

Normalisation

FIT2094

MONASH
INFORMATION
TECHNOLOGY
程序代写代做CS编程辅导



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Data Normalisation

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- Relations should be normalised in order to avoid anomalies which may occur when inserting, updating and deleting data
 - operates at the $Level$ level.
- Normalisation is a systematic series of steps for progressively refining the data model.
- A formal approach to analysing relations based on their primary key (or candidate keys) and functional dependencies.
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 - Email: tutorcs@163.com
- Used:
 - as a design technique "bottom up design", and
 - as a way of validating table structures produced via "top down design" (ER modelling)



Sample Data



FIGURE
6.1

Tabular representation of report format

PROJ_NUM	PROJ_NAME	EMP_ID	EMP_NAME	JOB_CLASS	CHG_HOUR	HOURS
15	Project Alpha	100	Jane E. Abough	Block Designer	84.50	23.8
		101	John G. News	Database Designer	105.00	19.4
		105	Alice K. Johnson	Database Designer	105.00	35.7
		106	William Smithfield	Programmer	35.75	12.6
		109	David W. Sneed	Systems Analyst	96.75	23.8
		114	Annelise Jones	Applications Designer	48.10	24.6
18	Amber Wave	108	James J. Frommer	General Support	18.36	45.3
		104	Anne K. Ramoras *	Systems Analyst	96.75	32.4
		112	Darlene M. Smithson	DSS Analyst	45.95	44.0
		105	Alice K. Johnson	Database Designer	105.00	64.7
		104	Aurelie K. Ramoras	Systems Analyst	96.75	48.4
22	Rolling Tide	113	Delbert K. Joenbrood *	Applications Designer	48.10	23.6
		111	Geoff B. Wabash	Clerical Support	26.87	22.0
		106	William Smithfield	Programmer	35.75	12.8
		107	Maria D. Alonso	Programmer	35.75	24.6
		115	Travis B. Bawangi	Systems Analyst	96.75	45.8
		101	John G. News *	Database Designer	105.00	56.3
25	Starflight	114	Amelia K. Jones	Applications Designer	48.10	33.1
		108	Ralph B. Washington	Systems Analyst	96.75	23.6
		118	James J. Frommer	General Support	18.36	30.5
		112	Darlene M. Smithson	DSS Analyst	45.95	41.4

Programs with data in Figure 6.1

- PROJ_NUM intended to be a **primary key**, but it contains nulls
- JOB_CLASS invites **en**gineer vs eng. Elec. Eng. vs Elect. Engineer vs E.E.
- Table has **redundant data**
 - Details of a character are repeated for every occurrence of job class
 - Every time an employee is assigned to a project emp name repeated
- Relations that contain redundant information may potentially suffer from several update anomalies
 - Types of update anomalies include:
 - **Insert Anomaly**
– Insert a new employee only if they are assigned to a project
 - **Delete Anomaly**
– Delete the last employee assigned to a project?
– Delete the last employee of a particular job class?
 - **Modification (or update) Anomaly**
– Update a job class hourly rate - need to update multiple rows



The Normalisation Process



- Creating valid relations. each relation meets the properties of the relational model. In particular:
 - Entity integrity
 - Referential integrity
 - No many-to-many relationship
 - Each cell contains a single value (is atomic).
- In practical terms.
 - Each table represents a single subject
 - No data item will be unnecessarily stored in more than one table.
 - The relationship between tables can be established (pair of PK and FK is identified).
 - Each table is void of insert, update and delete anomalies.

Representing a form as a relation

CUSTOMER ORDER			
Order Number:	613	Order Date:	12/3/2018
Customer Number:	127		
Customer Name:	Col		Centre
Customer Address:	123		Mol
			
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PART NUMBER	DESCRIPTION	QTY ORDERED	LINE PRICE
M128	Bookcase	1	800
B381	TV Cabinet	2	600
R210	Round Table	3	1500

ORDER (*orderno, orderdate, custnumb, custname, custaddress*
(*partno, partdesc, qtyordered, lineprice*))

- Note this is *not* a relation
- (*partno, partdesc, qtyordered, lineprice*) - is a multivalued set of attributes – called a repeating group in normalisation terminology

Functional Dependency Revisited



- An attribute B is FUNCTIONALLY DEPENDENT on another attribute A, if a value of A determines a single value of B at any one time.
 - $A \rightarrow B$
 - $EMP\# \rightarrow EMP_NAME$
 - $CUSTNUMB \rightarrow CUSTNAME$
 - $ORDER-NUMBER \rightarrow ORDER-DATE$
 - ORDER-NUMBER: independent variable, also known as the DETERMINANT
 - ORDER-DATE: dependent variable
- TOTAL DEPENDENCY
 - attribute A determines B AND attribute B determines A
 - $EMPLOYEE-NUMBER \rightarrow TAX-FILE-NUMBER$
 - $TAX-FILE-NUMBER \rightarrow EMPLOYEE-NUMBER$

