CE/CZ 4123 Big Data Management Tutorial 4
Cache Conscious Designs

Question 1

We have a 12-integer array in main memory as follows
1, 3, 5, 2, 4, 6, 4, 6, 8, 9, 11, 12
Let cache size be the size of 6 integers, and cache line size (transfer unit) be the size of 3 integers. Suppose initially the cache is empty, and there is a program sequentially accessing the whole array. The cache replace mechanism is the same as in the lecture notes: i.e., first cached first evicted.

(1) After the execution of the program, what are the final values stored in the cache? Please give the cache state after every access of the array element.
(2) How many cache hits and cache misses during the program execution? Please give the hit/miss state after every access of the array element.

Question 2

Suppose we have a 2-dimentional integer array A[N][N]. We consider the two ways of array scanning: row-by-row and column-by-column. Let cache size = 5000 integers.

(1) If N>5000 and cache line size (transfer unit)=100 integers, please give a formal analysis of the cache hits/misses of the two ways of writing codes.
(2) If N=250 and cache line size (transfer unit)=500 integers, please give a formal analysis of the cache hits/misses of the two ways of writing codes.

Question 3

We have an 8-integer array A in the main memory. Let cache size be 4 (integers), and cache line size be 2 (integers). Suppose that initially the cache is empty, and the cache replacement policy is the same as the one introduced in the lecture notes, i.e., first cached first evicted.

Let the round-trip scanning be scanning an array in the order from the beginning to the end (i.e., A[0] to A[7]), and then from the end to the beginning (i.e., A[7] to A[0]). How many cache hits and cache misses during the round-trip scanning? Please explain your answer.