Explain the working of micro programmed control unit.

mention its advantages.& disadvantages.

- Control unit- initiates a series of sequential steps of micro operations
- Control variables that are represented by a string of 0 and 1

In this method, the control variables at any time can be represented by a set of 1's and 0's called a control word. Controlled words can then be programmed to initiate the various components of the system in an organized manner. Control unit whose control variables are stored in the memory system are called microprogrammed control units. Each control word of the memory is called a microprogram. The use of microprogram involves placing all control variables in words of the ROM for use by the control unit through successive read operations. Once these operations are executed, the control unit must determine its next address.

Advantages and Disadvantages

Advantages

- The microprogram control unit is flexible in controlling the execution instruction.
- It can be modified easily as it is easy to change the code.
- It easily handles complex instructions also.
- The implementation of a microprogram control unit is less costly.

Disadvantages

- The microprogram control unit is slow as compared to the hardwired control unit.

Nowadays the cost of logic circuitry is not considerable anymore so usually, the hardwired control unit is preferred over the microprogrammed control unit.

Explain horizontal and vertical organization of a micro programmed control unit.

Horizontal Micro-Instructions

The scheme of micro-instruction by assigning one bit position to each control signal is called horizontal micro-instructions.

Example: 0111010011010011 10

In a horizontal microinstruction every bit in the control field attaches to a controller. Horizontal microinstructions represent several micro-operations that are executed at the same time. However, in extreme cases, each horizontal microinstruction controls all the hardware resources of the system.

Vertical Micro-Instructions

We can reduce the length of the horizontal microinstruction so easily by implementing another method known as vertical micro-instructions. In this case, Most signals are not needed simultaneously and many others are mutually exclusive In a vertical microinstruction, a code is used for each action to be performed andthe decoder translates this code into individual control signals. The vertical microinstruction resembles the conventional machine language format comprising one operation and a few operands. As opposed to horizontal microinstructions, the vertical microinstruction represents single micro-operations.

Differentiate micro routine and control word with respect to control unit design.

Write short note on micro routine.

Control Word

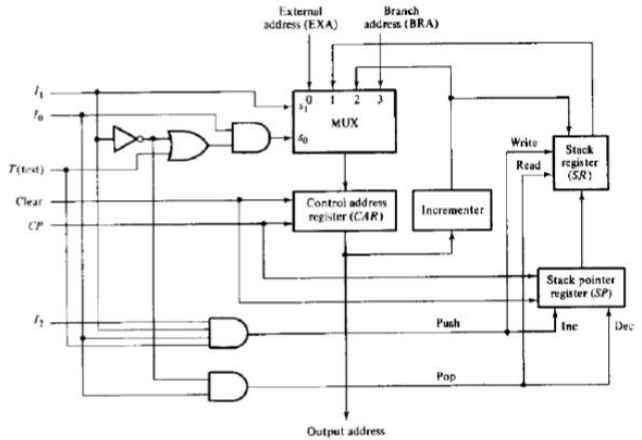
In a micro programmed system, the control variable at any given time can be represented by a string of 1's and 0's called control word. The control words can be programmed to initiate the various components in the system in an organized manner.

1. **Control Word :** A control word is a word whose individual bits represent various control signals.
2. **Micro-routine :** A sequence of control words corresponding to the control sequence of a machine instruction constitutes the micro-routine for that instruction.

What is the significance of a micro program sequencer? Explain its working with the help of a diagram.

Micro-program sequencer is capable of generating next address in the following scenarios:

1. Increments the present address of control memory
2. Branches to an address which will be specified in the bits of microinstruction
3. Branches to a given address if a specified status bit is equal to 1.
4. Transfers control to a new address as specified by an external source
5. Has a facility for subroutines calls and returns



