School of Computing Science

CSC1104 – Computer Organisation and Architecture

Laboratory/Tutorial 4:
Input/Output and Operating System (OS)

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Labs to be worked in Wednesday morning:

Labs Questions:

1. Consider a system using interrupt-driven I/O for a device that transfers data at average of 8 KB/s on a continuous basis. Assume interrupt processing takes about 100 μs (i.e., the time jump to ISR, execute it, return to main program). Determine what fraction of CPU time is consumed by this I/O device if it interrupts for every byte.

2. A system with a bus cycles 500 ns. Transfer of bus control from CPU to I/O device or vice versa, takes 250 ns. One I/O device has a transfer rate of 50 KB/s and employs DMA. Data are transferred 1 byte at a time.

   a) For DMA ***burst mode***, DMA module gains bus mastership prior to the start of a block transfer and maintains bus control until the whole block is transferred. How long would it occupy the bus to transfer a block of 128 bytes?

   b) Repeat the calculations for the DMA ***cycle stealing mode***. How long would it occupy the bus to transfer a block of 128 bytes?

Labs to be worked in Thursday afternoon:

3. Develop an SEC code for a 16-bit data word. Follow the same procedure of Example 3.4 on Page 20 of Lecture Notes 3, calculate the Hamming code, i.e., the syndrome word for the data word 0101000000111001. Please draw the table first to indicate the positions of each check bit and data bit.

   Typing the solution procedure in a Microsoft Word document, show that the Hamming code can correctly identify an error in data bit 4.

4. Hamming code algorithm is able to detect single error and correct the single error. Develop a C program for the Raspberry Pi, to implement a Hamming SEC code for 8-bit data stream (8 bits data). Reference to Example 3.4 on Page 20 of Lecture Notes 3.

   The inputs to be typed by users into the C program are:
   (1). The data stream without error.
   (2). The data stream with 1-bit error.

   For example, the user type these input to the C program:
   (1). The data stream without error: 00110011.
   (2). The data stream with 1-bit error: 00100011.

   The outputs from the C program (please use printf(" ") command;) are:
   (1). The check bits of the correct data stream, in the format of C8 C4 C2 C1.
   (2). The check bits of the data stream with 1-bit error, in the format of C'8 C'4 C'2 C'1.
   (3). The syndrome word, in the format of C''8 C''4 C''2 C''1.
   (4). Which position in the table including data bits and check bits gets error.

   Please download the Hamming code base from LMS xSite. Some of the codes have been provided. Please work on those missing part codes, and compile and execute it on your Raspberry Pi.