UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

CS411 - SQL: Triggers, Views, and Indexes

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Announcements

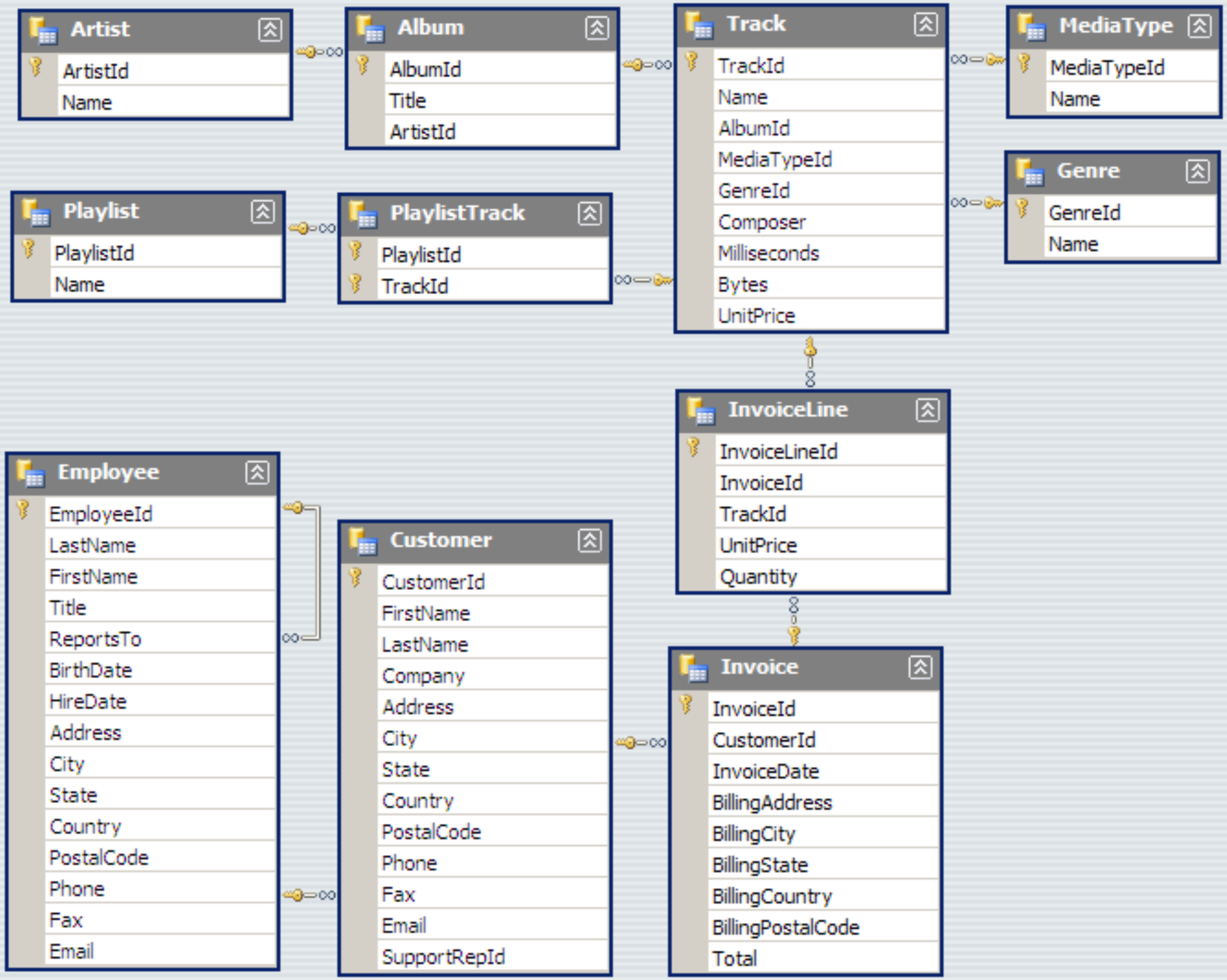
- Project Track 1
  - Stage 2 due Today
  - Stage 3 due Monday
- HW2 due Tomorrow night
  - NO HAND WRITTEN ASSIGNMENTS!
- MP1 resubmission will be available
  - if you do it, no extra credit points!

