How to Move Object-Relational Mapping into the Database

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OSCON 2005

Polymorphic Database Design

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Executive summary

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- Look at simple object-oriented examples

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- Examine typical database serialization approach

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- Make the **database** do the work

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- Look at simple object-oriented examples
- Examine typical database serialization approach
- Make the **database** do the work
- Let's give it a try

Start with a class

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- Simple UML is good UML

Standard Approach

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- Rules:

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  - Class == Table

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- Rules:
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  - Object == Row
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- Methodology
  - Create Table

Standard Approach

- Rules:
  - Class == Table
  - Object == Row
  - Attribute == Column
- Methodology
  - Create Table
  - Create SELECT query

Create a Table

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```
CREATE TABLE album (
    id INTEGER NOT NULL PRIMARY KEY
       AUTOINCREMENT,
    title     TEXT,
    artist    TEXT,
    publisher TEXT,
    isbn      TEXT
);
```

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CREATE TABLE album (
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- Not much to see here

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    artist    TEXT,
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);
```

- Not much to see here
- **Use primary keys!**

Write SELECT query

Write SELECT query

```
SELECT id, title, artist, publisher,
       isbn
FROM   album;
```

Write SELECT query

```
SELECT id, title, artist, publisher,
       isbn
FROM   album
WHERE  id = ?;
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- Inflate objects from each row

Write SELECT query

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FROM   album
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```

- Gee, that was easy
- Inflate objects from each row
- Let's see if it works...

Examine the output

id	title	artist	publisher	isbn
1	Rage Against the Machine	Rage Against the Machine	Atlantic	012848939
2	OK Computer	Radiohead	Atlantic	934293249
3	Elephant	The White Stripes	BMG	000864P55
4	Get Behind Me Satan	The White Stripes	BMG	949394595
5	Purple Rain	Prince and the Revolution	Warner Bro	638594823
6	Roots of a Revolution	James Brown	Polydor	496758395
7	Blood Sugar Sex Magik	Red Hot Chili Peppers	Warnter Br	957483845
8	Frizzle Fry	Primus	Atlantic	685968345

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- Hey cool!
- Single row == single object

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- Hey cool!
- Single row == single object
- Single column == single attribute

Let's add a subclass

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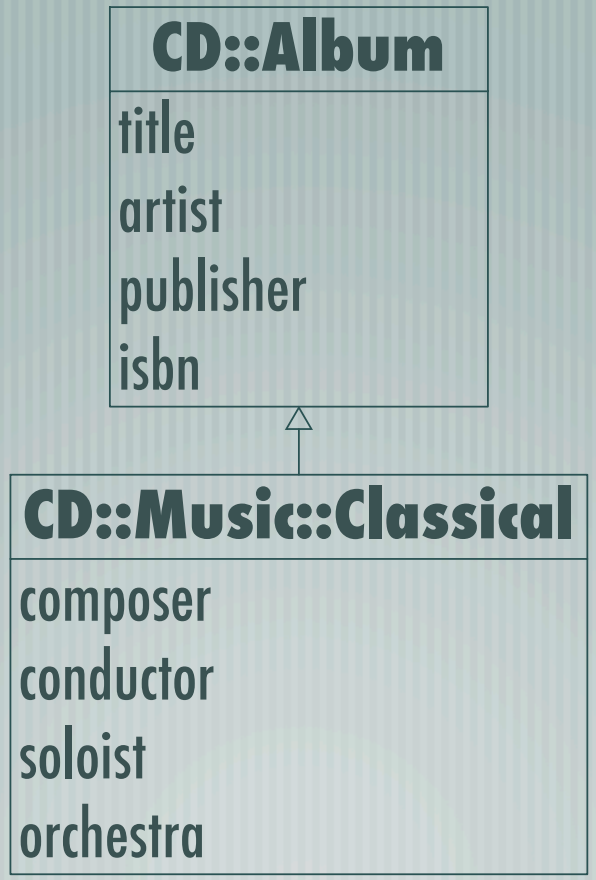

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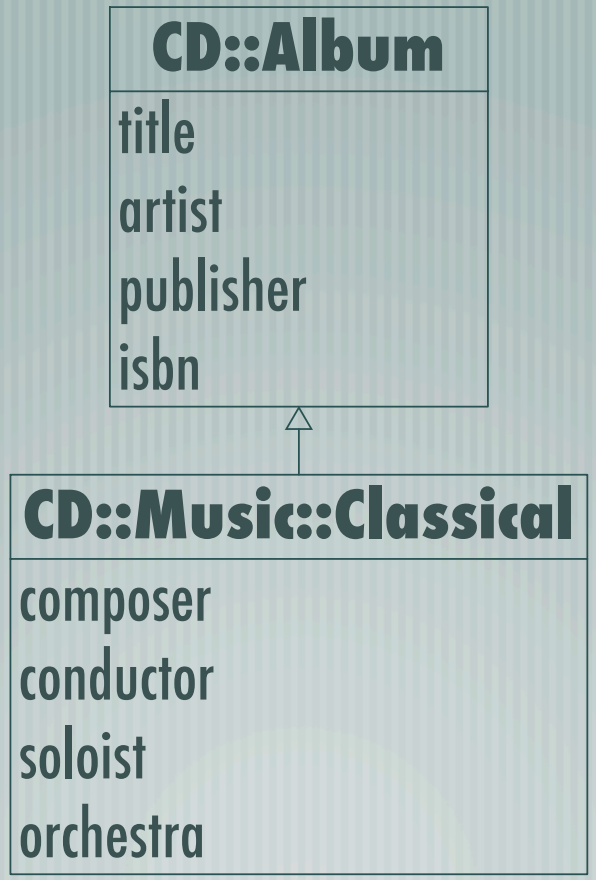

- Piece of cake, right?

Typical Subclassing Approach

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Typical Subclassing Approach

- Create another table
- Reference the parent class' table
- Write a two queries for each table
- Write a JOIN query for both tables

Create the new table

Create the new table

