Relational Algebra Exercises

Pubs Database Schema

$author(\underline{author\_id}, first\_name, last\_name)$

$author\_pub(\underline{author\_id}, \underline{pub\_id}, author\_position)$

$book(\underline{book\_id}, book\_title, month, year, editor)$

$pub(\underline{pub\_id}, title, book\_id)$

- $author\_id$ in $author\_pub$ is a foreign key referencing $author$
- pub_id in $author\_pub$ is a foreign key referencing pub
- $book\_id$ in pub is a foreign key referencing $book$
- $editor$ in $book$ is a foreign key referencing $author(author\_id)$
- Primary keys are underlined

Pubs Database State

$r(author)$

author_id	first_name	last_name
1	John	McCarthy
2	Dennis	Ritchie
3	Ken	Thompson
4	Claude	Shannon
5	Alan	Turing
6	Alonzo	Church
7	Perry	White
8	Moshe	Vardi
9	Roy	Batty

$r(author\_pub)$

author_id	pub_id	author_position
1	1	1
2	2	1
3	2	2
4	3	1
5	4	1
5	5	1
6	6	1

$r(book)$

book_id	book_title	month	year	editor
1	CACM	April	1960	8
2	CACM	July	1974	8
3	BST	July	1948	2
4	LMS	November	1936	7
5	Mind	October	1950	NULL
6	AMS	Month	1941	NULL
7	AAAI	July	2012	9
8	NIPS	July	2012	9

$r(pub)$

pub_id	title	book_id
1	LISP	1
2	Unix	2
3	Info Theory	3
4	Turing Machines	4
5	Turing Test	5
6	Lambda Calculus	6

Figure 1: Relational Database Schema

1. How many tuples will be returned by the following relational algebra query?

$$\pi_{book\_title}(book)$$

Solution: 7

2. What question does the following expression answer?

$$|\pi_{author\_id}(author) - \pi_{editor}(book)|$$

Solution: How many authors are not book editors.

3. Write a relational algebra expression that returns the names of all authors who are book editors.

Solution: $\pi_{first\_name,last\_name}(author \bowtie_{author\_id=editor} book)$

4. Write a relational algebra expression that returns the names of all authors who are **not** book editors.

Solution: $\pi_{first\_name,last\_name}((\pi_{author\_id}(author) - \pi_{editor}(book)) * author)$

5. Write a relational algebra expression that returns the names of all authors who have at least one publication in the database.

Solution: $\pi_{first\_name,last\_name}(author * author\_pub)$

6. How many tuples are returned by the following relational algebra expression?

$$author \rtimes_{author\_id=editor} book$$

Solution: 11

7. What question does the following relational algebra expression answer?

$$author * (author\_pub * (\sigma_{month='July'}(book) * pub))$$

Solution: Which authors authored a pub that was published in July?