Relational Model

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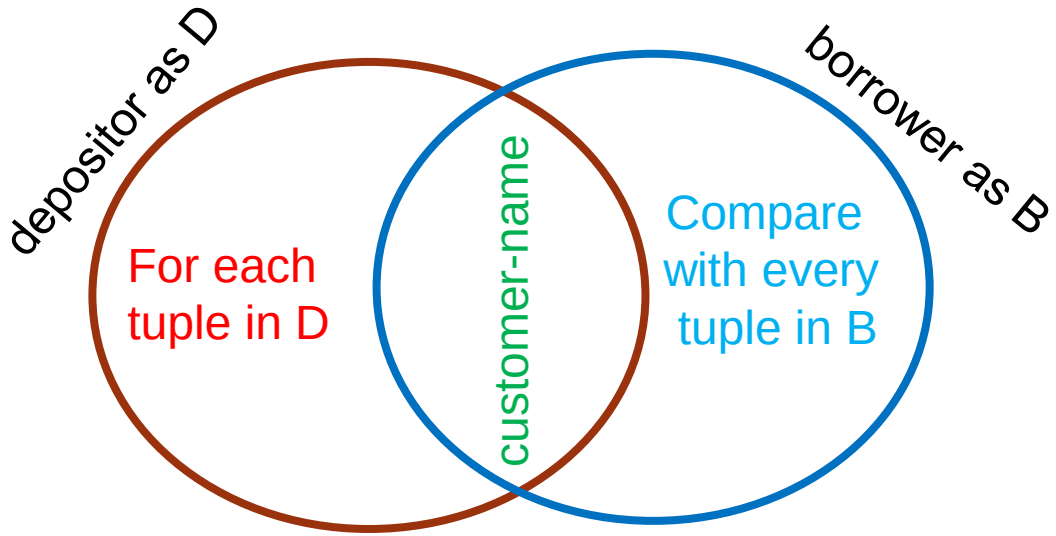
Test for Empty Relations

- The **exists** construct returns the value **true** if the argument subquery is nonempty.
- **exists** $r \Leftrightarrow r \neq \emptyset$
- **not exists** $r \Leftrightarrow r = \emptyset$

Test for Empty Relations

- Find all customer names who have both a loan and an account.

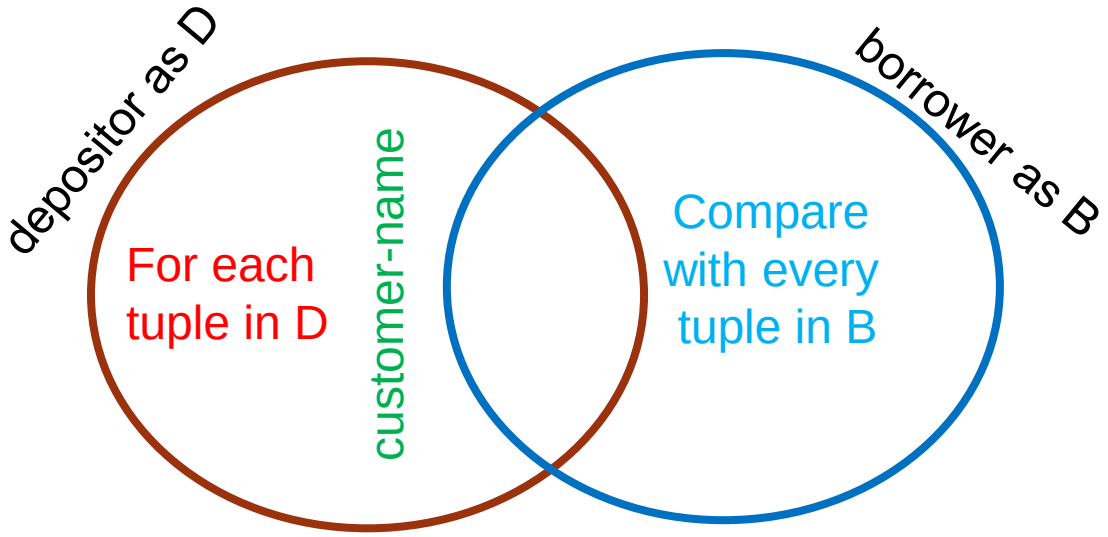
```
select customer-name
from depositor as D
where exists (select *
                from borrower as B
                where D.customer-name = B.customer-name)
```



