



- a. What is the maximum directly addressable memory capacity (in bytes)?
76
- b. Discuss the impact on the system speed if the microprocessor bus has
 1. a 32-bit local address bus and a 16-bit local data bus, or
68
 2. a 16-bit local address bus and a 16-bit local data bus.

c. How many bits are needed for the program counter and the instruction register?

Solution:

a. $2^{(32-8)} = 2^{24} = 16,777,216 \text{ bytes} = 16 \text{ MB}$, (8 bits = 1 byte for the opcode).

b.1. a 32-bit local address bus and a 16-bit local data bus. Instruction and data transfers would take three bus cycles each, one for the address and two for the data. Since if the address bus is 32 bits, the whole address can be transferred to memory at once and decoded there; however, since the data bus is only 16 bits, it will require 2 bus cycles (accesses to memory) to fetch the 32-bit instruction or operand.

b.2. a 16-bit local address bus and a 16-bit local data bus. Instruction and data transfers would take four bus cycles each, two for the address and two for the data. Therefore, that will have the processor perform two transmissions in order to send to memory the whole 32-bit address; this will require more complex memory interface control to latch the two halves of the address before it performs an access to it. In addition to this two-step address issue, since the data bus is also 16 bits, the microprocessor will need 2 bus cycles to fetch the 32-bit instruction or operand.


c. For the PC needs 24 bits (24-bit addresses), and for the IR needs 32 bits (32-bit addresses).

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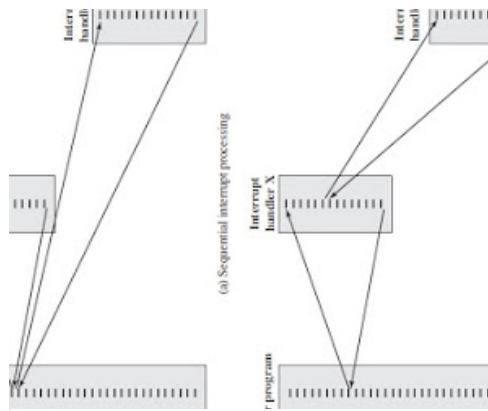
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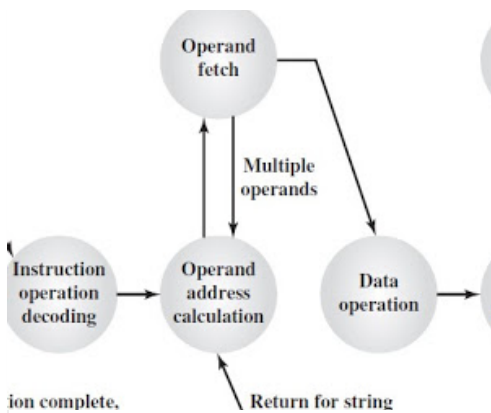
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