

### Week 6 Workshop – Normalisation



http://en.wikipedia.org/wiki/Ursus\_Wehrli



### Housekeeping

### Assignment Project Exam Help

Assignment 1 (SQL) (due 11:59pm, 3 Sep 2021)

That and teedback will be released on 17.5 sep 2021 om



### Housekeeping

### Assignment Project Exam Help

- Assignment 1 (SQL) (due 11:59pm, 3 Sep 2021)
  - The mark and feedback will be released on 17 Sep 2021
- An optional exercise website for our course

https://cs.anu.edu.au/dab/bench/db-exercises/

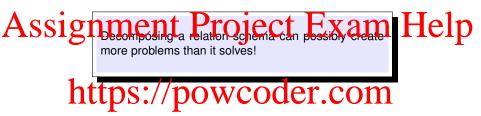


### Housekeeping

### Assignment Project Exam Help

- Assignment 1 (SQL) (due 11:59pm, 3 Sep 2021)
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- An anonymous curvey from our course representatives on Wattle (till Aeo roer West & Chat powcoder Help us to improve our planning and teaching









- That transition of the trans
  - Do we need to decompose a relation?



# Assignment Project Exam Help more problems than it solves!

- This terps of consprision of the construction of the constructio
  - Do we need to decompose a relation?

Addhelpus to decide Mather opos vecomposed etation



# Assignment Project Exam Help more problems than it solves!

- This terps of conspany of the constraints of the
  - Do we need to decompose a relation?

Addhelpus to decide whather open vector poed eation

2 What problem (if any) does a given decomposition cause?



# Assignment Project Exam Help more problems than it solves!

- This terps of consprision of the construction of the constructio
  - Do we need to decompose a relation?

Addhelput to decide what of the vector poed station

- 2 What problem (if any) does a given decomposition cause?
  - Two properties
    - → help us to decide how to decompose a relation



### **Two Properties**

## Assignment Project Exam Help In addition to data redundancy, we need to consider the following

In addition to data redundancy, we'need to consider the following properties when decomposing a relation:

https://powcoder.com



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properties when decomposing a relation:

### https://poweoder.com

To disallow the possibility of generating spurious tuples when a



### **Two Properties**

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In addition to data redundancy, we need to consider the following properties when decomposing a relation:

### https://poweoder.com

To disallow the possibility of generating spurious tuples when a NATURAL JOIN operation is applied to the relations after decomposition.



To ensure that each functional dependency can be inferred from functional dependencies after decomposition.

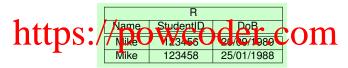


# Assignmental the same data. The same data of the same data. The same data of the same data

https://powcoder.com



# Assistance in the same data of Fx and Help same data of Fx and Help Join operation is applied to the relations after decomposition.



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	Mike	123456		123456	20/09/1989	
	Mike	123458		123458	25/01/1988	

• **Example 1:** Does the decomposition of *R* into *R*<sub>1</sub> and *R*<sub>2</sub> has the lossless join property?



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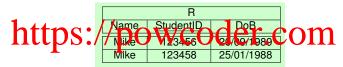
A	dd	River tude tub	Cha	tstud Au	WGOd	er
	Mike	123456		123456	20/09/1989	
	Mike	123458		123458	25/01/1988	

• **Example 1:** Does the decomposition of *R* into *R*<sub>1</sub> and *R*<sub>2</sub> has the lossless join property?

Yes, because the natural join of  $R_1$  and  $R_2$  yields R.



# A SST psales from the cossibility of general his surfound tuples and analyzing point of psales and psales and

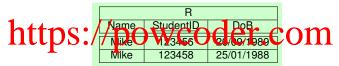




• **Example 2:** Does the decomposition of *R* into *R*<sub>3</sub> and *R*<sub>4</sub> has the lossless join property?



A SST psalled the cossibility of general hysterrous tuples annaly and possibility of general hysterrous tuples and possibility of general hysterrous and possibility of general hysterrous tuples and possibility of general hysterrous and possibility of general hysterrous



A	de	Vtu de till	Cha	Na na (	PWC0	der
	Mike	123456		Mike	20/09/1989	
	Mike	123458		Mike	25/01/1988	

• Example 2: Does the decomposition of *R* into *R*<sub>3</sub> and *R*<sub>4</sub> has the lossless join property?

No, because the natural join of  $R_3$  and  $R_4$  generates spurious tuples.



# Assistant in the claving ped repositor from Fint XRAMA desired phase the lossless join property. It generates spurious tuples.



R <sub>3</sub>					
Name	StudentID				
Mike	123456				
Mike	123458				

$R_4$					
Name DoB					
Mike	20/09/1989				
Mike	25/01/1988				

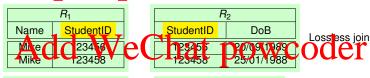


### Assignine numbroject Exam Help

StudentID

https://wike\_123456 20/09/1989 /Wike\_123458 21/04/1988 COM

Name



$R_3$					
Name Student					
Mike	123456				
Mike	123458				

$R_4$					
Name	DoB				
Mike	20/09/1989				
Mike	25/01/1988				

DoB

Not lossless join



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https://powcoder.com



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• Example 1: Given a FD  $\{StudentID\} \rightarrow \{Name\}\ defined\ on\ R$ 





■ Does the above decomposition preserves {StudentID} → {Name}?



### As Scange juffer led from Junctional dependencies after descriptishen. The 1p

• Example 1: Given a FD  $\{StudentID\} \rightarrow \{Name\}\ defined\ on\ R$ 





• Does the above decomposition preserves  $\{StudentID\} \rightarrow \{Name\}$ ? Yes, because  $\{StudentID\}$  and  $\{Name\}$  are both in  $R_1$  after decomposition and thus  $\{StudentID\} \rightarrow \{Name\}$  is preserved in  $R_1$ .



A S Schrödelick from Lucrifunal dependencies after de adoptition Tello

• Example 2: Given a FD  $\{StudentID\} \rightarrow \{Name\}\ defined\ on\ R$ 





■ Does the above decomposition preserves {StudentID} → {Name}?



### As Scange juffer led from Junctional dependencies after descriptishen. The 1p

• Example 2: Given a FD  $\{StudentID\} \rightarrow \{Name\}\ defined\ on\ R$ 





Does the above decomposition preserves {StudentID} → {Name}?
 No, because {StudentID} and {Name} are not in a same relation after decomposition.



### A S Schredeliteries from unctional dependency preservation. To ensure that each functional dependency preservation. To ensure that each functional dependency position. The property of the composition of

• Example 3: Given a set of FDs  $\{ \{ \text{StudentID} \} \rightarrow \{ \text{Email} \}, \{ \text{Email} \} \rightarrow \{ \text{Name} \}, \{ \text{StudentID} \} \rightarrow \{ \text{Name} \} \}$  defined on R

htte	-a./	MATT	Roadoro	om
nttr	Name	Still er til V	COEET.C	UIII
4	Mike	123456	123456@anu.edu.au	
	Tom	123123	123123@anu.edu.au	

	1111	1		
$\perp$		nalr	)OWCOOLE	r
Name	Email	StudentIL	Email	
Mike	123456@anu.edu.au	123456	123456@anu.edu.au	
Tom	123123@anu.edu.au	123123	123123@anu.edu.au	



### A S Schrede lift ried from unctional dependency preservation To ensure that each functional dependency 1 P

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ntti	Name	St) (e) tl 🗸	C(0)		COIII
	Mike	123456	1234560	@anu.edu.	au
	Tom	123123	1231230	@anu.edu.	au

Name	dd We	C	StudentID	owcode	r
Mike	123456@anu.edu.au		123456	123456@anu.edu.au	
Tom	123123@anu.edu.au		123123	123123@anu.edu.au	

■ Does the above decomposition preserves {StudentID} → {Name}?