Test for Empty Relations

- Find all customer names who have an account but no loan.

```
select customer-name
from depositor as D
where not exists (select *
                  from borrower as B
                  where D.customer-name = B.customer-name)
```



Correlated Nested Query

- Find all customers who have an account at all branches located in Brooklyn.

```
select distinct S.customer-name
from depositor as S
where not exists (
        (select branch-name
        from branch
        where branch-city = 'Brooklyn')
       except
        (select R.branch-name
        from depositor as T, account as R
        where T.account-number = R.account-number and
              S.customer-name = T.customer-name))
```

For each customer S, check

All branches at Brooklyn

Branches where customer S has an account

- (Schema used in this example)
- **Note that $X - Y = \emptyset \Leftrightarrow X \subseteq Y$**
- *Note:* Cannot write this query using = **all** and its variants

Example Query

- Find all customers who have an account at all branches located in Brooklyn.

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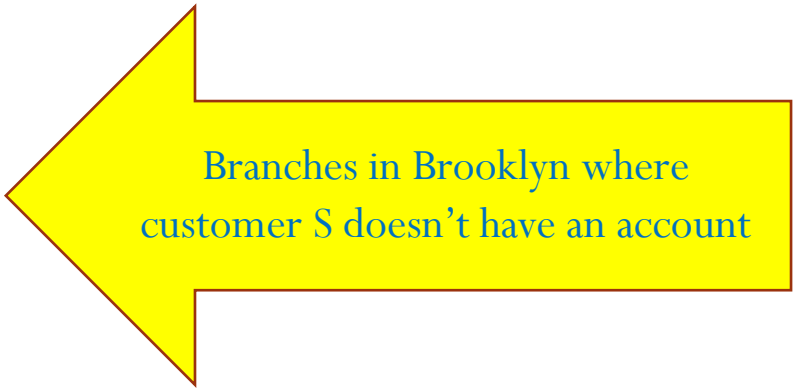