```
CREATE TABLE classical (
    id INTEGER NOT NULL PRIMARY KEY
               AUTOINCREMENT,
    album_id   INTEGER NOT NULL
               REFERENCES album(id),
    composer   TEXT,
    conductor  TEXT,
    orchestra  TEXT
);
```

Create the new table

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CREATE TABLE classical (
    id INTEGER NOT NULL PRIMARY KEY
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- Hrm...not bad

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- Hrm...not bad
- You use foreign keys, **right?**

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);
```

- Hrm...not bad
- You use foreign keys, **right?**
- What about the SELECT statement?

Write SELECT query

Write SELECT query

```
SELECT m.id, title, artist, publisher,
       isbn, c.id composer, conductor,
       orchestra
FROM   album m JOIN classical c
       ON m.id = c.album_id;
```

Write SELECT query

```
SELECT m.id, title, artist, publisher,
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FROM   album m JOIN classical c
       ON m.id = c.album_id;
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- Also not too bad

Write SELECT query

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SELECT m.id, title, artist, publisher,
       isbn, c.id composer, conductor,
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FROM   album m JOIN classical c
       ON m.id = c.album_id;
```

- Also not too bad
- Let's see how it works...

What's wrong here?

id	title	id	composer
9	Emperor Concerto	1	Beethoven
10	Eroica Symphony	2	Beethoven
11	Amadeus Soundtrack	3	Mozart

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- Different ID for the same object

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- Which to use?

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- Two IDs? That's annoying
- Different ID for the same object
- Which to use?
- **Stick to one and avoid the problem.**

Create the table again

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    id INTEGER NOT NULL PRIMARY KEY
       REFERENCES album (id),
    composer  TEXT,
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CREATE TABLE classical (
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- Gee, that's simpler

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- Gee, that's simpler
- The primary key is also a foreign key

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);
```

- Gee, that's simpler
- The primary key is also a foreign key
- You still use the foreign key constraint, **right?**

Write SELECT query again

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```
SELECT m.id AS id, title, artist,
       publisher, isbn, composer,
       conductor, orchestra
FROM   album m JOIN classical c
       ON m.id = c.id;
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SELECT m.id AS id, title, artist,
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- That got a bit simpler, too

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- That got a bit simpler, too
- Disambiguate the ID column

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- That got a bit simpler, too
- Disambiguate the ID column
- Let's see if it works...

Now we're talkin'!

id	title	composer	conductor
9	Emperor Concerto	Beethoven	Ozawa
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- Just one ID
- But why must we write a JOIN query?

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id          title                composer      conductor
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- Just one ID
- But why must we write a JOIN query?
- Couldn't it be **even simpler**?

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- Just one ID
- But why must we write a JOIN query?
- Couldn't it be **even simpler**?
- Can't we truly have one class == one table?

Yes, it can!

