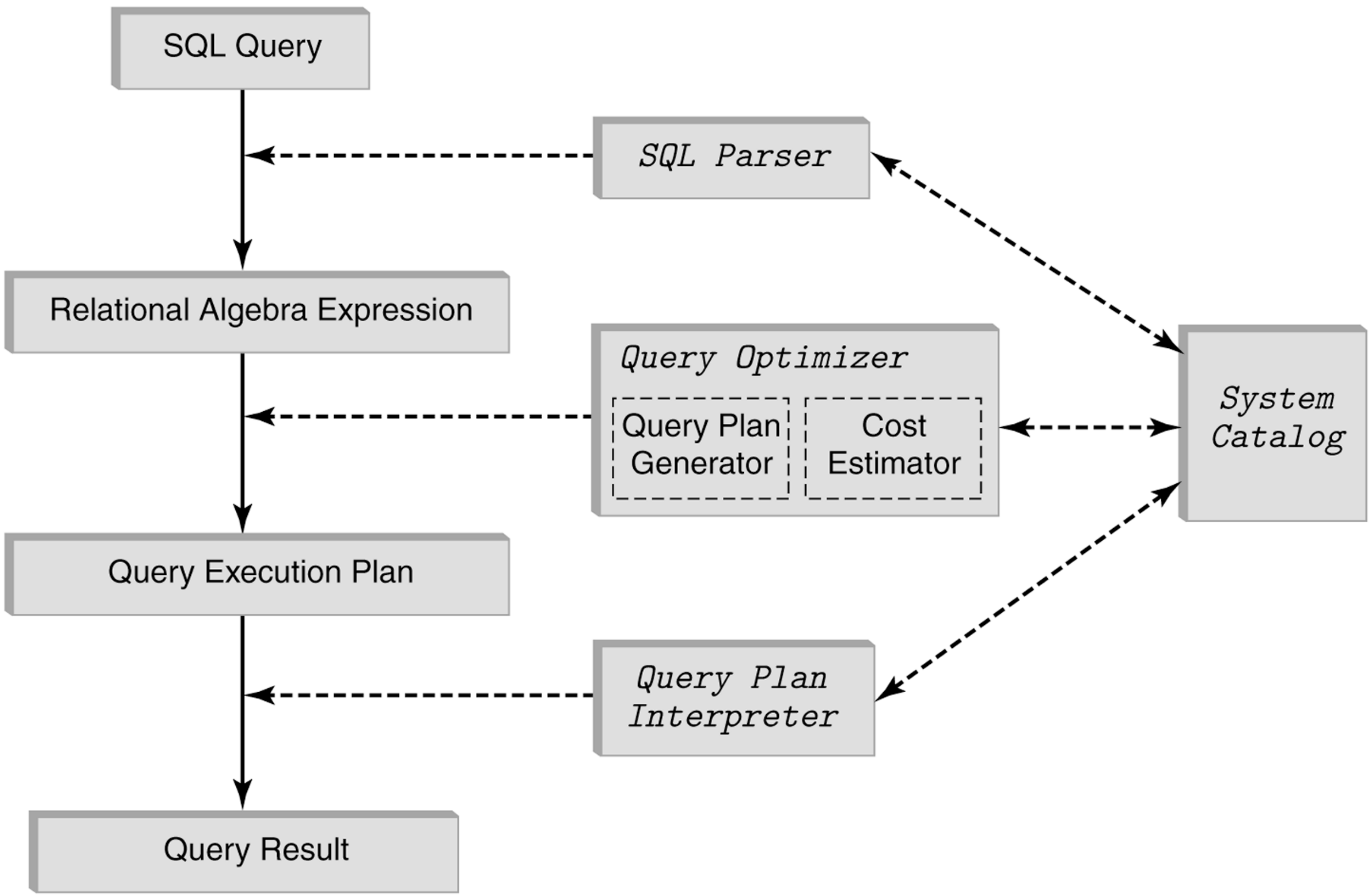
Query Processing and Relational Algebra 1

