CSCI 4710/5710 Databases

SQL JOINS

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Why JOINS

- Joins are used to select data from multiple tables.
  - Display the customer name with orders instead of the customer ID.
    - Can’t display this information using one table.
  - Will need the order information.
    - From the orders table.
  - Will need the customer information.
    - From the customers table.

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JOINS – How to.

- Joins can be achieved in two different ways:
  - Traditional method:
    - Using conditions in the where clause.
  - Example: Display ISBN, title, retail category and publisher's name for all books.

```
SELECT B.ISBN, B.Title, B.Retail, B.Category , P.Name as 'Published By'
FROM  BOOKS B , PUBLISHER P WHERE B.PubID = P.PubID;
```

ISBN	Title	Retail	Category	Published By
0401140733	REVENGE OF MICKEY	22.00	FAMILY LIFE	PRINTING IS US
9247381001	HOW TO MANAGE THE MANAGER	31.95	BUSINESS	PRINTING IS US
4981341710	BUILDING A CAR WITH TOOTHPICKS	59.95	CHILDREN	PUBLISH OUR WAY
9959789321	E-BUSINESS THE EASY WAY	54.50	COMPUTER	PUBLISH OUR WAY
1915762492	HANDCRANKED COMPUTERS	25.00	COMPUTER	AMERICAN PUBLISHING
3957136468	HOLY GRAIL OF ORACLE	75.95	COMPUTER	AMERICAN PUBLISHING
8843172113	DATABASE IMPLEMENTATION	55.95	COMPUTER	AMERICAN PUBLISHING
0132149871	HOW TO GET FASTER PIZZA	29.95	SELF HELP	READING MATERIALS INC.
0299282519	THE WOK WAY TO COOK	28.75	COOKING	READING MATERIALS INC.
1059831198	BODYBUILD IN 10 MINUTES A DAY	30.95	FITNESS	READING MATERIALS INC.
3437212490	COOKING WITH MUSHROOMS	19.95	COOKING	READING MATERIALS INC.
2147428890	SHORTEST POEMS	39.95	LITERATURE	REED-N-RITE
2491748320	PAINLESS CHILD-REARING	89.95	FAMILY LIFE	REED-N-RITE
8117949391	BIG BEAR AND LITTLE DOVE	8.95	CHILDREN	REED-N-RITE

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JOINS – How to.

- Join Method:
  - Using the JOIN keyword in the FROM clause.

```
SELECT B.ISBN, B.Title, B.Retail, B.Category , P.Name as 'Published By'
FROM  BOOKS B JOIN PUBLISHER P on B.PubID = P.PubID
```

ISBN	Title	Retail	Category	Published By
0401140733	REVENGE OF MICKEY	22.00	FAMILY LIFE	PRINTING IS US
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Types of JOINS.

- Cartesian Join.
  - Also called cross join.
- Inner Join.
  - Equality join.
  - Non-equality join.
  - Self join.
- Outer Join.
  - Right Join.
  - Left Join.
  - Full Join.

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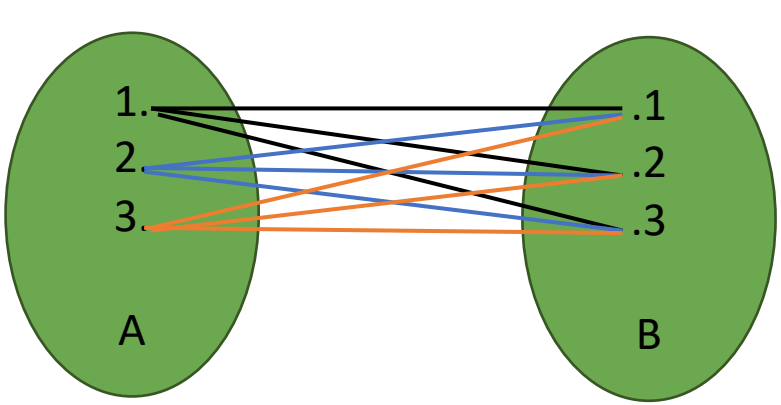
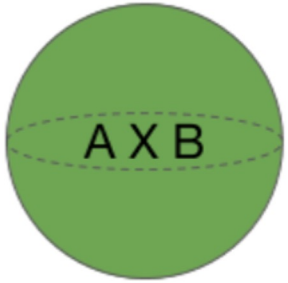
Cartesian (CROSS JOIN).

