Computer Architecture
Assignment-1

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This assignment implements the IAS computer and it's three cycles – Fetch, Decode and Execute.

What my program does:
I have created an array of 6 positive integers and am finding the minimum number present in the array and the sum of all the 6 integers.
The code consists of an assembler and processor.
The assembler converts the instructions passed in assembly language to machine code and stores the respective values in memory.
The processor then uses this memory to go through the 3 cycles mentioned above – fetch, decode and execute for the instructions.

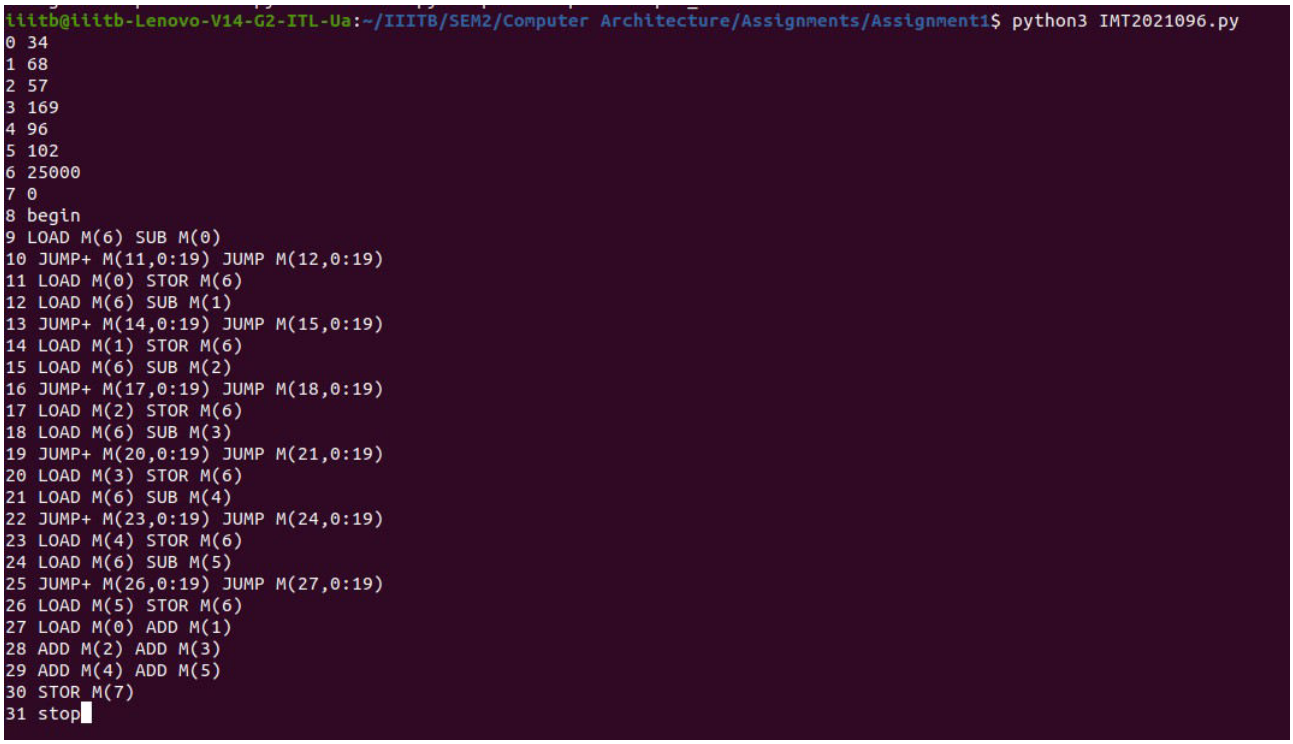
The registers I have used are as follows: (Have not used MQ)
PC : Program Counter – holds address of next instruction.
AC : Accumulator – holds the results of operations conducted by ALU.
MAR : Memory Address Register – Specifies address in memory of word to be written/read into MBR.
MBR : Memory Buffer Register - Contains a word to be read/stored in memory or I/O.
IR : Instruction Register – stores the Opcode of the instruction to be executed.
IBR : Instruction Buffer Register – Holds the RHS part of the 40 bit instruction.