```
SELECT m.id AS id, title, artist,
       publisher, isbn, composer,
       conductor, orchestra
FROM   album m JOIN classical c
       ON m.id = c.id;
```

Yes, it can!

```
CREATE VIEW classical AS
SELECT m.id AS id, title, artist,
       publisher, isbn, composer,
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Yes, it can!

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- Rename subclass table to represent inheritance

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- Now we have a single "table"
- Rename subclass table to represent inheritance
- Supported by PostgreSQL, SQLite, and MySQL

Query the VIEW

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Get the same output

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id          title               composer      conductor
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- Hey, awesome!
- Returns the same records as before

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- It's faster, too
- But what about INSERTs, UPDATEs, and DELETEs?

Back to the base class

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INSERT INTO album (title, artist, publisher, isbn)
VALUES ('Kid B', 'Radiohed', 'Polygramm', '0000');
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VALUES ('Kid B', 'Radiohed', 'Polygramm', '0000');

UPDATE album
SET    title     = 'Kid A',
       artist    = 'Radiohead',
       publisher = 'Polygram',
       isbn      = '4959'
WHERE  id        = 12;
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SET    title     = 'Kid A',
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```

- Seems pretty straight-forward
- Let's try it...

And now the subclass

And now the subclass

```
INSERT INTO classical (title, artist, publisher, isbn,
                       composer, conductor, orchestra)
VALUES ('Cinema Serenad', 'Itzack Perlman', 'BMC', '2323',
        'Verious', 'Jon Williams', 'Pittsburg Symphony');
```

And now the subclass

```
INSERT INTO classical (title, artist, publisher, isbn,
                       composer, conductor, orchestra)
VALUES ('Cinema Serenad', 'Itzack Perlman', 'BMC', '2323',
        'Verious', 'Jon Williams', 'Pittsburg Symphony');

UPDATE classical
SET    title     = 'Cinema Serenade',
       artist    = 'Itzak Perlman',
       publisher = 'BMG',
       isbn      = '2764',
       composer  = 'Various',
       conductor = 'John Williams',
       orchestra = 'Pittsburgh Symphony'
WHERE  id        = 13;
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DELETE FROM classical
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DELETE FROM classical
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```

Let's see if these work...

D'oh! What now?

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INSERT INTO classical (title, artist, publisher, isbn,
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SQL error: cannot modify classical because it is a view
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- VIEWs are not updatable

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SQL error: cannot modify classical because it is a view
```

- VIEWs are not updatable
- Must modify the two tables separately

INSERT classical object

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INSERT INTO album (title, artist, publisher, isbn)
VALUES ('Cinema Serenad', 'Itzack Perlman', 'BMC', '2323');

INSERT INTO album_classical
       (id, composer, conductor, orchestra)
VALUES (last_insert_rowid(), 'Verious', 'Jon Williams',
        'Pittsburg Symphony');
```

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INSERT INTO album (title, artist, publisher, isbn)
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- We have to modify the two table separately
- Use function to populate subclass ID

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  - MySQL: `last_insert_id()`

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- We have to modify the two table separately
- Use function to populate subclass ID
  - SQLite: `last_insert_rowid()`
  - MySQL: `last_insert_id()`
  - PostgreSQL: `CURRVAL('album_id_seq');`

UPDATE classical object

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- Again, modify the two table separately

DELETE classical object

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DELETE FROM album_classical
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- And again, modify the two table separately

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- And again, modify the two table separately
- Unless your foreign key is ON DELETE CASCADE

DELETE classical object

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WHERE  id = 13;

DELETE FROM album
WHERE  id = 13;
```

- And again, modify the two table separately
- Unless your foreign key is ON DELETE CASCADE
- Let's see how these queries work...

Is there no other way?

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- The more complex your relations, the more queries

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- The more complex your relations, the more queries
- All because you can't update VIEWs

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- All because you can't update VIEWs
- Or **can** you?

