Databases

The relational model

based on these principles

1. A data structure that prescribes how data is organized.
2. Operations that manipulate data structures.
3. Rules that govern valid relational data.

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Databases

Relational Rules

1. Data integrity - constraints that ensure data is valid and conforms to the business policy

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Databases

Relational Rules – Structural rules

Rules that govern data

1. Unique primary key
2. No duplicate column names
3. No duplicate rows

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Relational Rules– Business rules

1. Unique column values
2. No missing values – must contain known values
3. Delete cascade – ovoids broken links

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Relational Rules

1. Normalized – exactly one value in each cell.
2. Data Independence – rows and columns have no inherent order. We tend to make the columns in the logical order we see them as.

   The reason behind DI is that with the select statement you can put the columns in any order that you want.

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Null

1. Special value that represents missing data
2. Unknown – troublesome for business logic. Why**?**
3. Inapplicable – does not apply for this record
4. Keys should never be null. Foreign keys being null would have no related record. Allowed **?**
5. Common for web db to have null values

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Databases

Data types

Integer - INT, 4 bytes and SMALLINT as 2 bytes.

Decimal - FLOAT and DECIMAL.

Character - CHAR, VARCHAR, TEXT

Date and time – DATE, DATETIME, and TIMESTAMP

Binary – TINYBLOB, MEDIUMBLOB. LONGBLOB

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Databases

Keys

Primary key - one field that uniquely identifies the row.

Composite key- a field or combination of fields that uniquely identifies the record. More than three fields or more than 30 bytes use a surrogate key.

Surrogate key - a numeric value that has no relation to row other than to uniquely identify the row (auto number)

Foreign key - a primary key value placed in another table to link (relate) the two tables together.

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Databases

Referential integrity rules

1. All foreign key values must be fully null or match a primary key value (if fk != to a pk value it is incorrect)
2. Violations can occur when:
   1. Pk is updated
   2. Fk is updated
   3. Row with pk deleted
   4. Row with fk is inserted
3. Primary key inserts and foreign key deletes cannot violate referential integrity.

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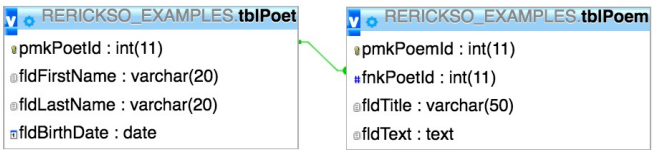
Databases

Joins: ERD is a road map for your joins

Join - only matching left and right table rows



Poet - Poems example

```
SELECT pmkPoetId, fldFirstName, fldLastName, fldBirthDate,
       pmkPoemId, fnkPoetId, fldTitle, fldText
FROM tblPoet
JOIN tblPoem ON pmkPoetId = fnkPoetId
ORDER BY fldFirstName, fldLastName
```

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Databases

JOIN Result

pmkPoetId	fldFirstName ▲ 1	fldLastName ▲ 2	fldBirthDate	pmkPoemId	fnkPoetId	fldTitle	fldText
5	A.O	Taner	1807-11-30	2	5	Binary Love	One is love, Two is everything else.
1	Karen	Ruffc	1806-04-30	3	1	Inside my Computer	My computer--disassembled is a maze of cables, dr...
4	Robert	Frost	1874-01-30	1	4	The Road Not Taken	Two roads diverged in a yellow wood, And sorry I c...

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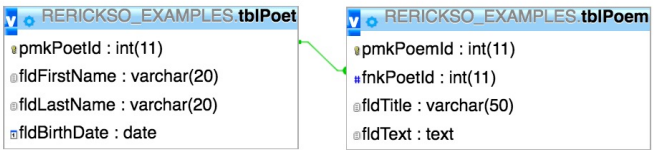
Databases

Joins

Left - all left table rows, but only matching right table rows




```
SELECT pmkPoetId, fldFirstName, fldLastName, fldBirthDate,
       pmkPoemId, fnkPoetId, fldTitle, fldText
FROM tblPoet
LEFT JOIN tblPoem ON pmkPoetId = fnkPoetId
ORDER BY fldFirstName, fldLastName
```

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Databases

LEFT JOIN Result

pmkPoetId	fldFirstName ▲ 1	fldLastName ▲ 2	fldBirthDate	pmkPoemId	fnkPoetId	fldTitle	fldText
5	A.O	Taner	1807-11-30	2	5	Binary Love	One is love, Two is everything else.
1	Karen	Ruffc	1806-04-30	3	1	Inside my Computer	My computer-- disassembled is a maze of cables, dr...
6	Lisa	Dion	2000-10-31	*NULL*	*NULL*	*NULL*	*NULL*
4	Robert	Frost	1874-01-30	1	4	The Road Not Taken	Two roads diverged in a yellow wood, And sorry I c...

