

HOMEWORK ASSIGNMENT #1
Due Wednesday, February 4th, 2009

*Be sure to put your homework **team number** and all members' **names** on the first page of your homework submission.*

1. (10 points) Memory Structures

A. For each of the below memory structures, express the memory size in bytes using the appropriate prefix (K, M, G, etc).

- a. 4096 x 4b
- b. 8192 x 12b
- c. 2097152 x 32b
- d. 8589934592 x 64b

B. For byte-wide memories of sizes 1.5kB, 1.5MB, 1GB, and 1TB, what is the number of memory locations and the range of addresses for each device, all expressed in hexadecimal. How many address bits does each device require?

2. (15 points) Memory Construction

Use SN74LVTH574 and SN74LVC1G139 devices to create a 4 x 8b SRAM. Obtain datasheets for them from Texas Instruments, Inc. Your circuit should have the following external connections; A[1:0], D[7:0], /WR, /RD. You may draw the schematic by hand (neatly), or use one of the many CAD programs available. Use the minimum number of devices and additional gates to complete the circuit.

3. (15 points) Memory Operation

A. For the circuit you designed in #2 above, draw the waveforms (/WR, /RD, A[1:0], D[7:0]) that would be required to perform the following sequence of operations.

- 1) write the value 0xA5 into the register at address 1
- 2) write the value 0xCC into the register at address 2
- 3) read the value in the register at address 1
- 4) read the value in the register at address 2

Ensure that any expected or required signal delays are made obvious on your diagram. Annotate your drawing to clearly indicate what is happening.

Draw vectors (multi-bit signals like A[1:0] & D[7:0]) as single busses (not bit blasted).

B. What does it mean when we say a signal is active-high or active-low? Are there any active-low signals in your memory system?

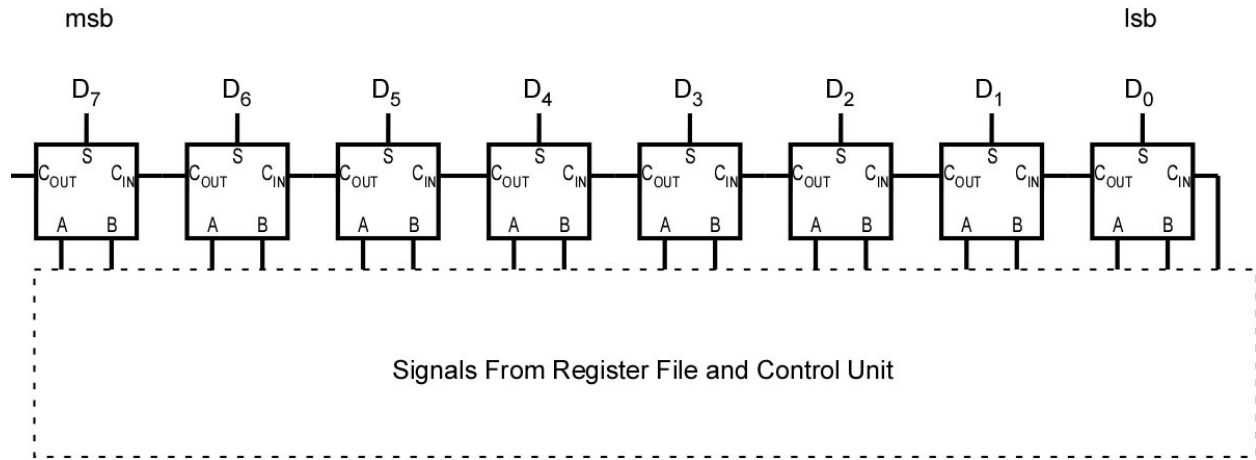
4. (10 points) Memory Map

A microprocessor generates 22-bit memory addresses. Draw a byte-wide memory map of its address space with boundaries specified in hexadecimal. A 1MB ROM is located in the memory address space ending at the highest possible address. A 512kB block of memory mapped I/O is located at base address 0x180000. A 256kB RAM is located at the lowest memory addresses. Show all of these devices in the memory map with their boundaries labeled in hexadecimal. How large is the total memory space?

5. (15 points) Flags Register

Microprocessors typically have a flags register (also commonly called a condition codes register or processor status register) where certain information about recent operations is stored. Common information includes whether there was an arithmetic overflow (for unsigned and signed operation), if the result was negative, and if the result was zero. (In the ARM7, these correspond to the CPSR register's C (unsigned overflow), V (2's-complement overflow), N (negative), and Z (zero) bits.) Assume that a microprocessor's ALU has an 8-bit adder as shown below.

- A. Draw logic to show how the four ARM flag bits can be efficiently generated.
- B. Explain how arithmetic overflow is detected for unsigned and signed operations, with examples.



6. (10 points) Memory Endian-ness

The value 0x3FC84 is to be stored in memory as a 32-bit value at address 0x0004 0128. Using small segments of a byte-wide memory map, show how it will be stored into memory in both a little-endian and big-endian system.

7. (15 points) Microprocessor Architectures

- A. Explain the fundamental difference between a Von Neumann and a Harvard architecture.
 - i. List an one advantage and one disadvantage of each type
 - ii. A PIC18F1320 is an example of what type (find the data sheet on-line)
 - iii. Name a processor of the other type (opposite of what the PIC18F is)
- B. What are the relative advantages/disadvantages of RISC versus CISC architectures?

8. (10 points) Quiz Question Development

Design one original quiz question operating at Bloom's Taxonomy level 3 for any material covered in Module 1. This must test one of the module objectives in a specific problem. **Explicitly state which particular objective you are attempting to test.** Provide a complete and detailed solution to your question.