

ASSIGNMENT 1b - 601.315/415/615 - Databases

Due date: Thursday, October 8, 2026 at 11:59 PM EDT

Part 2: Relational Algebra and Relational Calculus (60 points)

Consider the following relational database schema (with sample instantiations):

BOOK:	<i>BookID</i>	<i>Title</i>	<i>PublisherName</i>
	B229961	How to Avoid Publicity	Oxford University Press
	B315514	How to Mend Fences with your Family	Vanitas Press
	B119986	Management of Bad Publicity	Baghdad University Press
	B462341	The Art of the Deal	Random House

PUBLISHER:	<i>Name</i>	<i>City</i>	<i>Country</i>
	Oxford University Press	Oxford	UK
	Vanitas Press	Beverly Hills	USA

BOOK AUTHORS:	<i>BookID</i>	<i>AuthorName</i>
	B229961	Kim Kardashian
	B315514	Prince Harry, Duke of Sussex
	B119986	Prince Andrew, Duke of York
	B462341	Donald Trump

BOOK_COPIES:	<i>BookID</i>	<i>BranchID</i>	<i>NumCopies</i>
	B315514	1029	2
	B315514	1030	1
	B315514	1031	4
	B119986	1031	37
	B229961	1031	6

BOOK_LOANS:	<i>BookID</i>	<i>BranchID</i>	<i>CardNo</i>	<i>DateOut</i>	<i>DateDue</i>
	B315514	1029	44112	08-04-2026	08-04-2026
	B315514	1031	65771	08-06-2026	08-12-2026
	B315514	1030	65771	08-05-2026	08-11-2026
	B229961	1031	65771	09-16-2026	10-16-2026
	B229961	2341	31411	09-17-2026	10-17-2026
	B119986	2341	31411	09-18-2026	10-22-2026
	B119986	1031	65771	09-19-2026	10-19-2026
	B119986	1031	65771	09-20-2026	10-20-2026

BORROWER:	<i>CardNo</i>	<i>Name</i>	<i>Address</i>	<i>City</i>
	31411	Queen Consort Camilla	Buckingham Palace	London
	44112	Wes Moore	Governor's Mansion	Annapolis
	43769	Steve Bannon	6451 Wisconsin Ave	Bethesda
	65771	Linda Tripp	4112 Cricket Pass	Columbia
	53132	Kim Kardashian	3321 Big House Drive	Calabasas

LIBRARY_BRANCH:	<i>BranchID</i>	<i>BranchName</i>	<i>Address</i>	<i>City</i>	<i>Phone</i>
	1029	Charles Village	3301 N. St. Paul St.	Baltimore	410-366-2211
	1030	Towson South	11199 York Rd.	Towson	410-317-1166
	1031	Columbia	3299 Symphony Woods	Columbia	410-964-8116
	2341	Westminster	14 Green Park Ln	London	+44-7739-94493

LIBRARY_STAFF:

<i>EmployeeID</i>	<i>BranchID</i>	<i>Name</i>	<i>Position</i>	<i>Phone</i>
111	1029	Paul	Manager	410-366-2212
112	1030	Mary	Clerk	410-317-1167
113	1031	Ben	Sanitation	410-964-8117
114	2341	Lisa	Assistant	+44-7739-9444

BOOK_REVIEWS:

<i>ReviewID</i>	<i>BookID</i>	<i>CardNo</i>	<i>Rating</i>	<i>ReviewText</i>
10	B229961	31411	4	I loved it, I have never laughed so much ...
20	B315514	44112	3	As the other parent left after the death ...
30	B119986	43769	1	This book gives a voice to a person who ...
40	B462341	65771	5	This was an interesting, engaging, ...

