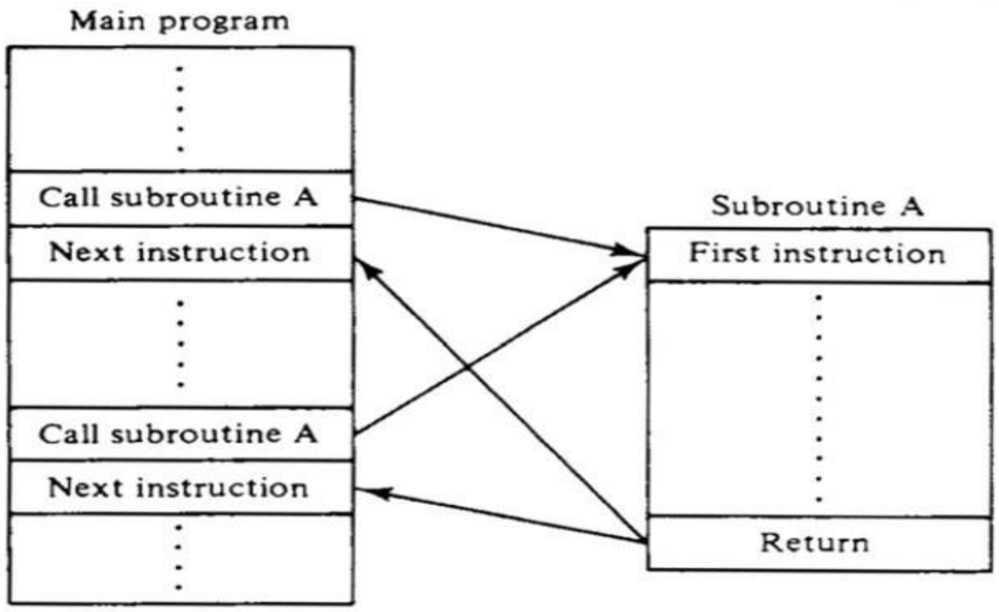
(4) Explain Subroutine with CALL and RET Instruction.

- A subroutine is a group of instructions that will be used repeatedly in different locations of the program. Rather than repeat the same instructions several times, they can be grouped into a one program which is called subroutine.
- When main program calls a subroutine the program execution is transferred to the subroutine.
- After the completion of the subroutine, the program execution returns to the main program.
- The microprocessor uses the stack to store the return address of the subroutine.
- The 8085 has two instructions for dealing with subroutines.

– The CALL instruction is used to CALL the subroutine.

– The RET instruction is used to return to the main program at the end of the subroutine.

- Subroutine process is shown in figure below.



The CALL Instruction

CALL 16-bit address

- The program sequence is transferred to the memory location specified by the 16-bit address given in the operand.
- Before the transfer, the address of the next instruction after CALL (the contents of the program counter) is pushed onto the stack.
- Example: CALL 2034H or CALL XYZ

We can also call the subroutine by using conditional CALL instruction. For Example,

CC 16-bit address	Call on if CY = 1
CNC 16-bit address	Call on no Carry CY = 0
CP 16-bit address	Call on positive S = 0
CM 16-bit address	Call on minus S = 1
CZ 16-bit address	Call on zero Z = 1
CNZ 16-bit address	Call on no zero Z = 0
CPE 16-bit address	Call on parity even P = 1
CPO 16-bit address	Call on parity odd P = 0

RET Instruction

RET none

- The program sequence is transferred from the subroutine to the calling program.
- The two bytes from the top of the stack are copied into the program counter, and program execution begins at the new address.
- Example: RET

We can also return from the subroutine by using conditional RET instruction. For Example,

RC 16-bit address	Return if CY = 1
RNC 16-bit address	Return if CY = 0
RP 16-bit address	Return if S = 0
RM 16-bit address	Return if S = 1
RZ 16-bit address	Return if Z = 1
RNZ 16-bit address	Return if Z = 0
RPE 16-bit address	Return if P = 1
RPO 16-bit address	Return if P = 0

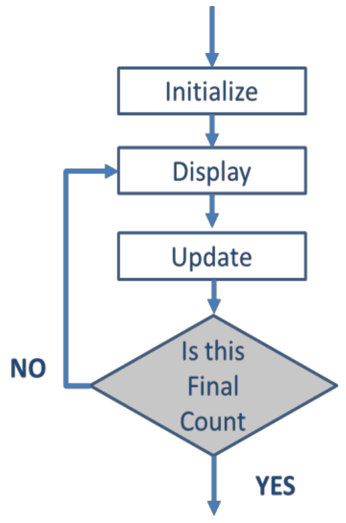
(5) Explain counter and Timing delays.