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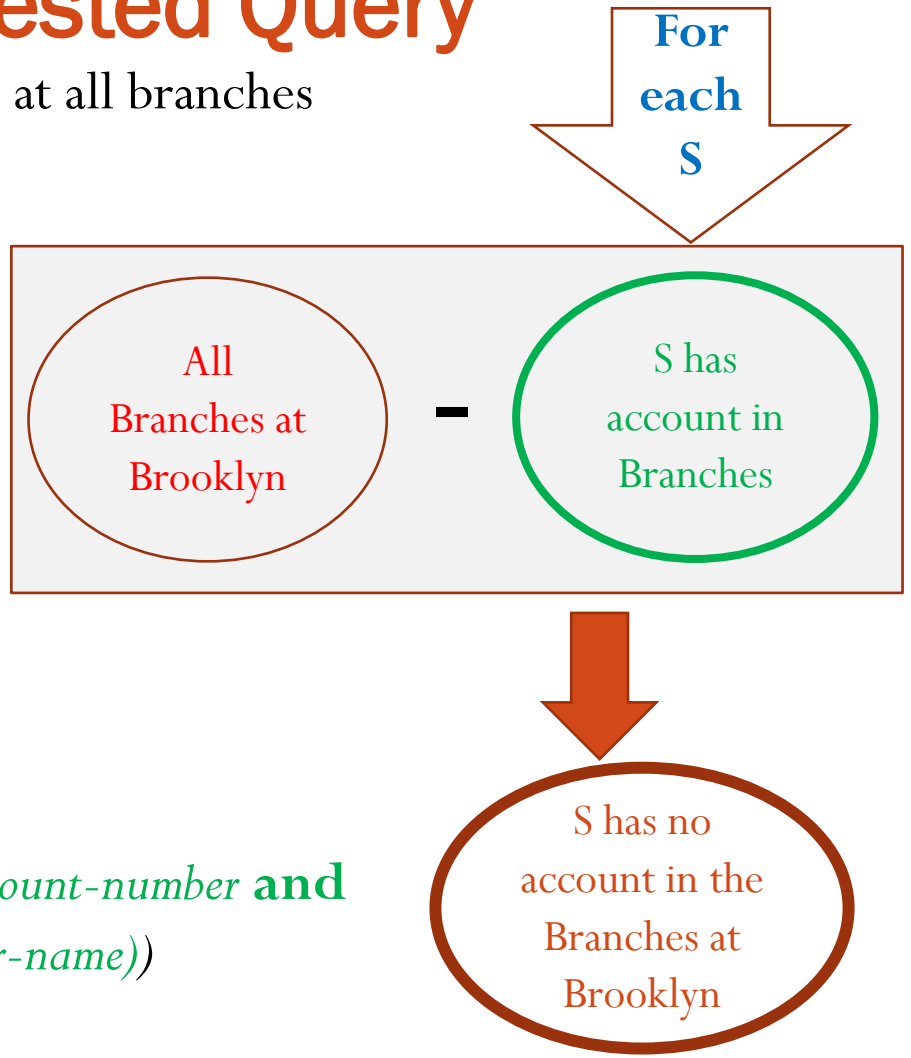

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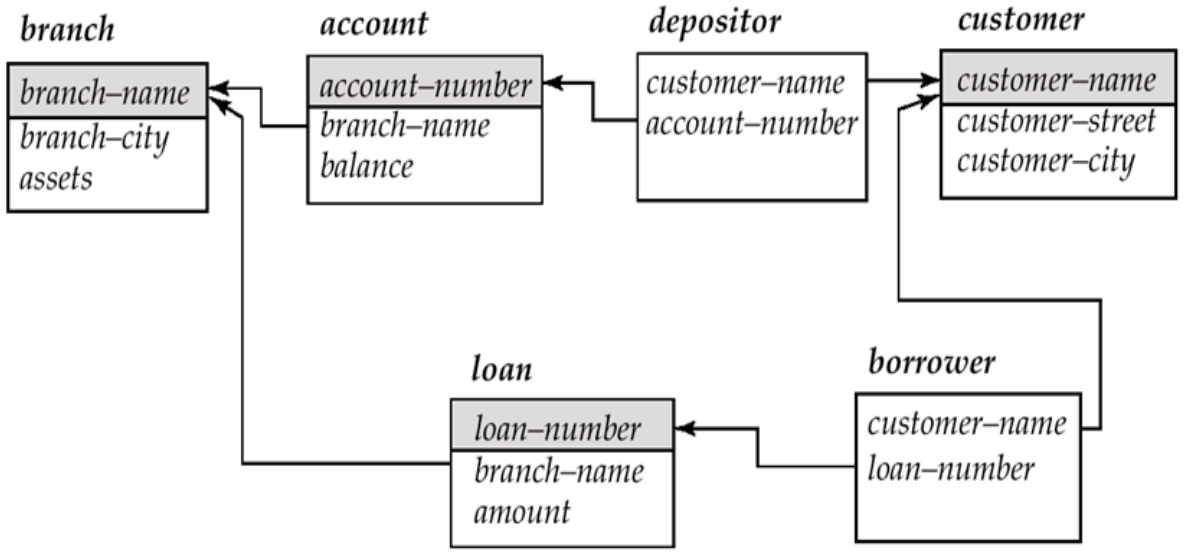
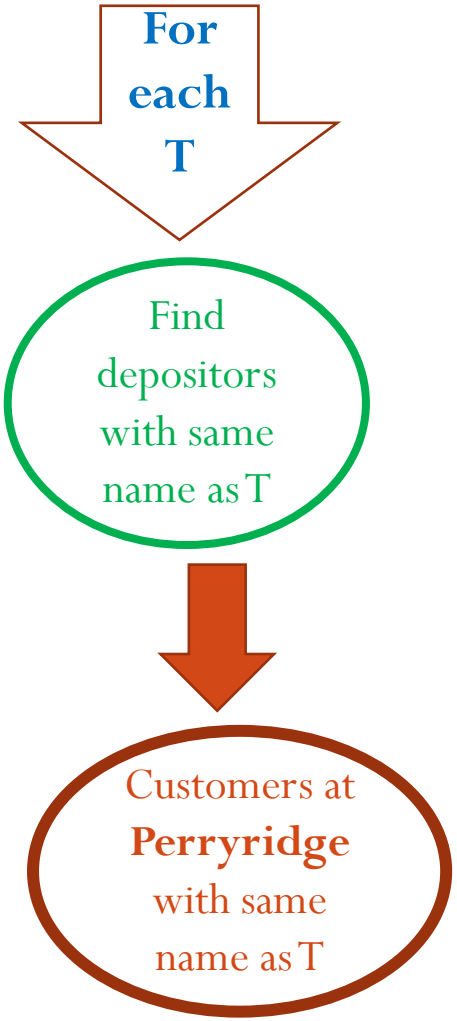
Test for Absence of Duplicate Tuples