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<i> </i>	in we		nat r	MAXCOGE	r
Name	Email	<u> </u>	StudentID	Email	
Mike	123456@anu.edu.au		123456	123456@anu.edu.au	]
Tom	123123@anu.edu.au		123123	123123@anu.edu.au	1

• Does the above decomposition preserves {StudentID}  $\rightarrow$  {Name}? Yes, because {StudentID}  $\rightarrow$  {Name} can be inferred by {StudentID}  $\rightarrow$  {Email} (preserved in  $R_2$ ) and {Email}  $\rightarrow$  {Name} (preserved in  $R_1$ ).



### Assignment Project, ExamitHelp

https://powcoder.com



### Assignment Project, Examithelp

• Lossless join if and only if the common attributes of  $R_1$  and  $R_2$  are a superkey for  $R_1$  or  $R_2$ ;

https://powcoder.com



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- $\begin{array}{c} \textbf{https://powcoder.com} \\ \textbf{https://powcoder.com} \end{array}$
- Consider R={A, B, C} with the set of FDs  $\Sigma = \{A \rightarrow B, B \rightarrow C, A \rightarrow C\}$ . Does the decompostion of R into  $R_1 = \{A, B\}$  and  $R_2 = \{A, C\}$  fullfill loss is spin and open encyprativing OWCOCCT



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  - $\Sigma_1 = \{A \rightarrow B\}$  and  $\Sigma_2 = \{A \rightarrow C\}$
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  - $\Sigma_1 = \{A \rightarrow B\}$  and  $\Sigma_2 = \{A \rightarrow C\}$
  - Lossless join? Yes because A is a superkey for  $R_1$ .
  - Dependency preserving? No because  $(\Sigma_1 \cup \Sigma_2)^* \neq \Sigma^*$  from the fact that  $\{A \to B, A \to C\} \not\vDash B \to C$ .



- Lossless join if and only if the common attributes of  $R_1$  and  $R_2$  are a superkey for  $R_1$  or  $R_2$ ;
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  - $\Sigma_1 = \{A \rightarrow B\}$  and  $\Sigma_3 = \{B \rightarrow C\}$
  - Lossless join? Yes because B is a superkey for  $R_3$ .

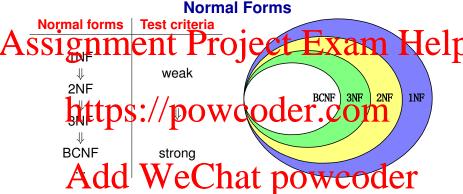


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- https://powcoder.com
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  - Lossless join? Yes because B is a superkey for  $R_3$ .
  - Dependency preserving? Yes because  $(\Sigma_1 \cup \Sigma_3)^* = \Sigma^*$  from the fact that  $\{A \to B, B \to C\} \models A \to C$ .





- Note that:
  - 1NF is independent of keys and functional dependencies.
  - 2NF, 3NF and BCNF are based on keys and functional dependencies.
  - 4NF and 5NF are based on other dependencies (will not be covered in this course).



#### **BCNF**

# Assignment Project Exam Help

Ddnettrepresent the same cact within a relation)!



#### **BCNF - Definition**

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https://powcoder.com



#### **BCNF - Definition**

# Assiratomentin Projecta neuxam Hebp

 When a relation schema is in BCNF, all data redundancy based on fun proteins and proteins of the contract of the



#### **BCNF - Definition**

# Assiratora a superkey . Projecta of the Assirator Assiratora a superkey .

 When a relation schema is in BCNF, all data redundancy based on functional rependency are removed OCET. COM

• Here data redundancy is considered in terms of FDs, i.e., for a non-trivial FD  $X \rightarrow Y$ , there exists a relation R that contains two distinct tuples t, and t, with  $t \cdot |XY| = t \cdot |XY|$ 

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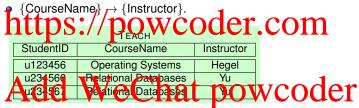
 $\{CourseName\} \rightarrow \{Instructor\}$ 

StudentID CourseName		Instructor	
u123456	Operating Systems	Hegel	
u234566	Relational Databases	Yu	
u234567	Relational Databases	Yu	



# Assa relation schema Riskin Project Exam Help

Consider the relation schema TEACH with the following FD:

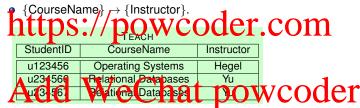


Is TEACH in BCNF?



# Assi belation schema Bisin Project Exam Help

Consider the relation schema TEACH with the following FD:



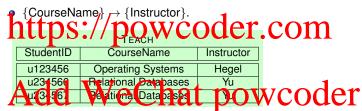
Is TEACH in BCNF?

Not in BCNF because {CourseName} is not a superkey.



# Assa relation schema Bis in Project Exam Help

Consider the relation schema TEACH with the following FD:



Is TEACH in BCNF?

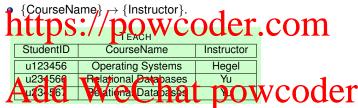
Not in BCNF because {CourseName} is not a superkey.

• Did we represent the same fact twice (or more times)?



# Assi belikida uperkey Project Exam Help

Consider the relation schema TEACH with the following FD:



Is TEACH in BCNF?

Not in BCNF because {CourseName} is not a superkey.

Did we represent the same fact twice (or more times)?
 Yes, the Instructor of Relational Databases is Yu.



# Assignment a relation schema R' and a set \( \sigma \) of FDs on R'.

**Output:** a set  $\mathcal S$  of relation schemas in BCNF, each having a set of FDs

https://powcoder.com



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https://powcoder.com



# Assignification schema H' and a set 2 of FDs on H'.

**Output:** a set S of relation schemas in BCNF, each having a set of FDs

 $\begin{picture}(100,0) \put(0,0){\line(1,0){100}} \put(0,0){\line(1,0){10$ 

- Find a (non-trivial) FD  $X \to Y$  on R that violates BCNF, if any;
- Replace R in S by two relation schemas XY and (R-Y) and



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**Output:** a set S of relation schemas in BCNF, each having a set of FDs

Start with  $S = /\{R'\}$ ; the start with  $S = /\{R'\}$ ; the start of the

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- ullet Replace R in  ${\mathcal S}$  by two relation schemas XY and (R-Y) and
- projectifier FDs to those two relation schemas.

  Does the bore Algorithm always plostuce a lossless decomposition?



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**Output:** a set S of relation schemas in BCNF, each having a set of FDs

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If R with a set  $\Sigma$  of FDs is decomposed into  $R_1$  with  $\Sigma_1$  and  $R_2$  with  $\Sigma_2$ , this decomposition is **lossless join** if and only if the common attributes of  $R_1$  and  $R_2$  are a superkey for  $R_1$  or  $R_2$ .



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**Output:** a set S of relation schemas in BCNF, each having a set of FDs

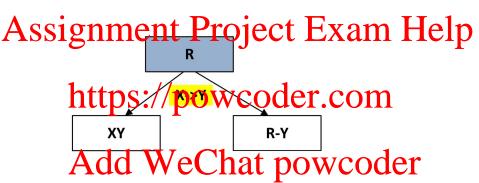
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• Yes because X is a superkey for XY.