Functional Dependency

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- For a **composite** PRIMARY KEY it is possible to have FULL or PARTIAL dependency.
- FULL DEPENDENCY
 - occurs when an attribute is always dependent on all attributes in the composite PK
 - ORDER-NUMBER, PART-NUMBER \rightarrow QTY-ORDERED
- Lack of full dependency for multiple attribute KEY = PARTIAL DEPENDENCY
 - ORDER-NUMBER, PART-NUMBER
 \rightarrow QTY-ORDERED, PART-DESCRIPTION
 - here although qty-ordered is **fully dependent** on order-number and part-number, *only* part-number is required to determine part-description
 - part-description is **said to be partially dependent** on order-number and part-number



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Functional Dependency

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- TRANSITIVE DEPENDENCY

- occurs when Y depends on X, and Z depends on Y - thus Z also depends on X i.e. $X \rightarrow Y \rightarrow Z$



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- Dependencies are depicted with the help of a Dependency Diagram.

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- Normalisation converts a relation into relations of progressively smaller number of attributes and tuples until an optimum level of decomposition is reached - little or no data redundancy exists.

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- The output from normalisation is a set of relations that meet all conditions set in the relational model principles.

PROJECT - REPRESENTATION 1

PROJ_NUM	PROJ_NAME	EMP_NUM	EMP_NAME	JOB_CLASS	CHG_HOUR	HOURS
15	Evergreen	103	June E. Arbough	Elect. Engineer	84.50	23.80
		101	John G. News	Database Designer	105.00	19.40
		105	Alice K. Johnson *	Database Designer	105.00	35.70
		106	William Smithfield	Programmer	35.75	12.60
		102	David H. Senior	Systems Analyst	96.75	24.60
18	Amber Wave	114	Annelise Jones	Applications Designer	48.10	24.60
		118	James J. Frommer	General Support	18.36	45.30
		104	Anne K. Ramoras *	Systems Analyst	96.75	32.40
		112	Darlene M. Smithson	DSS Analyst	45.95	44.00
22	Rolling Tide	105	Alice K. Johnson	Database Designer	105.00	64.70
		104	Anne K. Ramoras *	Systems Analyst	96.75	48.40
		113	Delbert K. Joe	Programmer	48.10	23.60
		111	Geoff B. Wabash	Clerical Support	26.87	22.00
		106	William Smithfield	Systems Analyst	35.75	12.80
25	Starflight	107	Maria D. Alonzo	Programmer	35.75	24.60
		115	Travis B. Bawangi	Systems Analyst	96.75	45.80
		101	John G. News	Applications Designer	105.00	56.30
		114	Annelise Jones	General Support	48.10	33.10
		108	Ralph B. Washington	Systems Analyst	96.75	23.80
		118	James J. Frommer	General Support	18.36	30.50
		112	Darlene M. Smithson	DSS Analyst	45.95	41.40

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EMPLOYEE PROJECT ASSIGNMENT - REPRESENTATION 2

PROJ_NUM	PROJ_NAME	EMP_NUM	EMP_NAME	JOB_CLASS	CHG_HOUR	HOURS
15	Evergreen	103	June E. Arbough	Elect. Engineer	84.50	23.80
15	Evergreen	101	John G. News	Database Designer	105.00	19.40
15	Evergreen	105	Alice K. Johnson	Database Designer	105.00	35.70
15	Evergreen	106	William Smithfield	Programmer	35.75	12.60
15	Evergreen	102	David H. Senior	Systems Analyst	96.75	23.80
18	Amber Wave	114	Annelise Jones	Applications Designer	48.10	24.60
18	Amber Wave	108	James J. Frommer	General Support	18.36	45.30
18	Amber Wave	104	Anne K. Ramoras *	Systems Analyst	96.75	32.40
18	Amber Wave	112	Darlene M. Smithson	DSS Analyst	45.95	44.00
22	Rolling Tide	105	Alice K. Johnson	Database Designer	105.00	64.70
22	Rolling Tide	104	Anne K. Ramoras *	Systems Analyst	96.75	48.40
22	Rolling Tide	113	Delbert K. Joenbrood *	Applications Designer	48.10	23.60
22	Rolling Tide	111	Geoff B. Wabash	Clerical Support	26.87	22.00
22	Rolling Tide	106	William Smithfield	Programmer	35.75	12.80
25	Starflight	115	Maria D. Alonzo	Programmer	35.75	24.60
25	Starflight	101	John G. News *	Database Designer	105.00	56.30
25	Starflight	114	Annelise Jones	Applications Designer	48.10	33.10
25	Starflight	108	Ralph B. Washington	Systems Analyst	96.75	23.60
25	Starflight	118	James J. Frommer	General Support	18.36	30.50
25	Starflight	112	Darlene M. Smithson	DSS Analyst	45.95	41.40

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Unnormalised Form (UNE) 编程辅导

- Identify a “subject” needs to be modelled
 - For example there are 6.1 possible “subjects” of interest:
 - PROJECT (we will call this representation 1)
 - EMPLOYEE (we will call this representation 2)
- Choose one subject of interest as a starting point and identify a primary key for this subject of interest.
 - For example for PROJECT, primary key would be project_number (or we will abbreviate it as proj_num).



