



# CS 525: Advanced Database Organisation

## 07: Query Processing Overview

Boris Glavic

Slides: adapted from a [course](#) taught by [Hector Garcia-Molina](#), Stanford InfoLab



# Query Processing

Q → Query Plan



# Query Processing

Q → Query Plan

## Focus: Relational Systems

- Others?

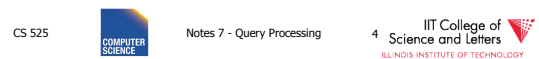
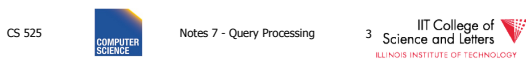
# Example

Select B,D

From R,S

Where R.A = "c" ∧ S.E = 2

R.C=S.C

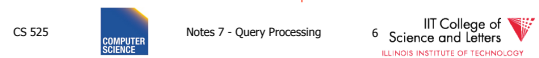
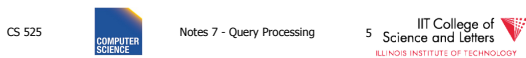


R	A	B	C	S	C	D	E
	a	1	10		10	x	2
	b	1	20		20	y	2
	c	2	10		30	z	2
	d	2	35		40	x	1
	e	3	45		50	y	3

R	A	B	C	S	C	D	E
	a	1	10		10	x	2
	b	1	20		20	y	2
	c	2	10		30	z	2
	d	2	35		40	x	1
	e	3	45		50	y	3

Answer 

B	D
2	x



- How do we execute query?

One idea

- Do Cartesian product
- Select tuples
- Do projection

RXS	R.A	R.B	R.C	S.C	S.D	S.E
	a	1	10	10	x	2
	a	1	10	20	y	2
	⋮					
	C	2	10	10	x	2
	⋮					

CS 525



Notes 7 - Query Processing



CS 525



Notes 7 - Query Processing



RXS	R.A	R.B	R.C	S.C	S.D	S.E
	a	1	10	10	x	2
	a	1	10	20	y	2
	⋮					
Bingo! → Got one...	C	2	10	10	x	2
	⋮					

CS 525

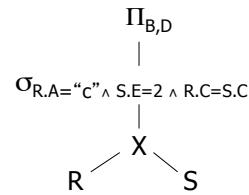


Notes 7 - Query Processing



Relational Algebra - can be used to describe plans...

Ex: Plan I



CS 525

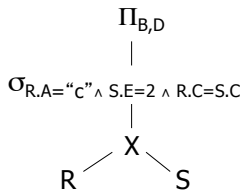


Notes 7 - Query Processing



Relational Algebra - can be used to describe plans...

Ex: Plan I



OR:  $\Pi_{B,D} [ \sigma_{R.A='c' \wedge S.E=2 \wedge R.C=S.C} (RXS) ]$

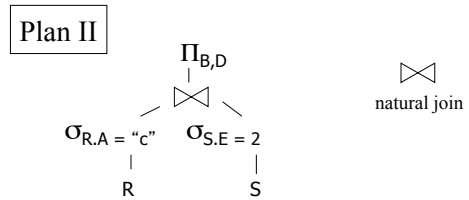
CS 525



Notes 7 - Query Processing



Another idea:

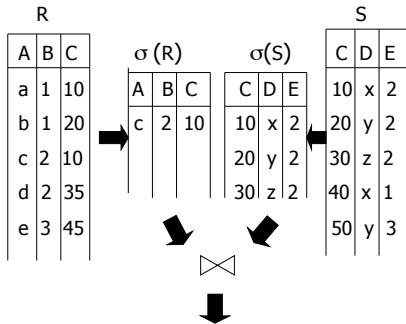


CS 525



Notes 7 - Query Processing





### Plan III

Use R.A and S.C Indexes

- (1) Use R.A index to select R tuples with R.A = "c"
- (2) For each R.C value found, use S.C index to find matching tuples