Applications of Counters and Time Delays

- Traffic Signal
- AC on off
- Digital Clocks
- Process Control
- Serial data transfer

Counters

- A counter is useful in counting how many numbers have been already processed
- A counter is designed simply by loading appropriate number into one of the registers and using INR or DNR instructions.
- Loop is established to update the count.
- Each count is checked to determine whether it has reached final number; if not, the loop is repeated.



```
1. MVI C,05
2. LOOP: MOV A,C
3.       OUT 01
4.       DCR C
5.    JNZ LOOP
6. HLT
```

Fig. Counter

Time Delay

- Time delay can be achieved by two ways 1. Delay using NOP instruction

  2. Timing delay using counters
- A time delay of specific time period can be designed by loading register with an appropriate number and decrementing the register until it reaches to zero by setting up loop.
- Each instruction passes through different combinations of Fetch, Memory Read, and Memory Write cycles.
- Knowing the combinations of cycles, one can calculate how long such an instruction would require to complete.
- It is counted in terms of number of T–states required.

Calculating this time we generate require software delay.

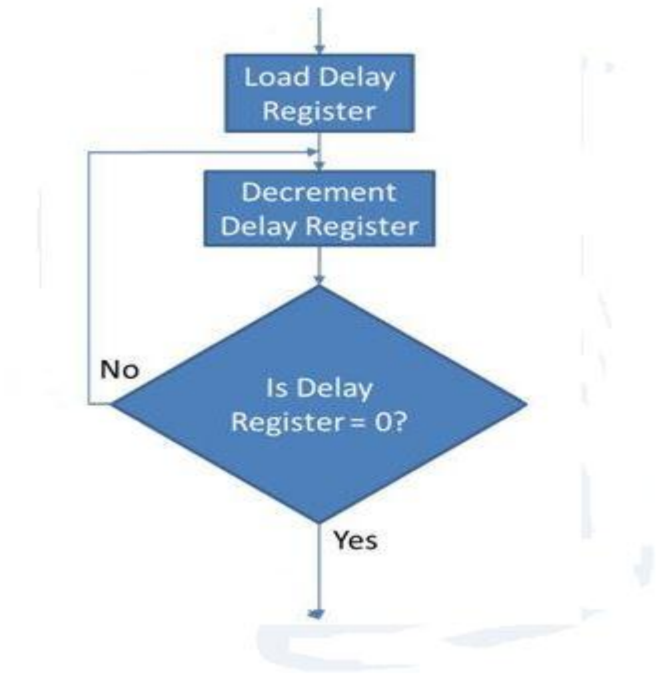


Fig. time delay

Time Delay Using Single Register

Label	Opcode	Operand	Comment	T-states
	MVI	C,05h	; Load Counter	**7**
LOOP:	DCR	C	; Decrement Counter	**4**
	JNZ	LOOP	; Jump back to Decr. C	**10/7**

MVI C 05 Mchine Cycle: OF + MR = 2 T-States: 4T + 3T = 7T	DCR C Mchine Cycle:O F = 1 T-States: 4T = 4T	JNZ LOOP (true) Mchine Cycle: OF +M R +M R = 3 T-States: 4T + 3T + 3T = 10T	JNZ LOOP (false) Mchine Cycle: OF +M R = 3 T-States: 4T + 3T = 7T

Total T states required to execute a given program are (no of T-states)
= 7 + (count-1) *(10+4) + (4 +7)
=7 + (5-1) *(14) + (11)
=74

Assume operating frequency of 8085 **is 5MHZ**

Time required for 1 T state = 1/**5MHZ**
=0.2µsec

Time required for executing above program = 74*0.2µsec
=14.8 µsec

Disadvantage of using software delay

- Accuracy of time delay depends on the accuracy of system clock.
- The Microprocessor is occupied simply in a waiting loop; otherwise it could be employed to perform other functions.
- The task of calculating accurate time delays is tedious.
- In real time applications timers (integrated timer circuit) are commonly used.
- Intel 8254 is a programmable timer chip that can be interfaced with microprocessor to provide timing accuracy.
- The disadvantage of using hardware chip includes the additional expense and the need for extra chip in the system.

