CSCI 2330 – Associative Caching Exercises

1. Consider an associative cache of effective size **C** bytes (i.e., the number of data bytes the cache can hold), where **S** is the number of sets, **E** is the number of lines per set, and **B** is the block size in bytes. Write an expression for E in terms of S, B, and/or C. You may find it easier to first write an expression for C using the other terms.

2. Consider a cache with (S, E, B) = (8, 2, 4), an 8-bit word size, and the partial contents shown below. In this cache, a single LRU bit indicates which line in each set was least recently used (LRU): if the LRU bit is 0, then the 1st line is LRU, while if the LRU bit is 1, then the 2nd line is LRU. For each of the following memory operations, indicate whether a cache hit or miss occurs, as well as any updates to the affected cache set. Consider each operation from the same starting contents shown below.

    a. Read 11100100 (Value: 9)

    b. Read 11100000 (Value: 17)

    c. Read 01100100 (Value: 7)

    d. Write 01000100 (Value: 10)

    e. Write 01100000 (Value: 2)

Set #	LRU	V	D	Tag	Data (4 Bytes)	V	D	Tag	Data (4 Bytes)
0	1	0	0	111	4	1	0	001	17
1	0	1	1	111	9	1	0	010	5
2				...	...			...	...
3									
4									
5									
6									
7									

3. Pick the word that correctly completes the following statement (and explain why):

    Two adjacent blocks of memory (e.g., the 4-byte blocks starting at addresses 64 and 68, respectively) **[must / may / cannot]** *be stored in the same cache set of an associative cache. Assume that the cache is *not* fully associative.*