

CS430 Problem Set #4

Date assigned: 3/11/15
Date due: 3/19/15 by 1pm
Points: 50

Show all work when answering each question for full credit.

Consider the following byte-addressable memory with 256 bytes where a memory dump yields the following:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0F	80	6D	F8	E6	5D	7E	A1	2B	3C	9B	F9	B1	9B	5C	2A
1	3D	C4	9A	1B	D6	B6	0A	A6	F5	E7	9C	1B	B0	E5	A6	7F
2	6A	0C	4C	7E	7C	9D	A2	D7	9B	0F	0A	9F	A2	6C	9C	9B
3	D5	3D	3F	1F	E6	1A	F5	B2	D2	C0	D6	E0	3E	D9	F7	E1
4	4C	8F	A0	5F	0A	D6	5E	2C	F5	3E	9F	E6	0C	8D	9F	F2
5	A9	0F	5F	5D	9D	C5	6D	5E	A1	0A	B7	B6	D5	D4	A7	F9
6	5E	0E	4A	E5	C2	6E	4F	E6	A3	D0	5F	2D	E2	A6	1C	A5
7	0D	E2	F9	C7	3B	2C	5D	A7	6F	A3	0E	C7	E0	D4	F1	4B
8	D8	9F	1F	8E	B9	1E	1B	4E	2F	A6	2A	3A	3B	6B	D8	2E
9	C8	E4	E6	8E	8D	F9	E9	B3	0F	7C	B6	0C	0F	3D	A0	B4
A	F0	2B	5B	A2	A5	6D	B5	F6	8F	C2	1B	0A	9A	1C	B4	4A
B	7F	F2	E2	E3	2A	8A	8F	F9	C4	A3	0D	C7	5D	D8	2F	9F
C	E5	C3	4F	D3	E1	5E	E9	D9	D2	A1	A6	3A	0E	E1	4D	A3
D	D7	B0	D7	A9	A9	5E	A7	D6	4D	D8	A2	9E	7C	7F	F1	4C
E	A4	5D	9E	D9	E4	6F	D2	C1	7B	0D	B9	0B	D0	8B	C0	B7
F	7D	9D	E2	0E	2B	9E	C6	4D	6A	8C	7C	0A	D9	B4	B0	C6

Each memory cell address is determined by its row and column, so for instance, the value at address 0xA1 is 2B. The system that produced this memory dump contains 4 lines of cache where each line contains 8 bytes. Assume that the following sequence of memory accesses take place: 0x2C, 0x6D, 0x86, 0x29, 0xA5, 0x82, 0xA7, 0x68, 0x80, and 0x2B.

Answer each of the following questions:

- 1) (6 pts) Assuming a direct mapped cache
 - a) Show the format for a main memory address.
 - b) What does the cache look like after the 10 memory accesses have been made? Draw the cache showing the contents of the cache including the tags.
 - c) What is the hit rate for this cache on the given sequence of memory accesses?
- 2) (6 pts) Assuming a fully associative cache
 - a) Show the format for a main memory address.

- b) What does the cache look like after the 10 memory accesses have been made assuming the data are loaded into the cache in the first available location and a FIFO replacement strategy is used. Draw the cache showing the contents of the cache including the tags.
- c) What is the hit rate for this cache on the given sequence of memory accesses?
- 3) (9 pts) Assuming a 2-way set associative cache
- a) Show the format for a main memory address.
- b) What does the cache look like after the 10 memory accesses have been made assuming an LRU replacement strategy? Draw the cache showing the contents of the cache including the tags.
- c) What is the hit rate for this cache on the given sequence of memory accesses?
- d) If a cache hit retrieves a value in 5ns and a main memory access requires 25 ns, what is the average effective access time for this cache assuming that all memory accesses exhibit the same hit rate as the sequence of the 10 given.
- 4) (6 pts) Consider adding the two 8-bit contents at 0x00 and 0x01
- a) Interpret the result as an unsigned decimal number.
- b) Interpret the result as a signed two's complement number.
- c) What is the value of CF and OF?
- 5) (6 pts) Consider subtracting the two 8-bit contents at 0x00 and 0x01
- a) Interpret the result as an unsigned decimal number.
- b) Interpret the result as a signed two's complement number.
- c) What is the value of CF and OF?
- 6) (7 pts) The "number of numbers" counts how many unique numbers can be represented. For instance, the number of numbers for an 8-bit 1's complement representation is 255 as there are two representations of zero while the number of numbers for an 8-bit unsigned representation is 256. For the IEEE 754 single-precision floating-point number, what is the "number of numbers" excluding infinity and NaN? Give your answer as a power of 2 formula and show how you arrived at your solution.
- 7) (10 pts) Assume a 16-bit representation of the IEEE 754 floating-point number exists with a sign bit, a 4-bit exponent, and an 11-bit mantissa (significand).
- a) Give a general formula for the largest negative value that can be represented using this format. That is, what is the negative value closest to zero?
- b) What is -17.2 using this format? Give your answer in HEX.

Note1: Please make sure your problem sets are typed, answered in order, and stapled together.

Note2: A hard copy of your Problem Set Solution is due to me no later than Thursday, 3/19/15 by 1pm. Also, place a copy of this solution 04PUNetID.pdf in the CS430 Drop Box by that day and time.