First Normal Form

- FIRST NORMAL FORM (part of formal definition of a relation)



– A RELATION IS IN FIRST NORMAL FORM (1NF) IF:

- a unique primary key has been identified for each tuple/row.
- it is a valid relation
 - Entity integrity ($\text{Email: tutorcs@163.com}$ of PK is null)
 - Single value for each cell.
 - No repeating group.
- all attributes are functionally dependent on all or part of the primary key

UNF to 1NF transformation



- Identify the repeating group(s), if any, in the unnormalised relation.
 - For repeating group(s), a project will have more than one employee assigned to it, hence there is a repeating group.
 - We have one-to-many relationship from PROJECT to EMPLOYEE.

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Q1. Is there any repeating group for the ASSIGNMENT?



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- A. Yes (what is it)?
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- B. No

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UNF Representations



- Representation 1:

- PROJECT (proj_name, emp_num, emp_name,))

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- Representation 2:

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- ASSIGNMENT(proj_name, emp_num, emp_name,))

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UNF to 1NF 程序代写代做 CS编程辅导

- Move from UNF by:
 1. identify a unique identifier for the repeating group
 2. remove the repeating group along with the PK of the main relation.
 3. The PK of the new relation resulting from the removal of repeating group will *normally* have a composite PK made up of the PK of the main relation and the unique identifier chosen in 1. above, but this **must be checked**.



UNF to 1NF (representation 1)



PROJECT (proj_name, pj_name)

ASSIGNMENT (assignment_name, project_name, exam_name,
job_class, chg_hour, assign_hours)
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Q2. Assume that we have started with **ASSIGNMENT** as the chosen “subject” (relation 2) in UNF and its UNF is in the form of:

ASSIGNMENT(proj_num, emp_num, proj_name, emp_name, job_class, chg_hrs, assign_hours)



What would be the 1NF of this UNF relation?

- A. Two relations
 - PROJECT (proj_num, proj_name)
 - ASSIGNMENT (proj_num, emp_num, emp_name,
job_class, chg_hour, assign_hours)
- B. ASSIGNMENT (proj_num, emp_num, proj_name, emp_name,
job_class, chg_hour, assign_hours)
- C. PROJECT (proj_num, proj_name)
- D. ASSIGNMENT (proj_num, emp_num, job_class, proj_name,
emp_name, chg_hour, assign_hours)

1NF to 2NF

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- A RELATION IS IN 1NF IF -
 - all non key attributes are functionally dependent on the **entire primary key** (simplified definition)
 - i.e. no partial dependencies exist
 - all non key attributes are functionally dependent on **any candidate key** (general definition)
 - for this unit we will only use the simplified definition ie. look for [partial dependencies based on the primary key](https://tutors.cs)

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Q3. Which of the following attributes has a partial dependency in the relation ASSIGNMENT?:

ASSIGNMENT(proj_nur, emp_name, proj_name, emp_name, job_class,

chg_hrs, assign_hours)



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- A. proj_name
- B. emp_name
- C. job_class
- D. chg_hrs
- E. assign_hours
- F. More than one option is correct.

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Q4. Which of the following attributes has a transitive dependency in the relation ASSIGNMENT?:

ASSIGNMENT(proj_nur, proj_name, emp_name, job_class,

chg_hrs, assign_hours)



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- A. proj_name
- B. emp_name
- C. job_class
- D. chg_hrs
- E. assign_hours
- F. More than one option is correct.

Representation 2: Dependency Diagram (1NF)

FIGURE
6.3

First normal

Dependency diagram



PARTIAL DEPENDENCIES:

(PROJ_NUM → PROJ_NAME)

(EMP_NUM → EMP_NAME, JOB_CLASS, CHG_HOUR)

TRANSITIVE DEPENDENCY:

(JOB CLASS → CHG_HOUR)

FULL

proj_no, emp_no → hours

1NF to 2NF Representation

程序代写代做CS编程1辅导

- Move from 1NF to 2NF by removing partial dependencies
 - 1NF: PROJECT (proj_num, proj_name)
 - 1NF: ASSIGNMENT (proj_num, emp_num,
emp_name, job_class, chg_hour, assign_hours)
- 1NF: PROJECT (proj_num, proj_name)
 - already in 2NF only one attribute in PK thus CANNOT
be any partial dependencies
 - 2NF: PROJECT (proj_num, proj_name)



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1NF to 2NF (Representation I)



