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Assignment Project Exam Help
Database Design II: Logical Modelling
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Reference

Several of the examples and diagrams used this session have been taken from:

Hoffer, J. A. , Prescott, M. B. & McFadden, F. R. “Modern Database Management”

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Step 2 (and 3) of the Design Process

- Step 1 Conceptual Model (session 2)
 - Database Model independent
- Step 2 Logical Model (this session)
 - Select which type (model) of database you wish to implement your conceptual model in
 - Network, Relational, OO, XML, NoSQL, ...
 - Database model dependent
- Step 3 Physical Model
 - Select which specific vendor for your chosen model you will implement in
 - Oracle, MySQL, IBM DB2, SQL Server, ...
 - Database vendor dependent
 - Final output schema file to implement model (for relational model a set of tables)



Summary of Terminologies at Different Levels

Conceptual	Logical (Relational)	Physical (Relational)
Entity	Relation	Table
Attribute	Attribute	Column
Instance	Tuple	Row
Identifier	Primary Key	Primary Key
Relationship	---	---
---	Foreign Key	Foreign Key



Recap Session 3 Relational Model Characteristics

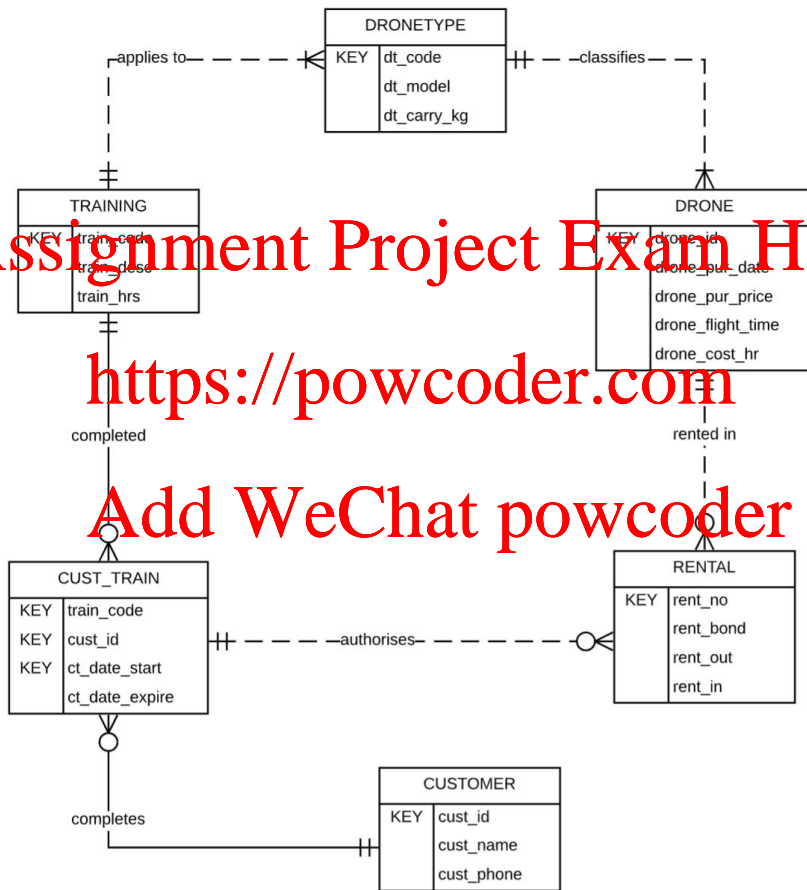
- Each relation must have a unique name
- Each attribute of a relation must have a distinct name within the relation
- An attribute cannot be multivalued (consist of repeating values)
- All values of an attribute need to be from the same domain
- The order of attributes and tuples in a relation is immaterial
- Each relation must have a primary key
- Logical (not physical) connections are made between relations by virtue of primary/foreign key pairing

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HiFlying Drone Conceptual Model



Transforming ER diagrams into relations (mapping conceptual level to logical level)

- Essentially
 - KEY to PK
 - Represent relationships with PK/FK pairs
- The steps are:
 - Map strong (regular) entities
 - Map weak entities
 - Map binary relationships
 - Map associative entities
 - Map unary relationships
 - Map ternary relationships
 - *Map supertype/subtype relationships (is not part of this unit).*

