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**CS 5600 – CRN: 13892**

1. **The student data file contains the following attributes:**

* **Id: Integer (2 bytes)**
* **Name: Varchar (16) (16 bytes)**
* **Age: Integer (2 bytes)**
* **Phone: Varchar (10) (bytes)**

**There are 1,000 records in this data file. We want to store the data file in a hard drive with the block(page) size = 512 bytes.**

**(Note. Each record is a fixed length record.)**

* 1. **How many blocks or pages that need for storing this data file in a hard drive? (3 pts.)**

***Answer:***

Given block size is 512 Bytes.

Total size of each student record = 2+16+2+10 = 30 Bytes per record

Given total number of student records = 1000 records = 30\*1000 = 30000 bytes

*Number of records can be stored in one block = 512/30*

Total number of blocks required to store 30,000 bytes (1000 Student records)

🡺 30,000/512 = 58.59375 🡺 *59 Blocks* required

But let’s say if hard drive has default header of 32 Bytes, then size = 512-32 = 480B

Number of blocks required to store 1000 student records

🡺 30,000/480 = 62.5 🡺 *63 Blocks* required

* 1. **If we store the data file in MySQL, how many blocks or pages that need for the storing? (2 pts.)**

***Answer:***

Page Size in MySQL is 16KB = 16384 Bytes (1KB =1024Bytes)

Total number of blocks required to store 30,000 bytes

🡺 30,000/16384 = 1.831 🡺 *2 Blocks* required

But let’s assume that MySQL has header and trailer ... so that header (38 Bytes) Trailer (8 Bytes)

Then available space = 16,384 – 38 -8 🡺 16,338 Bytes

Total Number of blocks required to store 30,000 bytes of student record = 30,000/16,338 = 1.836 🡺 *2 Blocks are required*

1. **What are the similarities and differences between RAID 0 and RAID 1? (2 pts.)**

***Answer:***

RAID stands for Redundant Array of Independent Disk.

*Differences:*

|  |  |  |
| --- | --- | --- |
|  | RAID 0 | RAID 1 |
| Key feature | Block level data striping with no mirroring or parity. | Data mirroring with no parity or striping |
| Striping | Yes (Evenly splits data across all disks) | No |
| Mirroring, redundancy, and fault tolerance | No No redundancy or fault tolerance. If one drive in the RAID fails, all data is lost. | Yes Two Hard disks are identical, if one fail… it will recover from another hard disk (mirror of first hard disk) |
| Performance | High, offers faster read and write speeds compared with RAID 1. | Normal, slower compared to RAID 0 |
| Storage Space Efficiency | 100% is utilized | Only 50% is utilized, other 50% is for backup through disk mirroring |
| Cost | Less Expensive | More expensive compared to RAID 0 |
| Data Security | Less, as there is no backup | High data security, as there is copy of disk |

*Similarities between Level 0 and Level 1:*

|  |  |  |
| --- | --- | --- |
|  | RAID 0 | RAID 1 |
| Parity Disk | Not used | Not used |
| Number of minimum disks required | 2 | 2 |

1. **Show the buffer’s page allocation using the replacement policy: Least Recently Used-LRU**

**Where buffer size = 3 (3 pts.)**

**Program require: 4, 3, 2, 1, 4, 5, 3, 1, 2, 4**

***Answer:***

**M – Miss, H – Hit**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 |  | 3 |  | 2 |  | 1 |  | 4 |  | 5 |  | 3 |  | 1 |  | 2 |  | 4 |  |
| 4 |  | 4 |  | 4 |  | 1 |  | 1 |  | 1 |  | 3 |  | 3 |  | 3 |  | 4 |  |
|  |  | 3 |  | 3 |  | 3 |  | 4 |  | 4 |  | 4 |  | 1 |  | 1 |  | 1 |  |
|  |  |  |  | 2 |  | 2 |  | 2 |  | 5 |  | 5 |  | 5 |  | 2 |  | 2 |  |
| **M** |  | **M** |  | **M** |  | **M** |  | **M** |  | **M** |  | **M** |  | **M** |  | **M** |  | **M** |  |