- 1NF: ASSIGNMENT (emp_num, emp_name, job_class, chg_hour, assign_hour)
 - emp_name, job_class, assign_hour depend on emp_num (partial dependency), chg_hour depends on job_class (transitive).
 - These attributes need to be removed into a new relation.
 - Also include the part of PK that causes the partial dependency to be the PK of the new relation.
 - 2NF EMPLOYEE(emp_num, emp_name, job_class, chg_hour)
 - It leaves ASSIGN relation with the remaining attributes.
 - 2NF ASSIGNMENT(proj_num, emp_num, assign_hours)

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2NF Representation 1

PROJECT (proj_num, proj_name)



EMPLOYEE (emp_num, emp_name, job_class,

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ASSIGNMENT (proj_num, emp_num,

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Q5. Where is the location of the FK for the relations below?



EMPLOYEE (emp_n, emp_name, job_class, chg_hour)

ASSIGNMENT(proj_n, proj_num, assign_hours)

PROJECT (proj_num, proj_name)

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A. EMPLOYEE Add WeChat powcoder

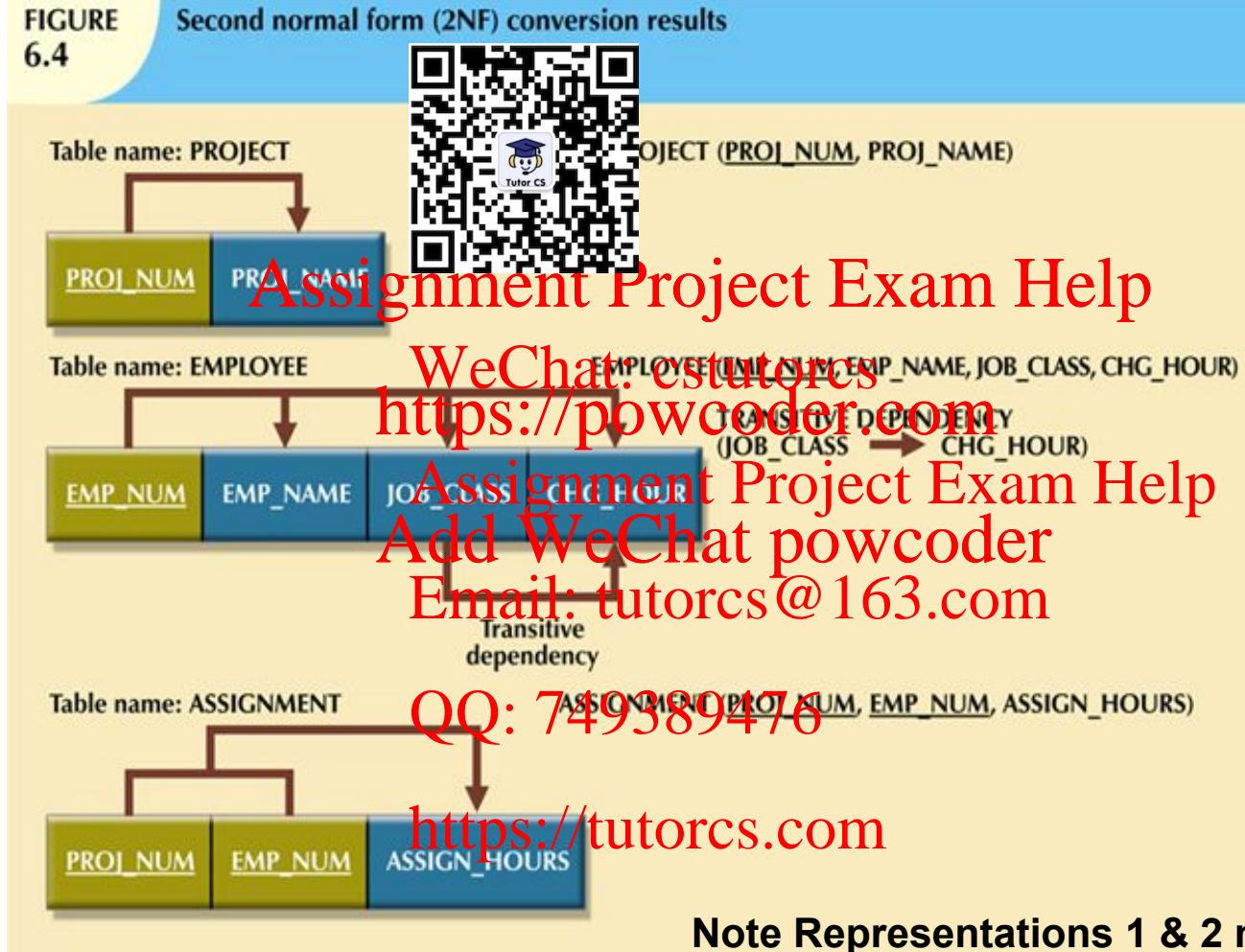
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B. ASSIGNMENT