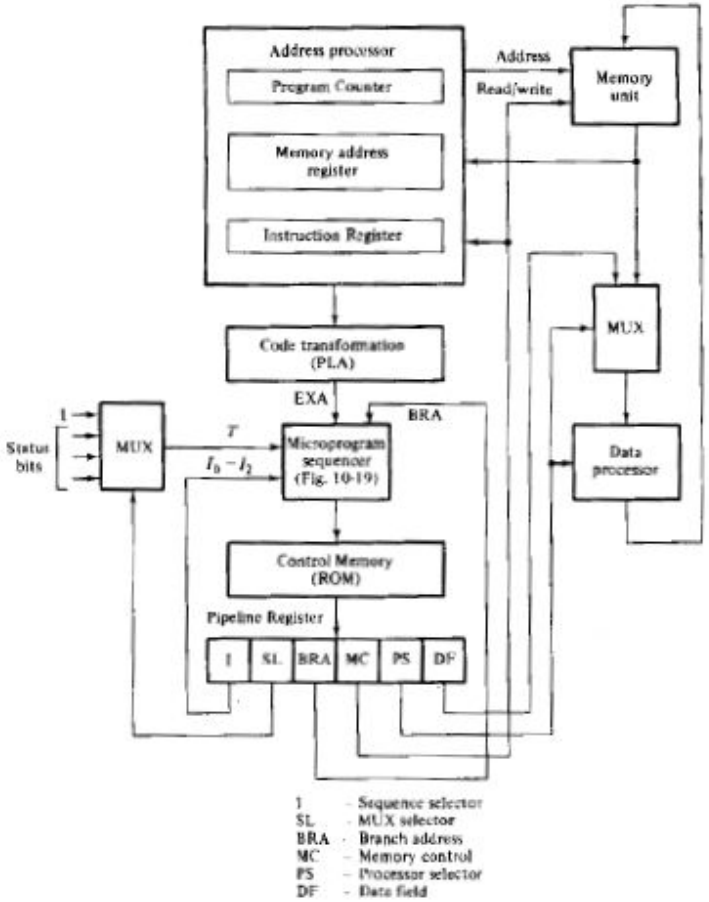
In computer architecture and engineering, a sequencer or microsequencer generates the addresses used to step through the microprogram of a control store. It is used as a part of the control unit of a CPU or as a stand-alone generator for address ranges.

It consists of a multiplexer that selects an address from four sources and routes it into a control address register (CAR).

The output from CAR provides the address for control memory.The contents of CAR are incremented and applied to the multiplexer and to the stack registerfile.

The register selected in the stack is determined by stack pointer. Inputs (I0-I2) specify the operation for the sequencer and input T is the test point for a status bit.Initially the address register is cleared to zero and clock pulse synchronizes the loading into registers.

Explain micro programmed CPU organization with the help of a diagram.



1. **The sequencer**: Generates next address
2. **A control memory**: Reads the next microinstruction while present microinstruction are being executed in the other units of the CPU and for storing microinstructions
3. **A multiplexer**: Selects one of the many status bits and applies to the T(test) input of the sequencer. One of the input of the multiplexer is always I to provide an unconditional branch operation
4. **A pipeline register**: speed up the control operation, Allows next address to be generated and the output of control memory to change while the control word in pipeline register initiates themicro-operations given by present microinstruction, It's not always necessary. The output of control memory can go directly to the control inputs of the various units in the CPU

Briefly explain, with diagrams, the different methods for control organization

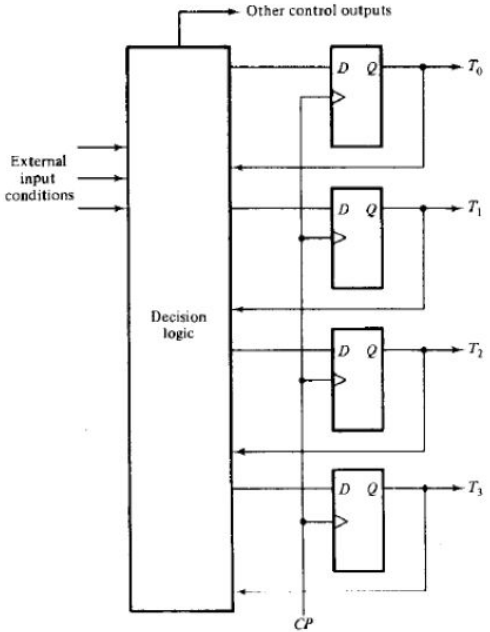
There are 4 different Methods:

- One flip-flop per state
- Sequence register and decoder method
- PLA control
- Micro-program control

One flip-flop per state:

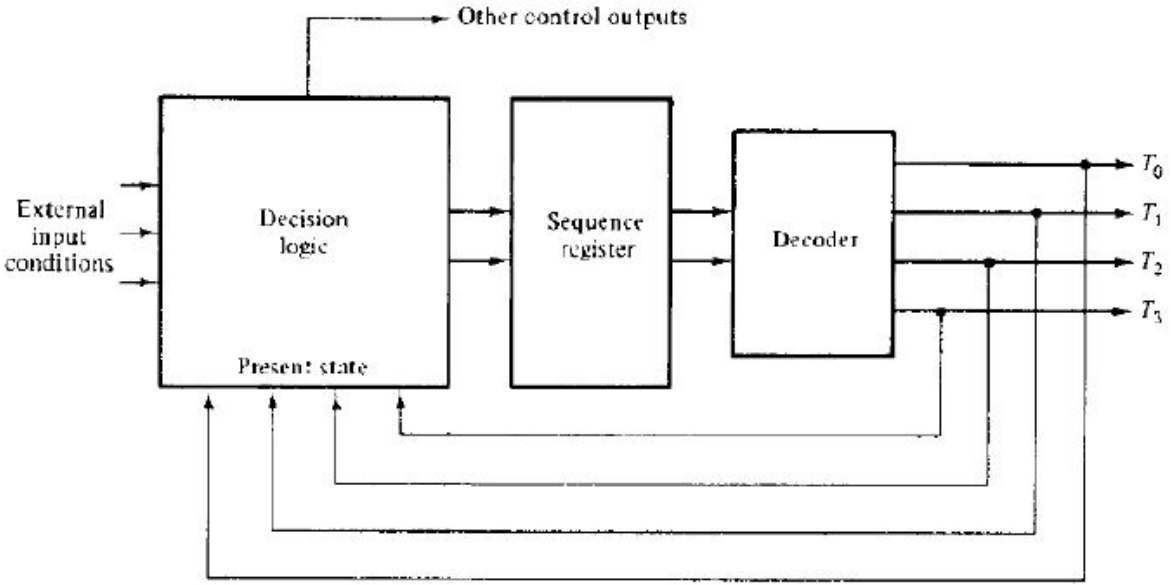
- One flip flop is at set state at any particular time while others are cleared
- A single bit is made to propagate under the control of a decision logic
- Each ff represents a state and is activated when a control bit is passed to it.
- At any particular time interval between two clock pulses, only one ff is equal to 0, all else are set to 1.
- The transition from the present state to the next state is a function of the present state.

In this method, maximum numbers of flip-flops were used. Example: A sequential circuit with 12 states requires a minimum of four flip-flops because 23< 12< 24. Control circuit uses 12 flip-flops, one fore each state



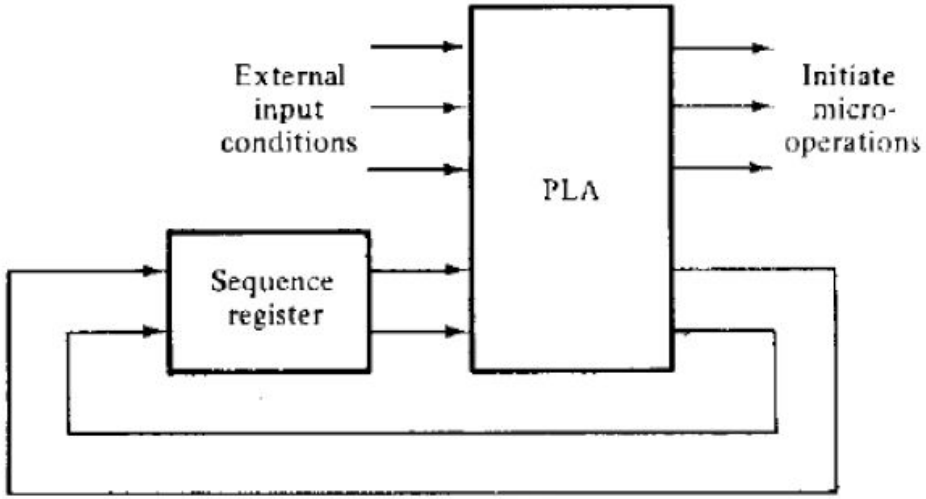
Sequence register and decoder method:

- Uses a register to sequence control states.
- Register is decoded to provide one output for each state.
- For a register having flip flops with n bits, the output will be 2^n output lines.
- The transition to the next state is a function of the present state as well as the external output.



PLA control:

- A PLA is used instead of a decoder
- By using a PLA it is possible to reduce the number of ICs and number of interconnection wires.
- The output is a function of the present state and the external input.
- There is no decision logic involved.
- It is cost effective.



Describe the steps in control logic design with the help of an example. (Example can be realised using either hardwired or microprogrammed control organization.)

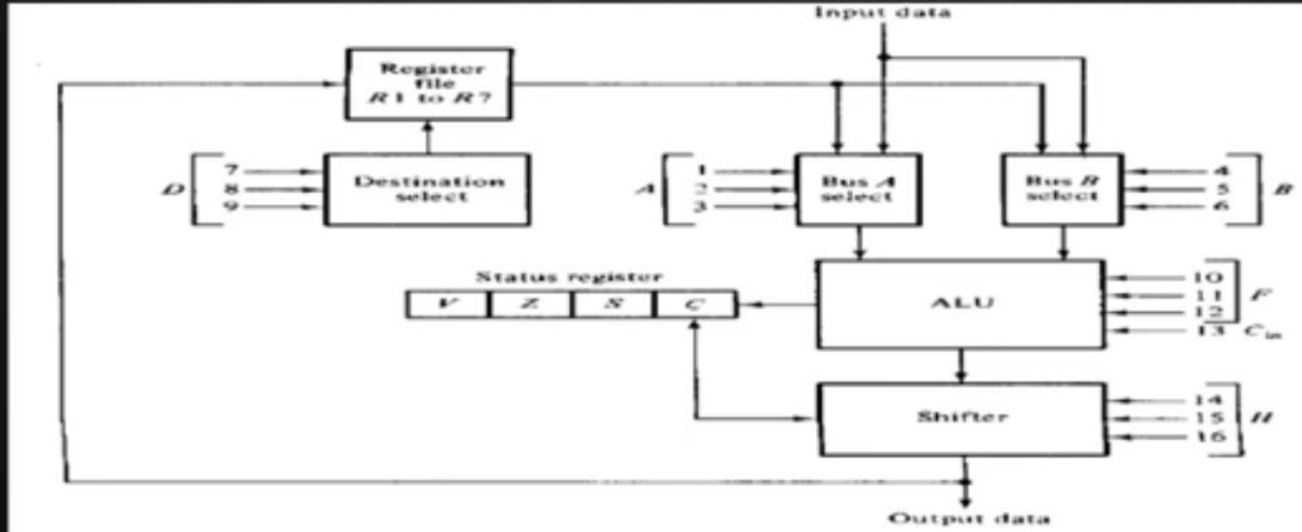
Hardwared Control logic design of sign-magnitude adder/subtractor.

Steps in control logic design

1. State the problem
2. Initial equipment configuration
3. Formulation of algorithm
4. Design of Data-processor part
5. Design of Control-logic

With the help of a block diagram, describe a complete processor unit with all components and appropriate control variables. Show with an example, how a control word for the processor can be defined.

Processor Unit with Control Variables



(a) Block diagram

(b) Control word

Draw the block diagram for the hardware that implements the following statement $x + yz$: $AR \leftarrow AR + BR$ where AR and BR are two n-bit registers and x, y, and z are control variables. Include the logic gates for the control function. (The symbol + designates an OR operation in a control or Boolean function and an arithmetic plus in a micro operation.)

6. Explain the terms processor stack, stack frame and frame pointer with relation to subroutine processing. Use a relevant example.