Lab Assignment 2 – CPU Design  

EQUIPMENT:  PC/Mac with ReTrO simulation system

EXPERIMENT 1 (8 points)
Build a working CPU with 16-bit data bus (8-bit op-codes, and 8-bit operands / 8-bit addresses). Use a 16-bit wide RAM module. Implement the following ALU/CU functions:

- \( 0 \) *  NOP  no operation
- \( 1 \) v  LOADC  load constant into accum.  \( acc := v \)
- \( 2 \) a  LOADM  load memory value into accum.  \( acc := mem[a] \)
- \( 3 \) v  ADDC  add constant to accumulator  \( acc := acc + v \)
- \( 4 \) a  ADDM  add memory value to accumulator  \( acc := acc + mem[a] \)
- \( 5 \) a  STORE  store accumulator to memory (high byte 0)  \( mem[a] := acc \)
- \( 6 \) a  BZ  branch cond. if acc = 0 to address a  if acc=0 then \( pc := a \)
- \( 7 \) a  BRA  branch unconditionally to address a  \( pc := a \)

EXPERIMENT 2 (2 points)
Write a program to calculate \( 1 + 2 + 3 \ldots + m \), for a given value \( m \) with \( m \geq 1 \).

Data locations:  value \( m \) in location \( \$A0 \)
result in location \( \$A1 \)

Algorithm:

\[ result = \sum_{i=1}^{m} i \]

clear result

loop:
  add mem[m] to result
  decrement mem[m]
  if (m \( \neq \) 0) branch to loop

done: branch to done /* finished: endless loop */