- Used to create all possible combinations between tables.
  - For two tables A and B, then :





CARTESIAN (CROSS) JOIN

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Cartesian (CROSS JOIN).

Cartesian-Product Operation – Example

- Relations r, s:

A	B
α	1
β	2

r

C	D	E
α	10	+
β	10	+
β	20	−
γ	10	−

s

- $r \times s$

A	B	C	D	E
α	1	α	10	+
α	1	β	10	+
α	1	β	20	−
α	1	γ	10	−
β	2	α	10	+
β	2	β	10	+
β	2	β	20	−
β	2	γ	10	−

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Cartesian (CROSS JOIN).

- Let us try with an example by consider the following tables:

CARS

Model
BMW
Ferrari
Mercedes Benz

COLORS

ColorCode	ColorName
1	Red
2	Blue
3	Yellow
4	Green

- Display all cars in all possible colors.

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Cartesian (CROSS JOIN).

- Can be done in two ways:
  1. Omitting the WHERE clause:

```
SELECT * FROM CARS, COLORS order by Model, ColorCode;
```

  2. Using CROSS JOIN:

```
SELECT * FROM CARS CROSS JOIN COLORS order by Model, ColorCode;
```

  - Both will give the same result

Model	ColorCode	ColorName
BMW	1	Red
BMW	2	Blue
BMW	3	Yellow
BMW	4	Green
Ferrari	1	Red
Ferrari	2	Blue
Ferrari	3	Yellow
Ferrari	4	Green
Mercedes Benz	1	Red
Mercedes Benz	2	Blue
Mercedes Benz	3	Yellow
Mercedes Benz	4	Green

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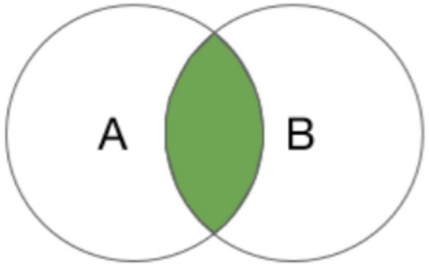
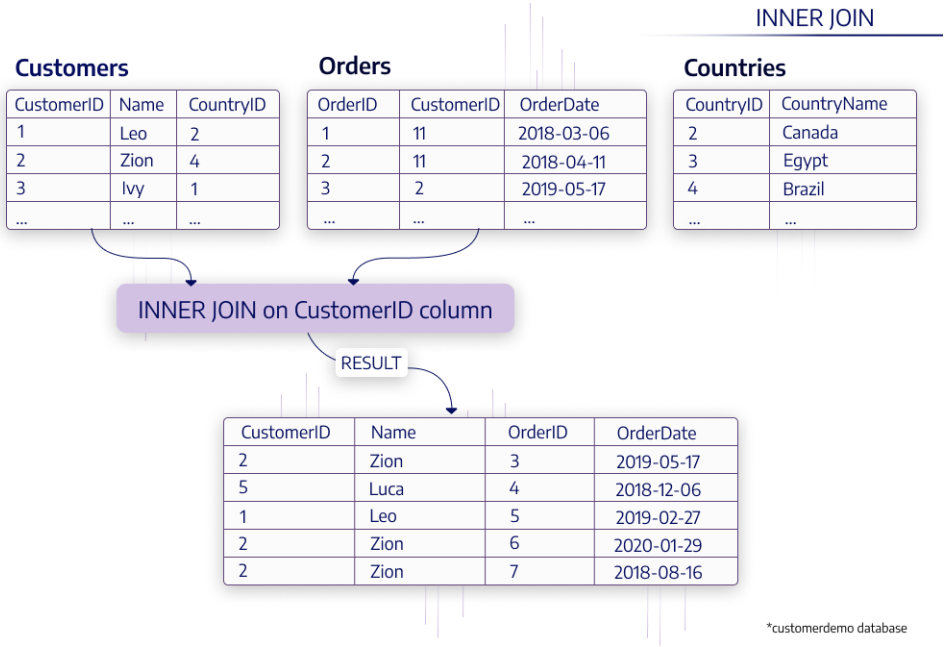
Inner Join

- Basic idea:



INNER JOIN



- Selects records that have matching values in both tables.

