

CMPE 120 HW#4 NEW

1. Identify the addressing mode of each of the following instruction

1a. Load R2, [R3]

1b. Load R2, [100]

1c. Move R2, #6

<answer>1. The addressing modes are Register Indirect, Direct, Immediate respectively.

2. Which addressing mode is appropriate for implementing

$x = 5$ high level language statement.

If x is held in R1, illustrate your answer.

<answer>2. Immediate Addressing Mode. MOV R1, #5.

3. Write an assembly language program to compute

the sum of an 1024-element array A.

[Use index register and immediate addressing mode]

<answer>

MOV R1,#0 ; accumulate the sum in R1, initially 0

MOV R2,#A ; R2 = address of the array A

MOV R3,#A+4096 ; R3 = address of the first word beyond A

LOOP: ADD R1,(R2) ; register indirect through R2 to get operand

ADD R2,#4 ; increment R2 by one word (4 bytes)

CMP R2,R3 ; are we done yet?

BLT LOOP; if R2 < R3, we are not done, so continue

5.3. Design an expanding opcode to allow all the following to be encoded in a 32-bit instruction: 15 instructions with two 12-bit addresses and one 4-bit register number 650 instructions with one 12-bit address and one 4-bit register number 80 instructions with no addresses or registers

<answer> 3. It can be done by allocating the high-order 4 bits as the main opcode. 15 instructions use 0000 to 1110 in these bits, leaving 28 bits for the two addresses and the register. Opcode 1111 uses the first 12-bit address field to distinguish the 650 instructions. With 4096 opcode slots available, there is plenty of room. The zero-address instructions are encoded with 1111 in the main opcode and one of the $4096 - 650 = 3446$ unused numbers in the first address field.

5.5. Is it possible to design an expanding opcode to allow the following to be encoded in a 12-bit instruction? A register is 3 bits. 4 instructions with three registers 255 instructions with one register 16 instructions with zero registers

<answer> 5. No. The three requirements take $4 \times 8 \times 8 \times 8 = 2048$ opcodes, $255 \times 8 = 2040$ opcodes, and 16 opcodes, respectively, for a total of 4104 opcodes. A 12-bit word has room for only 4096, so there is no way to do it.

5. 6. Given the memory values below and a one-address machine with an accumulator, what values do the following instructions load into the accumulator? word 20 contains 40 word 30 contains 50 word 40 contains 60 word 50 contains 70

a. LOAD IMMEDIATE 20

b. LOAD DIRECT 20

c. LOAD INDIRECT 20

d. LOAD IMMEDIATE 30

e. LOAD DIRECT 30

f. LOAD INDIRECT 30

<answer> 6. The instructions load 20, 40, 60, 30, 50, and 70, respectively.