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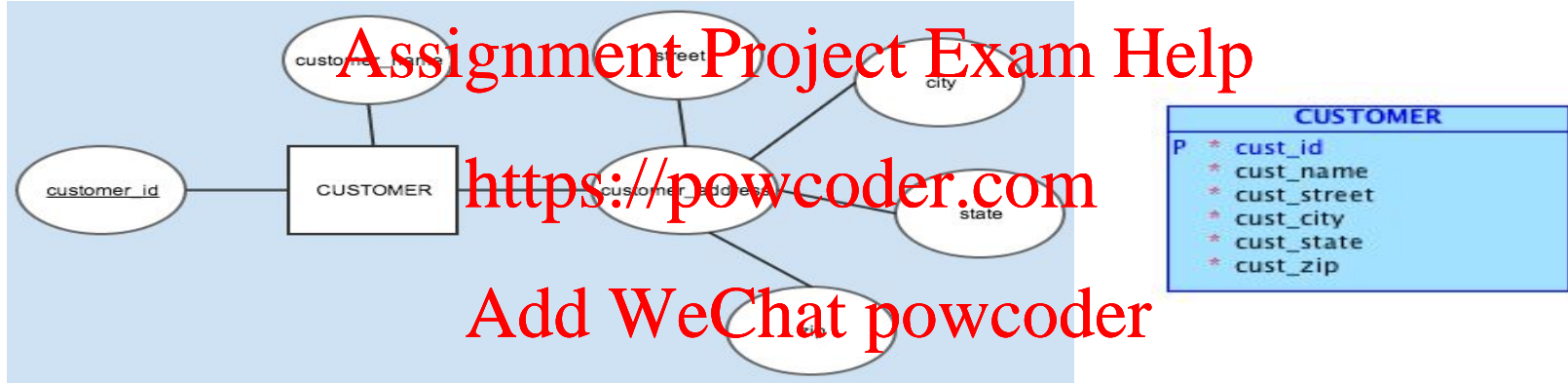


Map Regular Entities

- Composite Attributes

- When the regular entity type contains a composite attribute, only the simple component attributes of the composite attribute are included in the new relation.
- Compared to composite attributes, simple attributes not only improve data accessibility but also help in maintaining data quality
- Client input needed in some cases to determine if to be left as simple or broken into components. Mapping composite to simple component attributes is a *general requirement*, may be overridden *only* if the client requirements are such that it should not occur.

Mapping a Composite Attribute

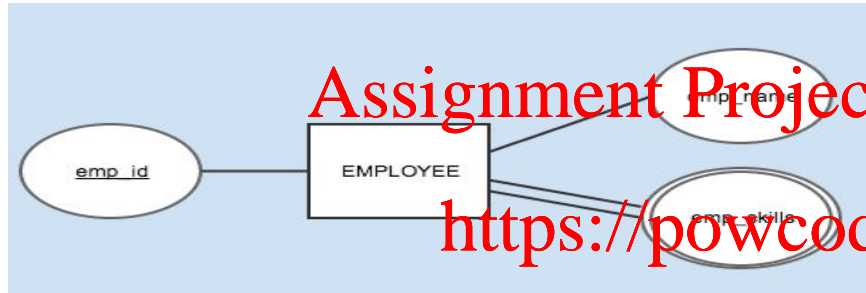


Map Regular Entities

- Multivalued Attribute

- When the regular entity type contains a multivalued attribute, two new relations are created.
- The first relation contains all the attributes of the entity type except the multivalued attribute itself.
- The second relation contains two attributes that form the PK. One of the attributes is the PK from the first relation, which becomes the FK in the second relation and the other is the multivalued attribute.
- There can also be non key attributes in the second relation depending upon the data requirements.

Mapping a Multi valued Attribute



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Is there a better solution than the one shown above?

What are the issues here - this was partially discussed in session 2

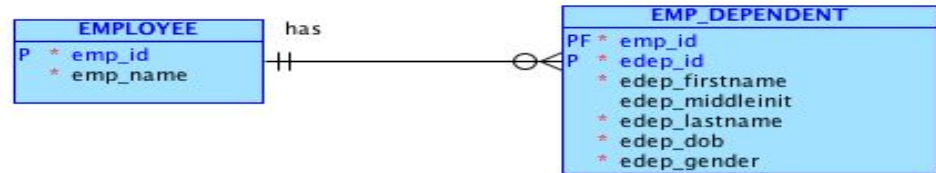
Mapping a Weak Entity

- For each weak entity type, create a new relation and include all of the simple attributes as attributes of this relation. The PK of the identifying relation is also included as the FK in this new relation.

