



Joins

Join Operator

- Most databases have many tables
- Combine tables using the join operator
- Each record in one table is combined with matching records from the other
- Specify matching condition
 - Can be any comparison but usually =
 - PK = FK most common join condition
 - Relationship diagram useful when combining tables

Join Operator Example

- FROM clause contains join operations
- Use INNER JOIN (or just JOIN) and ON keywords

Example

```
SELECT Faculty.FacSSN, FacFirstName,  
       OfferNo  
FROM Offering INNER JOIN Faculty ON  
       Faculty.FacSSN = Offering.FacSSN
```

Join Example

Faculty

FacSSN	FacName
111-11-1111	joe
222-22-2222	sue
333-33-3333	sara

Offering

OfferNo	FacSSN
1111	111-11-1111
2222	222-22-2222
3333	111-11-1111

Natural Join of Offering and Faculty

FacSSN	FacName	OfferNo
111-11-1111	joe	1111
222-22-2222	sue	2222
111-11-1111	joe	3333

Alternate Notation

- List tables in the FROM clause
- List join conditions in the WHERE clause

Example

```
SELECT Faculty.FacSSN, FacFirstName,  
       OfferNo  
FROM Offering, Faculty  
WHERE Faculty.FacSSN = Offering.FacSSN
```

Join Operator Style

Helps distinguish join conditions from non-join conditions

Example 11

```
SELECT OfferNo, CourseNo, FacFirstName,  
       FacLastName  
FROM Offering INNER JOIN Faculty  
     ON Faculty.FacSSN = Offering.FacSSN  
WHERE OffTerm = 'FALL' AND OffYear = 2007  
     AND FacRank = 'ASST' AND CourseNo LIKE 'IS%'
```

Name Qualification

- FacSSN is in both Faculty and Offering
- Must qualify FacSSN with name of table

```
SELECT Faculty.FacSSN,  
       FacFirstName, CourseNo  
FROM Faculty JOIN Offering  
ON Faculty.FacSSN = Offering.FacSSN
```

How to Join Two Tables

- The two tables should have a primary key / foreign key relationship
- Put the primary key on one side of the join condition, and the foreign key on the other side

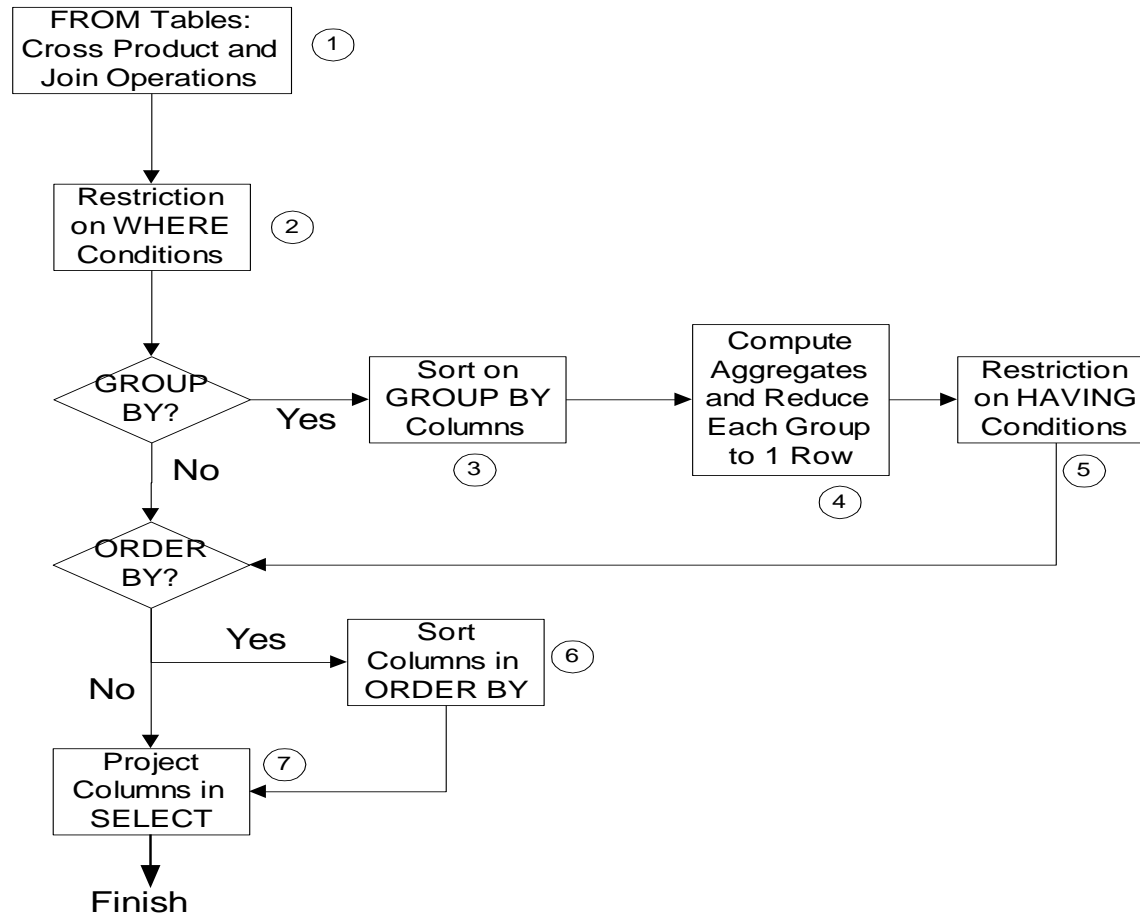
```
SELECT ...  
FROM Faculty JOIN Offering  
ON Faculty.FacSSN = Offering.FacSSN
```


