

## 4.3

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Program counter is used to store the location of next instruction to be executed. If there is no jump in the program, the program counter is equal to the number of instructions executed. But if there are jumps, it may be not equal to the number of instructions executed. But instruction pointer can show that it always points to the next instruction to be executed, so it's more insightful.

## 4.8

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- a.  $\lceil \log_2 225 \rceil = 8$  bits
- b.  $\lceil \log_2 120 \rceil = 7$  bits
- c. UNUSED bits have at most  $32 - 8 - 7 - 7 - 7 = 3$  bits.

## 4.9

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increment PC

## 4.19

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- a. MAR: 010  
MDR: 01010000
- b. 00111001

## 5.1

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- ADD: operate instruction, Addressing mode: immediate, register Use: add 2 registers or 1 register and a immediate number.
- JMP: control instruction. Addressing mode: register. Use: loads the PC with the contents of the register specified by the instruction.
- LEA: operate instruction, Addressing mode: immediate, register Use: loads the register specified by the instruction with the value formed by adding the incremented PC to the SEXT bits[8:0] of the instruction.
- NOT: operate instruction, Addressing mode: register Use: flip all bits of a register.

## 5.4

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- a. 8
- b. 6
- c. 6

## 5.9

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- a. ADD R1, R1, #0
- b. BRznp 1
- c. BR 0

a,c could be used for NOP.

The ADD instruction can be used to update the condition code with the content of R1.