NEW_BOOK_WISHLIST:

<i>BookID</i>	<i>CardNo</i>
B462341	44112
B229961	31411
B462341	65771
B462341	65771
B315514	43769

LIBRARY_COMPUTER:

ComputerID	BranchID	Location	OperatingSystem	Status
C101	1029	First-floor lab	Windows 11	Available
C102	1029	First-floor lab	macOS	OutOfService
C201	1031	Reference room	Windows 11	Available
C301	2341	Reading room	Linux	Available

COMPUTER_RESERVATION:

ComputerID	CardNo	ReservationDate	StartTime	EndTime
C101	65771	09-21-2026	10:00	11:00
C201	31411	09-21-2026	13:00	14:00
C301	44112	09-22-2026	09:00	10:30
C101	31411	09-22-2026	15:00	16:00

MEETING_ROOM:

<i>RoomID</i>	<i>BranchID</i>	<i>Capacity</i>	<i>RoomType</i>
R101	1029	4	Group
R102	1029	1	Individual
R201	1030	6	Group
R301	1031	30	Conference
R401	2341	4	Group

ROOM RESERVATION:	<u>RoomID</u>	<u>CardNo</u>	<u>ReservationDate</u>	<u>StartTime</u>	<u>EndTime</u>
	R101	65771	09-18-2026	10:00	11:00
	R102	44112	09-19-2026	13:00	14:00
	R201	43769	09-20-2026	09:00	10:00
	R201	43769	09-20-2026	09:00	10:00
	R301	65771	09-21-2026	15:00	16:00
	R401	31411	09-21-2026	12:00	13:00
	R201	65771	09-22-2026	11:00	12:00

LIBRARY EVENTS:	<u>EventID</u>	<u>BranchID</u>	<u>EmployeeID</u>	<u>CardNo</u>	<u>EventTitle</u>
	EV10	1029	111	31411	AI Ethics Seminar
	EV20	1031	113	65771	Book Restoration Workshop
	EV30	1029	111	44112	AI Ethics Seminar
	EV40	2341	114	43769	Rare Manuscripts Talk

- **NOTE:** Students can assume that *every* book/branch pair *is* listed in the BOOK_COPIES relation. If the branch does not have a copy of a book, then the value of BOOK_COPIES is 0.

QUESTIONS:

601.315 students should give expressions in the *relational algebra* for **all** of the queries between (and including) 2.1 and 2.25

601.315 students should give expressions in the *tuple relational calculus* queries 2.2, 2.6, 2.19, and 2.20.

601.415/615 students should give expressions in the *relational algebra* for **all** of the queries between (and including) 2.18 and 2.47.

601.415/615 students should give expressions in the *tuple relational calculus* for queries 2.6-2.8 and 2.19-2.22.

- 2.1 List the titles and review ratings of the books reviewed by the borrower named ‘Kim Kardashian’.
- 2.2 List the names and positions of library staff members who work at a branch in the same city as a borrower named ‘Kim Kardashian’.
- 2.3 List the names and card numbers of borrowers who have placed a book on their new-book wishlist but have neither borrowed nor reviewed that book.
- 2.4 List the names of borrowers, the computer IDs, and the branch names for all MacOS computer reservations made by borrowers who currently have at least one book checked out.

- 2.5 Retrieve the card numbers and names of all borrowers who have written a review for a book (in BOOK_REVIEWS), but have NEVER actually checked out that book from any library branch (in BOOK_LOANS).
- 2.6 List the names, positions, and phone numbers of all library staff members who work at a branch where 'Steve Bannon' has a book loan (during any date).
- 2.7 List the names and phone numbers of all borrowers who have booked an individual meeting room at both the library branches named 'Charles Village' and 'Towson South' on the same day.
- 2.8 List the names of borrowers who have written reviews for more than one book.
- 2.9 List the names of borrowers who have a book on their wishlist that they have also checked out.
- 2.10 List the card number and name of each borrower who has written a review with a rating of 1 or 2. For each such review, also list the title of the reviewed book and the rating. Do not include duplicate result tuples.
- 2.11 List the employee ID, employee name, and branch name of the staff members who work at a branch that owns at least one copy of a book appearing on some borrower's wishlist. Do not include duplicate result tuples.
- 2.12 List the card numbers and names of all borrowers who have checked out every book in the Charles Village branch.
- 2.13 List the names and addresses of branches who have more copies of the book 'Dishwashing for Dummies' than copies of 'Brave New World'. (You can assume only one publisher/author/BID for both of these books).
- 2.14 List the title and publisher of all books in the database with more than one author.
- 2.15 List the titles and publishers of every book available in the Charles Village branch but not in the Towson South branch.
- 2.16 List the name, address and card number of the borrowers who have not yet borrowed a book from a library branch in the same city where they live.
- 2.17 List the name, address and card number of the borrowers who have borrowed at least one book from every branch in the library system.
- 2.18 List the branch name and city of all branches that do **not** have any copies of *How to Avoid Publicity*.
- 2.19 List the names and positions of the library staff who work at branches that have at least 100 copies of the book titled *How to Avoid Publicity*.