C. PROJECT QQ: 749389476

D. More than one answer is correct
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2NF Conversion Results (程序代写代做CS编程辅导 1 & 2)



Q6. What type of relationship is the relationship between:

ASSIGNMENT and EMPLOYEE

and

ASSIGNMENT and PROJECT



EMPLOYEE (emp_num, emp_name, job_class, chg_hour)
ASSIGNMENT (proj_num, emp_num, assign_hours)
PROJECT (proj_num, proj_name)

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A. non-identifying, non-identifying

B. identifying, identifying

C. identifying, non-identifying

D. non-identifying, identifying

2NF to 3NF 程序代写代做 CS编程辅导

- A RELATION IS 2NF IF -
 - all transitive dependencies have been removed
 - check for **Assignment Project Exam Help** dependent on **another non key attribute**
- Move from 2NF to 3NF by removing transitive dependencies

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2NF to 3NF 程序代写代做 CS编程辅导

- PROJECT and ASSIGNMENT ready in 3NF
 - 3NF PROJECT (proj_num, proj_name)
 - 3NF ASSIGNMENT (proj_num, emp_num, assign_hours)
- 2NF EMPLOYEE (emp_num, emp_name, job_class, chg_hour)
 - It has transitive dependency job_class-> chg_hour.
 - Remove the attributes with transitive dependency into a new relation.
 - The determinant will be an attribute in both the original and new relations (it will become the PK and FK relationship)
 - Assign the determinant to be the PK of the new relation.

2NF to 3NF



- After the removal of transitive dependency in EMPLOYEE, we have:

- 3NF EMPLOYEE (emp_num, emp_name, job_class)

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- 3NF JOB (job_class, chg_hour)

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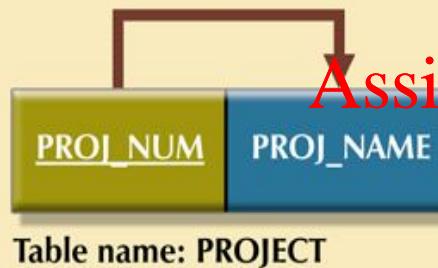
Relations in 3NF



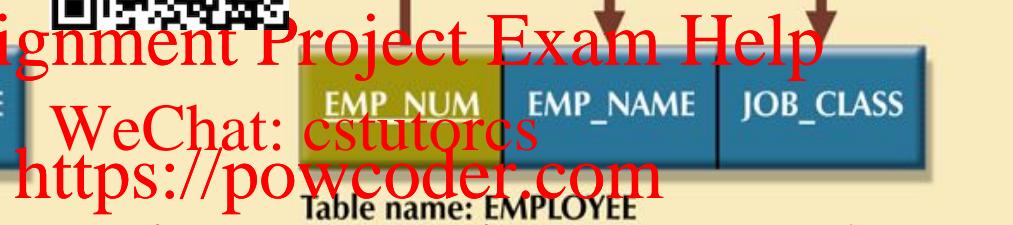
FIGURE
6.5

Third normal form

tion results



PROJECT (PROJ_NUM, PROJ_NAME)

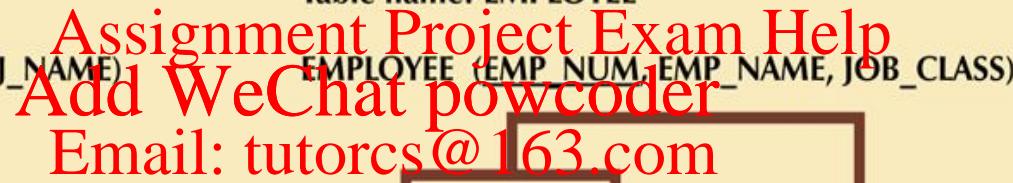


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Table name: JOB

JOB (JOB_CLASS, CHG_HOUR)



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ASSIGNMENT (PROJ_NUM, EMP_NUM, ASSIGN_HOURS)

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Q7. Where is the location of the FK for the relations below?



EMPLOYEE (emp_id, temp_name, job_class)
JOB (job_class, Assignment, hour, Project, Exam, Help)

- A. EMPLOYEE Assignment Project Exam Help
- B. JOB Add WeChat powcoder
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- C. Both EMPLOYEE and JOB

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Q8. What type of relationship is the relationship between the JOB and EMPLOYEE?