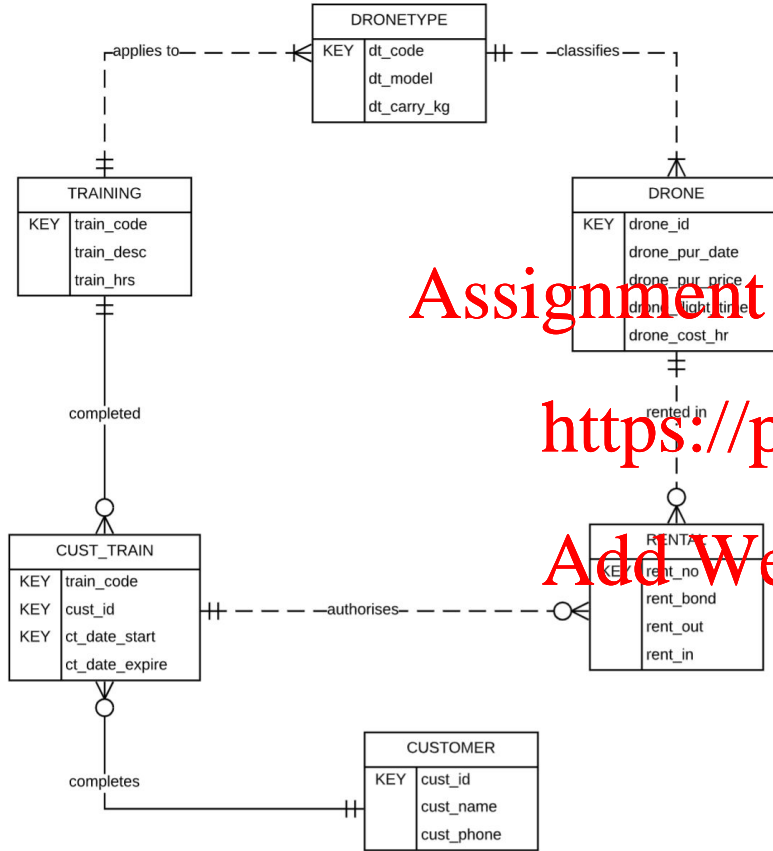
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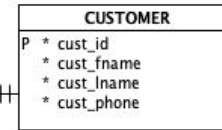
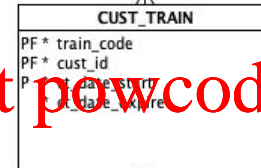
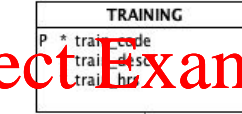
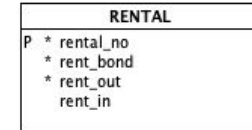
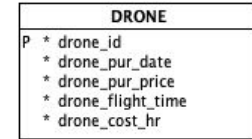
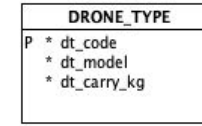
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Conceptual



Logical



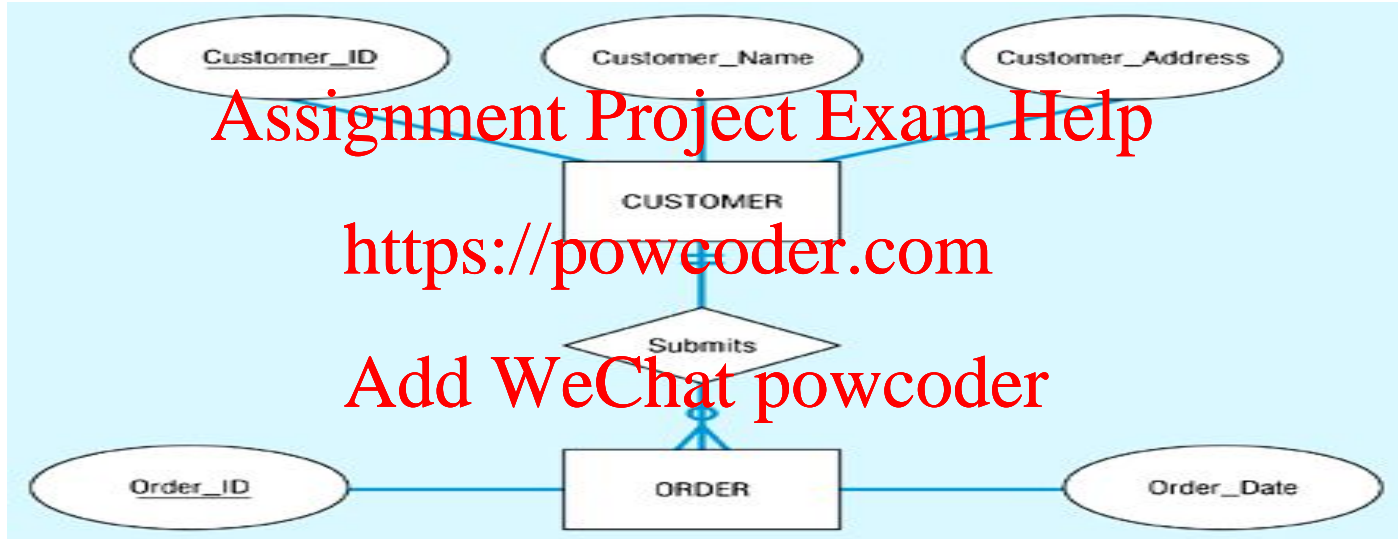
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Mapping a 1:M Binary Relationship