CS 525



Notes 7 - Query Processing

13



CS 525



Notes 7 - Query Processing

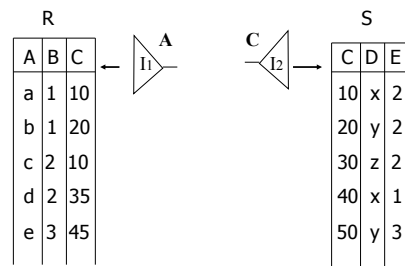
14



### Plan III

Use R.A and S.C Indexes

- (1) Use R.A index to select R tuples with R.A = "c"
- (2) For each R.C value found, use S.C index to find matching tuples
- (3) Eliminate S tuples S.E ≠ 2
- (4) Join matching R,S tuples, project B,D attributes and place in result



CS 525



Notes 7 - Query Processing

15

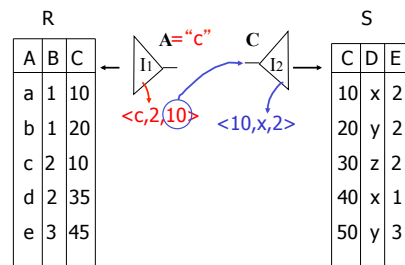
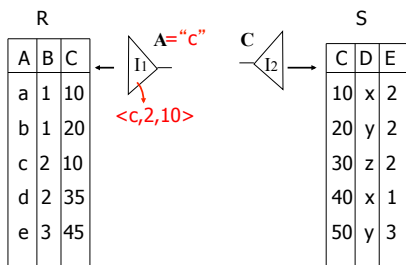


CS 525



Notes 7 - Query Processing

16



CS 525



Notes 7 - Query Processing

17



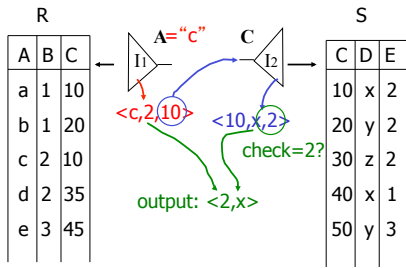
CS 525



Notes 7 - Query Processing

18





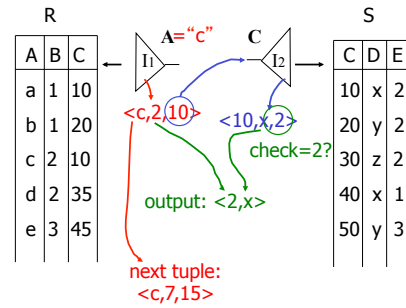
CS 525



Notes 7 - Query Processing

19

IIT College of Science and Letters  
ILLINOIS INSTITUTE OF TECHNOLOGY



CS 525

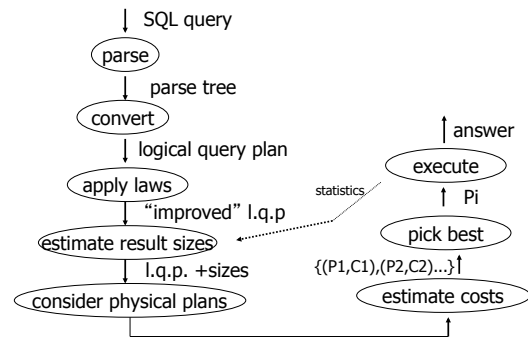


Notes 7 - Query Processing

20

IIT College of Science and Letters  
ILLINOIS INSTITUTE OF TECHNOLOGY

## Overview of Query Optimization



CS 525



Notes 7 - Query Processing

21

IIT College of Science and Letters  
ILLINOIS INSTITUTE OF TECHNOLOGY

CS 525



Notes 7 - Query Processing

22

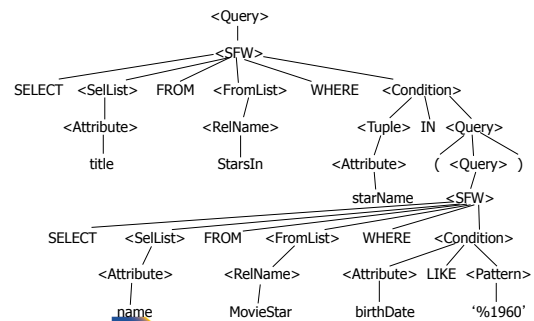
IIT College of Science and Letters  
ILLINOIS INSTITUTE OF TECHNOLOGY

