SYSC 4507 Assignment 2

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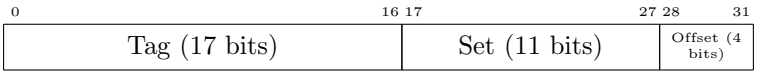
1. (a) If a set can hold up to 8 blocks of memory, then this cache is 8-way set associative.

   (b) 4 GB of memory means addresses are 32 bits long ($4\,\text{GB} = 2^{32}$). Each block contains $16 = 2^4$ bytes, so 4 bits are needed to specify the offset, and 28 bits in total are used for the tag & set. It is given that the tag size is 17 bits, so the number of set bits is $28 - 17 = 11$.



   (c) The size of this cache is given by the number of lines in the cache, times the size of a block:

$$\text{cache size} = n_{\text{lines}} \times s_{\text{block}}$$

$$n_{\text{lines}} = n_{\text{sets}} \times n_{\text{blocks per set}} = 2^{11} \times 2^3$$

$$n_{\text{lines}} = 2^{14}$$

$$\text{cache size} = 2^{14} \times 2^4$$

$$\text{cache size} = 256\,\text{KiB}$$

   (d) The given tag value of 3D gives tag bits 0 0000 0000 0011 1101. Lines 0-7 map to set 0, lines 8-15 map to set 1, so line 16 maps to set 2. So, the set bits for a cache hit will be 000 0000 0010. Finally, the second word would require offset bits 0001. So the final address resulting in a cache hit is 0000 0000 0001 1110 1000 0000 0010 0001, or 0x001E8021.

2. The effective access time of the memory hierarchy is:

$$EA = 0.85(2\,\text{ns}) + 0.15(0.94(2\,\text{ns} + 60\,\text{ns}) + 0.06(2\,\text{ns} + 60\,\text{ns} + 12\,\text{ms}))$$

$$EA = 0.108\,\text{ms}$$