Announcements

- Midterm 1 March 1st
- Ungraded SQL assignment available
  - prepare for exam
  - prepare for MP2
  - help for project

Review

- What parts of ACID do ***transactions*** help guarantee?
- What parts of ACID do ***constraints*** guarantee?
- What were the three types of read phenomena we learned about?
- What types of constraints did we learn?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Phone
Fax
Email
SupportRepId
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CustomerId
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BillingAddress
BillingCity
BillingState
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BillingPostalCode
Total

Chinook

- http://chinookdatabase.codeplex.com
- Open source sample database
  - provide scripts to import data into MySQL, sqlite, and many more
  - Based on an digital media store
  - Data is simulated or based on iTunes data

Setup Demo

Harsh Realities

- SQL implementations differ wildly
  - MySQL
    - doesn’t bother with CHECK constraints
    - doesn’t implement INTERSECT
  - sqlite
    - doesn’t implement OUTER JOIN
    - can’t add constraints to an existing table

Harsh Realities

- SQL syntax is different, too
  - in sqlite this is allowed:

    ```
    SELECT *
    FROM R, S, T
    ON (R.a = S.b AND S.b = T.c);
    ```
  - MySQL has AUTO_INCREMENT
    sqlite has AUTOINCREMENT

Harsh Realities

- That's just MySQL and sqlite
  - SQLServer, Oracle, PostgreSQL, ...
- Moral of the story:
  - Just pick one and stick with it
  - You'll have to translate what you learn to your DBMS of choice

Constraints

- Add attribute constraint to Employee
  - force email address to conform to a pattern
- ALTER TABLE doesn’t work for CHECK
  - We need to create a new table
  - Copy in the values
  - Drop old table
  - Rename new table

Constraints

- I'll do all this with a transaction
- Here's what we're going to change:

```
Email NVARCHAR(60)
=>
Email NVARCHAR(60)
    CHECK (email LIKE "_%@_%.com")
```

Constraints Demo

Triggers

- Constraints are
  - inefficient to implement
  - not very flexible
  - not always implemented
- Triggers enable a dynamic response to an event

Triggers

1. Awakened by an *event*
   – Insertions, deletions, updates
   – Transaction COMMITs
2. Test a *condition*
3. Perform an *action*
   – Any SQL statement is allowed

Sometimes called "ECA rules"

Trigger Syntax

```
CREATE [OR REPLACE] TRIGGER <trigger_name>
    {BEFORE|AFTER} {INSERT|DELETE|UPDATE}
        ON <table_name>
    [REFERENCING
        [NEW AS <new_row_name>] [OLD AS <old_row_name>]]
    [FOR EACH ROW [WHEN (<trigger_condition>)]]
    <trigger_body>
```

Trigger Syntax

- COMPLICATED!
- If you want to write your own, read reference material first
- Let's look at examples
  - See why/how they're used
  - Learn a bit of the syntax

Example

```
CREATE TRIGGER NoFallenJedi
AFTER UPDATE OF side ON Jedi
REFERENCING
   OLD ROW AS oldR,
   NEW ROW AS newR
FOR EACH ROW
WHEN oldR.side=“Light” AND newR.side=“Dark”
   UPDATE Jedi
   SET side=oldR.side
   WHERE name=newR.name
```

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Example

```
CREATE TRIGGER NoFallenJedi
AFTER UPDATE OF side ON Jedi
REFERENCING
   OLD ROW AS oldR,
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FOR EACH ROW
WHEN oldR.side=“Light” AND newR.side=“Dark”
   UPDATE Jedi
   SET side=oldR.side
   WHERE name=newR.name
```

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Example

```
CREATE TRIGGER ForceBalance
AFTER UPDATE OF side ON Jedi
REFERENCING
    OLD TABLE AS oldT,
    NEW TABLE AS newT
FOR EACH STATEMENT
WHEN (SELECT COUNT(*) FROM Jedi WHERE side='Light')=(SELECT COUNT(*) FROM JEDI WHERE side='Dark')
BEGIN
    DELETE FROM Jedi
    WHERE (name) IN (SELECT name FROM newT);
    INSERT INTO Jedi (SELECT * FROM OldT);
END;
```

Example

```
CREATE TRIGGER DefaultGreenSaber
BEFORE INSERT ON Jedi
REFERENCING
   NEW ROW AS newR,
   NEW TABLE AS newT
FOR EACH ROW
WHEN newR.saberCol IS NULL
   UPDATE newT SET saberCol=“Green”
```