Counter design with time delay

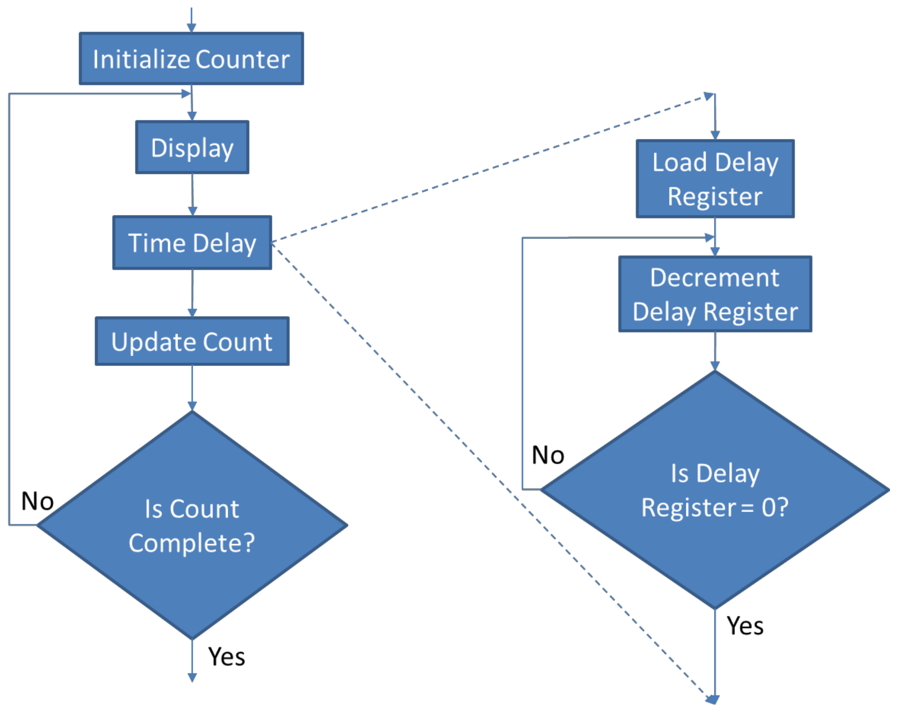


Fig. Counter design with time delay

- It is combination of counter and time delay.
- It consist delay loop within counter program.

(6) Explain MACRO with Example.

- **Macros:** A macro is a group of repetitive instructions in a program which are codified only once and can be used as many times as necessary.
- At the moment when the macro is executed, each parameter is substituted by the name or value specified at the time of the call.
- We can say that a procedure is an extension of a determined program, while the macro is a module

with specific functions which can be used by different programs.

- The parts which make a macro are:
  1. Declaration of the macro.
  2. Code of the macro.
  3. Macro termination directive
- Declaration of the macro: NameOfMacro MACRO [parameter1, parameter2...]
- Even though we have the functionality of the parameters it is possible to create a macro which does not need them.
- The directive for the termination of the macro is: ENDM
- An example of a macro, to place the cursor on a determined position on the screen is:
- Position MACRO Row, Column

```
PUSH AX
PUSH BX
PUSH DX
MOV AH, 02H
MOV DH, Row
MOV DL, Column
MOV BH, 0
INT 10H
POP  DX
POP  BX
POP  AX
ENDM
```

- To use a macro it is only necessary to call it by its name, as if it were another assembler instruction, since directives are no longer necessary as in the case of the procedures. Example: Position 8, 6.

Macro Libraries

- One of the facilities that the use of macros offers is the creation of libraries, which are groups of macros which can be included in a program from a different file.
- The creation of these libraries is very simple; we only have to write a file with all the macros which will be needed and save it as a text file.
- To call these macros it is only necessary to use the following instruction Include NameOfTheFile, on the part of our program where we would normally write the macros, this is, at the beginning of our program, before the declaration of the memory model.