**Lab 4 -- Questions & Instructions (Sep 23, 2021)**

You are required to attempt all questions…

Answers need to be succinct and in your own words… Verbosity is undesirable…

Total points = 225 + 10 (bonus points)

Your submission will be a singular pdf file <Naming convention Roll\_No.\_FirstName\_Lab4.pdf> - containing assumptions, theoretical answers, and code with outputs and observations; observations must demonstrate understanding of time + space complexities associated with the different query trees designed for the queries

Deadline for submission: Sep 29, 2021.

1. Consider the following partial tables of an ordered library catalogue:

Book\_Details:

| **Author\_ID** | **Book\_ID** | **Book** |
| --- | --- | --- |
| Da\_001 | Da001\_Sel | Self Comes to Mind |
| Mi\_009 | Mi009\_Emo | Emotion Machine |
| Mi\_009 | Mi009\_Soc | Society of Mind |
| Ra\_001 | Ra001\_Pha | Phantoms in the Brain |
| Ro\_015 | Ro015\_Fan | Fantastic Beasts and Where to Find Them |
| Ro\_015 | Ro015\_Gob | Goblet of Fire\_Harry Potter |
| Ro\_015 | Ro015\_Phi | Philosopher’s Stone\_Harry Potter |
| Ro\_015 | Ro015\_Pri | Prisoner of Azkaban\_Harry Potter |
| Sa\_001 | Sa001\_Voy | Voyage of the Turtle |
| Sa\_001 | Sa001\_Wha | What Animals Think |
| To\_015 | To015\_Fel | Fellowship of the Rings\_Lord of the Rings |
| Wo\_015 | Wo015\_Wod | Wodehouse at the Wicket |

Author\_Details:

| **Author\_ID** | **Author\_Name** |
| --- | --- |
| Da\_001 | Damasio |
| Mi\_009 | Minsky |
| Ra\_001 | Ramachandran |
| Ro\_015 | Rowling |
| Ru\_021 | Russel |
| Sa\_001 | Safina |
| Ta\_001 | Tagore |
| To\_015 | Tolkien |
| Wo\_015 | Wodehouse |

Book\_Purchase\_Details:

| **Book\_ID** | **Purchase\_Dt** | **Copies** |
| --- | --- | --- |
| Da001\_Sel | Sep 1, 2021 | 1 |
| Mi009\_Emo | Sep 2, 2021 | 2 |
| Mi009\_Soc | Sep 1, 2021 | 2 |
| Ra001\_Pha | Sep 2, 2021 | 2 |
| Ro015\_Fan | Sep 1, 2021 | 3 |
| Ro015\_Gob | Sep 1, 2021 | 3 |
| Ro015\_Phi | Sep 1, 2021 | 3 |
| Ro015\_Pri | Sep 1, 2021 | 3 |
| Sa001\_Voy | Sep 2, 2021 | 2 |
| Sa001\_Wha | Sep 2, 2021 | 2 |
| To015\_Fel | Sep 1, 2021 | 3 |
| Wo015\_Wod | Sep 5, 2021 | 1 |

1. Is the given database normalized? Would you want to normalize the given database any further? **(Points: 10 + 5 = 15)**
2. What would your choice of indexes be for every table? Justify your answer. **(Points = 10)**
3. Use a 4-bucket extendible hash + singly/doubly linked lists (as the core database arrangement structure for all tables) to compare between the different variations of optimization of execution of the following queries on the given tables; Answers must begin with the Relational Algebra expression, followed by the different Query-trees and execution of queries as per the query plans:
   1. Retrieve names of books written by ‘Rowling’
   2. Retrieve book names and author details of all books written by authors with names beginning with ‘R’ or ‘T’
   3. Retrieve all books with more than 2 copies
   4. Retrieve book\_ids and book\_names of all books that were purchased on the same date

**(Points: 10 for choice of hash function on index + (10 \* 4) for RA expressions and query tree designs + (10 \* 4) for comparisons in designs per query= 90)**

1. Use a 4-bucket linear hash + singly/doubly linked lists (as the core database arrangement structure for all tables) to compare between the different variations of optimization of execution of the following queries on the given tables; Answers must begin with the Relational Algebra expression, followed by the different Query-trees and execution of queries as per the query plans:
   1. Retrieve names of books written by ‘Rowling’
   2. Retrieve book names and author details of all books written by authors with names beginning with ‘R’ or ‘T’
   3. Retrieve all books with more than 2 copies
   4. Retrieve book\_ids and book\_names of all books that were purchased on the same date

**(Points: (10 \* 4) for RA expressions and query tree designs + (10 \* 4) for comparisons in designs per query = 80)**

1. Compare between the execution times for all queries in (c) and (d) and comment on the complexity of the different query plans. **(Points = 20 + 10 = 30)**

**\*\* Bonus points: Use of B-tree data structures in sync with the hashing mechanisms for both questions (5 + 5) \*\***

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