Trigger Demo

Views

- Subqueries can be used a lot
- ***Views*** are a way to query them like tables
- Two types
  - Virtual
    - do not exist physically
    - queried again each time
  - Materialized
    - physically stored on disk

View

- Syntax

```
CREATE VIEW Villians AS
   SELECT * FROM JEDI
   WHERE side=“Dark”;
```

Updateable Views

- Some views can be updated
  - Require certain circumstances:
    1. No subqueries in WHERE clause
    2. Only one relation in FROM clause
    3. Any attributes outside of the view must allow NULL
- If we want to update other views, we should use an INSTEAD OF trigger

View Demo

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Materialized Views

- If we use a view a lot, we can physically realize it on the disk
- Pros:
  - Faster to execute queries
- Cons:
  - More disk usage
  - Updates to underlying tables slower

Materialized Views

- Syntax

```
CREATE MATERIALIZED VIEW
Villians AS
   SELECT * FROM JEDI
   WHERE side=“Dark”;
```

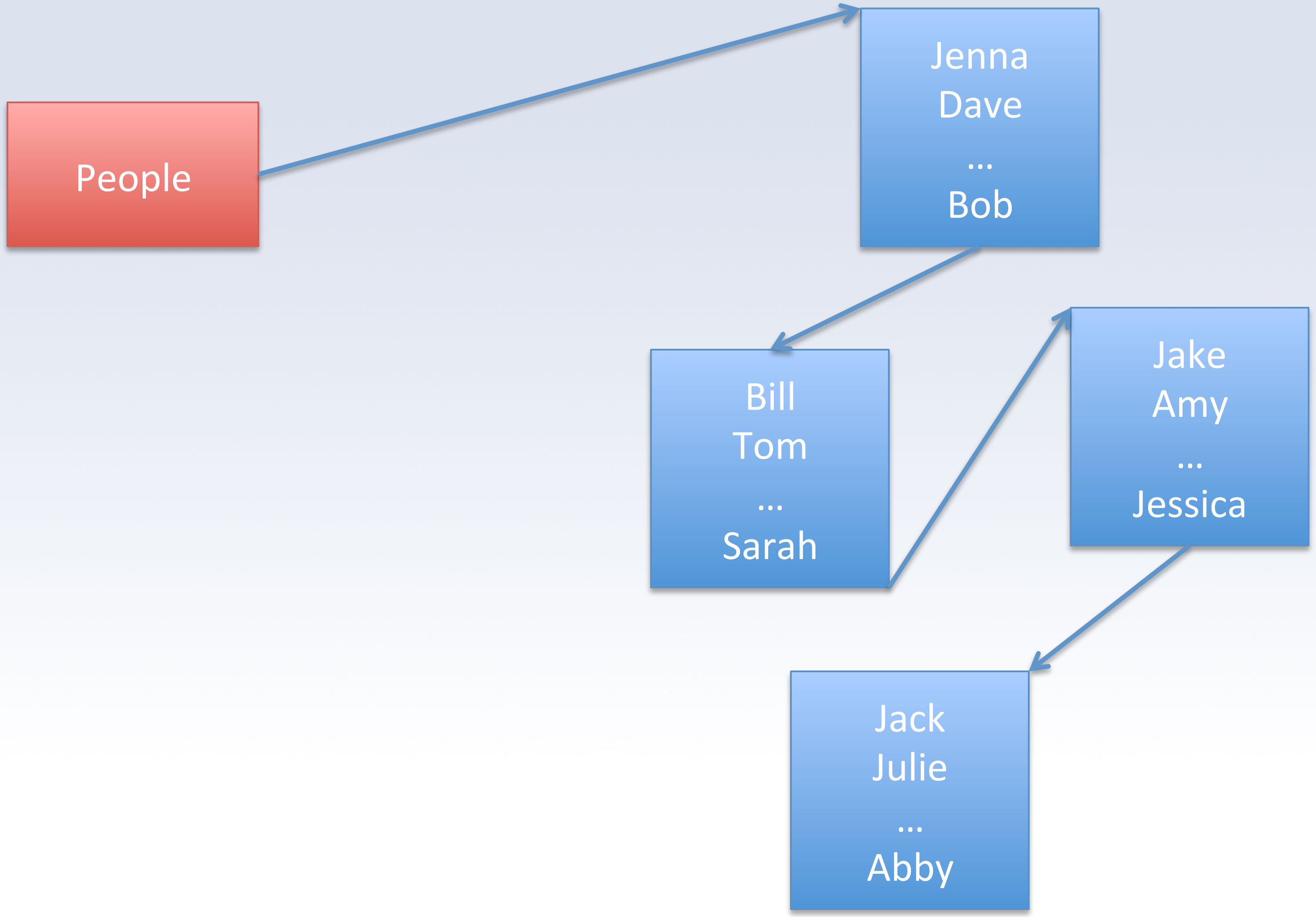
Materialized Views

- Used in enterprise scale DBMS implementations like Oracle and SQL Server
- Not supported in MySQL or sqlite

Indexes

- In reality, our tables are scattered across the disk
- Searching for specific tuples is inefficient

Indexes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Jessica
Jack
Julie
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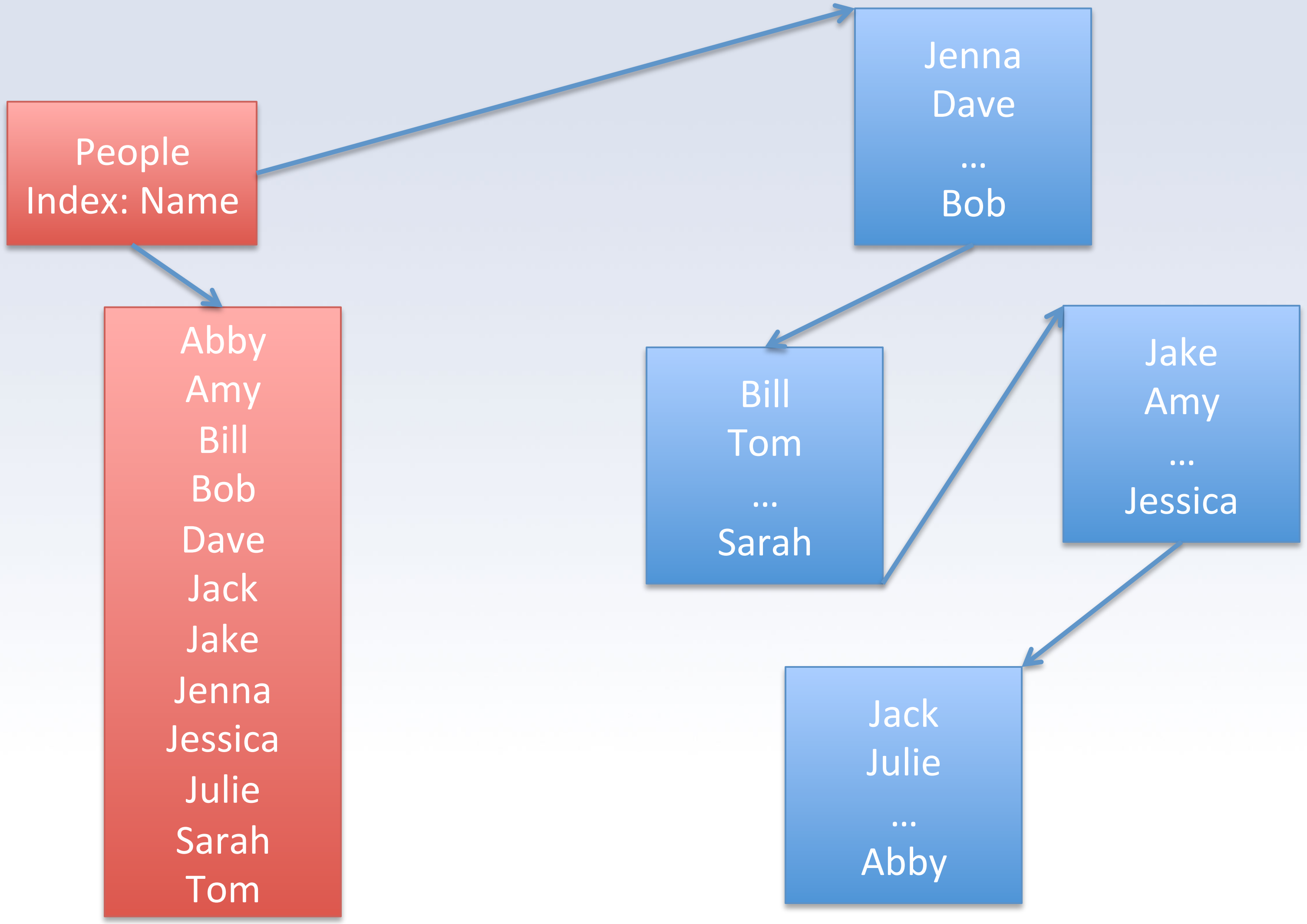
Abby

