

Week 8 Workshop – Query Processing and Optimisation





Housekeeping

Assignment Peroject Exame Help

- The submission deadline is 23:59, Oct 12, 2021.
- This assignment must be done individually (no group work). Please $\begin{array}{c} hith special drop-in sessions if you need any clarifications. \\ https://powcoder.com \end{array}$



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- All the labs on Oct/4/(Nonday, public holdey) in Week-9 will be moved to the same timeslots on Oct 11 (Monday) in Week 10.



Housekeeping

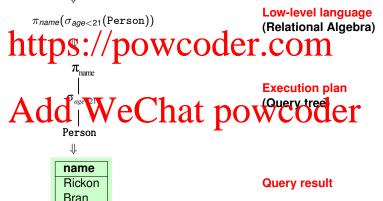
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- 2 All the labs on Oct/4/(Nonday, Mole flowday) in Week-9 will be moved to the same timeslots on Oct 11 (Monday) in Week 10.
- 3 Lab 8 is optional (no associated with any assessment items)
 - Werville per a separate sign on page or Wattle at 12pm of All the optional labs will be schedule from Oct 12 to Oct 15:
 - Three options are available
 - (1) Database Programming with Java
 - (2) Database Programming with Python
 - (3) Database Exercises on IMDB



Query Processing – Example

Assignment Project Essam Help





From SQL to RA Expressions

Assign the first project that the project of the courses (crsNr, title, unit)

SELECT lastName, result, title

http://www.cometer.com

Exams.crsNr=Courses.crsNr AND result <1.3;



From SQL to RA Expressions

Assign Mediter first plast Name that Exam Help Courses (crsNr, title, unit)

SELECT lastName, result, title

http://www.courselect.com

Exams.crsNr=Courses.crsNr AND result < 1.3;

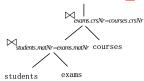
- RA Expressions: Calculated Some Man Condent (State of Some Man Condent (S
 - $\bowtie_{\sigma_{\mathtt{Exams}.\mathit{crsNr}=\mathtt{Courses}.\mathit{crsNr}}} \mathtt{Courses}))$
 - $\sigma_{\text{lastName, result, title}}(\sigma_{\text{result}} \le 1.3(\sigma_{\text{EXAMS. crsNr}=\text{Courses. crsNr}}(\sigma_{\text{Students. matNr}}(\text{Students} \times \text{Exams} \times \text{Courses}))))$
 - π_{lastName,result,title} ((Students ⋈_{Students.matNr}=Exams.matNr (σ_{result}≤1.3(Exams))) ⋈_{Exams.crsNr}=Courses.crsNr</sub> Courses)
 - 4 ...



From RA Expressions to Query Trees

Assignation can persented as a query tree: Help

- internal nodes represent the intermediate result;
- the root node represents the resulting relation.
- Example: $\pi_{las} N_{re,las} = \lim_{t \to \infty} \sigma_{res} u_{t} \leq \Omega(S) \text{ uvents } u_{ts} u_$





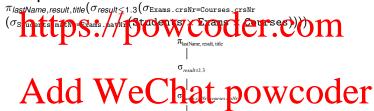
Query Tree Example

Assignment the executed proceeds bottom-up:

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but there can exist multiple methods of executing sibling nodes.

Example:

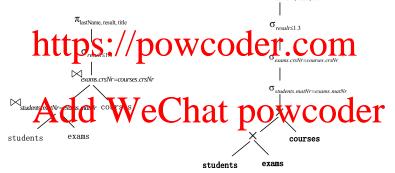


courses



Equivalent Query Trees (Query Optimisation)

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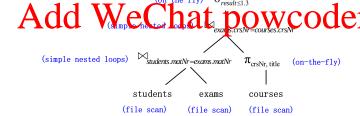




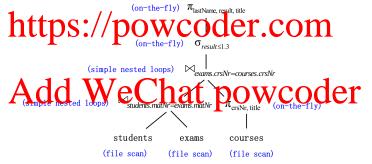
Assignment Project Examination additional annotation at each node indicating:

(1) the access method to use for each table, and

The simplementation method for each Apperator Om







Note: Pipelined evaluation may have significant saving on I/O cost, while materialized evaluation can avoid repeated computations.



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- This is determined by the query optimiser using a variety of algorithms
 (Fab: there is no true optimal solution in generall).
- Realistically, we cannot expect to always find the best plan, but we expect to consistently find a plan that is good.



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- This is determined by the query optimiser using a variety of algorithms (Fabrichers is no true optimal solution in adherall).
- Realistically, we cannot expect to always find the best plan, but we expect to consistently find a plan that is good.
- The promance white at election plane to Wy same purchay differ considerably (e.g., seconds vs. hours vs. eays):
 - different but equivalent RA expressions;
 - different algorithms for each RA operator.



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Assence ideas of algorithms is defor Reperators Exam Help selection: If there is no index we have to scan the table. Otherwise, we scan the indexes to retrieve matching tuples and apply remaining

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selection conditions to further restrict the tuples.



Assertion: If there is no index we have to scan the table. Otherwise, we scan the indexes to retrieve matching tuples and apply remaining selection conditions to further restrict the tuples.

Phdiaction refrieves a subset of attributes from each taple of the table (similar to selection). If requiring duplicate elimination, then we have to do sorting additionally (expensive part!)



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• Join: We may use nested loops join, or sort-merge join, hash joins,





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- Join: We may use nested loops join, or sort-merge join, hash joins,
- Group by and order by are typically implemented using sorting.

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 - Join: We may use nested loops join, or sort-merge join, hash joins, block pested loops join, et a 1 10 WCOOLET
 - Group by and order by are typically implemented using sorting.
 - Aggregation operators use temporary counters in main memory when retrieving tuples.
 - Set operators can use the same approach as projection to eliminate duplicates.



Estimating Query Costs - Example

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Estimating Query Costs - Example

Assimption proving got a non-University for an experimental its actors playing an argent? p $\pi_{title, production.year}(\sigma_{role.description='agent'}(BOLE \bowtie ACTOR_AWARD \bowtie (AWARD - \sigma_{award.country='USA'}(AWARD))))$

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Estimating Query Costs - Example







Size of Relations

Assignment-Project-Exam Help

Let n denote the average number of tuples in r, and ℓ_i the the average space (e.g., in bits) for attribute A_i .

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Size of Relations

Assignment-Project-Exam Help

• Let n denote the average number of tuples in r, and ℓ_j the the average space (e.g., in bits) for attribute A_i .

- Then, $n \cdot \sum_{j=1}^{k} \ell_j$ is the size of the relation r.
- We use this formula to assign sizes to leaf nodes in the query tree.