- Example: SELECT Orders.OrderID, Customers.CustomerName
  FROM Orders
  INNER JOIN Customers ON Orders.CustomerID = Customers.CustomerID;

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Inner Join

- The resulting table will contain all the attributes from both the tables including common column also.

Example: SELECT * FROM student S INNER JOIN Marks M
ON S.Roll_No = M.Roll_No;

Roll_No	Name	Roll_No	Marks
2	B	2	70
3	C	3	50

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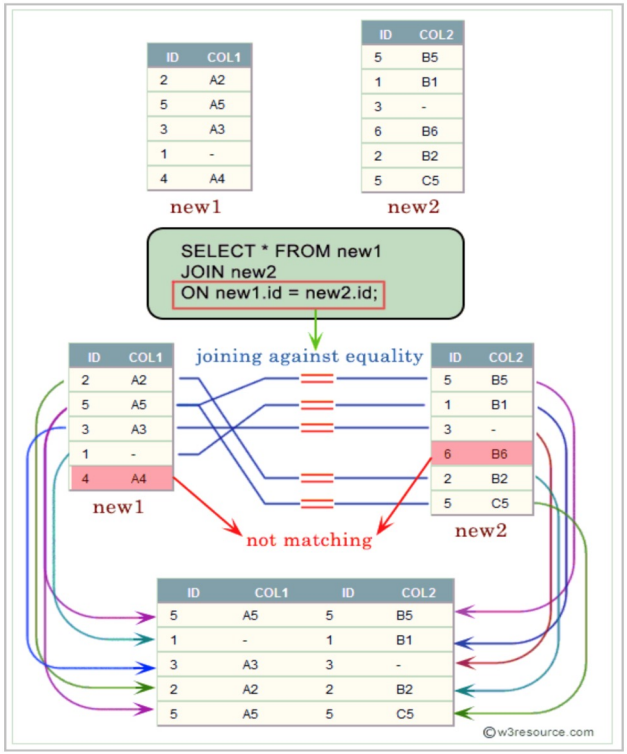
Equality Joins

- Link rows through equivalent data that exists in both tables.
  - **Matching tables on joining condition**
    - Based on a matching key (PK-FK)
  - **Output: Intersection of two tables**
    - Only include those matched
    - Non-matched rows excluded



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Equality Joins

- Examples:
  - Display order numbers, dates and customer's full name for all orders.

```
SELECT OrderID, OrderDate , concat(FirstName,' ',LastName) as 'Customer Name'
FROM ORDERS, CUSTOMERS where ORDERS.CustomerID = CUSTOMERS.CustomerID
```

  - Display order numbers, dates and customer's full name for all customers living in Florida.

```
SELECT OrderID, OrderDate , concat(FirstName,' ',LastName) as 'Customer Name'
FROM ORDERS, CUSTOMERS where ORDERS.CustomerID = CUSTOMERS.CustomerID
AND CUSTOMERS.State = 'FL'
```

If there is same column name in more than one table???

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Column Ambiguity

- When the same column name is present in more than one table.
  - Considered ambiguous.
  - Which column does the query refer to?
- Resolved by specifying the table containing the column.
  - Example: the column “CustomerID” exists in both the ORDERS table and the CUSTOMERS Table:
  - Trying this query:

```
SELECT OrderID, OrderDate, CustomerID , concat(FirstName,'  ',LastName) as 'Customer Name'
FROM ORDERS, CUSTOMERS where ORDERS.CustomerID = CUSTOMERS.CustomerID
```

Will result in an error: `Error Code: 1052. Column 'CustomerID' in field list is ambiguous`

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Column Ambiguity

- To resolve the issue:
  - Specify which table to pull data from:

```
SELECT OrderID, OrderDate, CUSTOMERS.CustomerID , concat(FirstName,' ',LastName) as 'Customer Name'
FROM ORDERS, CUSTOMERS where ORDERS.CustomerID = CUSTOMERS.CustomerID
```