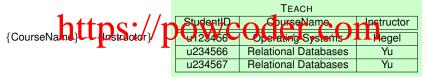


### Assignment Project Exam Help powcoder.com XY R-Y Add WeChat powcoder X'Y' R-Y-Y'



# Assign Riskin Project Exam Help

Consider the relation schema TEACH with the following FD:





# Assign Riskin Project Exam Help

Consider the relation schema TEACH with the following FD:

	TEACH			
{CourseNand}ttpstructor}	StudentID	CourseName	Instructor	
{CourseNaine} - lastruotor}	W128456	Operating Systems	Hegel	
	u234566	Relational Databases	Yu	
	u234567	Relational Databases	Yu	

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# Assign kind when the latest project Exam Help

Consider the relation schema TEACH with the following FD:

	TEACH			
{CourseNa.nattlestructor}/1	StudentID	CourseName	Instructor	
{CourseNa.hd}   lastraotor}	w123456	Operating Systems	Hegel	
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CourseName	Instructor
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		_	
StudentID		CourseName	
u123456		Operating Systems	
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u234567		Relational Databases	



# Assign knawsky Project Exam Help

Consider the relation schema TEACH with the following FD:

	TEACH			
{CourseNah}ttnstrotor}/1	StudentID	CourseName	Instructor	
{CourseNa.ne} - Instructor}	w128456	Operating Systems	Hegel	
	u234566	Relational Databases	Yu	
	u234567	Relational Databases	Yu	

· Can Ae par muliis We to fine to pow coder

CourseName	Instructor
Operating Systems	Hegel
Relational Databases	Yu

٠٠-٢			
StudentID	CourseName		
100450	0		
u123456	Operating Systems		
	. ,		
u234566	Relational Databases		
u234567	Relational Databases		
u204007	Ticiational Batabases		

Do not represent the same fact twice (within a relation)!



# Assignment of Project, Dexam Help

- {OfficerID, Date}  $\rightarrow$  {Room} • {CustomerID, Date}  $\rightarrow$  {OfficerID, Time} • {Date, Time, Room}  $\rightarrow$  {CustomerID}
- Is Interview in BCNE? If not, normalize Interview into BCNE Add WeChat powcoder



Assignmento Project, Exam Help

```
• {OfficerID, Date} \rightarrow {Room}

• {CustomerID, Date} \rightarrow {OfficerID, Time}

• {Date, Time, Room} \rightarrow {CustomerID}
```

Is INTERVIEW in BCNE? If not, normalize INTERVIEW into BCNE (CustomerID, Date), {Officerio, Date, Time}, and {Date, Time, Room} are the keys.



# Assignmento Project, Ram Help

- {OfficerID, Date}  $\rightarrow$  {Room}
- {CustomerID, Date} → {OfficerID. Tine} {Die Spate, De Wuscherter.com
- {Date, Time, Room} → {CustomerID}
- Is INTERVIEW in BCNE? If not, normalize INTERVIEW into BCNE.
  - {CustomerID, Date}, {OfficerID, Date, Time}, and {Date, Time, Room} are the keys.
  - Any superkey must contain one of of these keys as a subset.



# Assignmento Project, Ram Help

- {OfficerID, Date}  $\rightarrow$  {Room}
- $\label{eq:customerlD} \begin{array}{l} \{\text{CustomerlD, Date}\} \rightarrow \{\text{OfficerlD, Time}\} \\ \text{Delta bate}, \text{ in each of the constant of the c$
- {Date, Time, Room} → {CustomerID}
- Is INTERVIEW in BCNE? If not, normalize INTERVIEW into BCNE.
  - CustomerID, Date, {Officerib, Date, Time}, and {Date, Time, Room} are the keys.
  - Any superkey must contain one of of these keys as a subset.
- INTERVIEW is not in BCNF because  $\{OfficerID, Date\} \rightarrow \{Room\}$  and  $\{OfficerID, Date\}$  is not a superkey.



Assignment Project Examalelp

OfficerID	CustomerID	Date	Time	Room	
91011	P100 / /	12/11/2013	10:00	R15	
\$1)11	P 105	17/1/2013	<b>)</b> (2) (2)	R15	nm
S1024	P108'	14/11/2013	14:00	R10	
S1024	P107	14/11/2013	14:00	R10	

	A 1 1	TT
	NT ELV EV	WA
OfficerID	Date	Room
S1011	12/11/2013	R15
S1024	14/11/2013	R10

	INTERVIEW2					
	Di iice il D	C) stome (D)	[ at a	e	Time	
Ĭ	S1011	P100	12/11/2	013	10:00	
	S1011	P105	12/11/2	013	12:00	
	S1024	P108	14/11/2	013	14:00	
	S1024	P107	14/11/2	013	14:00	



AssignmenteProjecticExameHelp

OfficerID	CustomerID	Date	Time	Room	
91011	P100 / /	12/11/2013	10:00	R15	
\$1)11	P 105	1)2/7/2013	<b>)</b> (2) (2)	R15	nm
S1024	P108'	14/11/2013	14:00	R10	
S1024	P107	14/11/2013	14:00	R10	

	MERVEN	We
OfficerID	Date	Room
S1011	12/11/2013	R15
S1024	14/11/2013	R10

	INTERVIEW2				
U	Di ice il D	Custome (D	[alp	e	Time
Ĭ	S1011	P100	12/11/2	013	10:00
	S1011	P105	12/11/2	013	12:00
	S1024	P108	14/11/2	013	14:00
	S1024	P107	14/11/2	013	14:00

Do not represent the same fact twice (within a relation)!



Consider Interview={OfficerID, CustomerID, Data, Time, Room} with the Supplement Project Exam Help SSIPIPPIEIL FLU (OfficerID, Date)  $\rightarrow$  {Room}

- {CustomerID, Date} → {OfficerID, Time}
- {OfficerID, Date, Time} → {CustomerID}

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INTERVIEW1				
OfficerID	Date	Room		
S1011	2/14 2013	P 5		
S1024	11/11/2013	R10		

INTERVIEW2				
OfficerID	CustomerID	Date	Time	
S1011	P100	12/11/2013	10:00	
1 310th t	17195 XX/	12/11/2013	<b>~</b> 12:00	
15:1064 C		14/11/2018	14:00	
S1024	P107	14/11/2013	14:00	
	\$1011 \$1041 \$1061	OfficerID CustomerID  \$1011 P100	OfficerID         CustomerID         Date           \$1011         P100         12/11/2013           \$1021         P105         12/11/2013           \$1021         P105         12/11/2013	

Project FDs on two new relation schemas.



 $Assigned \begin{tabular}{l} \textbf{Consider INTERVIEW=} \{OfficerID, CustomerID, Data, Time, Room\} \label{eq:consider} \textbf{Assigned} \begin{tabular}{l} \textbf{Consider INTERVIEW=} \{OfficerID, CustomerID, Data, Time, Room\} \label{eq:consider} \textbf{With the Project Exam Help} \\ \{OfficerID, Data\} \rightarrow \{Room\} \end{tabular}$ 

- {CustomerID, Date} → {OfficerID, Time}
- {OfficerID, Date, Time} → {CustomerID}

https://poweroder.com

INTERVIEW1				
OfficerID	Date Room			
S1011	2/14 2043	PF A		
S1024	14/4/2013	R10		

INTERVIEW2				
OfficerID	CustomerID	Date	Time	
S1011	P100	12/11/2013	10:00	
1 310th t	17195 XX/	12/11/2013	<b>~</b> 12:00	
15:1064 C		14/11/2018	14:00	
S1024	P107	14/11/2013	14:00	
	\$1011 \$1041 \$1061	OfficerID CustomerID  \$1011 P100	OfficerID         CustomerID         Date           \$1011         P100         12/11/2013           \$1021         P105         12/11/2013           \$1021         P105         12/11/2013	