Map Binary Relationships (1:M)

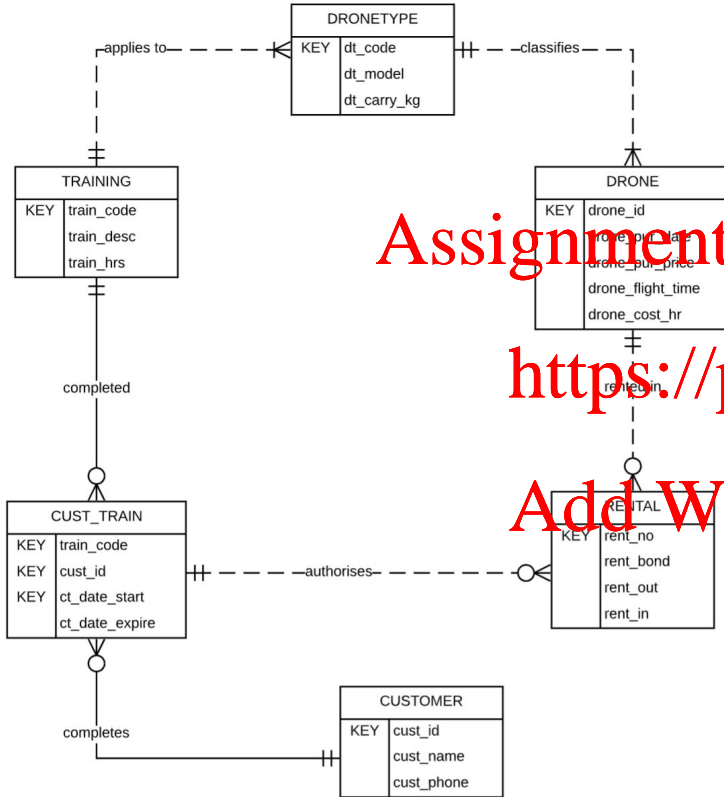


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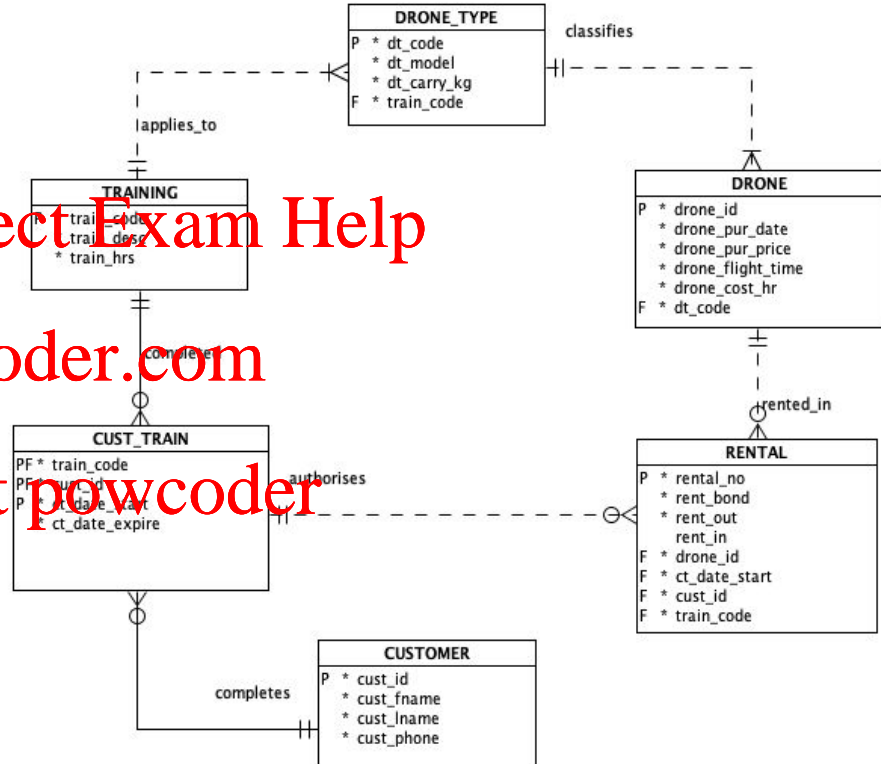
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For each 1:M binary relationship, first create a relation for each of the two entity types participating in the relationship. Then include the PK attribute (or attributes) of the entity on the one-side of the relationship as the FK on the many-side of the relationship.