  - Or similarly:

```
SELECT OrderID, OrderDate, ORDERS.CustomerID , concat(FirstName,' ',LastName) as 'Customer Name'
FROM ORDERS, CUSTOMERS where ORDERS.CustomerID = CUSTOMERS.CustomerID
```

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Aliasing

- Joining more than two tables requires more join conditions.
- Column aliasing makes it easier to specify tables and remove ambiguity.
  - It can be done using an alias (usually a letter or two) to refer to a table.
  - Syntax:
    - In the from clause:
    - Follow the table name with the alias.
    - Use the alias in the select clause as:
      - Alias.ColumnName.

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Joining Multiple Tables

- Example: Display the names of the customers along with the titles of the books they have ordered.
  - This requires fetching data from multiple tables.

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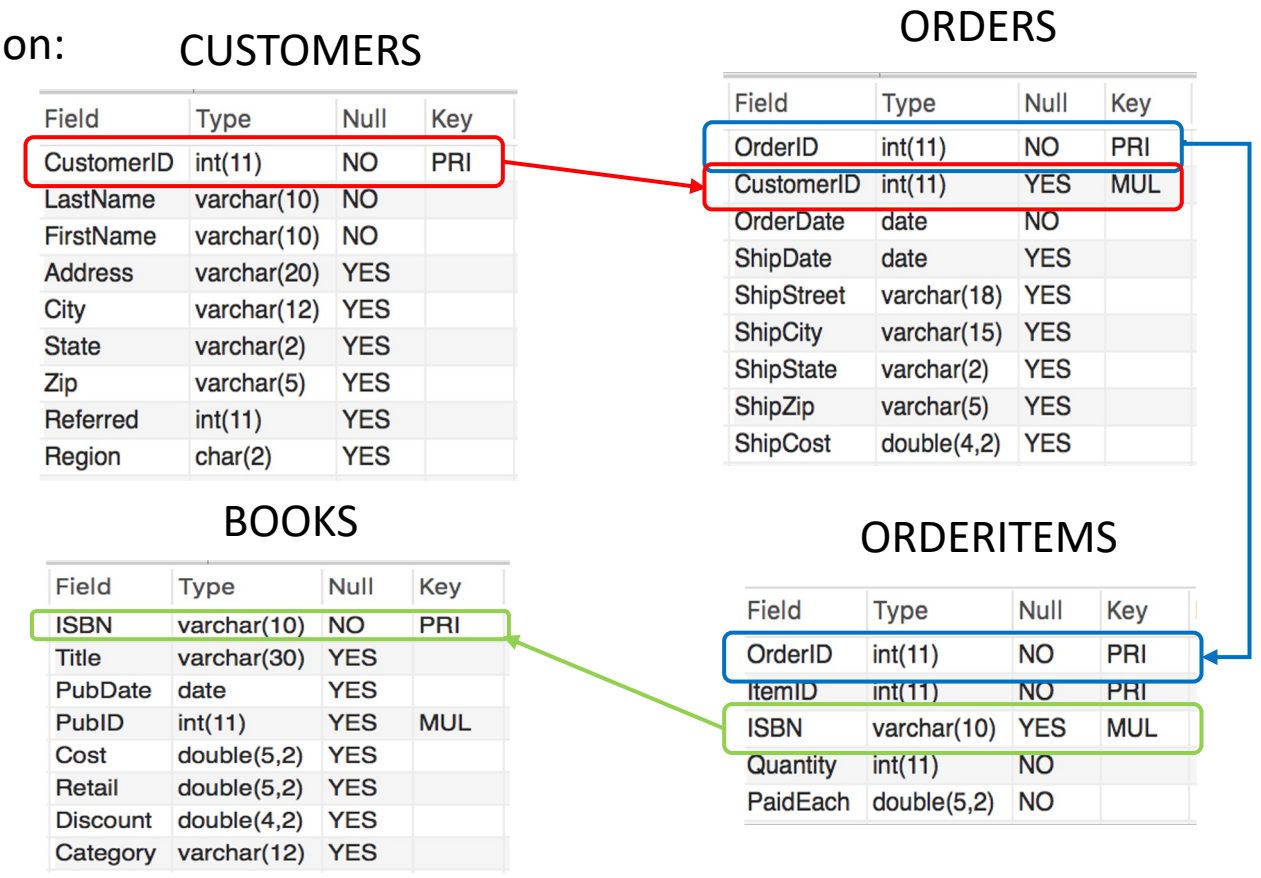
Joining Multiple Tables

