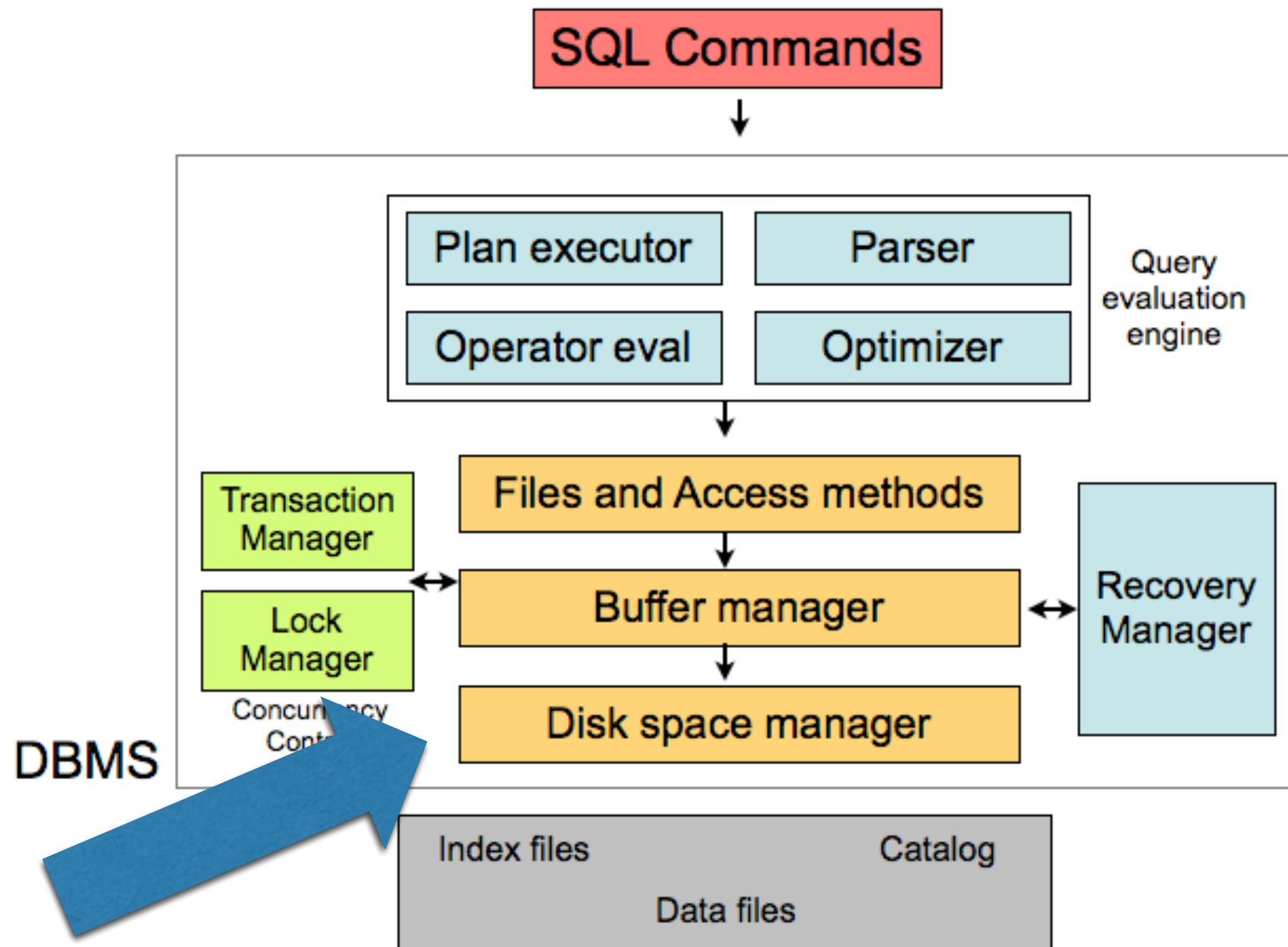


COSC 460 Lecture 4: Relational Algebra

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Fall 2018

Architecture of DBMS



<https://www.cs.colgate.edu/~mhay/cosc460/schedule.html>

Relational algebra

- Algebra: set of **values** and **operators** on those values
 - **Values**: relations
 - **Operators**: select, project, cross, intersect, union, difference, join, etc.
- Relational algebra is **closed** (“input: relations, output: relations”)
- Closure ➡ combine ops into **expressions**

Select: filter rows

Students

<u>sid</u>	name
1	Bob
2	Alice
3	Bob

$$\sigma_{name='Alice'}(S) =$$

sid	name
2	Alice

Shorthand: abbreviate relation name with its first letter.