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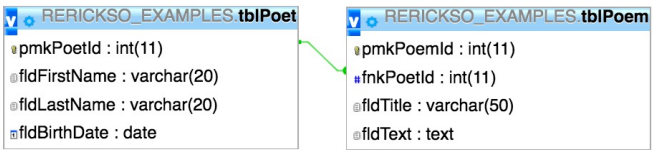
Databases

Joins

Right - all right table rows, but only matching left table rows




```
SELECT pmkPoetId, fldFirstName, fldLastName, fldBirthDate,
       pmkPoemId, fnkPoetId, fldTitle, fldText
FROM tblPoet
RIGHT JOIN tblPoem ON pmkPoetId = fnkPoetId
ORDER BY fldFirstName, fldLastName
```

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Databases

RIGHT JOIN Results

pmkPoetId	fldFirstName ▲ 1	fldLastName ▲ 2	fldBirthDate	pmkPoemId	fnkPoetId	fldTitle	fldText
NULL	*NULL*	*NULL*	*NULL*	4	*NULL*	Ode to PHP	
5	A.O	Taner	1807-11-30	2	5	Binary Love	One is love, Two is everything else.
1	Karen	Ruffc	1806-04-30	3	1	Inside my Computer	My computer-- disassembled is a maze of cables, dr...
4	Robert	Frost	1874-01-30	1	4	The Road Not Taken	Two roads diverged in a yellow wood, And sorry I c...

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Databases

Joins

Full - all left and right table rows (not in MYSQL)

Full (union) – How we make a full join work

```
SELECT pmkPoetId, fldFirstName, fldLastName, fldBirthDate,
pmkPoemId, fnkPoetId, fldTitle, fldText
FROM tblPoet
LEFT JOIN tblPoem ON pmkPoetId = fnkPoetId
UNION
SELECT pmkPoetId, fldFirstName, fldLastName, fldBirthDate,
pmkPoemId, fnkPoetId, fldTitle, fldText
FROM tblPoet
RIGHT JOIN tblPoem ON pmkPoetId = fnkPoetId
ORDER BY fldFirstName, fldLastName
```

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Databases

FULL JOIN (UNION) Results

pmkPoetId	fldFirstName ▲ 1	fldLastName ▲ 2	fldBirthDate	pmkPoemId	fnkPoetId	fldTitle	fldText
NULL	*NULL*	*NULL*	*NULL*	4	*NULL*	Ode to PHP	
5	A.O	Taner	1807-11-30	2	5	Binary Love	One is love, Two is everything else.
1	Karen	Ruffc	1806-04-30	3	1	Inside my Computer	My computer--disassembled is a maze of cables, dr...
6	Lisa	Dion	2000-10-31	*NULL*	*NULL*	*NULL*	*NULL*
4	Robert	Frost	1874-01-30	1	4	The Road Not Taken	Two roads diverged in a yellow wood, And sorry I c...

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Databases

Normal Form

A ***fact*** is a pair of related values

Redundancy is the repetition of a fact.

Designing tables with less redundancy (repeating values).

Six normal forms, sequence of steps to take.

ERD when done properly puts your tables into third normal form. This is our goal for this class.

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Databases

Normal Form

First Normal Form

Column A depends on column B. each B value is related to at most one A value. All non-key columns must depend on the primary key.

Passenger

● PassengerNumber	PassengerName
222	Elvira Yin
829	John Miller
333	Deepak Chopra
444	Mary Hutcher

First normal form

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Databases

Normal Form

Second Normal Form

All non-key columns must depend on the whole primary key. A non-key column cannot depend on part of a composite primary key.

Booking

● PassengerNumber	PassengerName	● FlightCode	FareClass	BoardingZoneNumber
222	Elvira Yin	AZ312	First	1
222	Elvira Yin	BF999	Economy	3
222	Elvira Yin	GC848	Business	2
333	Deepak Chopra	GC848	First	1
444	Mary Hutcher	GC848	First	1

First normal form

Booking

● PassengerNumber	● FlightCode	FareClass	BoardingZoneNumber
222	AZ312	First	1
222	BF999	Economy	3
222	GC848	Business	2
333	GC848	First	1
444	GC848	First	1

Passenger

● PassengerNumber	PassengerName
222	Elvira Yin
333	Deepak Chopra
444	Mary Hutcher

Second normal form

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Databases

Normal Form

Third Normal Form

all non-key columns must depend on the whole primary key and no other columns. All non-key columns depend on the key, the whole key, and nothing but the key.

Booking

● PassengerNumber	● FlightCode	FareClass	BoardingZoneNumber
222	AZ312	First	1
222	BF999	Economy	3
222	GC848	Business	2
333	GC848	First	1
444	GC848	First	1

Second normal form

Booking

● PassengerNumber	● FlightCode	FareClass
222	AZ312	First
222	BF999	Economy
222	GC848	Business
333	GC848	First
444	GC848	First

Third normal form

Fare

● FareClass	BoardingZoneNumber
First	1
Economy	3
Business	2

Third normal form

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