Conceptual



Logical



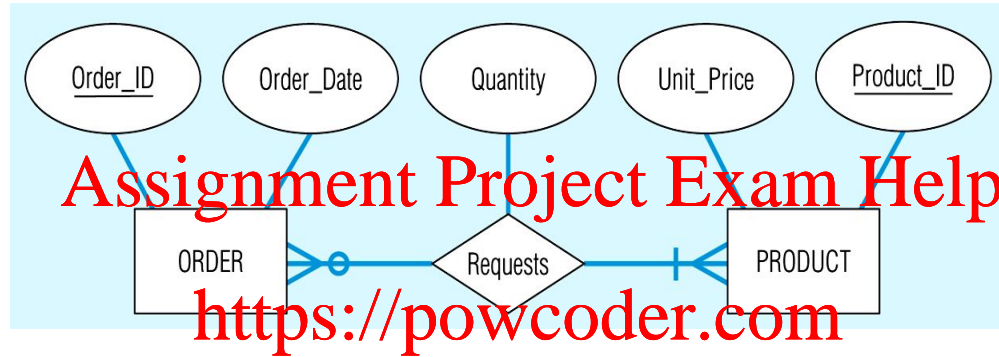
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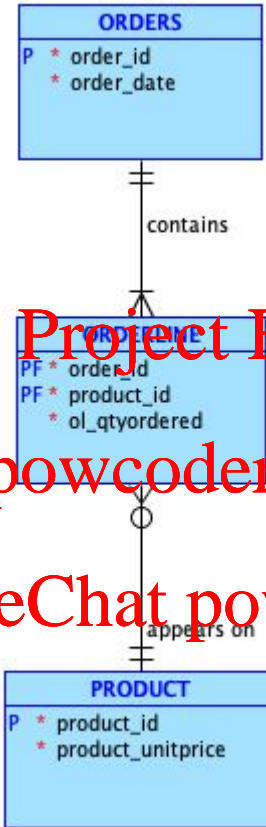
Mapping a M:N Binary Relationship