Summarization and Joins

Example 14: List the number of students enrolled in each fall 2007 offering.

```
SELECT Offering.OfferNo,  
       COUNT( * ) AS NumStudents  
FROM Enrollment JOIN Offering  
       ON Offering.OfferNo = Enrollment.OfferNo  
WHERE OffYear = 2007 AND OffTerm = 'FALL'  
GROUP BY Offering.OfferNo
```

Conceptual Evaluation Process



Conceptual Evaluation Lessons

- Row operations before group operations
 - FROM and WHERE before GROUP BY and HAVING
 - Check row operations first
- Grouping occurs only one time
- Use small sample tables

Conceptual Evaluation Problem

Example 15: List the number of offerings taught in 2006 by faculty rank and department. Exclude combinations of faculty rank and department with less than two offerings taught.

```
SELECT FacRank, FacDept,  
       COUNT(*) AS NumOfferings  
FROM Faculty, Offering  
WHERE Offering.FacSSN = Faculty.FacSSN  
       AND OffYear = 2007  
GROUP BY FacRank, FacDept  
HAVING COUNT(*) > 1
```

Advanced Problems

- Joining multiple tables
- Self joins
- Grouping after joining multiple tables
- Traditional set operators

Joining Three Tables

Example 16: List Leonard Vince's teaching schedule in fall 2005. For each course, list the offering number, course number, number of units, days, location, and time.

```
SELECT OfferNo, Offering.CourseNo, OffDays,  
       CrsUnits, OffLocation, OffTime  
FROM Faculty JOIN Offering  
       ON Faculty.FacSSN = Offering.FacSSN  
   JOIN Course  
       ON Offering.CourseNo = Course.CourseNo  
WHERE  
  OffYear = 2007 AND OffTerm = 'FALL'  
  AND FacFirstName = 'LEONARD'  
  AND FacLastName = 'VINCE'
```

Joining Four Tables

Example 17: List Bob Norbert's course schedule in spring 2006. For each course, list the offering number, course number, days, location, time, and faculty name.

```
SELECT Offering.OfferNo, Offering.CourseNo,  
       OffDays, OffLocation, OffTime,  
       FacFirstName, FacLastName  
FROM Faculty, Offering, Enrollment, Student  
WHERE Offering.OfferNo = Enrollment.OfferNo  
       AND Student.StdSSN = Enrollment.StdSSN  
       AND Faculty.FacSSN = Offering.FacSSN  
       AND OffYear = 2007 AND OffTerm = 'SPRING'  
       AND StdFirstName = 'BOB'  
       AND StdLastName = 'NORBERT'
```

Join Two Tables Revisited

- What if the two tables don't have a primary key / foreign key relationship?
- Find a common table that has a primary key / foreign key relationship with both
- Join all three tables

Example: List students and the courses in which they are enrolled

Join Two Tables Revisited

Example: List students and the courses in which they are enrolled

```
SELECT StdFirstName, StdLastName, CourseNo
FROM Student JOIN Enrollment ON
    Student.StdSSN = Enrollment.StdSSN
JOIN Offering ON
    Enrollment.OfferNo = Offering.OfferNo
```

Summary

- SQL is a broad language
- SELECT statement is complex
- Use problem solving guidelines
- Lots of practice to master query formulation and SQL

Further Reading

- SQL by Example, by John Russo
<https://ebookcentral.proquest.com/lib/bju/detail.action?docID=5602384>