

## Problem 1

Taken from the text by Hennesy and Patterson

Compare the memory efficiency of 4 different architectural styles:

- Accumulator
- Memory/Memory: *All three operands of each instruction are in memory*
- Stack: *All operations occur on top of the stack. Only push and pop access memory and all other instructions overwrite the top of the stack with the result.*
- Load/Store: *All operations occur between registers and register-register operations have 3 operands per instruction (register specifiers). There are 32 registers (how many bits wide is each register specifier?)*

Use the following assumptions:

- The opcode is always 1 byte
- All memory addresses are 2 bytes
- All data operands are 4 bytes
- All instructions are an integral number of bytes in length
- In the following A,B,C, and D are variable names and are in memory.

A) Write the 4 code sequences for

$$A = B + C;$$

For each of the architectural types. Calculate the total number of bytes needed to store the code and the total number of bytes needed to execute the code (fetch of instructions and retrieval of data)

B) Repeat part A) for the code sequence

$$A = B + C;$$

$$B = A + C;$$

$$D = A - B;$$