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varchar(20))

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Assignment Project Fxa, md Help

varchar(20))

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Assignment Project Fxa, md Help

varchar(20))

Estimate the average number of tuples as 15.

Letimate the average opacy (Cattiline Com.)



Assignment Project Fxa, md Help

varchar(20))

- Estimate the average number of tuples as 15.

 Let race the average opace of attribute. T. COM
 - Award_name: 8 · 20 = 160 bits (the mean length is 20);





Assignment Project Fxa, md Help

varchar(20))

- Estimate the average number of tuples as 15.

 Let race the average opace of attribute. T. COM
 - Award_name: 8 · 20 = 160 bits (the mean length is 20);
- Addition: 3:30 = 240 bits (the mean length is 30) er ward country: 8:10 = 80 bits (the mean length is 10).

• The average size of a tuple is 160 + 80 + 240 = 480 bits.



Assignment Project Exam Help

varchar(20))

- Estimate the average number of tuples as 15.

 Letting the average paw Catholice COM
 - Award_name: 8 · 20 = 160 bits (the mean length is 20);



- The average size of a tuple is 160 + 80 + 240 = 480 bits.
- The average size of a relation is estimated to be $15 \cdot 480 = 7,200$ bits.



Assignment variation reasonated. Help Role_description:varchar(100), Credits:varchar(40))

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Assignment value of pour for reason of the property of the pro

• Estimate the average number of tuples as 500.

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Assignment variation reasonated. Help Role_description:varchar(100), Credits:varchar(40))

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Assigning the variation reaction reaction. Help Role_description:varchar(100), Credits:varchar(40))

Estimate the average number of tuples as 500.

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- $d: 8 \cdot 8 = 64$ bits (as the domain is char(8));
- Title: $8 \cdot 25 = 200$ bits (the mean length is 25);

A Production year 13 hits (as the domain is number(4)):

Here_description. 8 - 50 2400 hits (the mean larger is 50);

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Assignment value of the Colon Very Help Role_description:varchar(100), Credits:varchar(40))

Estimate the average number of tuples as 500.

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- Credits: $8 \cdot 20 = 160$ bits (the mean length is 20).
- The average size of a tuple is 64 + 200 + 13 + 400 + 160 = 837 bits



Assignment value of the property of the proper

Estimate the average number of tuples as 500.

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- Credits: $8 \cdot 20 = 160$ bits (the mean length is 20).
- The average size of a tuple is 64 + 200 + 13 + 400 + 160 = 837 bits
- The average size of a relation is to be $500 \cdot 837 = 418,500$ bits



Assignment archar(40), Production year, number (4), Help

Year_of_award:number(4),Category:varchar(100),Result:varchar(20))

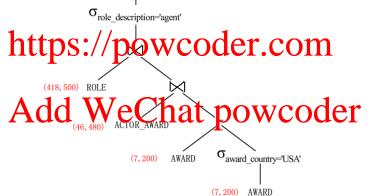
- Estimate the average number of tuples as 40

 Figure 300 bile (as before):
 - Title: 200 bils (as before);
 - Production_year: 13 bits (as before);
 - Role_description: 400 bits (as before);
- Adward harde 10 bits (as before); Nuclear of the contain is numbered; et
 - Category: 8 · 40 = 320 bits (the mean length is 40);
 - Result: $8 \cdot 7 = 56$ bits (the mean length is 7).
- The average size of a tuple is 200 + 13 + 400 + 160 + 13 + 320 + 56 = 1,162 bits.
- The average size of a relation is $40 \cdot 1162 = 46,480$ bits.



Estimating Query Costs - Example (Query Tree)

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Size of Selection Node

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Scan the relation one tuple after another (if there is no index);

Chack for each tuple whether the condition p is satisfied or not;

• Keep exactly those tuples satisfying φ .



Size of Selection Node

Assignment Projects Exama Help

Scan the relation one tuple after another (if there is no index);

https://powhether.the.con/lition.p. is satisfied or not;

- Keep exactly those tuples satisfying φ .
- Let s be the size of its single relevant node.
- . The size of a selection mode of the size of a selection mode.

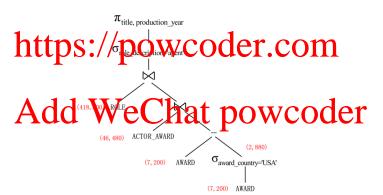
 $a_{\varphi}\cdot s$,

where a_{φ} is the average percentage of tuples satisfying φ .



Estimating Query Costs - Example (Selection)

Asspredenting and antiver Dissource of 1.4 Eq. 70% of the movilelp





Size of Difference Node

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- Let s_1 and s_2 be the sizes of the two relevant nodes.
- Again, two poed to do relations.



Size of Difference Node

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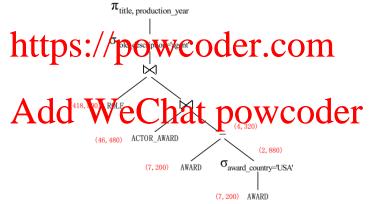
- Let s_1 and s_2 be the sizes of the two relevant nodes.
- Again, we poed to do relations. PS of the probability that tuples occurring both
- The size of a difference node is Add WeChat-powcoder

where (1 - p) is the probability that tuples from s_1 does not occur in s_2 .



Estimating Query Costs - Example (Difference)

Since 40% of the movie awards from the USA, it is probability of arrayard to SS be SUS awards 1.4. We have C(Ip) = 7.200 (1.1.4) = 4.120 (1p)





Size of Natural Join Node

Assignment Project Exam Help Leter and s₂ be the sizes of the two relevant nodes, and r₁ and r₂ be the

size of a tuple in these two nodes. $\frac{s_1}{r_1}$ and $\frac{s_2}{r_2}$ are the estimated number of tuples in these two hodes. OWCOder.COM



Size of Natural Join Node

Assignment Project Exam Help Let and s₂ be the sizes of the two relevant nodes, and r₁ and r₂ be the

size of a tuple in these two nodes. $\frac{s_1}{a}$ and $\frac{s_2}{a}$ are the estimated number of tuples in these two hodes.

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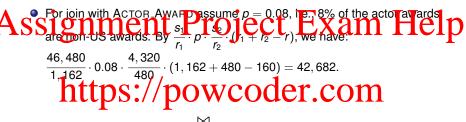
• The size of a natural join node is

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where r is the size of a tuple over the **common attributes**, and p is the matching probability (for any tuple of the first relevant node to match with any tuples in the second relevant relation). Note that $r_1 + r_2 - r$ is the size of a tuple after the natural join operation.