Indexes

- We can speed this process up using by ***indexing*** our table
- An ***index*** is a searchable structure that maps a series of attributes to actual tuples
- Queries using these attributes will execute faster

Indexes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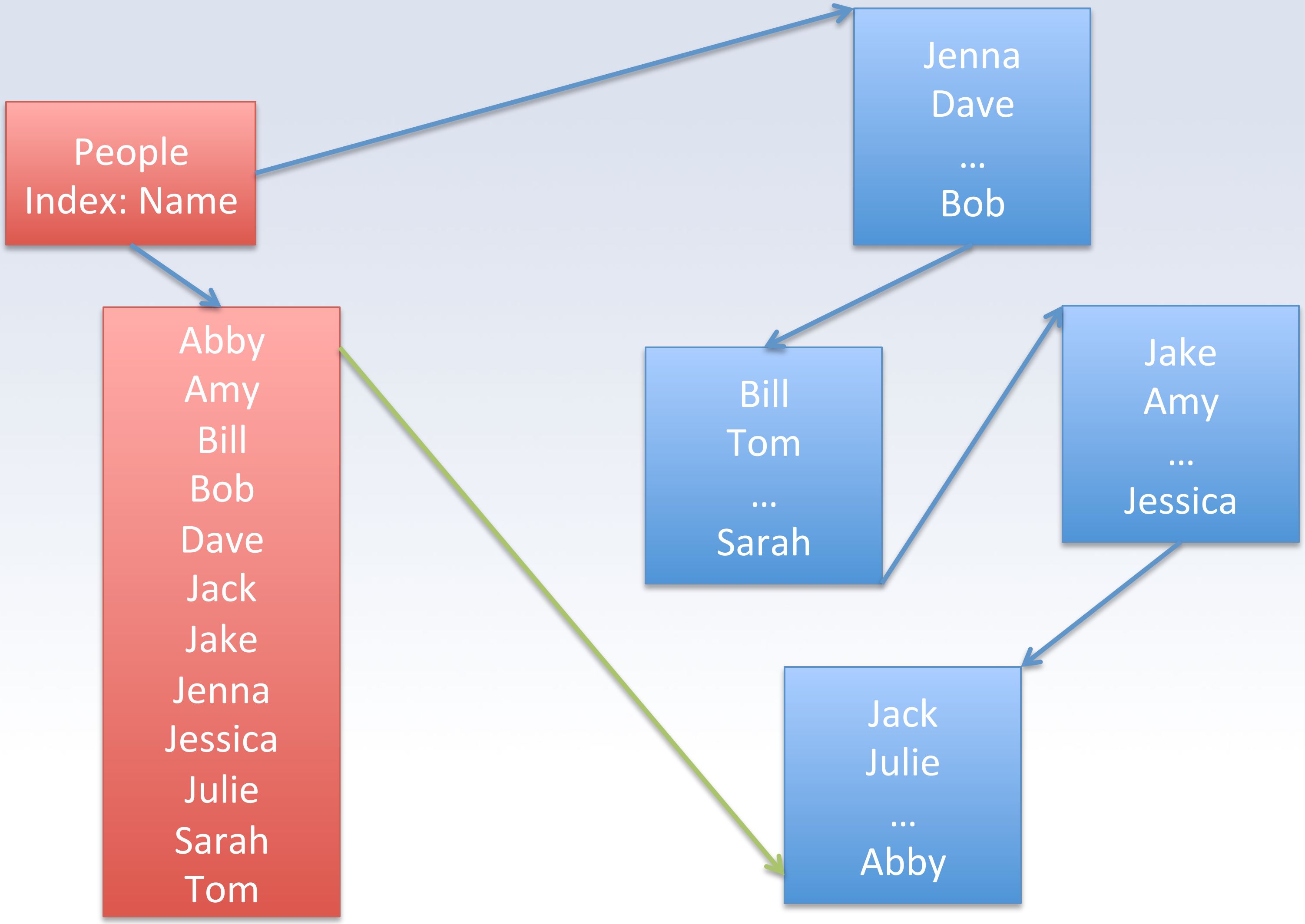
Indexes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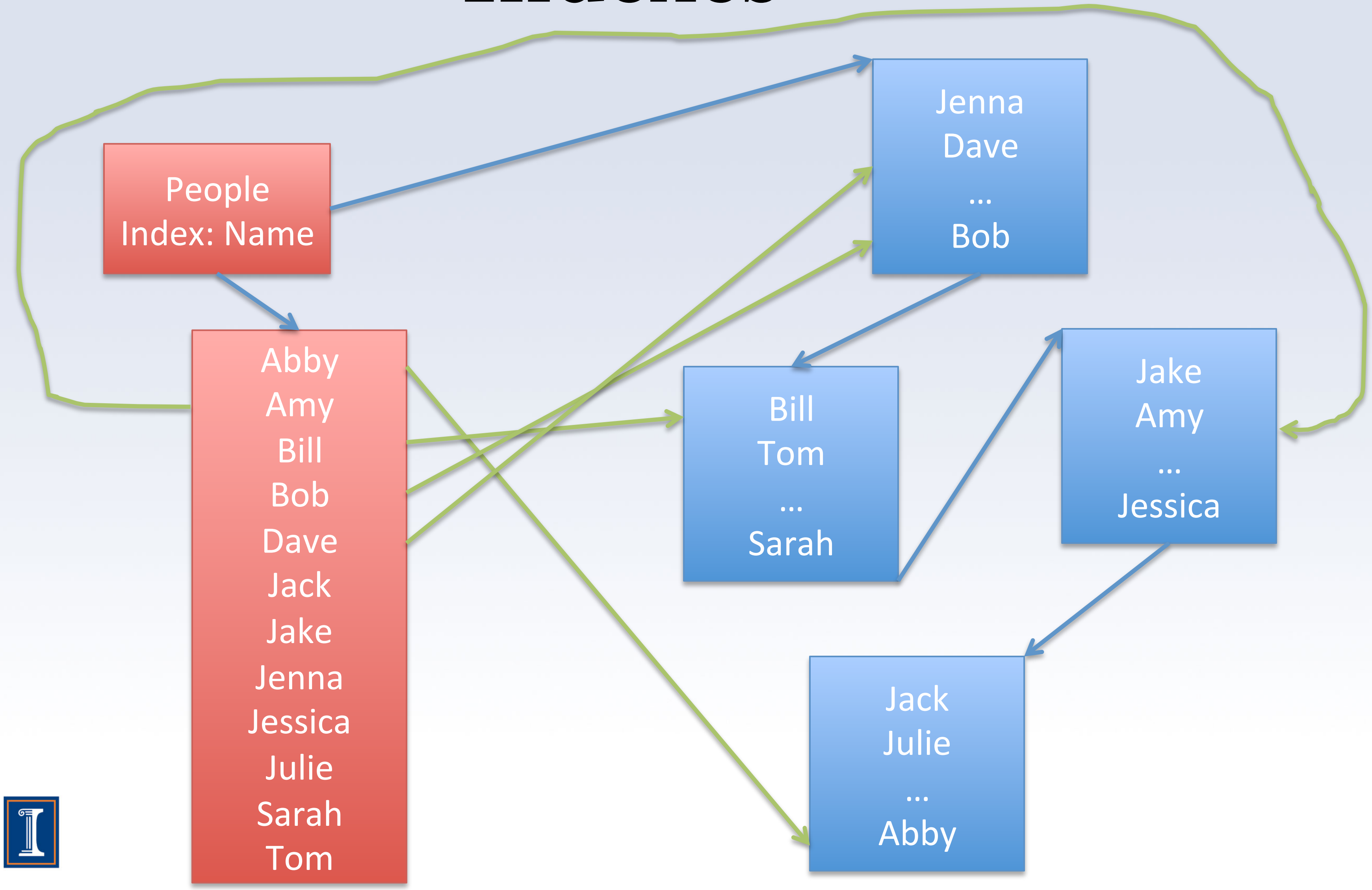
