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Redavierial Adgebrar

CS430/630 Lecture 2

Relational Query Languages

- Query languages:
 - Allow manipulation and retrieval of data from a database
- Assignment Project Exam Help
 Relational model supports simple, powerful QLs:
 - Strong formal fountains on passe oder gom
 - Allows for much optimization Add WeChat powcoder
- Query Languages != programming languages
 - QLs not intended to be used for complex calculations
 - QLs support easy, efficient access to large data sets



Formal Relational Query Languages

- Two languages form the basis for SQL:
 - Relational Algebra:
 - operational.
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 useful for representing execution plans

 - > very relevantition: /spartcodouteronoptimizers!

- Relational Calculus:
 - Lets users describe the result, NOT how to compute it declarative
 - We will focus on relational algebra



Preliminaries

- A query is applied to relation instances, and the result of a query is also a relation instance
 - Schemas of input relations for a query are fixed
 - The schema for the result of a given query is determined by operand schemas and operator type https://powcoder.com

- Each operation returns a relation
 - operations can be composed!
 - Well-formed expression: a relation, or the results of a relational algebra operation on one or two relations



Relational Algebra

- Basic operations:
 - \triangleright Selection σ Selects a subset of rows from relation
 - Projection Assignment Project dixam flool prelation

 - Division ÷ A bit Andre Workplextypill recover leater on
 - ▶ <u>Set-difference</u> <u>Union</u> <u>Union</u> <u>Intersection</u>
 - \triangleright Renaming \nearrow Helper operator, does not derive new result, just renames relations and fields

$$\rho(R(F),E)$$

▶ F contains oldname →newname pairs



Example Schema

Sailors

Boats

<u>sid</u>	sname	rating	age		1. ! .1	10.0100	1
22	ductin	A Zaigna	2650 PD	roject Ex	bid bid	name <mark>elp</mark> interlake	color
	dustiii	Assigin		loject Ex	101	interlake	red
31	lubber	8 htti	55,5	wcoder.c	: ሰበ ጸ	clipper	green
58	rusty	10^{100}	35.0	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	YUU	chipper	green

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sid	<u>bid</u>	day
22	101	10/10/96
58	103	11/12/96

Relation Instances Used

Sailors

\boldsymbol{C}	1
\sim	•
$\overline{}$	_

sid	sname	rating	age		sid	snam
22	dustin	Assigni	1451PP	roie	28 ct Ex	yuppy am H
31	lubber	8	55,5		31	lubbe
58	rusty	10 htt	55.5 ps://po 35.0	WCC	44 r.0	guppy
	1	Ad	d WeC	hat	LB&W	rusty

<u>S</u>	<u>2</u>	
	•	1

	<u>sid</u>	sname	rating	age
	28	yuppy	9	35.0
	31	yuppy am Help lubber	8	55.5
	dør.c	guppy	5	35.0
+	58 _W	rusty.	10	35.0

Reserves

R1

sid	<u>bid</u>	day
22	101	10/10/96
58	103	11/12/96



Projection

- Unary operator
- Deletes (projects out) attributes that are not in projection list

- Result Schema contains: the attributes in the projection list
 - With the same names that they had in the input relation Add WeChat powcoder
- Projection operator has to eliminate duplicates!
 - Real systems typically do not do so by default
 - Duplicate elimination is expensive! (sorting)
 - User must explicitly asks for duplicate eliminations (DISTINCT)



Projection Example

*S*2

sid	sname	rating	age		sname	rating
28	yuppy	As 9 ignn	1851OPr	oject Exam	yllppy	9
31	lubber	8 http	5.5/50v	vcoder.com	lubber	8
44	guppy	5	35.0		guppy	5
58	rusty	16 ^{Add}	13 5 .6°	hat powcod	Fusty	10

 $\pi_{sname,rating}(S2)$



Selection

- Unary Operator
- Selects rows that satisfy selection condition

- Condition contain https://aptswnodettributes from relation

 - Evaluated for each individual tuple
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 May use logical connectors AND (^), OR (V), NOT (¬)
- No duplicates in result! Why?
- Result Schema is identical to schema of the input relation



Selection Example

<i>S</i> 2		
d	sname	rat

<u>sid</u>	sname	rating	age
28	yuppy	Assign	1 33 eOt
31	lubber	8 ht	t55:5/pc
44	guppy	5	35.0
58	rusty	10 A	gg.we

	sid	sname	rating	age
1	28	yuppy	9	35.0
Proje	58 _{Ex}	rusty am Helr	10	35.0
loje		σ rating	>8 ^(S2)	

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sname	rating
yuppy	9
rusty	10

Selection and Projection
$$\pi_{sname,rating}(\sigma_{rating} > 8^{(S2)})$$



Cross-Product

Binary Operator

$$R \times S$$

Each row of Actacion Mentalited out he Estatur ble lof S

- https://powcoder.com

 Result Schema has one field per field of R and S
 - Field names 'inheld Weschat poweoder