- The **unique** construct tests whether a subquery has any duplicate tuples in its result.
- Find all customers who have at most one account at the Perryridge branch.

```
select T.customer-name
from depositor as T
where unique (
        select R.customer-name
        from account, depositor as R
        where T.customer-name = R.customer-name and
                R.account-number = account.account-number and
                account.branch-name = 'Perryridge')
```

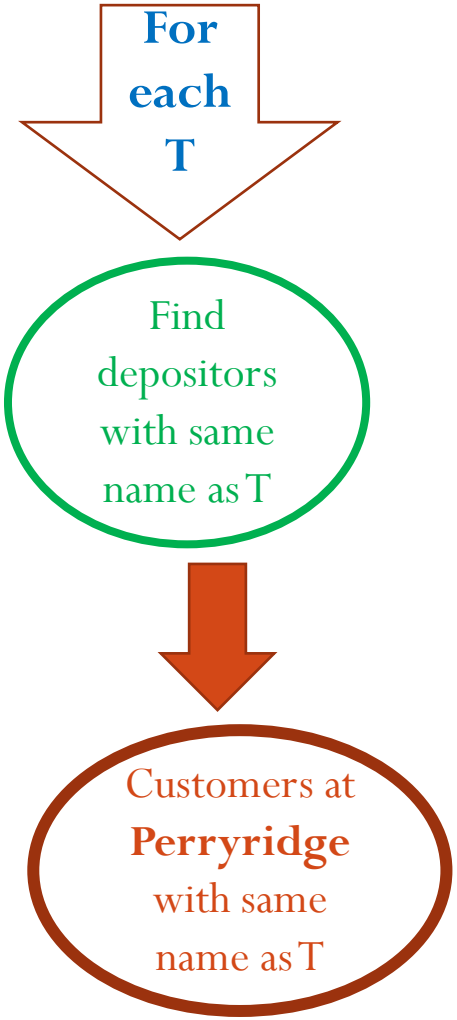




Example Query

- Find all customers who have at least two accounts at the Perryridge branch.

```
select distinct T.customer-name
from depositor as T
where not unique (
        select R.customer-name
        from account, depositor as R
        where T.customer-name = R.customer-name and
              R.account-number = account.account-number and
              account.branch-name = 'Perryridge')
```



Class Participation

Quiz-01

(15 Minutes)

THANK YOU