## Example: SQL query

```
SELECT title
FROM StarsIn
WHERE starName IN (
  SELECT name
  FROM MovieStar
  WHERE birthdate LIKE '%1960'
);
```

(Find the movies with stars born in 1960)

## Example: Parse Tree



CS 525



Notes 7 - Query Processing

23

IIT College of Science and Letters  
ILLINOIS INSTITUTE OF TECHNOLOGY

CS 525



Notes 7 - Query Processing

24

IIT College of Science and Letters  
ILLINOIS INSTITUTE OF TECHNOLOGY

Example: Generating Relational Algebra

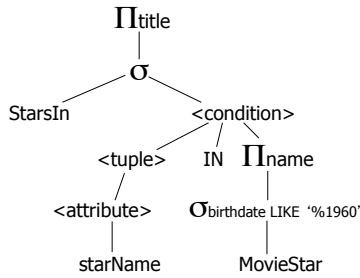


Fig. 7.15: An expression using a two-argument  $\sigma$ , midway between a parse tree and relational algebra

CS 525



Notes 7 - Query Processing

25



Example: Logical Query Plan

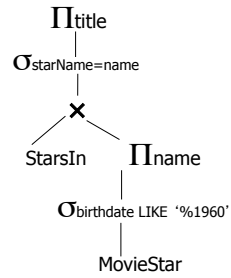


Fig. 7.18: Applying the rule for IN conditions

CS 525

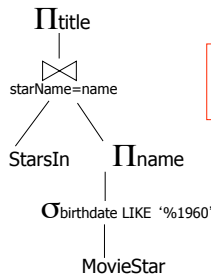


Notes 7 - Query Processing

26



Example: Improved Logical Query Plan



Question:  
Push project to  
StarsIn?

Fig. 7.20: An improvement on fig. 7.18.

CS 525

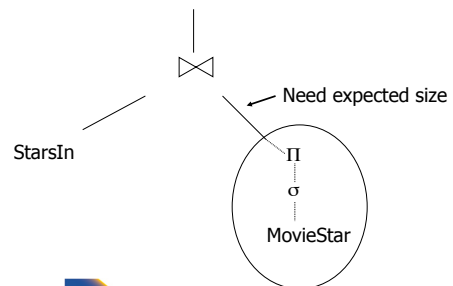


Notes 7 - Query Processing

27



Example: Estimate Result Sizes



CS 525

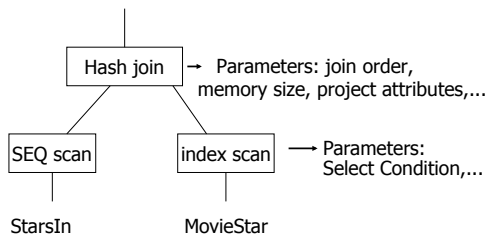


Notes 7 - Query Processing

28



Example: One Physical Plan



CS 525

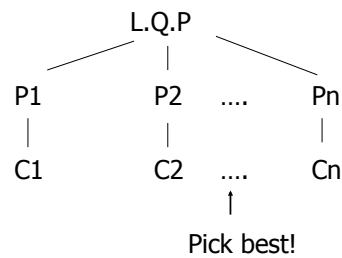


Notes 7 - Query Processing

29



Example: Estimate costs



CS 525



Notes 7 - Query Processing

30

