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>Response Time</td>
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<tr>
<td>CPU Utilization</td>
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<td>Buffer Size</td>
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<td>Cost</td>
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</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 100μs.
- Each data transfer using the internal bus takes 100μs.
- 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 50μs.
- 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 = 1,000μs