Cross-Product Example

*S*1

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	Assign	35ent

*R*1

sid	bid	<u>day</u>
22	101	10/10/96
58_	103	11/12/96

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C=S1 X R1

(sid)	https:	raping w	ader	com	bid	day
22	dustin	V ₂ Ch	45.0	22	101	10/10/96
22	Add dustin	WeCha	1 t pov 45.0	vçode 58	103	11/12/96
31	lubber	8	55.5	22	101	10/10/96
31	lubber	8	55.5	58	103	11/12/96
58	rusty	10	35.0	22	101	10/10/96
58	rusty	10	35.0	58	103	11/12/96

Conflict: Both R and S have a field called sid



Cross-Product + Renaming Example

\boldsymbol{C}	sid1	sname	rating	age	sid2	bid	day
	22	dustin	7	45.0	22	101	10/10/96
	22	dustin	7	45.0	58	103	11/12/96
	31	assign	m e nt l	Projec	½Exa	ım ₁ He	10 /10/96
	31	lubber	8	55.5	58	103	11/12/96
	58	rusty	h4.9\b	35.0	der.co	101	10/10/96
	58	rusty	ld ¹ We	35.0 hat	58 50WC	103 oder	11/12/96

Renaming operator $\rho(C(1 \rightarrow sid1, 5 \rightarrow sid2), S1 \times R1)$



Condition Join (Theta-join)

$$R\bowtie_{\theta} S = \sigma_{\theta}(R \times S)$$

Result Schemigraments Phajeof Erosuphbolpct

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Condition Join (Theta-join) Example

S1 X R1

sid1	sname	rating	age	sid2	bid	day
22	1 .	7	150	22	101	10/10/06
22	ausun	/	43.0	22	101	10/10/90
22	dustin	7	45.0	58	103	11/12/96
21AC	cianm	ent Pro	viect	Exam	Helr	10/10/06
	TUDUCT		13.30	<u> </u>	TUTT	10/10/90
31	lubber	,8	55.5	58	103	11/12/96
50	nups	:// pow	(çpge	r,com	101	10/10/06
120	Tusty	10	22.0	<i></i>	101	10/10/70
	,	10	250	~ 0	100	11/10/06
20	Turty	WEC	at bo	WCOC	Fho	11/12/90

$S1 \bowtie S1.sid < R1.sid$

sid1	sname	rating	age	sid2	bid	day
22	dustin	7	45.0	58	103	11/12/96
31	lubber	8	55.5	58	103	11/12/96



Equi-Join

 A special case of condition join where the condition contains only equalities

Assignment Project Exams Help R.attr1=S.attr2

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Result Schema similar to cross-product, but only one copy of fields for which equality specifically coder



Equi-Join Example

S1 X R1

sid1	sname	rating	age	sid2	bid	day
22	dustin	7	45.0	22	101	10/10/96
122	1	7	450	50	103	11/12/96
	uusiii uusiii	ent Pro	43.0 viect	50 Exam	103 Helr	10/10/06
121 20	TIMUUUT	- G	13.30	22	TUPT	10/10/90
21	1-1-1-1-	0		50	102	11/12/06
51	https	://pow	çode	rzcom	103	10/10/06
120	Tusty	10	33.0	<i></i>	101	10/10/70
58	rusty	WECT	35.0	58 WCOd	103	11/12/96

$$S1 \bowtie \underset{sid}{\bowtie} R1$$

sid	sname	rating	age	bid	day
22	dustin	7	45.0	101	10/10/96
58	rusty	10	35.0	103	11/12/96



Natural Join

▶ Equijoin on *all* common fields

 $R\bowtie S$

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Common fields are NOT duplicated in the result https://powcoder.com



Union, Intersection, Set-Difference

- All of these operations take two input relations, which must be <u>union-compatible</u>
 - Same number of fields.
 - Corresponding ignorest Projecte Example (p)

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What is the schema of result?



Union Example

*S*1

sid	sname	rating	age	
22	dustin	7	45.0	
31	lubber	Assign	ment P 33.3	roje
58	rusty	10htt	935/Apo	wco

<i>S2</i>		Ac	ld W	Ve(Chat
1.7	010 0100 0	motin o	0~0		

sid	sname	rating	age
28	yuppy	9	35.0
31	lubber	8	55.5
44	guppy	5	35.0
58	rusty	10	35.0

sid	sname	rating	age
95E	tam Hel	p 7	45.0
der.	h bber	8	55.5
58	rusty	10	35.0
p pw	gupery	5	35.0
28	yuppy	9	35.0

 $S1 \cup S2$



Intersection Example

*S*1

sid	sname	rating	age	
22	dustin	7	45.0	
31	lubber	Assign	ment P	rojec
58	rusty	10htt	35/.po	wco

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<i>S</i> 2	Add WeCha			
sid	sname	rating	age	
28	yuppy	9	35.0	
31	lubber	8	55.5	
44	guppy	5	35.0	
58	rustv	10	35.0	

dad.c	om me	rating	age
31 00w/	lubber oder	8	55.5
58	rusty	10	35.0

 $S1 \cap S2$



Set-Difference Example

*S*1

sid	sname	rating	age	
22	dustin	· ·	45.0_	
31	lubber	Assigni	nent P	roject Exam Hel
58	rusty	10htt	935/PPO	wcod er.com

*S*2

sid	sname	rating	age
28	yuppy	9	35.0
31	lubber	8	55.5
44	guppy	5	35.0
58	rusty	10	35.0

rating age sname Add WeChat powcoderin 45.0

S1-S2

