EXERCISE #1

Assume the following computer system.

If the I/O controller communicates with the host computer system using interrupt, what is the maximum data throughput in “bits per second (bps)” for the following assumptions?

1. The system bus is a 16-bit bus.
2. Each context-switching requires 80μs.
3. Each data transfer using the system bus requires 5μs.
5. Ignore all other overhead.

EXERCISE #2 Complete the above table for comparing the three methods.

<table>
<thead>
<tr>
<th></th>
<th>Interrupt</th>
<th>Polling</th>
<th>DMA</th>
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</thead>
<tbody>
<tr>
<td><strong>Response Time</strong></td>
<td></td>
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<tr>
<td><strong>CPU Utilization</strong></td>
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<td><strong>Buffer Size</strong></td>
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<tr>
<td><strong>Cost</strong></td>
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</tbody>
</table>

- **Response Time** = Waiting time after a packet arrives
- **CPU Utilization** = Number of machine cycles
- **Buffer Size** = Size of buffer on a NIC
- **Cost** = Cost of a NIC
EXERCISE #3

Assume the following computer system.

- The I/O device currently holds 10MB of data to be transferred to the main memory.
- Each data transfer between the I/O device and the I/O controller takes $100\mu s$.
- Each data transfer using the internal bus takes $100\mu s$.
- The I/O device and the I/O controller are connected by 16-parallel wires (16 bits can be transferred in one shot).
- The I/O controller, the processor and the memory are connected by 16-parallel wires (16 bits can be transferred in one shot).
- Each context switching takes the processor $50\mu s$.
- Each interrupt transfers 16bits while DMA can transfer any number of bits (but a multiple of 16 bits) in one DMA transfer session.
- Ignore any other overhead

**Question**: How long will it take to complete data transfer using interrupt and DMA?

**Note**:  
- B = “byte”  
- b = “bit”  
- M = $10^6$  
- 1 second = 1,000ms and 1ms = 1,000$\mu s$