- 2.20 List the title and publisher of every book that has never been borrowed by someone living in Towson
- 2.21 For each book that is loaned out from a branch located in Baltimore and whose DueDate is 10/1/26, retrieve the book title, the book author, the publisher's address, the borrower's name, and the borrower's address.
- 2.22 List the title and author of the book, and its publisher name and country, of all books with more copies in the Charles Village branch than the number of copies in the Charles Village branch of 'How to Mend Fences with your Family'?
- 2.23 List the name of all borrowers who have a MacOS reservation at the Charles Village branch who have a computer reservation at any other branch on the same day. Also give a column for the computer ID and start time for all of the Charles Village reservations that you list.
- 2.24 List the titles of all books that appear on the wishlists of at least two distinct borrowers. For each such book, also give the number of distinct borrowers who have placed it on a wishlist.
- 2.25 Write an English query of your choice and solve it in the relational algebra. Half of the points will be based on the creativity and complexity of the query.
- 2.26 How many copies of the book titled *How to Avoid Publicity* are owned by each library branch? (give branch name and total copies)
- 2.27 List the title and publisher of all books in the database with more than two authors.
- 2.28 List the titles and publishers of every book available in some branch in Baltimore but not available in some branch in Towson or Columbia.
- 2.29 Restricted to the authors and borrowers included in the database, list the names of authors who have *not* borrowed a book written by someone with the same name as themselves.
- 2.30 - List the card numbers and names of all borrowers who have checked out every book in some branch at least once.
- 2.31 List the title and publisher of every book that has never been borrowed by someone living in Towson but has been borrowed by someone living in Baltimore.
- 2.32 Retrieve the names of all books that have 1 or more more copies in *every* library branch in the database.
- 2.33 Restricted to the authors and borrowers included in the database, list the names of authors who have **not** borrowed a book written by someone with the same name as themselves.

- 2.34 List the title and author of the book, and its publisher name and country, with the most copies in the Charles Village branch.
- 2.35 List the titles and review ratings of the books reviewed by the borrower named 'Kim Kardashian' for a book written by 'Kim Kardashian'.
- 2.36 List the titles of books that have been placed on the new-book wishlists of at least two distinct borrowers and have been reviewed by at least one of those borrowers.
- 2.37 List the names of branches that have at least one available MacOS computer that has been reserved by a borrower who has placed at least one book on the new-book wishlist.
- 2.38 Retrieve the name and card number of the borrower who has checked out the greatest number of books. If there is a tie, list all borrowers in the tie.
- 2.39 Retrieve the card numbers and names of borrowers who have submitted a review for EVERY book that they have checked out (from the BOOK_LOANS relation).
- 2.40 List the card numbers and names of all borrowers who have attended a LIBRARY_EVENT hosted by a staff member in a 'Manager' position AND have also booked at least one group meeting room with a capacity greater than 10 at EVERY library branch located in 'London'.
- 2.41 Retrieve the names and card numbers of all borrowers whose wishlist contains every book written by *Kim Kardashian*.
- 2.42 List the names of all library staff whose branch has loaned out at least one book from every publisher represented in the database.
- 2.43 Find the borrower or borrowers who have written the largest number of reviews.
- 2.44 Find the books that have been reviewed by every borrower who has ever checked them out.
- 2.45 List the card numbers and names of the borrowers who have reserved at least one study room in every library branch that has a study room.
- 2.46 Retrieve the card number and name of the borrowers who have at least one book on their wishlist and have written a review for every book on their wishlist. The review may have any rating.
- 2.47 For each book that has at least one review, retrieve the title and the card number, name, and rating of every borrower whose rating is the highest distinct rating received by that book. If several borrowers gave that rating, report all of them.