Query Execution*



*This Figure is from a Book Titled Database Systems by Michael Kifer, Arthur Bernstein and Philip M. Lewis

Relational Algebra

- A collection of operators for manipulating relations
- A relation is a set of tuples
- The result of each relational algebra expression is a relation
- For this discussion we will strictly following the definition of a set so there will be no duplicate tuples in a relation
- We will relax this constraint when we talk about relational algebra in the context of query processing

Relational Algebra Operators

- Select
  - $\sigma_{condition}$
- Project
  - $\pi_{attr\ list}$
- Union
  - $\cup$
- Set Difference
  - $-$
- Intersection
  - $\cap$
- Cartesian product
  - $\times$

Relational Algebra Operators

- Joins
  - Natural join
    - $\bowtie$
  - Equi join and Theta join
    - $\bowtie_{Condition}$
- Division
  - $\div$ or $/$
- Renaming
  - Expression[A_1, A_2, …A_n]

Example Tables

T1

A	B	C	D
1	5	9	2
6	1	4	3
4	1	9	7
3	2	10	5
9	6	4	3
7	8	1	6

T2

A	B	E
1	5	2
6	1	7
6	1	15
3	2	3
4	12	9

Example Tables

T1

A	B	C	D
1	5	9	2
6	1	4	3
4	1	9	7
3	2	10	5
9	6	4	3
7	8	1	6

$\sigma_{A < 5}T1$

A	B	C	D
1	5	9	2
3	2	10	5

Example Tables

T1

A	B	C	D
1	5	9	2
6	1	4	3
4	1	9	7
3	2	10	5
9	6	4	3
7	8	1	6

$\sigma_{A < 5 \text{ and } B > 4} T1$

A	B	C	D
1	5	9	2

Example Tables

T1

A	B	C	D
1	5	9	2
6	1	4	3
4	1	9	7
3	2	10	5
9	6	4	3
7	8	1	6

$\pi_{A,\ D}$T1

A	D
1	2
6	3
4	7
3	5
9	3
7	6

Example Tables

T1

A	B	C	D
1	5	9	2
6	1	4	3
4	1	9	7
3	2	10	5
9	6	4	3
7	8	1	6

T2

A	B	E
1	5	2
6	1	7
6	1	15
3	2	3
4	12	9

T1 ⋈ T2

A	B	C	D	E
1	5	9	2	2
6	1	4	3	7
6	1	4	3	15
3	2	10	5	3

Divide Example

T1

A	B
1	X
1	Y
1	Z
2	X
2	Z
3	X
3	Y
3	Z

T2

B
X
Y
Z

T1 / T2

A
1
3

Divide Example

CoursesCompleted

SID	SName	CrsCode
1234	Sue	CS364
1234	Sue	CS464
1234	Sue	CS442
2222	Mark	CS364
2222	Mark	CS442
3333	Jane	CS364
3333	Jane	CS464
4444	Tim	CS464

DatabaseCourseCodes

CrsCode
CS364
CS464

CoursesCompleted/
DatabaseCoursesCodes

SID	SName
1234	Sue
3333	Jane

Problems

- Find libnums of libraries with a capacity greater than 200.
- Find the titles of books with copies housed in a library with a capacity greater than 200.
- Find the names of authors who have written a book housed in a library with a capacity greater than 200

Problems

- Find aid and name of authors who have not written any books
- Find booknum and title of books with no copies.
- Find the booknum and title of books with a copy in every library
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More Relational Algebra Problems

Suppose relations R and S contain Size(R) and Size(S) tuples. What are the minimum and maximum number of tuples in the results of relational algebra expression shown to the right (assume union compatibility where needed)?

- R U S
- R ∩ S
- R – S
- $\pi_A R$ where A is an attribute of R
- R x S
- R ⋈ S where A is the common attribute in R and S
- R / S assume all attributes of S are also attributes of R