Estimating Query Costs - Example (Natural Join)







Estimating Query Costs - Example (Natural Join)

Assignment si Project, Exam Help

 $\frac{418,500}{837} \cdot 0.002 \cdot \frac{42,682}{1,482} \cdot (837+1,482-200-400-13) = 49,133.$

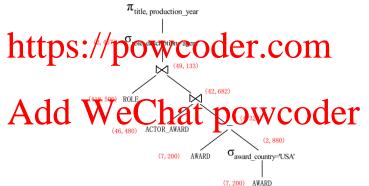
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Estimating Query Costs - Example (Selection)

For selection $\sigma_{\text{role description}}$ assume $a_{\text{c}} = 0.05$ (i.e., non-US awards for possible are 16). Her ce, Me layer C is = 0.05X401B1 2, 57 C p





Size of Projection Node

Assignment: Project Exam Help Project each tuple to the attributes in {A1,..., An}

Eliminate duplicates (Note: SQL does not eliminate tuples unless

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Size of Projection Node

Assignment: Project Exam Help Project each tuple to the attributes in {A1,..., An}

Eliminate duplicates (Note: SQL does not eliminate tuples unless DISTINCT is used).

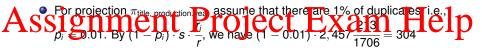
Let be the size of its injoir relevant hold with a Continuous average number n of tuples and its average size r of a tuple.

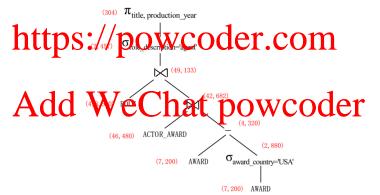
• The size of a projection node π_{A_1,\dots,A_n} is $Add \ We Chat_{(1-p_i)+s} powcoder$

where r_i is the average size of a tuple over $\{A_1, \ldots, A_n\}$, and p_i is the probability that two tuples coincide on A_1, \ldots, A_n (i.e., the same values on all attributes A_1, \ldots, A_n).



Estimating Query Costs - Example (Projection)







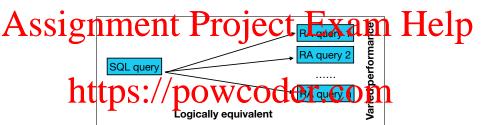
Assignment Project Exame Help can remember song lyrics from 2006 but not whatever maths

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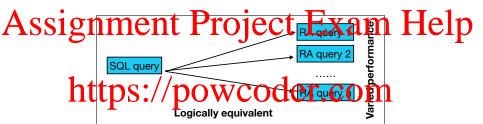
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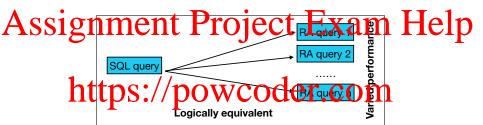
• Which Radiulty Wild be Cholen for a given SQL query? Oder





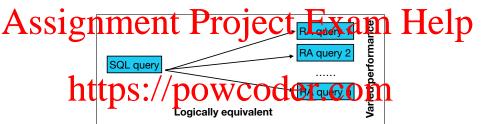
• Which RAlquery Will be chosen for a given SQL query? Who choose? Charles for a given SQL query?





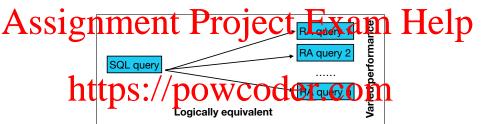
• Which RAlquery thruld be chosen for a given SQL query? Oder





- Which RAlquery Thruld be chosen for a given SQL query? Oder
 - How to choose?





- Which RAlquery thruld be chosen for a given SQL query optimiser. POWCOder
 - How to choose?
 - Semantic query optimisation
 - Rule-based optimisation
 - Cost-based optimisation



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Semantic query optimisation

Let 10 Sation so the Winting of the transferna query into the one with a lower cost (they return the same answer).



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- Semantic query optimisation

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- Rule-based query optimisation

Use heuristic fules to transform a relational algebra expression into an equivalent one with a possibly lower sost.



Assignment is a sit of each examing help optimisation approaches:

Semantic query optimisation

Let 10 Sation specific Leviantic Provedie to transferna query into the one with a lower cost (they return the same answer).

Rule-based query optimisation

Use heeristic fules to transform a relational algebra expression into an equivalent one with a possibly lower sost.

Cost-based query optimisation

Use a cost model to estimate the costs of plans, and then select the most cost-effective plan. This will not be assessed in our course.



Semantic Query Optimisation

Sign:ment Project Exam Help Person(id, first_name, last_name, year_born)

MOVIE(title, production_year, country, run_time, major_genre)

WRITER(id, title, production_year, credits) where

DIS PERSONO WCOCET. COM title, production_year] ⊆ MOVIE [title, production_year]

List the ids of the writers who have written movies produced in 2000.
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Semantic Query Optimisation

Assignment Project Exam Help Person(id, first_name, last_name, year_born)

MOVIE(<u>title</u>, production_year, country, run_time, major_genre)

WRITER(id, title, production_year, credits) where

nttps perspondition_year] ⊂ MOVIE [title, production_year]

• List the ids of the writers who have written movies produced in 2000. $\frac{Add}{\pi_{id}\sigma_{production, year=2000}} (\text{WRITER} \bowtie \text{PERSON} \bowtie \text{MOVIE})$

 $\pi_{id}\sigma_{production_vear=2000}(WRITER \bowtie PERSON)$

 $\pi_{id}\sigma_{production_year=2000}(WRITER \bowtie MOVIE)$



Semantic Query Optimisation

gnment Project Exam Help PERSON(id, first_name, last_name, year_born)

MOVIE(title, production_year, country, run_time, major_genre)

WRITER(id, title, production_year, credits) where

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List the ids of the writers who have written movies produced in 2000.

 $\pi_{id}\sigma_{production_year=2000}$ (WRITER \bowtie PERSON of MOVIE

 $\pi_{id}\sigma_{production_vear=2000}(WRITER \bowtie PERSON)$

 $\pi_{id}\sigma_{production_year=2000}(WRITER \bowtie MOVIE)$

 $\pi_{id}\sigma_{production_year=2000}$ WRITER \leftarrow the optimised RA



Assargement Project Example Help heuristic rules that typically improve the execution performance.

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Assargament Particular Examples Help heuristic rules that typically improve the execution performance.

• Key ideas: apply the most restrictive operation before other operations, which is the specific of the specific community and th



Assignment Project Examing Help heuristic rules that typically improve the execution performance.

- Key ideas: apply the most restrictive operation before other operations, which tall place the special results. COM
 - Push-down selection:

Apply as early as possible to reduce the number of tuples: $Add\ WeChat\ powcoder$



Assignment Project Examing Help heuristic rules that typically improve the execution performance.