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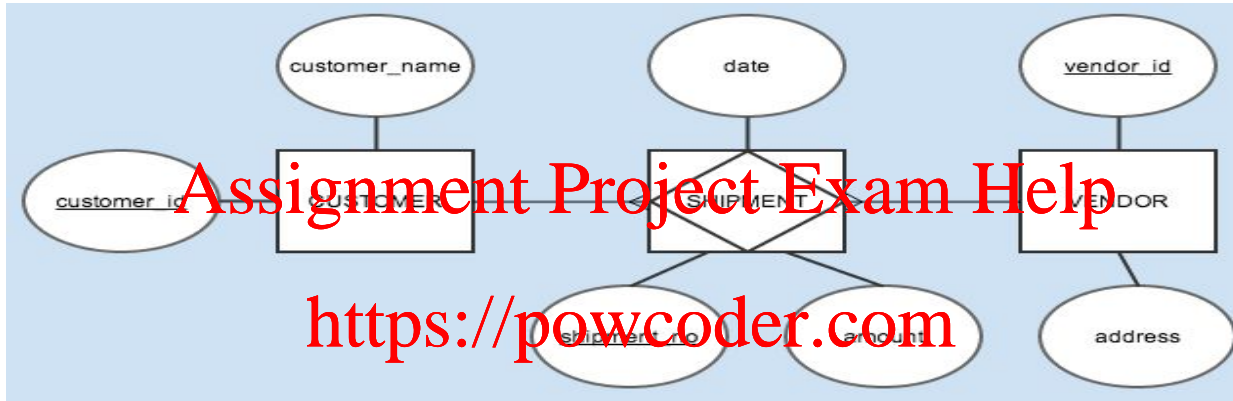
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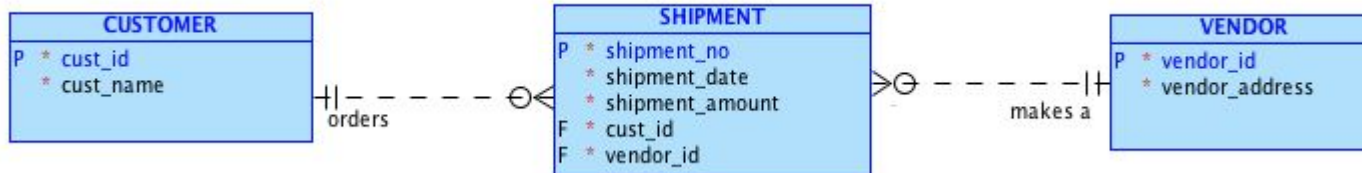
Map Binary Relationship (M:N)

- For a M:N binary relationship
 - First create a relation for each of the two entity types participating in the relationship.
 - Then create a new relation and include as foreign key attributes, the PK attribute (or attributes) for each of the two participating entity types. These attributes become the PK of the new relation.
 - If there are any nonkey attributes associated with the M:N relationship, they are also included in the new relation.

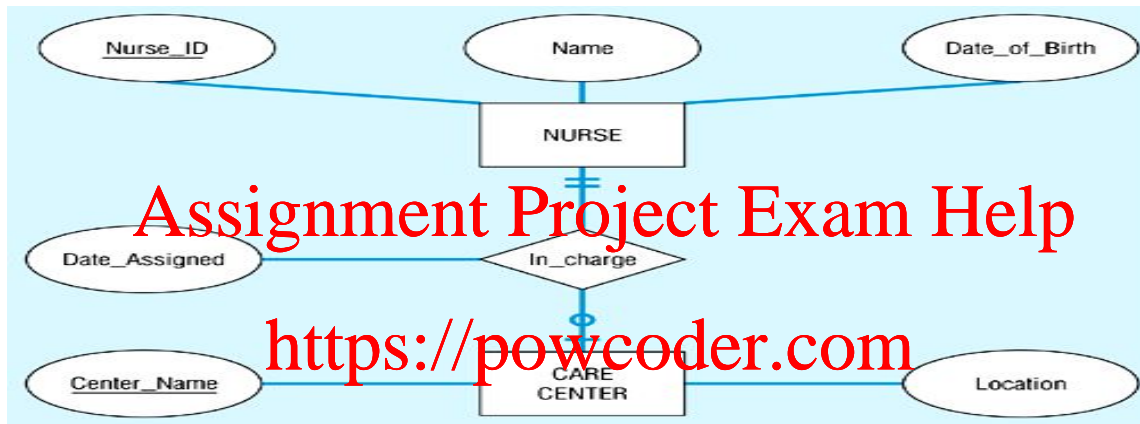
Mapping an associative entity with an Identifier



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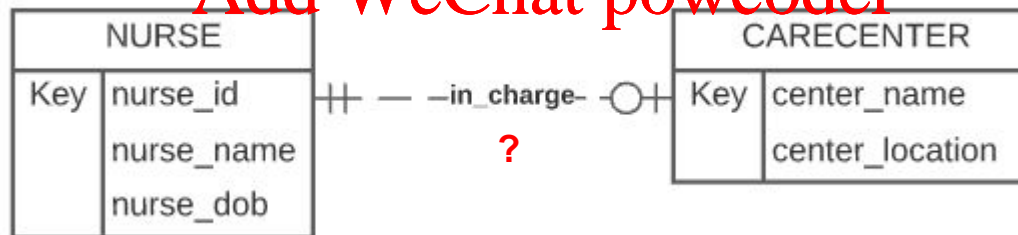
Mapping a 1:1 Binary Relationship



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Relationship Participation Mandatory vs Optional



