Additional (derived) operations

- Set-Intersection operation

  Customers who have both a loan account and a borrower account

  $\pi_{customer\_name}(borrower) \cap \pi_{customer\_name}(depositor)$

- $r \cap s = r - (r - s)$

customer_name
Hayes
Johnson
Jones
Lindsay
Smith
Turner

Depositor

$\cap$

customer_name
Adams
Curry
Hayes
Jackson
Jones
Smith
Williams

Borrower

→

customer_name
Hayes
Jones
Smith

Natural-Join

- Simplifies Cartesian product
    - used much more
- Often: Cartesian-product then select
    - Customer with both a loan and an account
        - $\sigma_{\texttt{loan.name = account.name}}(\texttt{loan x account})$
- Natural Join: Cartesian product => select with equality of common attributes => removes duplicates

Examples of natural join

Customer_name	Customer_street	Customer_city
Adams	Spring	Chicago
Brooks	Senator	Brooklyn
Curry	Elm	Harrison
Glenn	New Era	Stamford

Customer

customer_name	account_number
Hayes	A-102
Johnson	A-101
Johnson	A-201
Jones	A-217

Depositor

account_number	*branch_name*	*balance*
A-101	Downtown	500
A-102	Perryridge	400
A-201	Brighton	900
A-215	Mianus	700
A-217	Brighton	750
A-222	Redwood	700
A-305	Round Hill	350

Account

customer_name	account_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14

Borrower

- Names of all branches with customers who have an account and who live in Harrison
- Customers who have *both* a loan and an account number
- `r ⊠ s = r x s, if … ?`

Formal definition of Natural Join

- Schemas R and S (lists of attributes)
- $R \cap S$, $R \cup S$, $R - S$, $S - R$
- If r(R) and s(S)

$$r \boxtimes s = \pi_{RuS} (\sigma_{r.A1=s.A1 \wedge r.A1=s.A1 \wedge \ldots\ldots \wedge r.An=s.An} r \times s)$$

where, $R \cap S = \{A_1, \ldots A_n\}$