CS 429H
Assignment 5

This assignment covers material from class and in Chapters 6 of "Computer Systems: A Programmer's Perspective". Familiarity with the reading in this chapter is essential.

Your assignment is to provide solutions for Chapter 6 problems 6.30, 6.31, 6.32 6.42, and to answer the following questions.

Questions:

1. Give one advantage and one disadvantage of increasing the associativity of a cache.
2. Give an example reference stream that has a higher hit rate on a 2-way set associative cache relative to a direct mapped (1-way set associative) cache.
3. Given the following access times and hit rates, what is the average memory access time of the system?
   - L1: 90% (5 cycles)
   - L2: 98% (300 cycles)
   - Main Memory: 99.9% (1000 cycles)
   - Disk: 100% (10,000,000 cycles)

   What is the element contributing the most to the access time?

4. You are trying to appreciate how important the principle of locality is in justifying the use of a cache memory, so you experiment with a computer having an L1 data cache and a main memory (exclusively focusing on data accesses). The latencies (in CPU cycles) of the different kinds of accesses are as follows: cache hit, 1 cycle; cache miss, 105 cycles, main memory access with cache disabled, 100 cycles.

   - When you run a program with an overall miss rate of 5%, what will the average memory access time (in CPU cycles) be?
   - Next you run a program specifically designed to produce completely random data accesses with no locality. Toward that end, you use an array of size 256MB (all of it fits in main memory). Accesses to random elements of this array are continuously made (using a uniform random number generator to generate the elements' indices). If your data cache size is 64KB, what will the average memory access time be?
   - If you compare the result obtained in part (2) with the main memory access time when the cache is disabled, what can you conclude about the role of the principle of locality in justifying the use of cache memory.

Only electronic submissions will be accepted. Electronic submissions must be in text (.txt) or pdf formats. Turnin your assignment using Canvas by 11:59 pm, April 18, 2014.