“S” refers to Students relations

Project: filter columns

(and eliminate duplicates)

Takes

<u>sid</u>	<u>cid</u>
1	301
2	460
2	301
3	460

$\pi_{sid}(T) =$

sid
1
2
3

Cross product

Students

<u>sid</u>	name
1	Bob
2	Alice
3	Bob

Courses

<u>cid</u>	title	time
301	os	10:20
460	db	1:20

$S \times C =$

sid	name	cid	title	time
1	Bob	301	os	10:20
1	Bob	460	db	1:20
2	Alice	301	os	10:20
2	Alice	460	db	1:20
3	Bob	301	os	10:20
3	Bob	460	db	1:20

Set operations

Students

<u>sid</u>	name
1	Bob
2	Alice
3	Bob

WiCS Club

<u>sid</u>	name
2	Alice
4	Courtney
325	Sam

Takes

<u>sid</u>	<u>cid</u>
1	301
2	460
2	301
3	460

$$S \cap W =$$

sid	name
2	Alice

$S \cup T = \text{error!}$

Schemas don't match!

Natural Join

Students

<u>sid</u>	name
1	Bob
2	Alice
3	Bob

Takes

<u>sid</u>	<u>cid</u>
1	301
2	460
2	301
3	460

$$S \bowtie T =$$

sid	name	cid
1	Bob	301
2	Alice	460
2	Alice	301
3	Bob	460

Join on **common attribute(s)**: sid

Theta Join

WiCS Club

<u>sid</u>	name
2	Alice
4	Courtney
325	Sam

Courses

<u>cid</u>	title	time
301	os	10:20
460	db	1:20

$W \bowtie_{sid > cid} C =$

sid	name	cid	title	time
325	Sam	301	os	10:20

Among all pairs: keep only those
that match condition

More complex predicates

$$\sigma_{sid=1 \wedge name='Bob'}(S) =$$

sid	name
1	Bob

$$\sigma_{sid=1 \vee name='Alice'}(S) =$$

sid	name
1	Bob
2	Alice

Anywhere you can put a predicate, you can put an arbitrary logical expression. (Predicate must be on attribute values.)

Book-Keeping operators

Rename
attributes

$$\rho_{cid \rightarrow cno, title \rightarrow name, time \rightarrow hour}(C) =$$

(by name)

cno	name	hour
301	os	10:20
460	db	1:20

$$\rho_{1 \rightarrow cno, 2 \rightarrow name, 3 \rightarrow hour}(C) =$$

(by position)

cno	name	hour
301	os	10:20
460	db	1:20

Assign
name to
result

$$R_1 \leftarrow S \bowtie T$$

Expressions

Students

<u>sid</u>	name
1	Bob
2	Alice
3	Bob

WiCS Club

<u>sid</u>	name
2	Alice
4	Courtney
325	Sam

Takes

<u>sid</u>	<u>cid</u>
1	301
2	460
2	301
3	460

Courses

<u>cid</u>	title	time
301	os	10:20
460	db	1:20

Expression for names of students taking 460
(shown on board)

Essential vs. derived operators

(shown on board; see handout)

Cow book exercises

Suppliers(sid,sname,addr)

Parts(pid,pname,color)

Catalog(sid,pid,cost)

1. Find the names of suppliers who supply some red part.
2. Find the sids of suppliers who supply some red or green part.
3. Find the sids of suppliers who supply some red part or are at 221 Packer Street.
4. Find the sids of suppliers who supply some red part and some green part.
5. Find the sids of suppliers who supply every part.