

Operating Systems – Fall 2003
Quiz Number 2 – Solution
August 13, 2003
10 Points (10 Minutes)

Name: _____ **SOLUTION**

Question:

Consider a hypothetical microprocessor generating a 16-bit address (for example, assume that the program counter and the address registers are 16 bits wide) and having a 16-bit data bus.

1. What is the maximum memory address space that the processor can access directly if it is connected to a “16-bit memory”?

With 16 bits to represent the memory address there are 2^{16} unique addressable locations.

With 16-bit memory each location contains 2 bytes of data. Hence the total memory directly accessible by the processor is 2^{16} locations X 2 bytes /location = 131,072 bytes or 128 k bytes.

2. What is the maximum memory address space that the processor can access directly if it is connected to an “8-bit memory”?

With 8-bit memory each location contains 1 byte of data. Hence the total memory directly accessible by the processor is 2^{16} locations X 1 byte/location = 65,536 bytes or 64 k bytes.

3. What architectural features will allow this microprocessor to access a separate “I/O space”?

Having separate instructions for I/O operations in the Instruction Set of the microprocessor would allow it to have a separate I/O space.

4. If an input and an output instruction can specify an 8-bit I/O port number, how many 8-bit I/O ports can the microprocessor support? How many 16-bit I/O ports? Explain.

With an 8-bit I/O port number the microprocessor can support $2^8 = 256$ unique 8-bit I/O ports.

With an 8-bit I/O port number the microprocessor can support $2^8 = 256$ unique 16-bit I/O ports.

The size of the I/O port does not affect the number of I/O ports because the number of I/O ports that can be supported only depends on the number of bits used to represent the I/O port number which in both cases is 8 bits.