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NURSE participation *in this relationship?*

CARECENTRE participation *in this relationship?*

Map Binary Relationship (1:1)

- Create two relations, one for each of the participating entity types.
 - The primary key (PK) on the mandatory side of the relationship becomes the foreign key (FK) on the optional side of the relationship.
 - where both are optional place the FK on the side which causes the fewest nulls
 - Special case: 1:1 total relationship (mandatory participation from both sides)
 - Consider consolidating the two entity types into one relation

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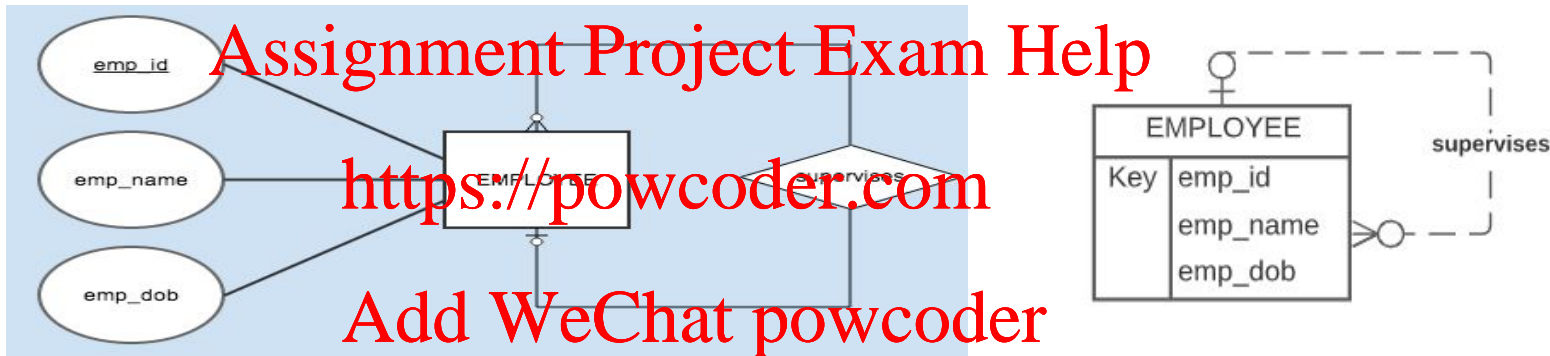
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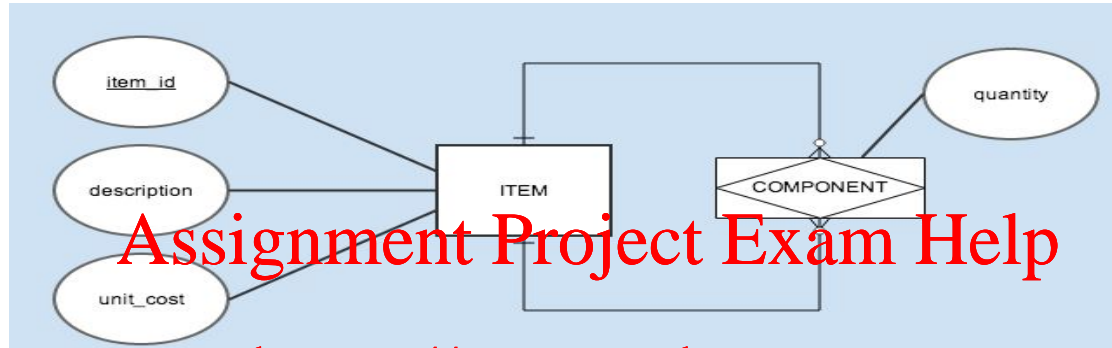
Map unary relationships

- Unary Relationship is a relationship between the instances of a single entity type.
- Unary 1:M Relationship – A relation is created for the entity type. Add a FK within the same relation that references the PK of the relation. A recursive foreign key is a FK in a relation that references the PK values of the same relation.
- Unary M:N Relationship – Two relations are created, one for the entity type in the relationship and the other as the associative relation to represent the M:N relationship itself. The PK of the associative relation consists of two attributes (with different names) taking their values from the PK of the other relation.