Project FDs on two new relation schemas. INTERVIEW1: {OfficerID, Date} → {Room}



Assignment Project Exam Help

- {CustomerID, Date} → {OfficerID, Time}
- {OfficerID, Date, Time} → {CustomerID}

https://poweroder.com

INTERVIEW1			
OfficerID	Date Room		
S1011	2/14 2043	P 5	1
S1024	11/11/2013	R10	′

-						
	INTERVIEW2					
	OfficerID	CustomerID	Date	Time		
$ \bot $	\$1011	P100	12/11/2013	10:00		
	1 310th t	1P105 TX70	12/11/2013 1	<b>~</b> 12:00		
_	15:10 <u>6</u> 4 L		14/1 1/2018	14:00		
	S1024	P107	14/11/2013	14:00		

• Project FDs on two new relation schemas. INTERVIEW1:  $\{\text{OfficerID}, \text{Date}\} \rightarrow \{\text{Room}\}$  INTERVIEW2:  $\{\text{CustomerID}, \text{Date}\} \rightarrow \{\text{OfficerID}, \text{Time}\}$ ,  $\{\text{OfficerID}, \text{Date}, \text{Time}\} \rightarrow \{\text{CustomerID}\}$ .



### **BCNF** - Exercise

Assignment Project Exam Help

- $\bullet \ \{\mathsf{OfficerID}, \, \mathsf{Date}\} \to \{\mathsf{Room}\}$
- {CustomerID, Date} → {OfficerID, Time}
- {OfficerID, Date, Time} → {CustomerID}

### https://poweoder.com

INTERVIEW1					
OfficerID	Pate	4	I B	om_	V
S1011	12/1	201	3   <b>X</b> ?	<b>16</b>	7
S1024	14/11	/2013	3   R	10	

OfficerID	CustomerID	Date	Time
340#1 <b>+</b>	1P100 TT7	12/11/2013	<b>~</b> 10:00
15:1001	P105/ VV \	72/1/2013	12:00
S1024	P108	14/11/2013	14:00
S1024	P107	14/11/2013	14:00
	S1024	OfficerID CustomerID  OfficerID CustomerID  S1024 P108	S1024 P108 14/11/2013

Is this decomposition dependency-preservation?



### **BCNF** - Exercise

# Assam Help

- $\bullet \ \{\mathsf{OfficerID}, \, \mathsf{Date}\} \to \{\mathsf{Room}\}$
- {CustomerID, Date} → {OfficerID, Time}
- ¶ {OfficerID, Date, Time} → {CustomerID}

### https://poweeder.com

INTERVIEW1					
OfficerID	Pate	4	Foom	1	
S1011 4	12/1	2013	1 K16	7	
S1024	14/11	/2013	R10		

	OfficerID	CustomerID	Date	Time
	340#J	1P190 T T 7 (	12/11/2018	<b>~</b> 10:00
_	15:100:11	P105/ VV \	72/1/2013	12:00
	S1024	<b>P</b> 108	14/11/2013	14:00
	S1024	P107	14/11/2013	14:00

Is this decomposition dependency-preservation?
 No because {Date, Time, Room} → {CustomerID} is lost (and cannot be recovered)!



## Assignment Project Exam Help

 When applying BCNF decomposition, the order in which the FDs are applied may lead to different results.

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## Assignment Project Exam Help

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- Exhit pside / powender.com



## Assignment Project Exam Help

- When applying BCNF decomposition, the order in which the FDs are applied may lead to different results.
- Exhit pside / powender.com.
  - Case 1: (Using  $C \rightarrow B$  first)



- When applying BCNF decomposition, the order in which the FDs are applied may lead to different results.
- Exhit psido / powender.com.
  - Case 1: (Using  $C \rightarrow B$  first)

$$\begin{matrix} A_1 = \{\textit{B},\textit{C}\}, \Sigma_1 = \{\textit{B} \rightarrow \textit{C}.\textit{C} \rightarrow \textit{B}\}; \textit{R}_2 = \{\textit{A},\textit{C}\}, \Sigma_2 = \{\textit{A} \rightarrow \textit{C}\} \\ \textbf{WeChat powcoder} \end{matrix}$$



- When applying BCNF decomposition, the order in which the FDs are applied may lead to different results.
- Exhittpsion/pawaoder.com.
  - Case 1: (Using  $C \rightarrow B$  first)

$$\begin{array}{l} A_1 = \{B,C\}, \Sigma_1 = \{B \rightarrow C.C \rightarrow B\}; R_2 = \{A,C\}, \Sigma_2 = \{A \rightarrow C\} \\ A_2 = \{C,C\}, \Sigma_3 = \{A \rightarrow C\} \\ A_3 = \{C,C\}, \Sigma_4 = \{A,C\}, \Sigma_5 = \{A \rightarrow C\} \\ A_4 = \{C,C\}, \Sigma_5 = \{A \rightarrow C\}, \Sigma_6 = \{A,C\}, \Sigma_6$$



- When applying BCNF decomposition, the order in which the FDs are applied may lead to different results.
- Exhittpside/Apawaoder.com.
  - Case 1: (Using  $C \rightarrow B$  first)

$$A_1 = \{B, C\}, \Sigma_1 = \{B \rightarrow C.C \rightarrow B\}; R_2 = \{A, C\}, \Sigma_2 = \{A \rightarrow C\}$$

$$A_2 = \{B, C\}, \Sigma_1 = \{B \rightarrow C.C \rightarrow B\}; R_2 = \{A, B\}, \Sigma_2 = \{A \rightarrow B\};$$

$$R_1' = \{B, C\}, \Sigma_1' = \{B \rightarrow C.C \rightarrow B\}; R_2' = \{A, B\}, \Sigma_2' = \{A \rightarrow B\};$$



### **Lossless Join & Dependency Preservation**

- So far, we know how to find a lossless BCNF-decomposition, but it may not be lapered preser in OWCOGET. COM
- Is there a less restrictive normal form such that a lossless and dependency-preserving decomposition can always be found? Add we chart powcoder



### **Lossless Join & Dependency Preservation**

- So far, we know how to find a lossless BCNF-decomposition, but it may not be lape deproper ser in OWCOGET. COM
- Is there a less restrictive normal form such that a lossless and dependency-preserving decomposition can always be found? Yes, refered ONF.



### 3NF - Definition

## Assignment Project Exam Help

• Question: If R is in BCNF, then R is in 3NF?



### 3NF - Definition

## Assignment Project Exam Help

• Question: # R is in BCNF, then R is in 3NF?

Yes



### 3NF - Definition

## Assignment Project Exam Help

• Question: If R is in BCNF, then R is in 3NF?

Yes

3NF preserves all the functional dependencies at the conditional dependencies at the cond



 $Assignment \begin{picture}(20,0) \put(0,0){\line(1,0){19}} \put(0,0){\line(1,0){$ 

4	ENROL						
ł		<ul> <li>Course No</li> </ul>	Senresten	Confirmed By ID 1	StaffName		
1	T23 56	COM 2400	2010 S2	u12	Jane		
	123458	COMP2400	2008 S2	u13	Linda		
	123458	COMP2600	2008 S2	u13	Linda		



 $Assignment \begin{picture}(20,0) \put(0,0){\line(1,0){19}} \put(0,0){\line(1,0){$ 

4	ENROL -						
ľ	1 Studen IC	• Coursello 1	Semester (	Confirmed By ID 1	StaffName		
-	T23 56	COM 22400	2010 S2	u12	Jane		
	123458	COMP2400	2008 S2	u13	Linda		
	123458	COMP2600	2008 S2	u13	Linda		

• 15 Add We Chat powcoder



 $Assignment \begin{picture}(20,0) \put(0,0){\line(1,0){19}} \put(0,0){\line(1,0){$ 

4	ENROL						
	1 Studen C	• Course No	Semester /	Confirmed By (D) 1	BtaffName		
1	T23 56	COM 2400	2010 S2	u12	Jane		
	123458	COMP2400	2008 S2	u13	Linda		
	123458	COMP2600	2008 S2	u13	Linda		

• Is EAROGONEWe Chat powcoder student ID, Course No, Semester is the only key.