Updatable views

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- SQLite supports triggers on VIEWs

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- SQLite supports triggers on VIEWs
- PostgreSQL supports rules on VIEWs

Updatable views

- SQLite supports triggers on VIEWs
- PostgreSQL supports rules on VIEWs
- With work, you **can** INSERT, UPDATE, and DELETE on VIEWs

SQLite INSERT trigger

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```
CREATE TRIGGER insert_classical
INSTEAD OF INSERT ON classical
FOR EACH ROW BEGIN
  INSERT INTO album (title, artist, publisher, isbn)
  VALUES (NEW.title, NEW.artist, NEW.publisher, NEW.isbn);

  INSERT INTO album_classical
         (id, composer, conductor, orchestra)
  VALUES (last_insert_rowid(), NEW.composer, NEW.conductor,
          NEW.orchestra);
END;
```

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- Use NEW variable to populate values

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          NEW.orchestra);
END;
```

- Use NEW variable to populate values
- Use last_insert_rowid() for classical ID

PostgreSQL INSERT rule

PostgreSQL INSERT rule

```
CREATE RULE insert_classical AS
ON INSERT TO classical DO INSTEAD (
  INSERT INTO album (title, artist, publisher, isbn)
  VALUES (NEW.title, NEW.artist, NEW.publisher, NEW.isbn);

  INSERT INTO album_classical
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  VALUES (CURRVAL('seq_album_id_seq'), NEW.composer,
          NEW.conductor, NEW.orchestra);
);
```

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);
```

- Use NEW variable to populate values
- Use CURRVAL() to populate classical ID

SQLite UPDATE trigger

SQLite UPDATE trigger

```
CREATE TRIGGER update_classical
INSTEAD OF UPDATE ON classical
FOR EACH ROW BEGIN
  UPDATE album
  SET    title     = NEW.title,
         artist    = NEW.artist,
         publisher = NEW.publisher,
         isbn      = NEW.isbn
  WHERE  id        = OLD.id;

  UPDATE album_classical
  SET    composer  = NEW.composer,
         conductor = NEW.conductor,
         orchestra = NEW.orchestra
  WHERE  id        = OLD.id;
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```

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SQLite DELETE trigger

SQLite DELETE trigger

```
CREATE TRIGGER delete_classical
INSTEAD OF DELETE ON classical
FOR EACH ROW BEGIN
  DELETE FROM album_classical
  WHERE  id = OLD.id;

  DELETE FROM album
  WHERE  id = OLD.id;
END;
```

SQLite DELETE trigger

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- Let's see how they work...

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- Much simpler client-side code
- Fewer queries sent to the database
- Reduced network overhead
- Maintains normalization

One-to-many relationships

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- Often have one-to-many relationships

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- Generally requires two queries, one for each object

```
SELECT id, title, numb, album_id
FROM   track;

SELECT id, title, artist, publisher, isbn
FROM   album
WHERE  id = $album_id;
```

JOIN composite objects

```
SELECT track.id AS id, track.title AS title, numb,
       album.id    AS album__id,
       album.title AS album__title,
       artist      AS album__artist,
       publisher   AS album__publisher,
       isbn        AS album__isbn
FROM   track JOIN album
       ON track.album_id = album.id;
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FROM   track JOIN album
       ON track.album_id = album.id;
```

- Or, do a JOIN, instead
- Saves network overhead
- But might as well make a view for it...

JOIN composite objects

```
CREATE VIEW track AS
SELECT _track.id AS id, _track.title AS title, numb,
       album.id    AS album__id,
       album.title AS album__title,
       artist      AS album__artist,
       publisher   AS album__publisher,
       isbn        AS album__isbn
FROM   _track JOIN album
       ON _track.album_id = album.id;
```

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What about MySQL?

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What about MySQL?

- MySQL 5 supports views
- Can INSERT, UPDATE, & DELETE on single table views
- Cannot on multi-table (JOIN) views
- MySQL supports triggers
- Cannot assign triggers to views
- No rules

Resources

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- “PostgreSQL: Introduction and Concepts” by Bruce Momjian
  http://xrl.us/gy3a

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- MySQL: http://dev.mysql.com/doc/mysql/en/views.html

Thank you

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