- Key ideas: apply the most restrictive operation before other operations, which tall election of the point of the company of
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Apply as early as possible to reduce the number of attributes.



Rule-based Query Optimisation

Assignment Project Examing Help heuristic rules that typically improve the execution performance.

- Key ideas: apply the most restrictive operation before other operations, which tall elective points rectain the community of the second control of the community of the commun
 - Push-down selection:

Apply as early as possible to reduce the number of attributes.



Rule-based Query Optimisation

Assargement Project Examing Help heuristic rules that typically improve the execution performance.

- Key ideas: apply the most restrictive operation before other operations, which tall place the special results. COM
 - Push-down selection:

Apply as early as possible to reduce the number of tuples:

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Apply as early as possible to reduce the number of attributes.

 But we must ensure that the resulting query tree gives the same result as the original query tree, i.e., the equivalence of RA expressions.



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- $\sigma_{\varphi}(\sigma_{\psi}(R)) \equiv \sigma_{\varphi \wedge \psi}(R);$ https://powcoder.com
- $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$;



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$Assign they be executed in Option Project Exam Help <math display="block"> \int_{\sigma_{\varphi}(\sigma_{\psi}(R))}^{\text{Merging Richer Rations}} Help$

 $\sigma_{\textit{CourseNo}='\textit{COMP2400'}}(\sigma_{\textit{UID}=111}(\textit{STUDY})) \quad \text{v.s. } \sigma_{(\textit{Course}='\textit{COMP2400'}) \land (\textit{UID}=111)}(\textit{STUDY})$

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333	STAT2001	120		111	BUSN2011	110		111	COMP2400	120
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Assignment Toject Exam Help $\sigma_{\varphi}(\sigma_{\psi}(R)) \equiv \sigma_{\varphi \wedge \psi}(R)$;

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	STUDY	
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333	STAT2001	120
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120 110

(without any intermediate relation)

	STUDY	
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111	COMP2400	120



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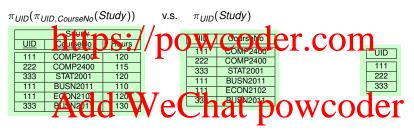
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 $\pi_{UID}(\pi_{UID,CourseNo}(Study))$ v.s. $\pi_{UID}(Study)$

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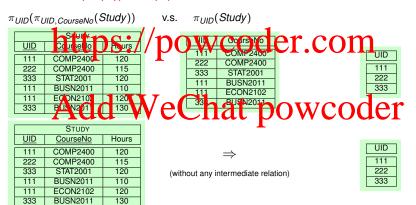


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Assign they be executed in Poo? Heroing Reperators Help $\pi_{X(R)}(R) = \pi_X(R)$ if $X \subseteq Y$,





Assignment Project Exam Help

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Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$

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Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$ $\sigma_{Course.No=Enrol.CoureNo}(Course \times Enrol)$

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Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$ $\sigma_{Course.No=Enrol.CoureNo}(Course \times Enrol)$

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COMP2400	Relational Databases	6		111	BUSN2011	2016 S1	active
BUSN2011	Management Accounting	6		222	COMP2400	2016 S1	active
D00142011	Wanagement Accounting			111	COMP2400	2016 S2	active



Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$ • $\sigma_{Course.No=Enrol.CourseNo}(Course \times Enrol)$

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	No	Cname	Unit
	COMP2400	Relational Databases	6
	BUSN2011	Management Accounting	6

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Ī	BUSN2011	Management Accounting	6	111	BUSN2011	2016 S1	active
	BUSN2011	Management Accounting	6	222	COMP2400	2016 S1	active
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Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$ $\sigma_{Course.No=Enrol.CoureNo}(Course \times Enrol)$

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COMP2400	Relational Databases	6	222	COMP2400	2016 S1	active
COMP2400	Relational Databases	6	111	COMP2400	2016 S2	active
BUSN2011	Management Accounting	6	111	BUSN2011	2016 S1	active
BUSN2011	Management Accounting	6	222	COMP2400	2016 S1	active
BUSN2011	Management Accounting	6	111	COMP2400	2016 S2	active



Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$ • Course $\bowtie_{Course.No=Enrol.CourseNo}$ Enrol

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COMP2400	Relational Databases	6		222	COMP2400	2016 S1	active
BUSN2011	Management Accounting	6		111	COMP2400	2016 S2	active



Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \times R_2) \equiv R_1 \bowtie_{\varphi} R_2$ Course $\bowtie_{Course, N_0 = Enrol, CourseN_0}$ Enrol

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No	Cname	Unit	StudentID	CourseNo	Semester	Status
COMP2400	Relational Databases	6	222	COMP2400	2016 S1	active
COMP2400	Relational Databases	6	111	COMP2400	2016 S2	active
BUSN2011	Management Accounting	6	111	BUSN2011	2016 S1	active



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Assignment Project Exam Help

- $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ;

 $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_2 ;
- $\pi_X(R_1\bowtie R_2)\equiv\pi_X(\pi_{X_1}(R_1)\bowtie\pi_{X_2}(R_2))$, if the join condition contains attributes not in X, where X contains attributes both in R_1 and X, and and X in X in X and X in X in
- $\pi_X(R_1 \bowtie R_2) \equiv \pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2)$, if the join condition involves only attributes in X, where X_i contains attributes both in R_i and X, and ones both in R_1 and R_2 ;



Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ; $\sigma_{Cname='ManagementAccounting'}(Course \bowtie Enrol)$

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Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ; $\sigma_{Cname='ManagementAccounting'}(Course \bowtie Enrol)$

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Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ; $\sigma_{Cname='ManagementAccounting'}(Course \bowtie Enrol)$

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	COMP2400	Relational Databases	6	111	2016 S2	active
	BUSN2011	Management Accounting	6	111	2016 S1	active



Assignment Project Exam Help

• $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ; $\sigma_{Cname='ManagementAccounting'}(Course \bowtie Enrol)$

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CourseNo	V nit V	Student D	CourseNo	er je ter	Status
COMP2400 Relational Databases	6	111	BUSN2011	2016 S1	active
BUSN2011 Management Accounting	6	222	COMP2400	2016 S1	active
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4	COMP2400	Relational Databases	C	222	2010-51	active
	COMP2400	Relational Databases	6	111	2016 S2	active
	BUSN2011	Management Accounting	6	111	2016 S1	active

CourseNoNo	Cname	Unit	StudentID	Semester	Status
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BUSN2011	Management Accounting	6	111	2016 S1	active



Assignments Project JEX am Help

- $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ;

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Assignments: Project; Exam Help

