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CS143 Homework #4

1. a. Total capacity can be found by multiplying the units out.

   6 surfaces * 10000 cylinders (or tracks/surface) * 500 sectors/track * 1024 bytes/sector = 30000000 KB
   = 30000 MB
   = 30 GB

   b. Access Time = Seek Time + Rotational Delay + Transfer Time
   = 10 ms + 10/2 ms [since it's average] + 0.02 ms
   = 15.02 ms

   We need to calculate Transfer Time given:
   1/500 track/sector

   10/500 ms = 1/50 ms = 0.02 ms

   c. Each tuple uses 2 + 4 + 4 + 4 + 4 + 4 + 30 + 20 = 72 bytes
   One disk sector or block holds 1024 bytes
   Therefore, 1024/72 (floor) = 14 means a block can hold 14 tuples

   We have 1000 tuples to hold.
   Therefore, 1000/14 (ceiling) = 72 means we need 72 disk blocks

   d. In order to run this query for sequential blocks, we need to set disk head, then go through all 72 blocks.

   Time = Seek Time + Rotational Delay + Transfer Time [all blocks]
   = 10 ms + 5 ms + 72(0.02 ms)
   = 16.44 ms

   e. We have to re-seek and rotate through the front of each sequential block for a total of 24 times, then transfer for each of the 3 sequential blocks.

   Time = Seek Time + Rotational Time + 24 Transfer Time + …
   = 24(10 ms) + 24(5 ms) + 72(0.02 ms)
   = 361.44 ms

   f. We know the query will return 10 classes. But the B+ tree does not group up our class tuples in the memory, so we are looking at 10 random I/Os rather than the previous sequential I/Os. Therefore, there is no benefit to making a B+ in this case.

   10(10 ms + 5 ms + 0.02 ms)
   = 150.2 ms

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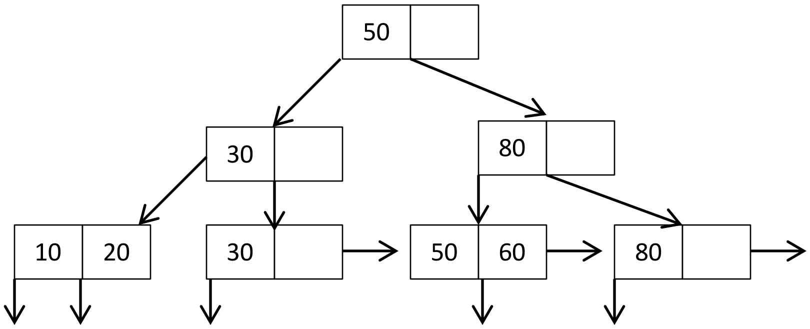
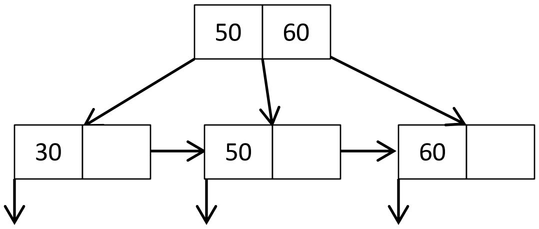
2. a. After we insert 60, 20, and 80:



b. After we delete 20, 10, and 70:



3. B+ tree with 300 records and n=5; find min/max heights:

Minimum:
Level 1: 4 records
Level 2: 5(4) = 20 records
Level 3: 5(4)(4) = 80 records
Level 4: 5(4)(4)(4) = 320 records

We need a minimum of 4 levels in order to fit 300 records.

Maximum: [both leaf/non-leaf need 3 pointers to prevent underflow]
Level 1: 2 records
Level 2: 6 records
Level 3: 12 records
Level 4: 24
Level 5: 48
Level 6: 96
Level 7: 192
Level 8: 384

We can reach a maximum of 7 levels by having 2 records and 3 pointers in each leaf at the very bottom.

4. We did not cover extendible hash tables in class.