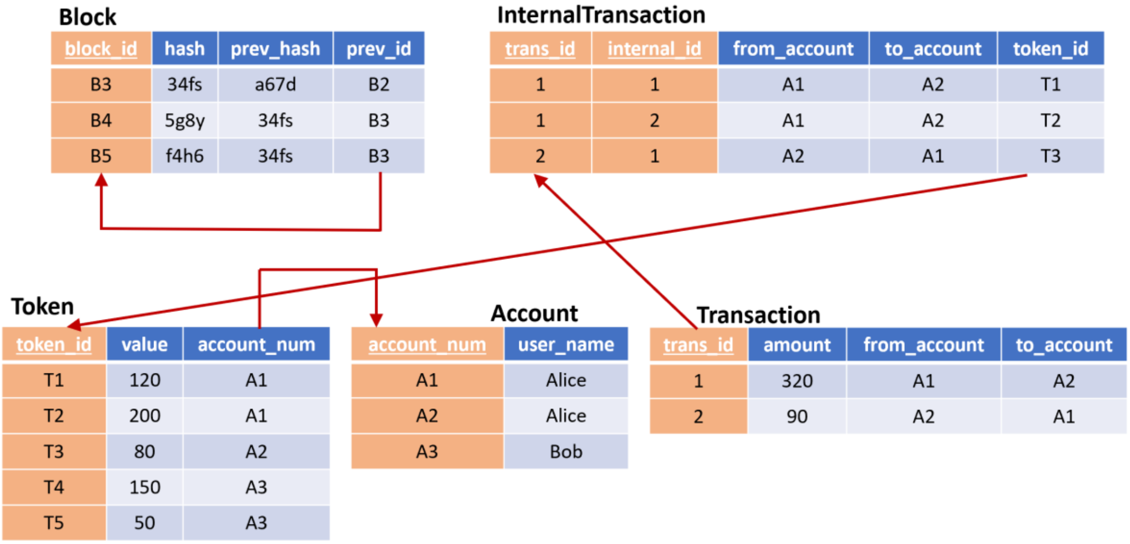
COMP3278B Introduction to Database Management Systems 2020

Assignment 2: Relational Algebra

Due Date: 23:59 April 9, 2021



Block

block_id	hash	prev_hash	prev_id
B3	34fs	a67d	B2
B4	5g8y	34fs	B3
B5	f4h6	34fs	B3

InternalTransaction

trans_id	internal_id	from_account	to_account	token_id
1	1	A1	A2	T1
1	2	A1	A2	T2
2	1	A2	A1	T3

Token

token_id	value	account_num
T1	120	A1
T2	200	A1
T3	80	A2
T4	150	A3
T5	50	A3

Account

account_num	user_name
A1	Alice
A2	Alice
A3	Bob

Transaction

trans_id	amount	from_account	to_account
1	320	A1	A2
2	90	A2	A1

Question 1 (70%). Given the background information of Question 1 in Assignment 1 and the tables above, we could write a SQL query to achieve a task as shown below.

> "Find the internal transaction(s), which is(are) produced by 'Alice' and the transferred token value is smaller than 100."

```
SELECT IT.internal_id, To.value
FROM Account A, Token To, InternalTransaction IT
WHERE IT.token_id = To.token_id AND A.account_num = To.account_num
AND To.value < 100 AND A.user_name = 'Alice'
```

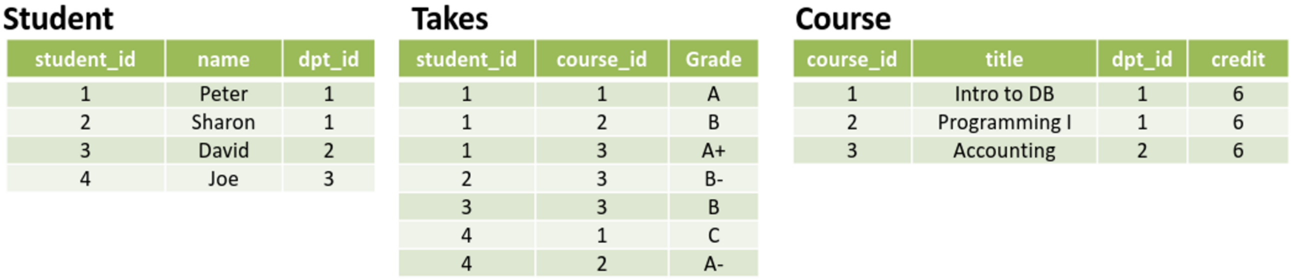
(a) Please transform the above SQL query to relational algebra expression, and draw the corresponding expression tree. (*Hint*: *you do not need to apply equivalence rules at this stage*.)

(b) Please apply at least **4** equivalence rules to optimize your relational algebra expression in (a). Write the final relational algebra expression after optimization, and draw the final optimized expression tree.

1) Describe clearly your results and list the equivalence rules used step by step;
2) Use the example tables above to explain clearly the computational complexity of the relational algebra expression before and after optimization.

Question 2 (30%). When we introduced the "division operator" in Lecture 6, we have the following tables and use "division" to answer a question, "find the IDs of all students who have taken all CS courses (dpt_id = 1)". The corresponding relational algebra expression is

“$\pi_{\text{student\_id, course\_id}}$ (Takes) ÷ $\pi_{\text{course\_id}}$ ($\sigma_{\text{dpt\_id=1}}$(Course))”.



Student

student_id	name	dpt_id
1	Peter	1
2	Sharon	1
3	David	2
4	Joe	3

Takes

student_id	course_id	Grade
1	1	A
1	2	B
1	3	A+
2	3	B-
3	3	B
4	1	C
4	2	A-

Course

course_id	title	dpt_id	credit
1	Intro to DB	1	6
2	Programming I	1	6
3	Accounting	2	6

(a) Please write three *different* SQL queries, which correspond to the above relational algebra expression.

[End of Paper]