 $Assignment \begin{picture}(20,0) \put(0,0){\line(1,0){19}} \put(0,0){\line(1,0){$ 

4	ENROL						
ł		• Course No	Semester	and in med By ID	BtaffName		
1	T23 56	COM 2400	2010 S2	u12	Jane		
	123458	COMP2400	2008 S2	u13	Linda		
	123458	COMP2600	2008 S2	u13	Linda		

• Is EARO ON NEW Chat powcoder StudentID, CourseNo, Semester is the only key.

A relation schema R is in **3NF** if whenever a non-trivial FD  $X \to A$  holds in R, then X is a **superkey** or A is a **prime attribute**.



 $Assignment \begin{picture}(20,0) \put(0,0){\line(1,0){19}} \put(0,0){\line(1,0){$ 

4	ENROL						
ł		• Course No	Semester	and in med By ID	BtaffName		
1	T23 56	COM 2400	2010 S2	u12	Jane		
	123458	COMP2400	2008 S2	u13	Linda		
	123458	COMP2600	2008 S2	u13	Linda		

• Is EARON NEW eChat powcoder student ID, Course No, Semester is the only key.

A relation schema R is in **3NF** if whenever a non-trivial FD  $X \to A$  holds in R, then X is a **superkey** or A is a **prime attribute**.

 Not in 3NF, because of {ConfirmedBy\_ID} → {StaffName}: {ConfirmedBy\_ID} is NOT a superkey and {StaffName} is NOT a prime attribute.



## Assignment Project Exam Help

**Input:** a relation schema R and a set  $\Sigma$  of FDs on R.

Output: a set S of relation schemas in 3NF each having a set of FDs NTUPS.//POWCOGET.COM



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• Group FDs in  $\Sigma'$  by their left-hand-side attribue sets



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- For each distinct left-hand-side  $X_i$  of FDs in  $\Sigma'$  that includes





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• Remove all redundant ones from S (i.e., remove  $R_i$  if  $R_i \subseteq R_i$ )



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 $A_{Add} \xrightarrow{X_i} \underbrace{W_i}_{A_{1}} \underbrace{e_{X_i}}_{\{A_1\}} \underbrace{v_i}_{\{A_2\}} \underbrace{p_i}_{\{A_2\}} \underbrace{v_i}_{\{A_2\}} \underbrace{v_i}_{\{A_2\}}$ 

- Remove all redundant ones from S (i.e., remove  $R_i$  if  $R_i \subseteq R_i$ )
- if S does not contain a superkey of R, add a key of R as  $R_0$  into S.



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- For each distinct left-hand-side  $X_i$  of FDs in  $\Sigma'$  that includes

 $A_{Add}^{X_i} A_{Add}^{X_i} e_{X_i \cup \{A_1\} \cup \{A_2\}}^{X_i} rat powcoder$ 

- Remove all redundant ones from S (i.e., remove  $R_i$  if  $R_i \subseteq R_i$ )
- if S does not contain a superkey of R, add a key of R as  $R_0$  into S.
- Project the FDs in  $\Sigma'$  onto each relation schema in S



# Assignment Project Exam Help

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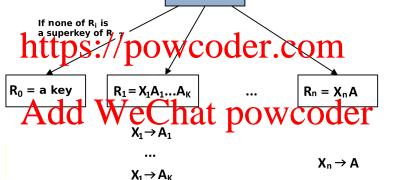


## Assignment Project Exam Help

 $X_1 \rightarrow A_K$ 

 $X_n \rightarrow A$ 







## Assignment Project Exam Help

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# Assignment Project Exam Help



• Example :  $\sum_{t=1}^{\infty} \frac{1}{t} = \sum_{t=1}^{\infty} \frac{1}{t} = \sum_{t=1}^$ 



## Assignment Project Exam Help



• Example :  $\sum_{1} \sum_{1} \sum_{1} \sum_{2} \sum_{1} \sum_{1$ 





- Example :  $\sum_{1} \sum_{1} \sum_{1$
- Example 2:

$$\Sigma_1 = \{X \to Y, XY \to Z\} \text{ and } \Sigma_2 = \{X \to Y, X \to Z\}$$
 If  $\Sigma_1^* = \Sigma_2^*$ ,





- Example :  $\Sigma_1 = \Sigma_2$ , then  $\Sigma_1$  is not minimal
- Example 2:

$$\begin{split} \Sigma_1 &= \{X \to Y, XY \to Z\} \text{ and } \Sigma_2 = \{X \to Y, X \to Z\} \\ \text{If } \Sigma_1^* &= \Sigma_2^*, \text{ then } \Sigma_1 \text{ is not } \underset{\textbf{minimal}}{\textbf{minimal}} \end{split}$$



# Assignment Project Exam Help



- Example :  $\Sigma_1 = \Sigma_2$ , then  $\Sigma_1$  is not minimal
- Example 2:

$$\Sigma_1 = \{X \to Y, XY \to Z\}$$
 and  $\Sigma_2 = \{X \to Y, X \to Z\}$   
If  $\Sigma_1^* = \Sigma_2^*$ , then  $\Sigma_1$  is not **minimal**

Questions: Can we find the minimal one among equivalent sets of FDs?



### **Minimal Cover - The Hard Part!**

## Assignment Project Exam Help

https://powcoder.com



### **Minimal Cover – The Hard Part!**

# Assignment Project Exam Help

 $\begin{array}{l} \sum_{\textit{m}} \text{ is equivalent to } \Sigma, \text{ i.e., start with } \Sigma_{\textit{m}} = \Sigma; \\ \textbf{https://powcoder.com} \end{array}$ 



#### **Minimal Cover – The Hard Part!**

## Assignment Project Exam Help

- $\Sigma_m$  is equivalent to  $\Sigma$ , i.e., start with  $\Sigma_m = \Sigma$ ;

  Dependent each  $\Sigma_m$  has only a single attribute on its right hand side, i.e., replace each  $\Sigma_m$  has  $\Sigma_m$  with  $\Sigma_m$
- Add WeChat powcoder



#### **Minimal Cover – The Hard Part!**

## Assignment Project Exam Help Let Doe a set of FDs. A minimal odver $\Sigma_m$ of $\Sigma$ is a set of FDs such that

- $\Sigma_m$  is equivalent to  $\Sigma$ , i.e., start with  $\Sigma_m = \Sigma$ ;

  The product each  $\Sigma_m$  has only a single attribute on its right hand side, i.e., replace each  $\Sigma_m$  for  $\Sigma_m$  with  $\Sigma_m$  with  $\Sigma_m$  and  $\Sigma_m$  with  $\Sigma_m$
- **3 Let ri han** V and FD has a Sew a tricules XY be let in Y and Y does not solve Y and Y and Y and Y and Y be seen if we can replace  $X \to A$  with  $(X B) \to A$  in Y.



