CSCI 2330 — Cache Exercises

1. Consider a direct-mapped cache with two lines and 16-byte blocks. For each of the six accessed address below, record the memory-block number, cache set, and **H** or **M**. For each miss, record the block evicted if a block was evicted. The cache is initially empty.

   ```
   0, 4, 16, 32, 20, 8
   ```

2. Consider a two-way set-associative cache with a total size of 256 bytes and a block size of 16 bytes. Recall that **C = S × E × B**, where C is the total size, S is the number of sets, E is the number of lines per set, and B is the number of bytes per block.

   a. Calculate the total number of cache lines.

   b. Calculate the number of cache sets.

3. Consider a direct-mapped cache with eight lines and 1-byte blocks. For each accessed address below, record whether the access is a **H** (hit) or **M** (miss). For each miss, record the block evicted if a block was evicted. The cache is initially empty.

   a. Eight addresses read in a cycle:

   ```
   5, 7, 6, 2, 1, 4, 3, 0,
   5, 7, 6, 2, 1, 4, 3, 0,
   5, 7, 6, 2, 1, 4, 3, 0
   ```

   Repeat the exercise for the addresses below, again assuming that the cache is initially empty.

   b. Ten addresses read in a cycle:

   ```
   8, 3, 6, 2, 7, 5, 1, 9, 0, 4,
   8, 3, 6, 2, 7, 5, 1, 9, 0, 4,
   8, 3, 6, 2, 7, 5, 1, 9, 0, 4
   ```

4. Consider a four-way set-associative cache (i.e., **E** = 4 lines per set) with **S** = 2 sets, **B** = 1-byte blocks, and LRU replacement with total cache size **C** = 8 bytes. For each accessed address below, record whether the access is a **H** (hit) or **M** (miss). For each miss, record the block evicted if a block was evicted. The cache is initially empty.

   a. Four addresses read in a cycle:

   ```
   24, 0, 16, 8,
   24, 0, 16, 8,
   24, 0, 16, 8
   ```

   Repeat the exercise for the addresses below, again assuming that the cache is initially empty.

   b. Five addresses read in a cycle:

   ```
   24, 16, 32, 8, 0,
   24, 16, 32, 8, 0,
   24, 16, 32, 8, 0
   ```