- $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ;
 - $\sigma_{Cname=ManagementAccounting'}(Course) \bowtie Figure 1$





Assignments Project je Exam Help

- $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ;
- $\sigma_{Cname=\text{'Management}Accounting'}(Course) \bowtie Finrol$



BUSN2011 Management Accounting





Assignments: Project; Exam Help

- $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ;
 - $\sigma_{Cname='ManagementAccounting'}(Course) \bowtie Enrol$





Assignments: Project : Exam Help

- $\sigma_{\varphi}(R_1 \bowtie R_2) \equiv \sigma_{\varphi}(R_1) \bowtie R_2$, if φ contains only attributes in R_1 ;
 - $\sigma_{Cname='ManagementAccounting'}(Course) \bowtie Enrol$



CourseNo	Cname	Unit	StudentID	Semester	Status
BUSN2011	Management Accounting	6	111	2016 S1	active



Assignment Project Exam Help

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Assignment Project Exam Help $\pi_{X_2}(R_1\bowtie R_2)\equiv\pi_{X_1}(R_1)\bowtie\pi_{X_2}(R_2)$, if the join condition involves only attributes in X, how could we derive X_1 and X_2 ?

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COMP2400	 	Relational Data	nases	6		111	BUSN2011	2016 S1	active
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Assignment Project Exam Help $\pi_X(R_1 \bowtie R_2) \equiv \pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2)$, if the join condition involves only attributes in X, how could we derive X_1 and X_2 ?

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	COMP2400	Relational Databases	6	- 111	2016 S2	active
	BUSN2011	Management Accounting	6	111	2016 S1	active



Assignment Push select/project Exam Help $\pi_{X}(R_1 \bowtie R_2) \equiv \pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2)$, if the join condition involves only attributes in X, how could we derive X_1 and X_2 ?

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	BUSN2011	Management Accounting	6	111	2016 S1	active

CourseNo	Cname	StudentID
COMP2400	Relational Databases	222
COMP2400	Relational Databases	111
BUSN2011	Management Accounting	111

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Assignment Project Exam Help

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Assignment Project Exam Help $\pi_{X_1}(H_1 \bowtie H_2) \equiv \pi_{X_1}(H_1) \bowtie \pi_{X_2}(H_2)$, if the join condition involves only attributes in X, how could we derive X_1 and X_2 ?

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Assignment Project Exam Help $\pi_X(H_1 \bowtie H_2) \equiv \pi_{X_1}(H_1) \bowtie \pi_{X_2}(H_2)$, if the join condition involves only attributes in X, how could we derive X_1 and X_2 ?

 $\pi_{\textit{CourseNo},\textit{Cname}}(\textit{Course}) \bowtie \pi_{\textit{CourseNo},\textit{StudentID}}(\textit{Enrol})$

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BUSN2011	Management Accounting	6

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BUSN2011	Management Accounting			22	2	COMP2400		
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attributes in X, how could we derive X_1 and X_2 ?

 $\pi_{CourseNo,Cname}(Course) \bowtie \pi_{CourseNo,StudentID}(Enrol)$

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CourseNo	Cname	StudentID
COMP2400	Relational Databases	222
COMP2400	Relational Databases	111
BUSN2011	Management Accounting	111



Assignment Project Exam Help

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Assignment Project Exam Help $\pi_{X}(H_1 \bowtie H_2) \equiv \pi_X(\pi_{X_1}(H_1) \bowtie \Gamma_{X_2}(H_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

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Assignment Project Exam Help $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

 π_{Cname} , $\mathit{StudentID}$ (Course $\bowtie \mathit{Enrol}$)

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 $\pi_{Cname,StudentID}(Course \bowtie Enrol)$

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Assignment Project Exam Help $\pi_X(H_1 \bowtie H_2) \equiv \pi_X(\pi_{X_1}(H_1) \bowtie_{\pi_{X_2}(H_2)})$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{\mathit{Cname},\mathit{StudentID}}(\mathit{Course}\bowtie \mathit{Enrol})$

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ŀ	CourseN	Ļ	┰	L	9	cname	Ц_	ν	Unit	V	4	Sidoon.		Course	48	Se me	ster	Status
ł	COMP240	-	\vdash	Re	latio	nal Dat	ahase	-	6	1	Γ	111		BUSN20	111	2016	S1	active
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	COMP2400	Relational Databases	6	1 111	2016 S2	active
	BUSN2011	Management Accounting	6	111	2016 S1	active



Assignment Project Exam Help $\pi_{\chi(H_1 \bowtie H_2)} = \pi_{\chi(\pi_{\chi_1}(H_1) \bowtie \pi_{\chi_2}(H_2))}$, if the join condition involves

attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{\mathit{Cname},\mathit{StudentID}}(\mathit{Course}\bowtie \mathit{Enrol})$

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4	C 11/12/10	Rulational Databases	Ctt	222	2013	Oc. iv
	COMP2400	Relational Databases	6	1 111	2016 S2	active
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Cname	StudentID
Relational Databases	222
Relational Databases	111
Management Accounting	111

Status active active



Assignments: Project je Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?



Assignments: Project; Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

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Course										
CourseNo	Cname	Unit								
COMP2400	Relational Databases	6								
BUSN2011	Management-Accounting	6								



Assignments: Project; Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

• $\pi_{X_1}(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

• $\pi_{X_1}(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

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İ	CourseNo	Cname	Unit		
	COMP2400	Relational Databases	6		
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Assignments: Project; Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

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	Course			Enro	L	
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COMP2400	Relational Databases	6		COMP2400		active
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			_			
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Assignments: Project; Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

Totale, recentle (Course) Enrol)?

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	Course				Enroi	L	
CourseNo	Cname	Unit		StudentID	CourseNo	Semester	Status
	2 27 2			111	BUSN2011	2016 S1	active
COMP2400	Relational Databases	6		222	COMP2400	2016 S1	active
BUSN2011	Management Accounting			4 111	COMP2400	201 S2	active
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Assignments: Project; Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

hatting (Spirito) (Procession of Course) Of Spanito (Enrol)?

	Course				Enro	L	
CourseNo	Cname	Unit		StudentID	CourseNo	Semester	Status
COMP2400	Relational Databases	6		111	BUSN2011	2016 S1	active
BUSN2011		6		222	COMP2400	2016 S1	active
BUSINZUTT	Management Accounting			<u> 111</u>	COMP2400	201 S2	active
π _{Cname} C DUR	add We	Cn	8	π _{StutentID} E)WC(ode	
Cname		_		π _{SturentID} E StudentI	NHOE -		
Relational				111			
Managemen	t						
				222			

Is $\pi_{Cname}(Course) \bowtie \pi_{StudentID}(Enrol)$ our desired result?



