Gradiance Online Accelerated Learning

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Help

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Your score: 4

Storage

1. Consider a hard disk with the following specifications.

- 3.5in diameter
- 3840 RPM
- 10 platters, and 2 surfaces each platter
- Usable capacity: 10GB
- Number of cylinders: 256
- 1 block = 4 KB
- 20% overhead between blocks (gaps)
- Average seek time: 20 ms.

Compute the following numbers:

1. What's the average time to access a block?
2. What's the average time to read 4 adjacent blocks?
3. What's the average time to read one track? Assume we must start the reading from the "start position" of the track.

Which of the following is true?

a) The average time to read 4 adjacent blocks is approximately 40.42 ms

b) The average time to read a track is approximately 50.81ms

c) The average time to read 4 adjacent blocks is approximately 20.08 ms

d) The average time to read a track is approximately 43.44ms

Answer submitted: **c)**

Your answer is incorrect.

It can be computed by adding the average seek time, the average rotational delay, and the time of reading 4 blocks with 3 gaps. See Sect. 13.2.3 (p. 564) for a discussion of how to calculate disk-access time.

Question Explanation:

First let's compute the following numbers:

1. The transfer time for a block without a gap can be computed as: 0.8 * 60s / (3840 * 512), where 0.8 is the ratio of the non-gap (data) region in one block, 60s is one minute, 3840 is the number of rotations per minute, and 512 is the number of blocks per track.
2. The transfer time for a block with a gap can be computed by dividing the time without a gap by 0.8.

3. The average rotational delay is approximately 7.8ms. It's half of a rotation, which is 60secs/3840RPM.

Now consider the three questions:

1. The average time to access a block is approximately 27.84ms. It is the summation of the average seek time (20ms), average rotational delay (7.81ms, half of a rotation), and the transfer time of reading a block without a gap.
2. The average time to read 4 adjacent blocks is approximately 27.93 ms. It can be computed by adding the time of reading the first block (see the first question) and the time of reading the next three blocks with gaps.
3. The average time to read a track is approximately 43.44ms. It can be computed by adding the average seek time, the rotational delay, and the time of one rotation.

The correct choice is: **d)**

2. Consider a four-level B-tree; that is, there is one leaf level and three nonleaf levels. When we talk about leaf nodes, we do not include the sequence pointer (pointer to next leaf to the right). Assume that nodes have slots for 100 keys. Calculate the maximum and minimum numbers of pointers and keys at the root, the leaves, and at interior nodes other than the root. What are the minimum and maximum number of records that are indexed by this B-tree? Which of the following statements is true?

a) The minimum number of indexable records is 125,000.

b) The minimum number of pointers for a nonleaf, nonroot node is 50.

c) The maximum number of pointers for a leaf, nonroot node is 100.

d) The minimum number of keys for a nonleaf, nonroot node is 51.

Answer submitted: **c)**

You have answered the question correctly.

Question Explanation:

If *n* is the number of slots for keys in a node, then the relevant limits are:

	Max Ptrs	Max Keys	Min Ptrs	Min Keys
Non-leaf (nonroot)	n + 1	n	ceil((n+1)/2)	ceil((n+1)/2)-1
Leaf (nonroot)	n	n	floor((n+1)/2)	floor((n+1)/2)
Root	n + 1	n	2	1

For the case *n*=100, as in this problem:

	Max Ptrs	Max Keys	Min Ptrs	Min Keys
Non-leaf (nonroot)	101	100	51	50
Leaf (nonroot)	100	100	50	50
Root	101	100	2	1

3. Suppose blocks of 1024 bytes are used to store variable-length records. The header of the block will have one 8-byte pointer to each record, and 24 other bytes for fixed data, including a count of the number of records currently in the block. Records may begin at any multiple of 4 bytes. Determine the constraint involving the number of records and the total length of the records that allows a set of records to fit on one block. Demonstrate your understanding by identifying which of the following combinations of records will fit in such a block.

a) 10 records of 40 bytes each and 10 records of 48 bytes each.

b) A record of 152 bytes, a record of 256 bytes, a record of 352 bytes, and 7 records of 24 bytes each.

c) Fourteen records of sizes 8, 16, 24, 32,...,112.

d) 5 records of 96 bytes each and 4 records of 120 bytes each.

Answer submitted: **c)**

You have answered the question correctly.

Question Explanation:

There are 1000 bytes to store records and the 8-byte pointer to the records. As a result, a record of n bytes consumes n+8 (rounded up to the nearest multiple of 4) bytes. Thus, to see whether a combination of records is feasible, add 8 to each, round up (which is never actually necessary with the given choices), and sum. If the result is 1000 or less, the answer is correct; otherwise it is not.

4. There are many parameters that could be used to describe disk performance; among them are:

number of bits per track	disk capacity (in bits)	number of disk surfaces
rotational speed	rotational latency	transfer rate
tracks per surface	sectors per track	blocks per track
sectors per block	seek time	speed of disk arm
block-read time	number of blocks	

Some of these parameters are independent, and others are (approximately) linearly related. That is, doubling one doubles the other. Decide which of these parameters are linearly related. Then, select from the list below, the relationship that is true, to within a close approximation.

Note: none of the statements may be true exactly, but one will always be much closer to the truth than the other three. *Also note*: you should assume all dimensions and parameters of the disk are unchanged except for the ones mentioned.

a) If you divide tracks into half as many sectors, then you halve the capacity of the disk.

b) If you double the number of sectors per block, then you halve the capacity of the disk.

c) If you double the rotational speed of the disk, then you halve the average rotational latency.

d) If you double the number of sectors on a track, then you double the capacity of the disk.

Answer submitted: **c)**

You have answered the question correctly.

Question Explanation:

Several of the correct answers are based on the idea that doubling the number of tracks on a surface or surfaces on a disk, while leaving everything else the same, doubles the number of bits on the disk. Another is based on the idea that the rotational latency is the inverse of the rotation speed of the disk. Likewise, the transfer rate of the disk is proportional to the rotation speed.

5. Consider a buffer pool that can hold 3 pages only, and the following sequence of requests, where each number is the ID of a disk page.

1 2 3 3 1 4 2 5 1 4

Suppose we use the **LRU ("least recently used")** replacement policy. Compute the following numbers:

- Number of disk IO's.
- The blocks that remain in buffers at the end.
- The number of hits.

Which of the following statements is true?

a) The number of hits is 5

b) The number of hits is 3

c) The number of disk IO's is 7.

d) The number of hits is 2.

Answer submitted: **d)**

You have answered the question correctly.

Question Explanation:

The LRU policy keeps a timestamp for each buffer in the pool. Every time the buffer is replaced or read, the timestamp is set to the current time. When a buffer needs to be replaced, we find the buffer with the smallest ("oldest") timestamp, since it's the "least recently used."

1	**2**	**3**	**3**	**1**	**4**	**2**	**5**	**1**	**4**
1*	1	1	1	1	1	1	5*	5	5
E	2*	2	2	2	4*	4	4	1*	1
E	E	3*	3	3	3	2*	2	2	4*

"E" means "empty," and "*" means a disk IO. Therefore:

- The number of disk IO's is 8.
- The blocks that remain in buffers at the end are: 5, 1, 4.
- The number of hits is 2.