EMPLOYEE (emp_id, temp_name, job_class)
JOB (job_class, Assignment, Project, Exam, Help)

- A. non-identifying
- B. identifying
- C. Cannot be determined

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Entire Process (程序代写与做CS编程辅导) (Presentation 1)

- UNF

- PROJECT (proj_num, proj_name)
EMPLOYEE (emp_num, emp_name, job_class,
chg_hour, assign_hours)



- 1NF – remove repeating groups

- PROJECT (proj_num, proj_name)
 - ASSIGNMENT (proj_num, emp_num, emp_name, job_class, chg_hour,
assign_hours)

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- 2NF – remove partial dependencies

- PROJECT (proj_num, proj_name)
 - EMPLOYEE (emp_num, emp_name, job_class, chg_hour)
 - ASSIGNMENT (proj_num, emp_num, assign_hours)

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- 3NF – remove transitive dependencies

- PROJECT (proj_num, proj_name)
 - EMPLOYEE (emp_num, emp_name, job_class)
 - ASSIGNMENT (proj_num, emp_num, assign_hours)
 - JOB (job_class, chg_hour)

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Entire Process (程序代写与做CS编程辅导) (Presentation 2)

- UNF
 - ASSIGNMENT (proj_num, emp_num, proj_name, emp_name, job_class, chg_hour, assign_hours)
- 1NF – remove repeating group
 - ASSIGNMENT (proj_num, emp_num, proj_name, emp_name, job_class, chg_hour, assign_hours) => 1NF is only identify PK, no repeating group.
- 2NF – remove partial dependencies
 - ASSIGNMENT (proj_num, emp_num, assign_hours)
 - PROJECT (proj_num, proj_name)
 - EMPLOYEE (emp_num, emp_name, job_class, chg_hour)
- 3NF – remove transitive dependencies
 - ASSIGNMENT (proj_num, emp_num, assign_hours)
 - PROJECT (proj_num, proj_name)
 - EMPLOYEE (emp_num, emp_name, job_class)
 - JOB (job_class, chg_hour)



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Monash Software 程序代写代做 CS 编程辅导 EMPLOYEE form

- List all attributes in the form, maintain consistency with previously used attribute names if exist:
 - emp_no, emp_lname, emp_fname, emp_dob, emp_street_no, emp_street, emp_town, emp_pcode, phone_type, phone_no, degree_name, degree_institution, degree_year, fmemb_no, fmemb_name, fmemb_dob, skill_name
- Determine if any attribute is multivalued for a given entity instance
 - phone_type, phone_no, degree_name, degree_institution, fmemb_no, fmemb_name, fmemb_dob, skill_name



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Monash Software EMPLOYEE form continued

- Group multivalued attributes that are related and place in brackets



EMPLOYEE (emp_no, emp_fname, emp_lname, emp_dob,
emp_street_no, emp_street, emp_town, emp_pcode, (phone_type,
phone_no), (degree_name, degree_institution, degree_year),
(fmemb_no, fmemb_name, fmemb_dob), (skill_name))

- This is our beginning 3NF
 - PK of main relation EMPLOYEE is emp_no
 - Four repeating groups to remove

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Monash Software 程序代写代做 CS 编程辅导 EMPLOYEE form continued

EMPLOYEE (emp_no, emp_fname, emp_lname, emp_dob,
emp_street_no, emp_street, emp_town, emp_pcode, (phone_type,
phone_no), (degree_name, degree_institution, degree_year),
(fmemb_no, fmemb_name, fmemb_dob), (skill_name))



1NF

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EMPLOYEE (emp_no, emp_fname, emp_lname, emp_dob,
emp_street_no, emp_street, emp_town, emp_pcode)

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EMP_PHONE (emp_no, phone_no, phone_type)

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EMP_QUALIFICATION (emp_no, degree_name, degree_institution,
degree_year)

Email: tutorcs@163.com

FAMILY_MEMBER (emp_no, fmemb_no, fmemb_name, fmemb_dob)

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Monash Software 程序代写代做 CS 编程辅导 EMPLOYEE form continued

2NF



There are no partial dependencies, relations are in 2NF

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EMPLOYEE (emp_no, emp_name, emp_lname, emp_dob,
emp_street_no, emp_street, emp_town, emp_pcde)

EMP_PHONE (emp_no, phone_no, phone_type)

EMP_QUALIFICATION (emp_no, degree_name, degree_institution,
degree_year)

FAMILY_MEMBER (emp_no, fmemb_no, fmemb_name, fmemb_dob)

EMPLOYEE_SKILL (emp_no, skill_name)

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Monash Software ~~EMPLOYEE~~ form continued

3NF



There are no transitive dependencies, relations are in 3NF

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EMPLOYEE (emp_no, emp_name, emp_lname, emp_dob,
emp_street_no, emp_street, emp_town, emp_pcde)

EMP_PHONE (emp_no, phone_no, phone_type)

EMP_QUALIFICATION (emp_no, degree_name, degree_institution,
degree_year)

FAMILY_MEMBER (emp_no, fmemb_no, fmemb_name, fmemb_dob)

EMPLOYEE_SKILL (emp_no, skill_name)

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Consolidate 3NF 程序代写代做CS编程辅导 relations and Logical Model

- Check to see whether relation has been discovered from the normalisation
- Check to see whether attribute has been discovered from the normalisation
- Check whether FKs are correctly identified
- Update Logical Model
 - Reflect changes back to Conceptual Model