#### Minimal Cover - The Hard Part!

## Assignment Project Exam Help Let Doe a set of FDs. A minimal of Exam Help

- $\bigcirc$   $\Sigma_m$  is equivalent, to  $\Sigma$ , i.e., start with  $\Sigma_m = \Sigma$ ;
- **Description** each FD M has only a single attribute on its right hand side, i.e., replace each FD  $X \to \{A_1, \ldots, A_k\}$  in  $\Sigma_m$  with  $X \to A_1, \ldots, X \to A_k$ ;
- **Solution** The parameter  $X \to A$  in  $X_m$ , check each attribute B of X to see if we can replace  $X \to A$  with  $(X B) \to A$  in  $\Sigma_m$ ;
- **a** Remove a FD from  $\Sigma_m$  if it is redundant.



Given the set of FDs Σ

Asspented Seminoral Semi

• we can compute the minimal cover of  $\Sigma$  as follows:

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Given the set of FDs Σ

 $SS(\text{promprem} \text{sement}) \text{ confirmed By LID}) \to \{\text{StaffName}\}$ 

• we can compute the minimal cover of  $\Sigma$  as follows:

https://powcoder.com



Given the set of FDs Σ

 $SS(\text{promperson}) = \{\text{CsafirmedBy}, \text{ID}\} \rightarrow \{\text{StaffName}\} = \{\text{CsafirmedBy}, \text{ID}\} \rightarrow \{\text{StaffName}\}$ 

• we can compute the minimal cover of  $\Sigma$  as follows:

chack yiether all the Fosty Ehroeo legge attribute on the right hand side.



Given the set of FDs Σ

 $s_{\text{Constrained By \_ID}} \to \{s_{\text{aff Name}}\} \text{ to the boundary of the point of the property of the propert$ 

ullet we can compute the minimal cover of  $\Sigma$  as follows:

start from  $\Sigma$ : chack yiether allung Fosty Chave on pore attributer on the right hand side;  $\{ \textbf{StudentID}, \, \textbf{CourseNo}, \, \textbf{Semester} \} \rightarrow \{ \begin{array}{c} \textbf{ConfirmedBy\_ID}, \, \textbf{StaffName} \end{array} \}$ 



Given the set of FDs  $\Sigma$ 

ts Project Byxam Help {ConfirmedBv\_ID} → {StaffName}

• we can compute the minimal cover of  $\Sigma$  as follows:

start from  $\Sigma$ : hacing lighter allume of Design Energe on Loope attributer on the right  $\{ StudentID, CourseNo, Semester \} \rightarrow \{ \begin{array}{c} ConfirmedBy\_ID, StaffName \end{array} \}$ can be replaced by



Given the set of FDs Σ

 $\begin{array}{c} \textbf{ASS[Figer III] Performance StaffName} \\ \textbf{StudentID, CourseNo, Semester} \\ \textbf{\{StaffName\}} \\ \textbf{\{ConfirmedBy\_ID\}} \rightarrow \textbf{\{StaffName\}} \\ \end{array}$ 

• we can compute the minimal cover of  $\Sigma$  as follows:

sattoςΣ;//powcoder.com
check whether all the FDs in Σ have only one attribute on the right hand side;



 Given the set of FDs Σ Spening end Sement Jeon melby voam Help (SweentlD, CourseNo, Semester) StaffName)

 $\{ConfirmedBy\_ID\} \rightarrow \{StaffName\}$ 

• we can compute the minimal cover of  $\Sigma$  as follows:

all the FDs in Σ have only one attribute on the right hand side;

check whether all the FDs in  $\Sigma$  have redundant attribute on the left



- we can compute the minimal cover of  $\Sigma$  as follows:
  - IslatingΣ;//DOWCOCET.COM
    check whether all the FDs in Σ have only one attribute on the right hand side;
  - side;

    check whether all the FDs in Σ have redundant attribute on the left hand side;

    Student Σ Course No, Semester } Control E LID} is minimal with respect to the left hand side check if { Student ID, Course No, Semester } → {StaffName} is minimal with respect to the left hand side



Given the set of FDs  $\Sigma$   $S \text{ Figure 117, President Semester} \rightarrow \text{ StaffName}$   $\{\text{ConfirmedBy\_ID}\} \rightarrow \{\text{StaffName}\}$ 

- we can compute the minimal cover of  $\Sigma$  as follows:
  - IslatingΣ;//DOWCOCET.COM
    check whether all the FDs in Σ have only one attribute on the right hand side;
  - check whether all the FDs in  $\Sigma$  have redundant attribute on the left hand side; Students courselves the left hand side check if { Students, CourseNo, Semester }  $\rightarrow$  {StaffName} is minimal with respect to the left hand side All look good!



Given the set of FDs Σ

Specific StaffName StaffNa  $\{ConfirmedBy\_ID\} \rightarrow \{StaffName\}$ 

- we can compute the minimal cover of  $\Sigma$  as follows:
  - all the FDs in  $\Sigma$  have only one attribute on the right hand side;
  - check whether all the FDs in  $\Sigma$  have redundant attribute on the left And the WeChat powcoder



- Given the set of FDs  $\Sigma$  Size the set of FDs  $\Sigma$  Size
  - we can compute the minimal cover of  $\Sigma$  as follows:
    - The state of the
    - 3 check whether all the FDs in  $\Sigma$  have redundant attribute on the left hand side; The country of the confirmed By\_ID}, {StudentID, CourseNo, Semester}  $\rightarrow$

 $\{StaffName\}, \{ConfirmedBy\_ID\} \rightarrow \{StaffName\} \}$ 



Given the set of FDs  $\Sigma$  Size the set of FDs  $\Sigma$  Size

- we can compute the minimal cover of  $\Sigma$  as follows:
  - IslatingΣ;//DOWCOCET.COM
    check whether all the FDs in Σ have only one attribute on the right hand side;
  - 3 check whether all the FDs in  $\Sigma$  have redundant attribute on the left hand side; Left the fill of t
    - {StudentID, CourseNo, Semester} → {StaffName} is redundant and thus is removed



Given the set of FDs  $\Sigma$ Spening end Sement December With Manne Help (Studentild, CourseNo, Semester) StaffName)  $\{ConfirmedBy\_ID\} \rightarrow \{StaffName\}$ 

- we can compute the minimal cover of  $\Sigma$  as follows:
  - owcoder.cor all the FDs in  $\Sigma$  have only one attribute on the right hand side;
  - check whether all the FDs in  $\Sigma$  have redundant attribute on the left  $\mathbf{Add}$  reduced in  $\mathbf{A}$  attento,  $\mathbf{A}$  over,  $\mathbf{Add}$   $\mathbf{A}$

{ConfirmedBy\_ID}, {StudentID, CourseNo, Semester} →  $\{StaffName\}, \{ConfirmedBy_ID\} \rightarrow \{StaffName\}\}$ 

- {StudentID, CourseNo, Semester} → {StaffName} is redundant and thus is removed
- Therefore, the minial cover of Σ is { StudentID, CourseNo,  $Semester\} \rightarrow \{ConfirmedBy\_ID\}, \{ConfirmedBy\_ID\} \rightarrow \{StaffName\}\}_{38/50}$



## Assignment Project Fixantathelp

 $\bullet \ \{\mathsf{ConfirmedBy\_ID}\} \to \{\mathsf{StaffName}\}$ 

Stud	dentID	CourseNo	<u>Semester</u>	ConfirmedBy <sub>-</sub> ID	StaffName
htt	DS:	://po	WCO	der.co	<u>m</u>

• Can we normalise ENROL into 3NF by a lossless and dependency preserving decomposition?



## Assignments Project Fixed Plants Project Confirmed Plants Project Fixed Plants Project Project Plants Plants Project Plants Plants Plants Project Plants P

- A minimarcover is {{StudentID, CourseNo, Semester} → {ConfirmedBy\_ID}, {ConfirmedBy\_ID} → {StaffName}}.
- \* Henge, we have: We Chat powcoder



## Assignment, course No, semeser C (Confirmed By ID) - {StaffName}

StudentID CourseNo Semester ConfirmedBy\_ID StaffName

11155://DOWCOGER...COM...

