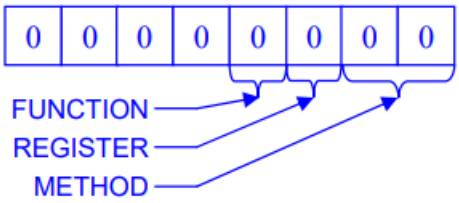
1. What opcode will blank memory initialized to 0x00 look like to the processor?

In binary, the opcode 0x00 is simply all zeros:



A function of 0 represent a store function, the register of 0 represents the accumulator (ACC), and the method of 00 indicates that the operand is an address. This means that the opcode 0x00 is:

STOR ACC, [address]

Assuming all memory is cleared, then the operand will also be 0x0000. Therefore, the final function will be:

STOR ACC, [0x0000]

2. Of the 256 possible opcodes we can get from and 8-bit opcode, how many are not being used in our instruction set, i.e., how many instructions could we add for future expansions of our processor?

My team listed all the 256 possible opcodes and found the operation for each one. It identified:

- **one branch opcode (0x17)**
- **special opcodes 0x1a, 0x1b, 0x1c, 0x1d, 0x1e, and 0x1f**
- **All the opcodes beginning with "001"**
- **All the opcodes beginning with a binary "01"**

We counted these opcodes and came up with 103 undefined opcodes.

My team also noticed that it shouldn't be possible to store a value into a constant, opcodes 0x01 and 0x05. We discounted the opcodes that had operands of three or more bytes. These totaled 18.

Therefore, we accepted answers in the range of 103 to 121.

3. What would we need to add to our simulator to be able to include the following instructions: compare ACC with a constant, PUSH to or PULL from the stack, and take the 2's complement of ACC?

Each of these operations would require an additional opcode assigned to that function. In the case of the 2's complement, this would be difficult because all of the opcode patterns are

already used for the mathematical/logical operations. The other two could be assigned to the "special operations" set without much problem though.

- **To compare ACC with a constant, there would need to be an additional register for the "virtual subtraction" and a set of flags to hold the result.**
- **For PUSH and PULL, at least one additional pointer register would be needed to point to memory where the stack would be contained. There would be no additional memory required, only a vector or pointer to where the stack was in existing memory. Stacks work out of the same memory in which code and data are stored.**

4. If executeInstruction() were divided into two parts, decode and execute, what additional global resources would be needed for your simulator?

To divide executeInstruction() into two parts, we would have to pass the results of the decode, i.e., what operation is being performed, to the execute function in order to perform it.