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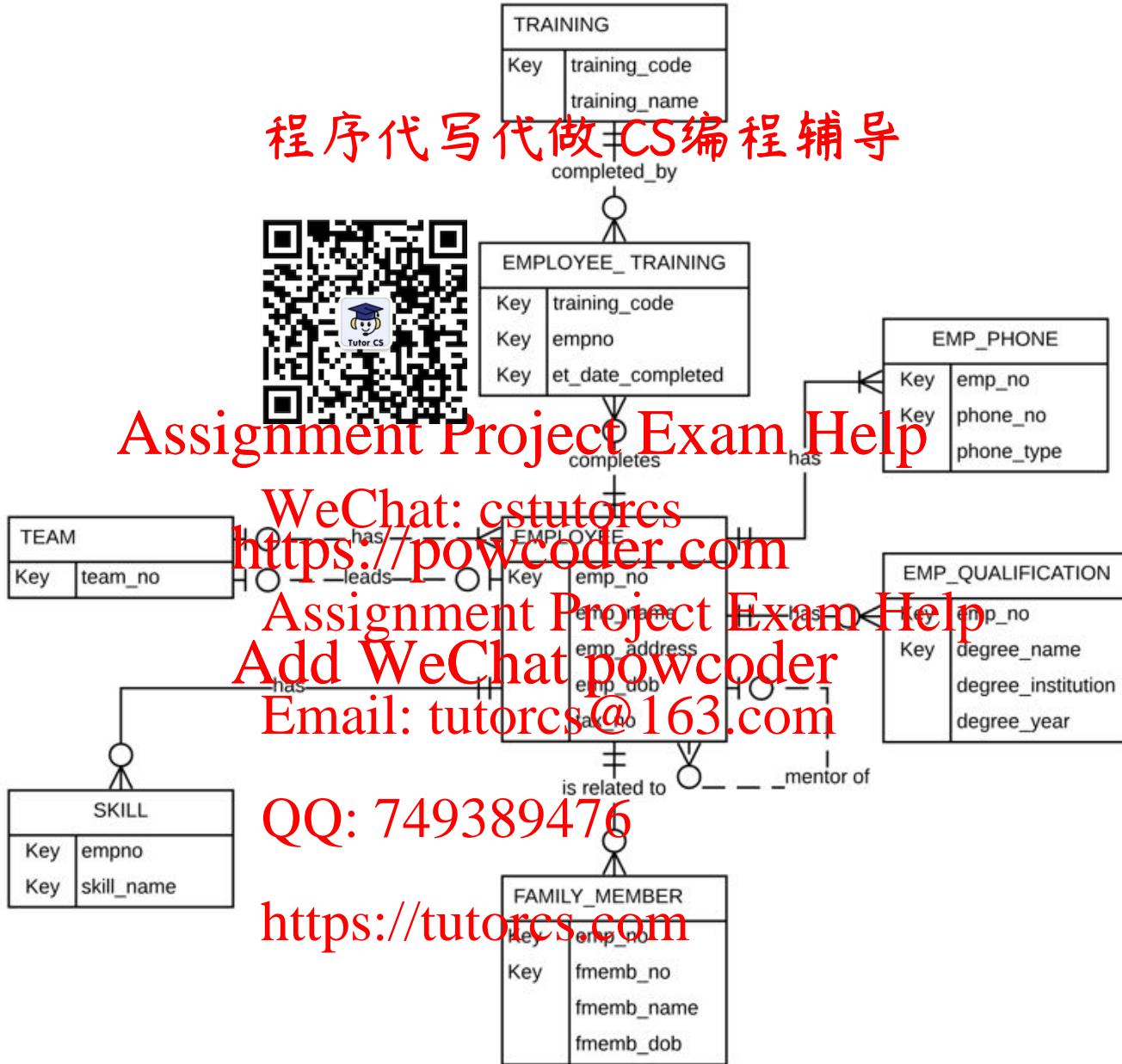
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程序代写代做 CS 编程辅导



Monash Software 程序代写代做 CS 编程辅导 EMPLOYEE form continued

As we are operating at the **EMPLOYEE** level, surrogate keys may be added **AFTER** normalisation has been completed to improve design:



EMPLOYEE (emp_no, emp_name, emp_lname, emp_dob, emp_street_no, emp_street, emp_town, emp_pcde)

EMP_PHONE (emp_no, phone_no, phone_type)

EMP_DEGREE (emp_no, degree_code, degree_year)

DEGREE (degree_code, degree_name, institution_code)

INSTITUTION (institution_code, institution_name)

