

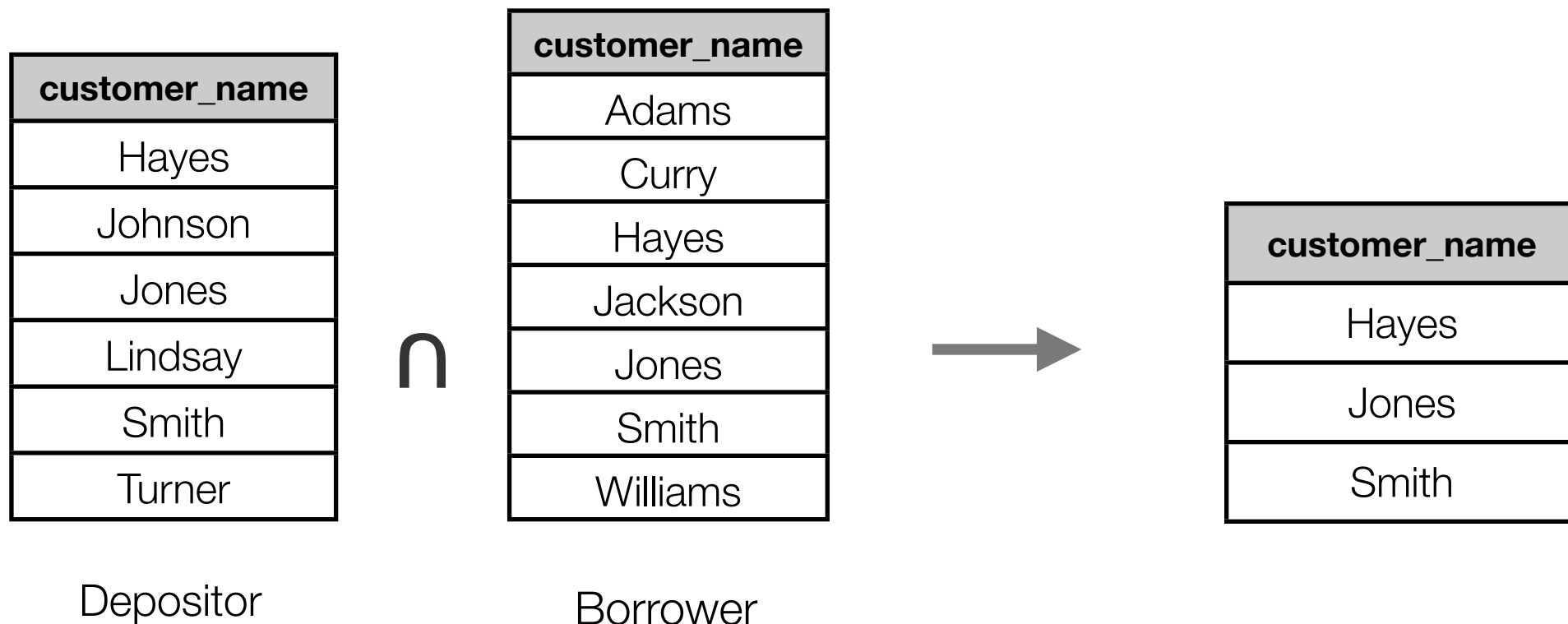
Additional (derived) operations

- Set-Intersection operation

Customers who have both a loan account and a borrower account

$$\pi_{\text{customer_name}}(\text{borrower}) \cap \pi_{\text{customer_name}}(\text{depositor})$$

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



Natural-Join

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

Examples of natural join

Customer_name	Customer_street	Customer_city	customer_name	account_number	account_number	branch_name	balance
Adams	Spring	Chicago	Hayes	A-102	A-101	Downtown	500
Brooks	Senator	Brooklyn	Johnson	A-101	A-102	Perryridge	400
Curry	Elm	Harrison	Johnson	A-201	A-201	Brighton	900
Glenn	New Era	Stamford	Jones	A-217	A-215	Mianus	700
					A-217	Brighton	750
					A-222	Redwood	700
					A-305	Round Hill	350

Customer

Depositor

Account

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

- 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
- $r \bowtie s = r \times s$, 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 $s(S)$

$$r \bowtie s = \pi_{R \cup S} (\sigma_{r.A_1=s.A_1 \wedge r.A_2=s.A_2 \wedge \dots \wedge r.A_n=s.A_n} (r \times s))$$

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