- A minimarcover is {{StudentID, CourseNo, Semester} → {ConfirmedBy\_ID}, {ConfirmedBy\_ID} → {StaffName}}.



## Assignment, again: Project Fxam, tafwame} Project Confirmed By LID} -> {StaffName}

StudentID CourseNo Semester ConfirmedBy\_ID StaffName https://powcoder.com...

- A minimarcover is {{StudentID, CourseNo, Semester} → {ConfirmedBy\_ID}, {ConfirmedBy\_ID} → {StaffName}}.
- Hence, we have:

  At Estudent October (Student October) {Confirmed By ID (Vitt 1) {Student ID, Course No, Semester}
  - R<sub>2</sub>={ConfirmedBy\_ID, StaffName} with {ConfirmedBy\_ID} → {StaffName}



## Assignments, again: Project Fxam, tafwame} Project Fxam, tafwame} p {ConfirmedBy.ID} → {StaffName}

- A minimarcover is {{StudentID, CourseNo, Semester} → {ConfirmedBy\_ID}, {ConfirmedBy\_ID} → {StaffName}}.
- Hence, we have:

  At Estudent October (Student October) {Confirmed By ID (Vitt 1) {Student ID, Course No, Semester}
  - $R_2$ ={ConfirmedBy\_ID, StaffName} with {ConfirmedBy\_ID}  $\rightarrow$  {StaffName}
  - Omit  $R_0$  because  $R_1$  is a superkey of ENROL.



## Assignments again: Project Fxam Help (Confirmed By LID) -> {StaffName}

- A minimar cover is {{ studentID, CourseNo, Semester} → {ConfirmedBy\_ID}, {ConfirmedBy\_ID} → {StaffName}}.
- Hence, we have:

  At Estudent D CourseNo, Semester } {ConfirmedBy ID () iff 1 }

  {StudentID, CourseNo, Semester}
  - R<sub>2</sub>={ConfirmedBy<sub>-</sub>ID, StaffName} with {ConfirmedBy<sub>-</sub>ID} → {StaffName}
  - Omit  $R_0$  because  $R_1$  is a superkey of ENROL.
- Is {StudentID, CourseNo, Semester} → {ConfirmedBy\_ID, StaffName} preserved?



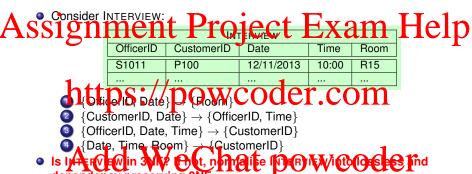
## Assignments again: Project Fxam Help (Confirmed By LID) -> {StaffName}

- A minimar cover is {{ studentID, CourseNo, Semester} → {ConfirmedBy\_ID}, {ConfirmedBy\_ID} → {StaffName}}.
- Hence, we have:

  At Estudent D CourseNo, Semester } {ConfirmedBy ID () iff 1 }

  {StudentID, CourseNo, Semester}
  - R<sub>2</sub>={ConfirmedBy<sub>-</sub>ID, StaffName} with {ConfirmedBy<sub>-</sub>ID} → {StaffName}
  - Omit  $R_0$  because  $R_1$  is a superkey of ENROL.
- Is {StudentID, CourseNo, Semester} → {ConfirmedBy\_ID, StaffName} preserved? Yes.







# Assign Project Exam Help OfficerID CustomerID Date Time Room S1011 P100 12/11/2013 10:00 R15

- ② {CustomerID, Date} → {OfficerID, Time}
- O {Date, Time Room} CustomerID}
- Is ly the role of the light of
  - A relation schema R is in **3NF** if whenever a non-trivial FD  $X \to A$  holds in R, then X is a **superkey** or A is a **prime attribute**.



## Assignment Project Exam Help

12/11/2013

10:00

**R15** 

https://powcoder.com

{CustomerID, Date} → {OfficerID, Time}

P100

S1011

- (CustomerID)

  Is ly Republic to the companies of the comp
  - dependency preserving 3NF.
    A relation schema R is in 3NF if whenever a non-trivial FD X → A holds in R, then X is a superkey or A is a prime attribute.
    - We know that {CustomerID, Date}, {OfficerID, Date, Time}, and {Date, Time, Room} are the keys.



## Assignment Project Exam Help OfficerID | CustomerID | Date | Time | Room

12/11/2013

10:00

**R15** 

https://powcoder.com

{CustomerID, Date} → {OfficerID, Time}

P100

S1011

- Is ly Fred in 3/1/2 that, in finalite in the little in the
  - A relation schema R is in **3NF** if whenever a non-trivial FD  $X \to A$  holds in R, then X is a **superkey** or A is a **prime attribute**.
  - We know that {CustomerID, Date}, {OfficerID, Date, Time}, and {Date, Time, Room} are the keys.

INTERVIEW is in 3NF because all the attributes are prime attributes.



Assignment Project Fxam, Help the following FDS:

FD1: PropertyID → Lot, County, Area

FD2: Lot, County → Area PropertyID

FD3: Lot, County → Area Prop



Assignment Project Exam, Help the following FDS:

- FD1: PropertyID → Lot, County, Area

  FD2: Lot County → Area PropertyID

  HD8: Area Only OWCOGER.COM
- Let us abbriviate attributes of LOTS with first letter of each attribute and represent burset widepen enclar at f: { possible for the first letter of each attribute and representation attribute and representation attributes of LOTS with first letter of each attribute and representation attributes of LOTS with first letter of each attribute and representation attributes of LOTS with first letter of each attribute and representation attribute and representation attributes of LOTS with first letter of each attribute and representation attributes of LOTS with first letter of each attribute and representation attributes at the second attribute and representation attributes at the second attribute attribute and representation attributes at the second attribute attributes at the second attr
- The minimal cover of a set of functional dependencies always exists but is not necessarily unique.



## Assignment Project Exam Help

https://powcoder.com



## Assignment Project Exam Help Initialise: {P - LCA, LC - AP, A - C}

https://powcoder.com



## Assignment Project Exam Help

- **1** Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$

https://powcoder.com



## Assignment Project Exam Help

- **1** Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **Dependent:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .
- https://powcoder.com



## Assignment Project Exam Help

- **1** Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **Dependent:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .



### Assignment Project Exam Help

- **Initialise:**  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **Dependent:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}.$

- Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .



## Assignment Project Exam Help

- Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **2** Dependent:  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .

- **5** Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .
- (Case Y) Find a minimal cover of F = {P  $\rightarrow$  LCA, LC  $\rightarrow$  AP, A  $\rightarrow$  C}



### Assignment Project Exam Help

- Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **Dependent:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .

- **5** Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .
- (Case Y) Find a minimal cover of  $F = \{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$



- Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **Dependent:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}.$
- Peterminant:/{P \rightarrow LP \rightarrow CP \rightarrow ALC \rightarrow P \rightarrow C}.
- **5** Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .
- (Case Y) Find a minimal cover of  $F = \{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$ 
  - Anitidist: (W.E.C.) at apoweoder.



- **Initialise:**  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **Dependent:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}.$
- Peterminant:/{P \rightarrow L P \rightarrow C P \rightarrow A L C \rightarrow P \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow C \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow C \rightarrow A L C \rightarrow P \rightarrow C \rightarrow C \rightarrow C \rightarrow A \rightarrow A \rightarrow C \rightarrow A \right
- **5** Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .
- (Case Y) Find a minimal cover of  $F = \{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$ 
  - Anitidia: WEChat poweoder.
  - **Determinant:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .



- 1 Initialise:  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **2** Dependent:  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .
- **Determinant:**  $/\{P \rightarrow L P \rightarrow C P \rightarrow A L C \rightarrow P A \rightarrow C\}$ .
- Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .
- (Case Y) Find a minimal cover of  $F = \{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$ 
  - Anitidist: Weschät powcoder.
  - **3** Determinant:  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .
  - **Remove redundant FD:**  $\{LC \rightarrow P, P \rightarrow A\} \models LC \rightarrow A$ .  $\{P \rightarrow A, A \rightarrow C\} \models P \rightarrow C$ .



- **Initialise:**  $\{P \rightarrow LCA, LC \rightarrow AP, A \rightarrow C\}$
- **2** Dependent:  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .
- **Determinant:**/ $\{P \rightarrow L, P \rightarrow C, P \rightarrow A\} LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}.$ Heb DeSedura DES WCO GER LOOM
- **5** Thus a minimal cover is  $\{P \rightarrow LC, LC \rightarrow AP, A \rightarrow C\}$ .
- (Case Y) Find a minimal cover of F = {P  $\rightarrow$  LCA, LC  $\rightarrow$  AP, A  $\rightarrow$  C}
  - Anitidia: WEChat poweoder.
  - **Determinant:**  $\{P \rightarrow L, P \rightarrow C, P \rightarrow A, LC \rightarrow A, LC \rightarrow P, A \rightarrow C\}$ .
  - **Remove redundant FD:**  $\{LC \rightarrow P, P \rightarrow A\} \models LC \rightarrow A$ .  $\{P \rightarrow A, A \rightarrow A\} \models LC \rightarrow A$ . C}  $\models P \rightarrow C$ .
  - **5** Thus a minimal cover is  $\{P \rightarrow LA, LC \rightarrow P, A \rightarrow C\}$ .



# Assignment Project Exam Help \*\*BONF: Whenever a non-trivial FD \*\* A holds in R, then X is a superkey.\*\*

https://powcoder.com



# Assignment Project Exam Help \*\*BONF: Whenever a non-trivial FD \*\*> A holds in R, then X is a superkey.

Ponet represent the same fact more han ence within a relation, seven is some VIS have to be abandoned.



# Assignment Project Exam Help

**BCNF**: Whenever a non-trivial FD  $\mathcal{N} \rightarrow A$  holds in R, then X is a **superkey**.

Ponet represent the same fact more han ence within a relation, Seven is some FDS have to be abandoned.



# Assignment Project Exam Help BONF: Whenever a non-trivial FD X A holds in R, then

**BONF**: Whenever a non-trivial FD  $\mathcal{P} \rightarrow A$  holds in R, then X is a **superkey**.

Ponet represent the same fact more han ence within a relation, Seven is some FDS have to be abandoned.

• 3NF: Whenever a non-trivial ED  $X \to A$  holds in R, then X is a superkey or A Curre at those  $X \to A$  holds in R, then X is a superkey or X is a superkey or X is a superkey or X in X in X is a superkey or X in X in X in X in X is a superkey or X in X in

Do not abandon any FDs, even if some facts have to be represented more than once within a relation!



# Assignment Project Exam Help

- Repeat until no changes
  - Find a problematic FD
  - Spit Hing to smale owcoder.com



# Fanment Projecto Fram Help

- Repeat until no changes
  - Find a problematic FD

- Find a minimal cover
- Group FDs in the minimal cover
- Add a key (if necessary)
- Project FDs



### Assignment Project-Exam Help

- Repeat until no changes
  - Find a problematic FD
  - Spit Firito No smaller in swind and project FDs

- Find a minimal cover
- Group FDs in the minimal cover
- Oder educations
  - Add a key (if necessary)
  - Project FDs

### Add product aport aport against aport apor



# gament Projecto Exam Help

- Repeat until no changes
  - Find a problematic FD

- Find a minimal cover
- Group FDs in the minimal cover
- - Add a key (if necessary)
  - Project FDs

### A det professionest apont age der



Lossless join



Lossless join + dependency preservation



### ECVIPORMENT Propression Help

- Repeat until no changes
  - Find a problematic FD
- Group FDs in the minimal cover
- Selit Printe two smaller one WCO GET COM ...
  - Project FDs

### Add Weehatproweder



### scription Properties Help

- Repeat until no changes
  - Find a problematic FD
  - Selit Printe two smaller one WCOGEL COM
- - Group FDs in the minimal cover
    - - Project FDs

### Add Weehatproweder

SOME superkeys (check)

SOME superkeys (check) ALL candidate keys ONE minimal cover



#### **Denormalisation**

# complize Pation scheme in Examination of Silving p

- Denormalisation is a design process that
  - happens after the normalisation process,

#### is of the parto/m/e of the object of spall besides sage, and

- reduces the number of relations that need to be joined for certain queries.
- The string of th

  - Normalised redundancy is reduced after a systematic design (to minimise data inconsistencies).
  - Denormalised redundancy is introduced after analysing the normalised design (to improve efficiency of queries)



# A SS No maisation to prite Recurring to the following relations.





# A SSN por a realing to prite Redundant by the following relations.



However, the query for "list the names of students who enrolled in a course with a utils (requires 2) on operations.

```
SELECT Name, CourseNo

FROM ENROL e, COURSE c, STUDENT s

WHERE e.StudentID=s.StudentID AND e.CourseNo=c.CourseNo
AND c.Unit=6;
```



# Assignment Project Exam Help

 If a student enrolled 15 courses, then the name and DoB of this student need to be stored repeatedly 15 times in ENROLMENT.

https://powcoder.com													
	Name	StudentiD	DoB	<u>CourseNo</u>	Semester	Unit							
	Tom	123456	25/01/1988	COMP2400	2010 S2	6							
	Tom	123456	25/01/1988	COMP8740	2011 S2	12							
$\triangle$	Mich ach	2468	21/(4/1005-	GOVPR4007	C2003 82 C	210							
	MU	• • • • •	Cilut	POW	Cour								



# Assignment Project Exam Help

 If a student enrolled 15 courses, then the name and DoB of this student need to be stored repeatedly 15 times in ENROLMENT.

ŀ	144	n	a • /	//1		71.	<b>T</b> 7	0		A	Δ1	r	~	1	1			
L	Itt	ttps://powcoder.com																
	Nan	ie	StudentiD			DoB			<u>Co</u>	<u>Semester</u>				Unit				
	Tom		123456			25/01/1988			CO	2010 S2				6				
	Ton	Tom		123456			25/01/1988			CO	20	2011 S2			12			
Z	Mich	act	2	46	2	21/0	A	199	<b>1</b>	60	VP?	400		703	82	4	<u> 1</u>	<b>?</b>
•				_								VV		lacksquare			7	

• The query for "list the names of students who enrolled a course with 6 units" can be processed efficiently (no join needed).

SELECT Name, CourseNo FROM ENROLMENT WHERE Unit=6;



#### (credit cookie) Raymond F. Boyce (1947-1974)

# Assignment Project Exam Help

Donald D. Chamberlin Raymond F. Boyce

### https://poper.com

tructured English query Language (SEQUEL) which can be used for accessing data in an integrated relational data base. Without resorting to the concepts of bound variables and quantifiers SEQUEL identifies a set of simple operations on tabular structures, which can be shown to be of equivalent power to the first order predicate calculus. A SEQUEL user is presented with a comsis-

A distributed for the production of the producti

"SEQUEL: A Structured English Query Language", D.D. Chamberlin and R.F. Boyce,

Proc. ACM SIGMOD Workshop on Data Description, Access and Control,

Ann Arbor, Michigan (May 1974)