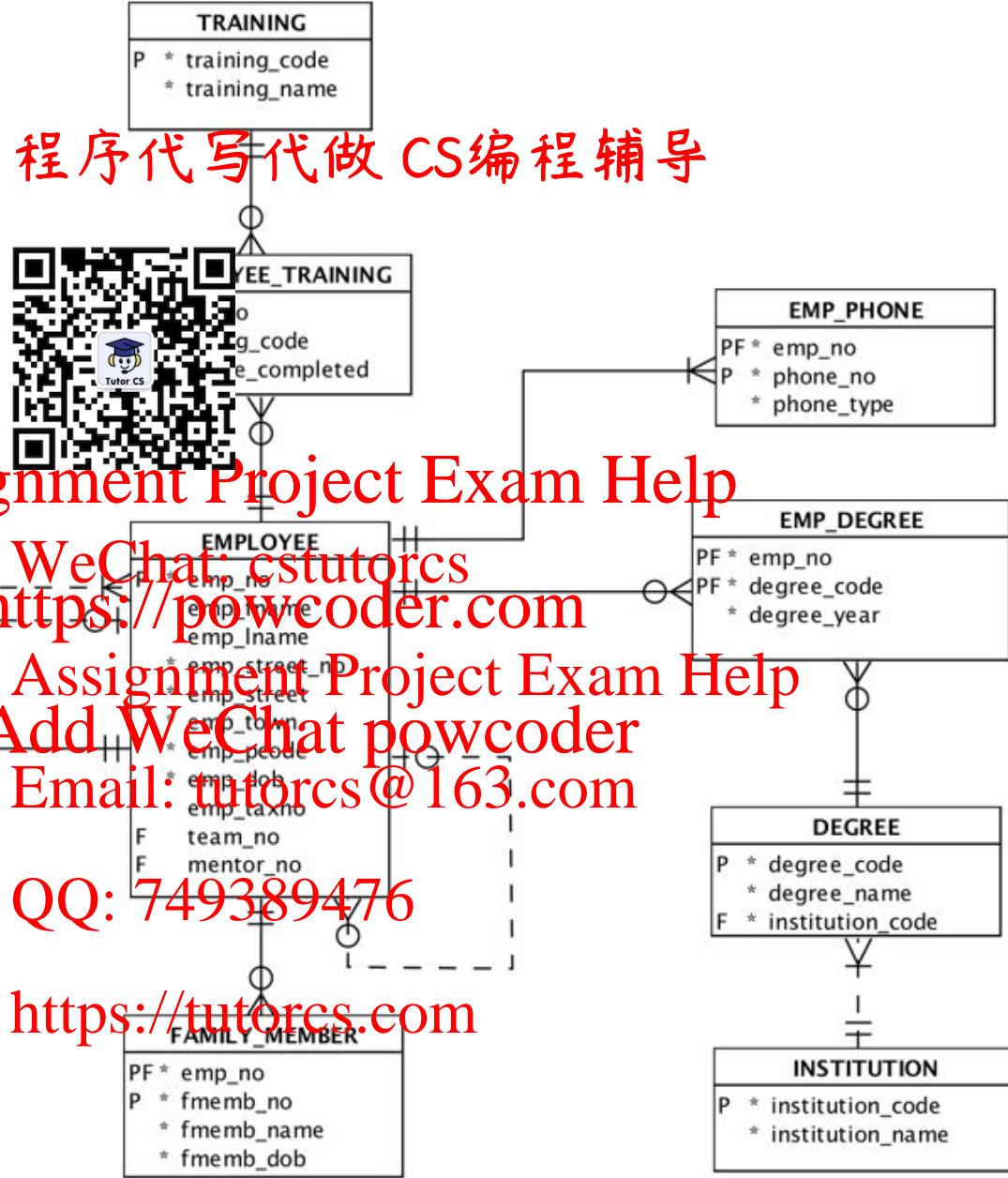
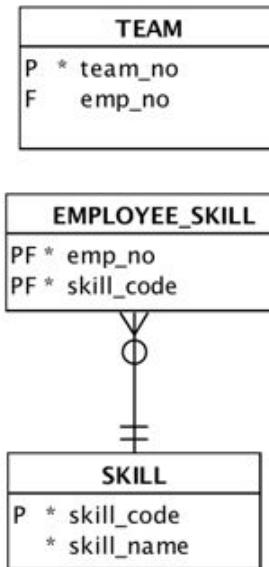
FAMILY_MEMBER (emp_no, fmemb_no, fmemb_name, fmemb_dob)

EMPLOYEE_SKILL (emp_no, skill_code)

SKILL (skill_code, skill_name)

These surrogate keys must not be reflected on your conceptual model

* Note - labels and legend have been omitted for clarity
- they must be shown in your work



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Summary

程序代写代做 CS编程辅导

- Things to remember

- Primary Key is important, it determine the starting point (choose your subject of interest).
- Functional dependency.
- Process of removing attributes in relations based on the concept of 1NF, 2NF and 3NF.
 - UNF to 1NF define PK & remove repeating group.
 - 1NF to 2NF remove partial dependency.
 - 2NF to 3NF remove transitive dependency.