Assignments: Project; Exam Help

• $\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2))$, if the join condition involves attributes outside X, how could we derive X_1 and X_2 ?

Totale, recentle (Conserve Enrol) Anarch (Course) Assamble (Enrol)?

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Cours		_		Enro	L	
		_	StudentID	CourseNo	Semester	Status
	ame Uni	l l	111	BUSN2011	2016 S1	active
	Databases 6	_	222	COMP2400	2016 S1	active
BUSN2011 Managemen	nt-Accounting 6	11	4 111	COMP2400	201 S2	active
π _{Cname} Counties Cname Relational Management	wec	na	Studentill 111 222)WC	ode	

Is $\pi_{Cname}(Course) \bowtie \pi_{StudentID}(Enrol)$ our desired result?

No. $\pi_{Cname,StudentID}(Course \bowtie Enrol) \neq \pi_{Cname}(Course) \bowtie \pi_{StudentID}(Enrol)$



Can join be executed last? \rightarrow Push select/project before join.

ASSIGNMENT PROJECT, if Example involves I attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{Cname,StudentID}(Course \bowtie Enrol)$



• Can join be executed last? \hookrightarrow Push select/project before join.

attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{Cname,StudentID}(Course \bowtie Enrol)$

 $h_{TDS}^{\pi_{Cname}, StudentID}(\pi_{CourseNo, Cname}(Course) \bowtie \pi_{CourseNo, StudentID}(Enrol))$

 CourseNo
 Cname
 Unit

 COMP2400
 Relational Databases
 6

 BUSN2011
 Management Accounting
 6



• Can join be executed last? \rightarrow Push select/project before join.

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attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{\mathit{Cname}}, \mathit{StudentID}(\mathit{Course} \bowtie \mathit{Enrol})$

 $\begin{array}{c} h^{\pi_{\textit{Cname}},\textit{StudentID}}(\pi_{\textit{CourseNo},\textit{Cname}}(\textit{Course}) \bowtie \pi_{\textit{CourseNo},\textit{StudentID}}(\textit{Enrol})) \\ https://bowcoder.com \end{array}$

	COURSE		
CourseNo	Cname	Unit	
COMP2400	Relational Databases	6	
BUSN2011	Management Accounting	6	
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π cours	PA 1, C na ne COURS		hat powcoder
CourseNo	Cname		nat powerati
COMP2400	Relational Databases		
BUSN2011	Management Accounting		
	COMP2400 BUSN2011 TourseNo COMP2400	CourseNo Cname COMP2400 Relational Databases BUSN2011 Management Accounting ### COURSENS CourseNo Cname COMP2400 Relational Databases	CourseNo Cname Unit COMP2400 Relational Databases 6 BUSN2011 Management Accounting 6 # dourseN Lotate Course CourseNo Cname COMP2400 Relational Databases



Can join be executed last?

→ Push select/project before join.

entributes outside X, how could we derive X_1 and X_2 ?

 π_{Cname} , $\mathit{StudentID}(\mathit{Course} \bowtie \mathit{Enrol})$

 $\mathsf{https://powcoder.Course} / \pi_{\mathsf{CourseNo},\mathsf{Cname}}(\mathsf{Course}) \bowtie \pi_{\mathsf{CourseNo},\mathsf{StudentID}}(\mathsf{Enrol}))$

COURSE									
CourseNo	CourseNo Cname							Unit	
COMP2400	R	elatio	nal Da	atab	ase	s		6	
BUSN2011	Mar	Management Accounting							
				•					

- INNOL - I											
StudentID	CourseNo	Semester	Status								
111	BUSN2011	2016 S1	active								
222	COMP2400	2016 S1	active								
111	COMP2400	2016 S2	active								

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CourseNo		Cname						
COMP2400	Relational Databases							
BUSN2011	Management Accounting						ng	

Chat powcoder



• Can join be executed last? \rightarrow Push select/project before join.

attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{Cname,StudentID}(Course \bowtie Enrol)$

 $\pi_{Cname,StudentID}(\pi_{CourseNo,Cname}(Course) \bowtie \pi_{CourseNo,StudentID}(Enrol))$

COURSE
CourseNo Cname Unit
COMP2400 Relational Databases 6
BUSN/2011 Management Accounting 6

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BUSN2011	Mar	ager	nent A	CCO	unt	ing	6	1	
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CourseNo			Cnam	e	•		<u> </u>		٦
COMP2400	Re	elatio	nal Da	taba	ase	s			

COMP2400	Relational Databases
BUSN2011	Management Accounting

- NNOL - I						
StudentID	CourseNo	Semester	Status			
111	BUSN2011	2016 S1	active			
222	COMP2400	2016 S1	active			
111	COMPSANO	2016 52	activo			

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	1	11		Т	BU	JSN	2011					

111	BUSN2011
222	COMP2400
111	COMP2400



attributes outside X, how could we derive X_1 and X_2 ?

 $\pi_{Cname,StudentID}(Course \bowtie Enrol)$

 $\pi_{Cname,StudentID}(\pi_{CourseNo,Cname}(Course) \bowtie \pi_{CourseNo,StudentID}(Enrol))$

Cname CourseNo Unit COMP2400 Relational Databases BUSN2011 Management Accounting

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CourseNo	Cname				, I
COMP2400	Relational Databases				
BUSN2011	Management Accounting				

BUSN2011	Management Accounting

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StudentID	CourseNo	Semester	Status				
111	BUSN2011	2016 S1	active				
222	COMP2400	2016 S1	active				
111	COMP2400	2016 S2	active				

	Studentib	Courseivo	Semester	Status
	111	BUSN2011	2016 S1	active
	222	COMP2400	2016 S1	active
	111	COMP2400	2016 S2	active
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Stud IntID	CourseNo
111	BUSN2011
222	COMP2400
111	COMP2400

CourseNo	Cname	StudentID
COMP2400	Relational Databases	222
COMP2400	Relational Databases	111
BUSN2011	Management Accounting	111



Can join be executed last? → Push select/project before join.

Assignment Project Fx and Help attributes outside X, how could we derive X₁ and X₂?