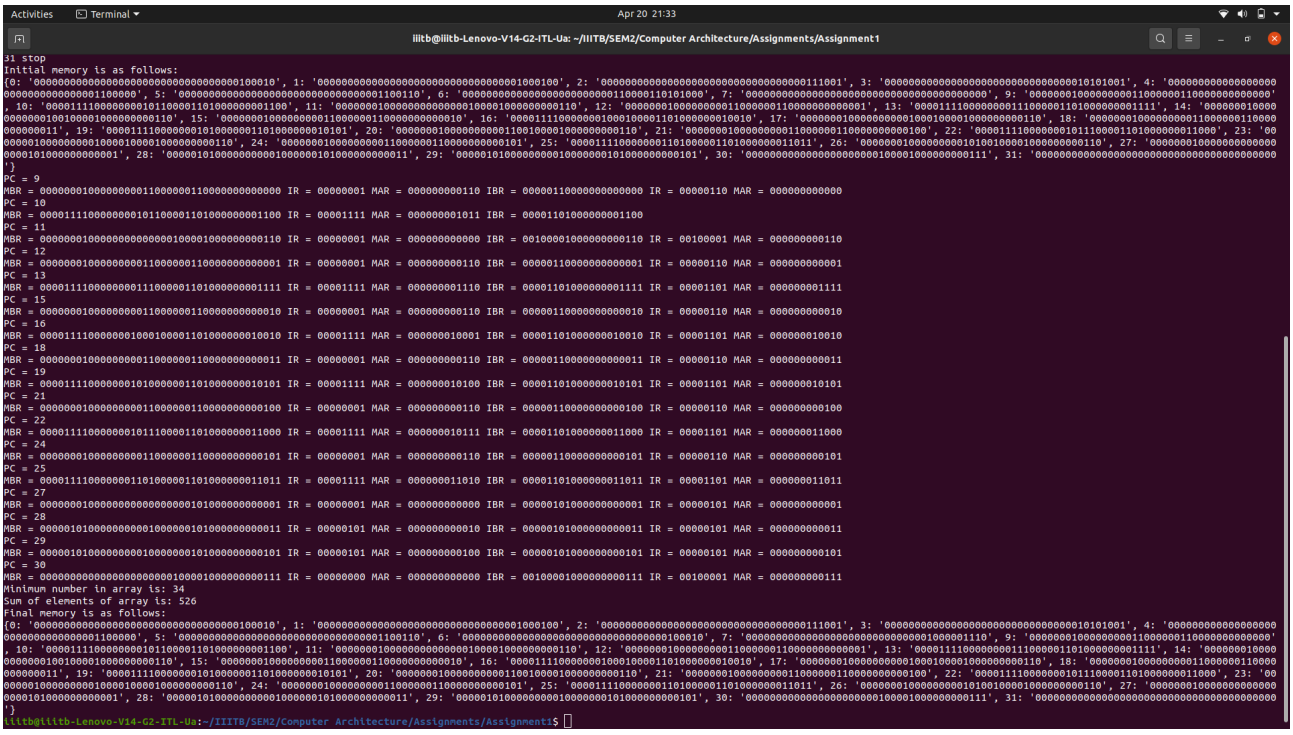
The instructions I have used are: (out of the 21 total instructions)
1) LOAD M(X) – stores contents in memory location X in accumulator(AC).
2) STOR M(X) – stores contents in AC into the memory location X.
3) ADD M(X) – adds value in memory location X to that in AC and stores result in AC.
4) SUB M(X) – subtracts value in memory location X from that in AC and stores result in AC.
5) JUMP+ M(X,0:19) – takes next instruction from LHS of M(X) if value in AC is greater than 0.
6) JUMP M(X,0:19) – takes next instruction from LHS of M(X) without checking for any condition.

Logic:
The program uses the first 6 memory locations(0-5) to store the positive integers and 6,7 to store the minimum value and the sum. I have stored 25000 in memory location 6 just so it is a large enough number for my comparison method to work and is simple.(The maximum number that can be used instead is 2^40-1)

I am loading value in memory location 6 and using the SUB instruction to subtract values in memory locations 0 till 5. Whenever value is greater than 0, it means the value in the corresponding memory location(whose value we subtracted from AC) is the minimum number up till that point. I then store this value in memory location 6 and repeat the same for all elements in the array. Finally, memory location 6 will store the minimum value.
I have used JUMP+ and JUMP instructions to check for this condition of AC.
The starting condition for the instructions is begin and ending condition is stop.

Memory location 7 is used to store the sum of all the elements of the array. This uses 3 lines of instruction, using just LOAD and ADD instructions.
The input and output has been stored in files as taking a screenshot of both together wasn't possible. The following are screenshots of Input and Output individually on terminal after running the code.





Running my program:
The file code.cpp is the equivalent of the IAS code but in the language C++. I have used the same values as my input file. Running the file IAS.py and pasting the input given in the input file will produce the desired output as given by code.cpp.