Homework 1

Problem 1

Suppose we have a hard disk with:

512 B sector size

206 Sectors per track in average

50864 tracks per surface

2 surfaces per platter

14 platters per disk

A. What is the capacity of disk in GB? Please use the unit conversion 1KB=1024B and similar conversions on MB and GB.

B. The manufacturer claims it to be a 146.8GB hard disk. If you didn't make anything wrong in the first sub-problem, the actual capacity is smaller than the claimed one.

   a) Why could there be such a difference?

   b) How much percentage of capacity is lost between the actual one and the claim one?

Problem 2

Suppose that a 1MB file consisting of 512-byte logical blocks is stored on a disk drive with the following characteristics:

Rotational rate: 10,000 RPM

$T_{avg\ seek}$: 5 ms

Average # sectors/track: 1000

Surfaces: 4

Sector size: 512 B

For each case below, suppose that a program reads the logical blocks of the file sequentially, one after the other, and that the time to position the head over the first block is $T_{avg\ seek} + T_{avg\ rotation}$.

A. Best case: Estimate the optimal time (in ms) required to read the file given the best possible mapping of logical blocks to disk sectors (i.e., sequential).

B. Random case: Estimate the time (in ms) required to read the file if blocks are mapped randomly to disk sectors.

Problem 3

Permute the loops in the following function so that it scans the three-dimensional array a with a stride-1 reference pattern.

```
1.  #define N 8
2.  int sumarray3d (int a[N][N][N])
3.  {
4.       int i, j, k, sum = 0;
5.
6.       for (i = 0; i < N; i++) {
7.           for (j = 0; j < N; j++) {
8.               for (k = 0; k < N; k++) {
9.                   sum += a[k][i][j];
10.              }
11.          }
12.      }
```