 $\pi_{Cname.StudentID}(Course \bowtie Enrol)$

 $\pi_{Cname.StudentID}(\pi_{CourseNo.Cname}(Course) \bowtie \pi_{CourseNo.StudentID}(Enrol))$

COURSE
CourseNo Cname Unit
COMP2400 Relational Databases 6
BUSN2011 Management Accounting 6

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COMP2400	Re	elatio	nal Da	atab	ase	s	ĺ		
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Г	CourseNo	Cname	StudentID
Г	COMP2400	Relational Databases	222
	COMP2400	Relational Databases	111
Г	BUSN2011	Management Accounting	111

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StudentID	CourseNo	Semester	Status	
111	BUSN2011	2016 S1	active	
222	COMP2400	2016 S1	active	
111	COMP2400	2016 S2	active	

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	Stud	mtlD	CourseNo	_
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	11	1	COMP2400	

Cname	StudentID
Relational Databases	222
Relational Databases	111
Management Accounting	111



Heuristic Rules and Query Trees

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https://powcoder.com



Heuristic Rules and Query Trees

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https://powcoder.com

 $\overset{\text{(2)}}{A} \overset{\pi_{X}(\pi_{Y}(R))}{A} \overset{=}{\overset{\pi_{X}(R)}{\bullet}} \overset{\text{if } X \subset Y;}{\overset{Y}{\leftarrow}} \underset{\text{if } X \overset{Y}{\leftarrow} Y}{\overset{Y}{\leftarrow}} \underset{\text{if } X \overset{Y}{\leftarrow} Y}{\overset{Y}{\leftarrow}} \underbrace{powcoder}$





Heuristic Rules

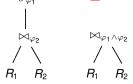
Assignment Project Exam Help https://powcoder.com



Heuristic Rules

Assignment Project Exam Help https://powcoder.com

⁽⁴⁾A'dd WeChat powcoder





Assign the relation that Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre)
ROLE(id, mtitle, mprod_year, description, credits)

OUNT (IN SWA/ IN IN SITE ARE PORTED TO THE TOUR TIME.

 $\pi_{title,production}$, year $(\sigma_{title=mittle} \land production.$ year = mprod. year $(\sigma_{major.genre='war'} \land first.name='Tom' \land last.name='Cruise' (MOVIE <math>\times (PERSON \bowtie ROLE))))$

Add WeChat powcoder



Assign the relation that Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre)
ROLE(id, mtitle, mprod_year, description, credits)

- Quant (igt) (Cwar my Sulat are rego need by Com (Time).
 - $\pi_{title,production_year}(\sigma_{title=mittle} \land production_year=mprod_year(\sigma_{major_genre='war'} \land first_name='Tom' \land last_name='Cruise'(MOVIE <math>\times (PERSON \bowtie ROLE))))$
- Question Can we poly the following rule to optimise the query? $\sigma_{\varphi}(R_1 \cup R_2) = \sigma_{\varphi_1}(R_1 \cup R_2)$ and φ_2 contains only attributes in R_2



Assiver the relation scholma Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre)
ROLE(id, mtitle, mprod_year, description, credits)

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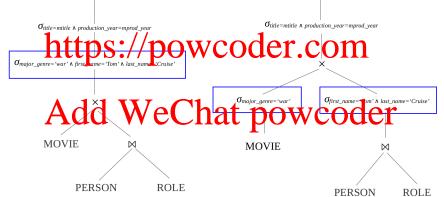
 π title_production_year (σ title=mittle\production_year=mprod_year (σ major_genre='war'\first_name='Tom'\alst_name='Cruise' (MOVIE \times (PERSON \bowtie ROLE))))

- Question Can we imply the following rule to optimise the queiv? $\sigma_{\varphi} (R_1 \cap R_2) = R_1 \cap R_2$ and φ_2 contains only attributes in R_2
- We would have

 $\pi_{title,production_year}(\sigma_{title=mtitle \land production_year=mprod_year}(\sigma_{major_genre='war'}(MOVIE) \times \sigma_{tirst_name='Tom' \land last_name='Cruise'}(PERSON \bowtie ROLE)))$



Assignment Project Exam Help





Assignation that Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre)
RQLE(id, mtitle, mprod_year, description, credits)

• Quantitita Boyar In West Nava Co Correct by Com Miles.

 $\pi_{\textit{title},\textit{production}_\textit{year}}(\sigma_{\textit{title}=\textit{mtitle}\land\textit{production}_\textit{year}=\textit{mprod}_\textit{year}}(\sigma_{\textit{major}_\textit{genre}='\textit{war'}}(\mathsf{MOVIE})$

***GILLIAM TO THE COLOR (PERSON NO ROLE)))



Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre) ROLE(id, mtitle, mprpd_year, description, credits)

Tip By of the Bold of the Companie.

 $\pi_{title,production_year}(\sigma_{title=mtitle \land production_year=mprod_year}(\sigma_{major_genre='war'}(\mathsf{MOVIE}))$

Can we apply $\sigma_{\varphi}(R_1 \times E_2) = 0$ Rerson \bowtie Role)))



PESON(id, first_name, last_name, year_born) Exam Help

MOVIE(title, production_year, country, run_time, major_genre) ROLE(id, mtitle, mprod_year, description, credits)

tiphwar mostavae e ored by comtribe.

 $\pi_{title,production_year}(\sigma_{title=mtitle \land production_year=mprod_year}(\sigma_{major_genre='war'}(\mathsf{MOVIE}))$

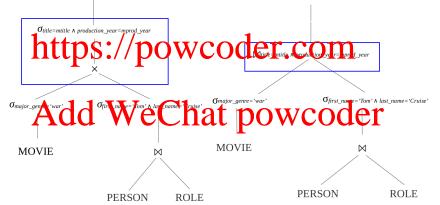
- $\begin{array}{c} \times \sigma_{\text{tilet.nam}} = \text{Tom} \land \text{Ts. frame} = \text{Cruse}(\text{PERSON} \bowtie \text{ROLE}))) \\ \text{Can we apply } \sigma_{\varphi}(R_1 \times R_2) = \text{PL}_{\varphi} R_2 \cdot \text{powcoder} \end{array}$
- We would have

```
\pi_{title,production\_year}(\sigma_{major\_genre='war'}(\mathsf{MOVIE}) \bowtie_{title=mtitle \land production\_year=mprod\_year})
```

 $\sigma_{\text{first_name}=\text{`Tom'} \land \text{last_name}=\text{`Cruise'}}(PERSON \bowtie ROLE)))$



Assignment Project Exam Help





Assignment Project Exam Help

Person(id, first_name, last_name, year_born)

Movie(title, production_year, country, run_time, major_genre)

ROLE(id4mtitle_mpyod_year_description_credits)

• Query: List all war mayies that are performed by 'Tom Cruise'.