Miss = 10; Hits = 0; Miss Rate = 10/10 = 100%

1. **Show the buffer’s page allocation using the replacement policy: Most Recently Used-MRU Where buffer size = 3 (3 pts.)**

**Program require: 1, 2, 4, 1, 2, 5, 3, 2, 4, 1**

***Answer:***

**M – Miss, H – Hit**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | 2 |  | 4 |  | 1 |  | 2 |  | 5 |  | 3 |  | 2 |  | 4 |  | 1 |  |
| 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  | 1 |  |
|  |  | 2 |  | 2 |  | 2 |  | 2 |  | 5 |  | 3 |  | 2 |  | 2 |  | 2 |  |
|  |  |  |  | 4 |  | 4 |  | 4 |  | 4 |  | 4 |  | 4 |  | 4 |  | 4 |  |
| **M** |  | **M** |  | **M** |  | **H** |  | **H** |  | **M** |  | **M** |  | **M** |  | **H** |  | **H** |  |

Miss = 6; Hits = 4; Miss Rate = 60%, Hits Rate = 40%

1. **Create the B-Tree Index(m=4) after insert the following input index: (7 pts.)**

**12, 13, 10, 5, 6, 1, 2, 3, 7, 8, 9, 11, 4, 15, 19, 16, 14, 17.**

***Answer:***

m = 4

min = ⌈4/2⌉ = 2

A piece of paper with writing on it

Description automatically generated with medium confidence

Diagram, engineering drawing

Description automatically generated

Diagram, engineering drawing

Description automatically generated

Diagram, engineering drawing

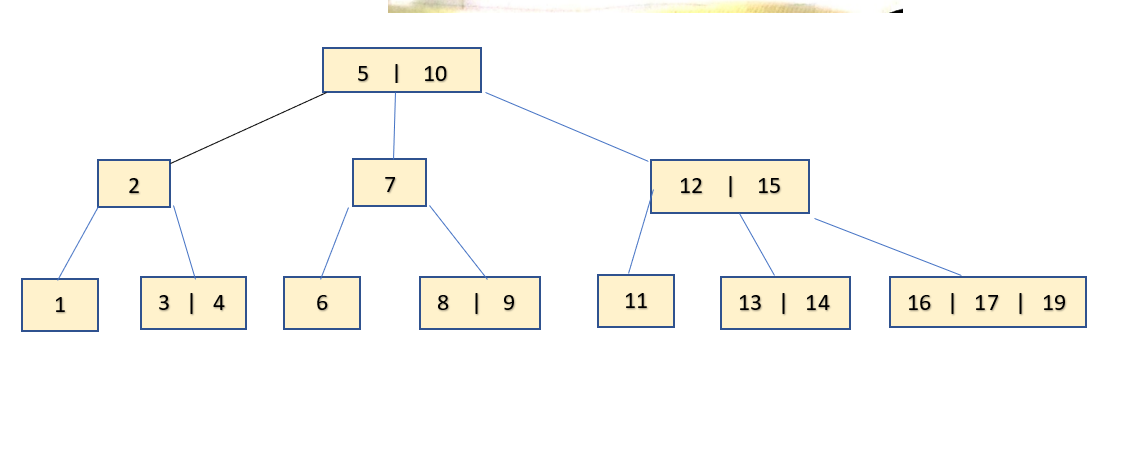
Description automatically generated

Diagram, engineering drawing

Description automatically generated

Diagram, engineering drawing

Description automatically generated



1. **Regarding to the following B-Tree Index(m=4):**

**Diagram

Description automatically generated with medium confidence**

**If we delete index key 6, 3, and 7 what is the B-Tree Index after the deletion? (3 pts.)**

***Answer:***

Diagram, engineering drawing

Description automatically generated

Diagram

Description automatically generated

Diagram, engineering drawing

Description automatically generated

A picture containing text, clock

Description automatically generated

1. **Regarding to the following B-Tree Index(m=3):**

**Diagram

Description automatically generated**

**If we delete index key 11 and 5, what is the B-Tree Index after the deletion? (2 pts.)**

***Answer:***

Diagram

Description automatically generatedDiagram

Description automatically generated

7

3

13

15

10 | 12

6

2