Indexes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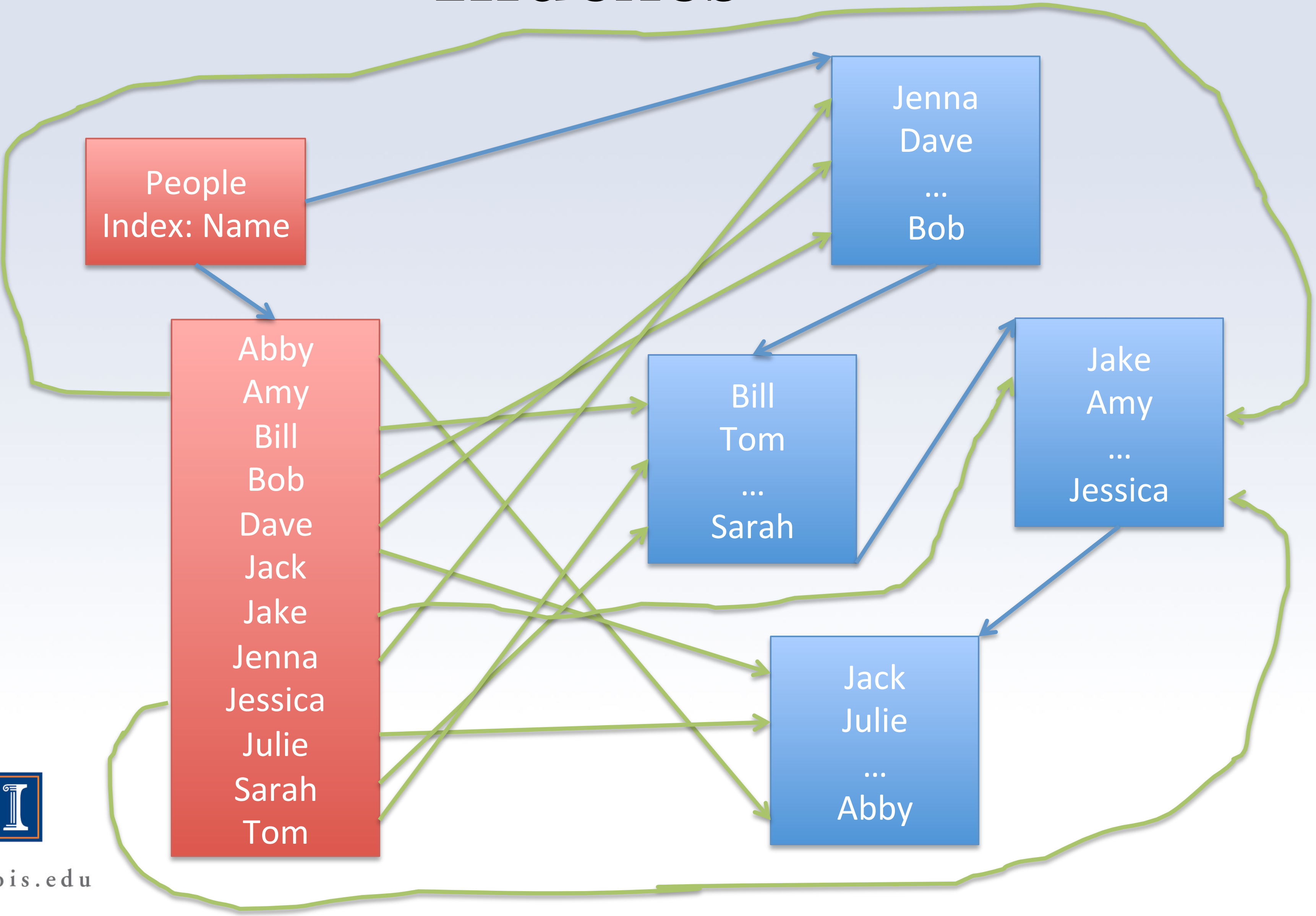
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Syntax

- We can create indexes in SQL as follows:

```
CREATE INDEX <IndexName>
ON <Table(attributes)>
```

Indexes

- Pros:
  - Speed up queries
- Cons:
  - Require disk space
  - Slow modification
- We'll investigate this in depth later

Indexes

- Multiple attributes can form an index
- Values for index don’t have to be unique
  - Attributes indexed don’t need to form a key

Indexes

- When designing indexes, we should:
  - Index on keys or “nearly” keys
  - Index on attributes we query a lot
  - Put more commonly queried attributes first
- These are just heuristics.
- A deeper understanding will come when we study implementation.

Index Demo