 $\pi_{\textit{title,production_year}}(\sigma_{\textit{major_genre='war'}}(\mathsf{MOVIE}) \bowtie_{\textit{title=mtitle} \land \textit{production_year=mprod_year}}(\sigma_{\textit{title,production_year}}(\sigma_{\textit{major_genre='war'}}(\mathsf{MOVIE}) \bowtie_{\textit{title=mtitle} \land \textit{production_year=mprod_year}}(\sigma_{\textit{title,production_year}}(\sigma_{\textit{major_genre='war'}}(\mathsf{MOVIE}) \bowtie_{\textit{title=mtitle} \land \textit{production_year=mprod_year}}(\sigma_{\textit{title,production_year}}(\sigma_{\textit{major_genre='war'}}(\mathsf{MOVIE}) \bowtie_{\textit{title=mtitle} \land \textit{production_year=mprod_year}}(\sigma_{\textit{title,production_year}}(\sigma_{\textit{major_genre='war'}}(\sigma_{\textit{major_genre='war'}}(\mathsf{MOVIE}) \bowtie_{\textit{title=mtitle} \land \textit{production_year=mprod_year}}(\sigma_{\textit{major_genre='war'}}(\sigma_{\textit{major_gen$



Assignment Project Exam Help

PERSON(id, first_name, last_name, year_born)

Movie(title, production_year, country, run_time, major_genre)

ROLE(id4mtitle, mp/od_vear_description_credits)

Query: List all war mavies that are performed by 'Tom Cruise'.



Question: Can we apply the following rule to optimise the query?

$$\pi_X(R_1 \bowtie R_2) \equiv \pi_X(\pi_{X_1}(R_1) \bowtie \pi_{X_2}(R_2)),$$

where X_i contains attributes both in R_i and X, and ones both in R_1 and R_2



iven the relation schema Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre) Role(id, mtitle, mprod_year, description, credits)

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 $\pi_{title,production_year}(\sigma_{major_genre='war'}(\mathsf{MOVIE}) \bowtie_{title=mtitle \land production_year=mprod_year})$

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Assigned the relation schoma Project Exam Help

MOVIE(title, production_year, country, run_time, major_genre)
ROLE(id, mtitle, mprod_year, description, credits)

o authtips war in portavac lo are disy com tribe.

```
\pi_{\it title,production\_year}(\sigma_{\it major\_genre='war'}({\sf MOVIE})\bowtie_{\it title=mtitle}\land_{\it production\_year=mprod\_year}
```

 $\sigma_{\textit{first name}=\text{`Tom'} \land \textit{last name}=\text{`Cruise'}(PERSON \bowtie ROLE)))}$

• we Madde: We Chat powcoder

```
\pi_{title,production\_year}(\pi_{title,production\_year}(\sigma_{major\_genre='war'}(\mathsf{MOVIE}))
```

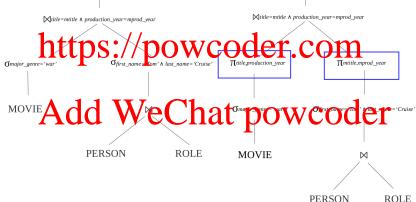
⊠title=mtitle∧production_year=mprod_year

```
(\pi_{\textit{mtitle}, \textit{mprod}\_\textit{year}}(\sigma_{\textit{first}\_\textit{name}='\textit{Tom}' \land \textit{last}\_\textit{name}='\textit{Cruise}'}(\mathsf{PERSON} \bowtie \mathsf{ROLE}))))
```

We further apply some rules to optimise the guery ...



Assignment Project Exam Help





Assignin	ARTS={	Rank Artist, Song v	vith 10 Tuples and 3 a	ttr Helj
	1	Chingy	Right Thurr	
	2	Scribe	Stand up	
http	$S_{4.}^{3.}$	Aguilera and Kim Evanescence	tan't hold us down	
•	5	Justin Timberlake	Senorita	
	6	Brooke Fraser	Better	
۸ .1.	177	Black Eyed Peas	Where is the love?	
Au	J V	ve U nat	DOWCOU	er
			<u></u>	

- Compare two strategies of evaluating "Who is top of the pops?":
 - σ Rank=1 (π Rank, Artist(CHARTS))
 - π Rank, Artist $(\sigma_{Rank=1}(CHARTS))$



Assignit	ARTS={	Rank Artist, Song v	with 10 Tuples and 3 a	ttr Hel
	1	Chingy	Right Thurr	_
	2	Scribe	Stand up	
http	$S_{4.}^{3.}$	Aguilera and Kim Evaries dense	an't hold us down	
•	5	Justin Timberlake	Senorita	
	6	Brooke Fraser	Better	
۸ .1.	177	Black Eyed Peas	Where is the love?	
Au	J V	vecnat	DOWCOU	er
			<u></u>	

- Compare two strategies of evaluating "Who is top of the pops?":
 - σ Rank=1 $(\pi$ Rank, Artist(CHARTS))
 - π Rank, Artist $(\sigma_{Rank=1}(CHARTS))$

Selection before Projection is preferred.



Assig	gider Cty	ARZS = {Rank Atjet	with 100 tubles and	50	ttribu	tes:	ב
	Rank	Artist	Song	Î			
	1	Chingy	Right Thurr				
1	2	Scribe	Stand up				
r	itto	Aguilera and Kity	Can lid (As dovin	\mathbf{n}	<u>n</u>		
-	4	Evanescence	Going under		·		
	5	Justin Timberlake	Senorita				
	6	Brooke Fraser	Better				
	77	Black Fyed Peas	Where is the love?		م ا	r	
	TUC		ai powc	יעי	uc	∕┺	

- Compare two strategies of evaluating?
 - σ Rank > $10^{(\pi)}$ Rank. Artist (CHARTS))
 - π Rank, Artist $(\sigma$ Rank > 10(CHARTS))



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	Rank	Artist	Song	Ĺ		
	1	Chingy	Right Thurr			
1	2	Scribe	Stand up			
r	itto	Aguilera and Kity	Can) lid (As dovin	01	Ŋ.	
-	4	Evanescence	Going under		·	
	5	Justin Timberlake	Senorita			
	6	Brooke Fraser	Better			
	77	Black Hyped Peas	Where is the love?		م ا	10
I	TUC		iai powc	יעי	uU	/

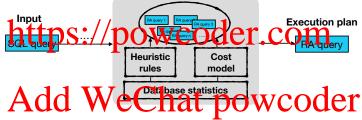
- Compare two strategies of evaluating?
 - σ Rank > 10 $(\pi$ Rank, Artist(CHARTS))
 - π Rank, Artist $(\sigma$ Rank > 10(CHARTS))

Projection before Selection is preferred.



Query Optimisation

Assignment Project Exam Help



Trade-off:

Time for executing a RA query vs Time for finding a better RA query



(credit cookie) memorising vs understanding

Assignment Project Exame Help 1 can remember song lyrics from 2006 but not whatever maths 1 herpyla // provider et offy

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