- Visualization:



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Joining Multiple Tables

- Example: Display the names of the customers along with the titles of the books they have ordered.
  - This requires fetching data from multiple tables.
    - Customer Name: Customers Table.
    - Book Title: Books Table:
    - Which books and in which order: Order Items Table.
    - Which order belongs to which customer: Orders table:

```
SELECT C.FirstName, C.LastName, B.Title FROM
 CUSTOMERS C, ORDERS O, ORDERITEMS OI, BOOKS B
WHERE C.CustomerID = O.CustomerID
AND O.OrderID = OI.OrderID
AND OI.ISBN = B.ISBN;
```

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Natural Join

Natural Join Operation – Example

- Relations r, s:

A	B	C	D
α	1	α	a
β	2	γ	a
γ	4	β	b
α	1	γ	a
δ	2	β	b

r

B	D	E
1	a	α
3	a	β
1	a	γ
2	b	δ
3	b	ϵ

s

- $r \bowtie s$

A	B	C	D	E
α	1	α	a	α
α	1	α	a	γ
α	1	γ	a	α
α	1	γ	a	γ
δ	2	β	b	δ

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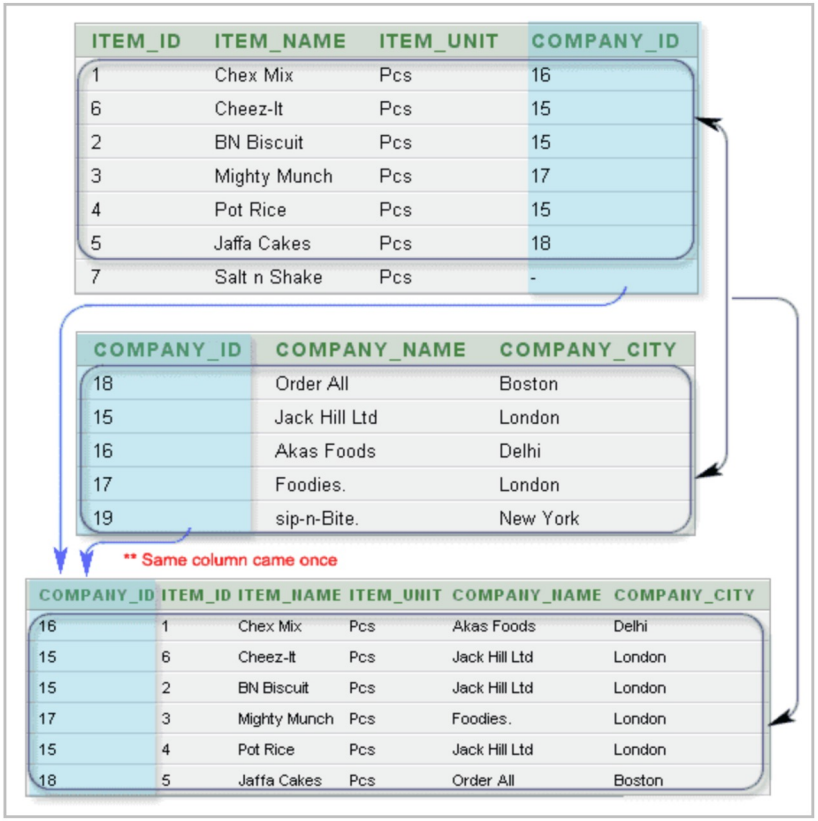
Natural Join

- When tables have columns with identical column names.
- Having the same data type.
- Natural join can be used in this case. No duplicate columns.
- Example:



ITEM_ID	ITEM_NAME	ITEM_UNIT	COMPANY_ID
1	Chex Mix	Pcs	16
6	Cheez-It	Pcs	15
2	BN Biscuit	Pcs	15
3	Mighty Munch	Pcs	17
4	Pot Rice	Pcs	15
5	Jaffa Cakes	Pcs	18
7	Salt n Shake	Pcs	-

COMPANY_ID	COMPANY_NAME	COMPANY_CITY
18	Order All	Boston
15	Jack Hill Ltd	London
16	Akas Foods	Delhi
17	Foodies.	London
19	sip-n-Bite.	New York

** Same column came once

COMPANY_ID	ITEM_ID	ITEM_NAME	ITEM_UNIT	COMPANY_NAME	COMPANY_CITY
16	1	Chex Mix	Pcs	Akas Foods	Delhi
15	6	Cheez-It	Pcs	Jack Hill Ltd	London
15	2	BN Biscuit	Pcs	Jack Hill Ltd	London
17	3	Mighty Munch	Pcs	Foodies.	London
15	4	Pot Rice	Pcs	Jack Hill Ltd	London
18	5	Jaffa Cakes	Pcs	Order All	Boston

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM CUSTOMERS NATURAL JOIN ORDERS
```

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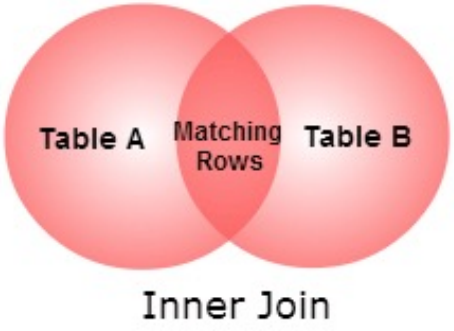
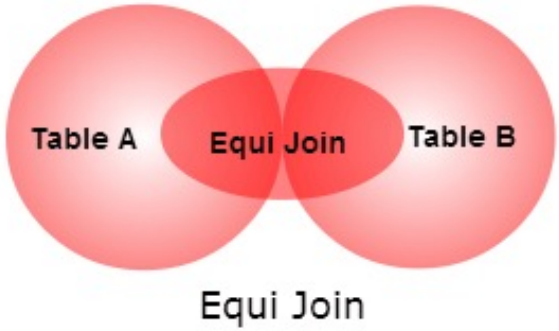
Natural Join vs Inner Join

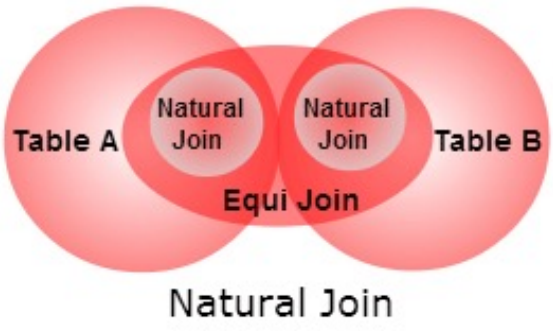
- Natural Join joins two tables based on same attribute name and datatypes.
- Inner Join joins two table on the basis of the column which is explicitly specified in the ON clause.



Inner Join



Equi Join



Natural Join

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JOIN …USING

- When the tables have some columns with the same column name.
  - Another way is to use:

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM ORDERS JOIN Customers USING (CustomerID)
```

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JOIN ON

- When the column names are different in the tables.
  - Suppose that the customer id in the customers table is named ID.
  - JOIN….ON can be used.
  - Specify the column to join on.
  - Then:

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM ORDERS O JOIN CUSTOMERS C
 ON  C.ID = O.CustomerID
```

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Inner Join Wrap Up

Traditional: WHERE clause

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM ORDERS O, CUSTOMERS C WHERE
O.CustomerID = C.CustomerID
```

NATURAL JOIN

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM ORDERS  NATURAL JOIN CUSTOMERS
```

JOIN…….USING

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM ORDERS  JOIN CUSTOMERS
USING (CustomerID)
```

JOIN……ON

```
SELECT LastName , FirstName, OrderID, OrderDate
FROM ORDERS O JOIN CUSTOMERS C
 ON  C.ID = O.CustomerID
```