Mapping a 1:M Unary Relationship

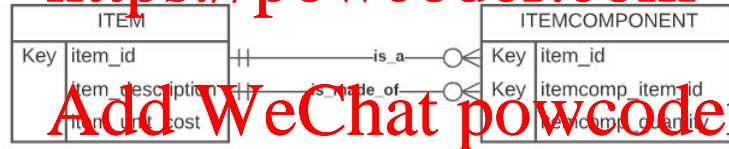


Mapping a M:N Unary Relationship

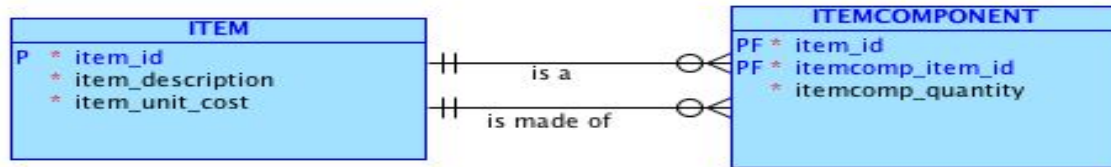


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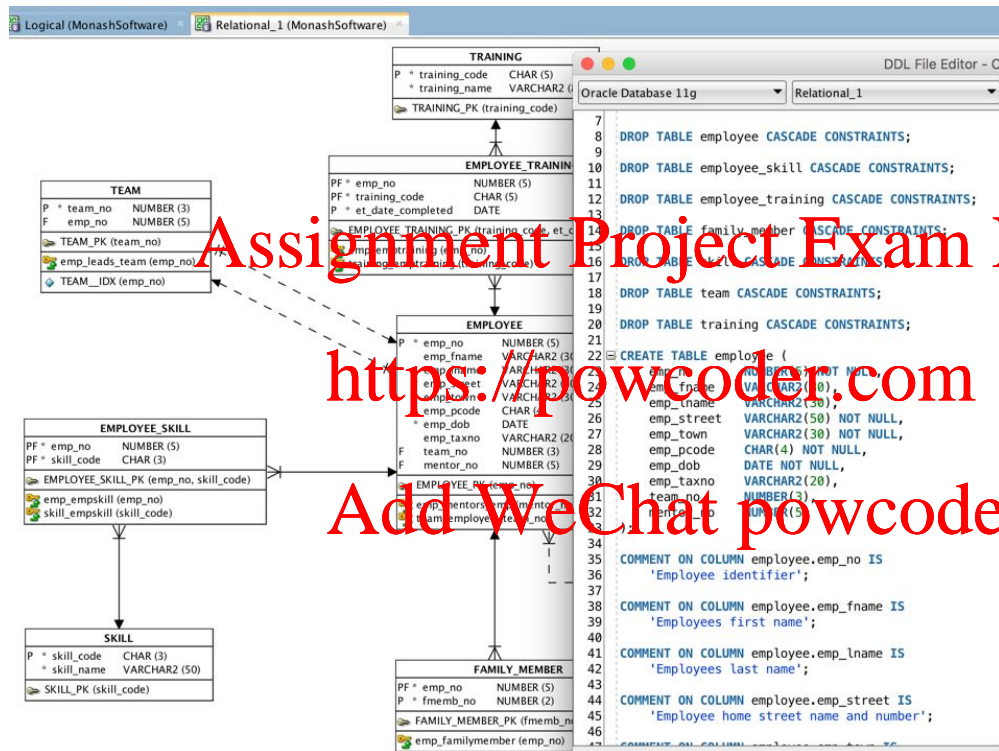
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SQL Developer Data Modeler



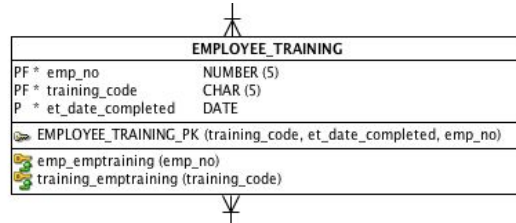
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Adding surrogate keys



Surrogate PK's may be added **ONLY** on the logical model provided they are justified (include in documentation / assumptions).

Potential problem:

Need to ensure that the identified key from the conceptual model - the natural key:

(emp_no, training_code, et_date_completed) will still remain unique

Solution, where needed:

Define a unique index on the attributes of natural key

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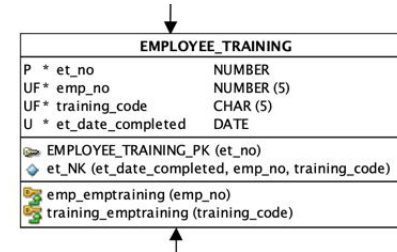
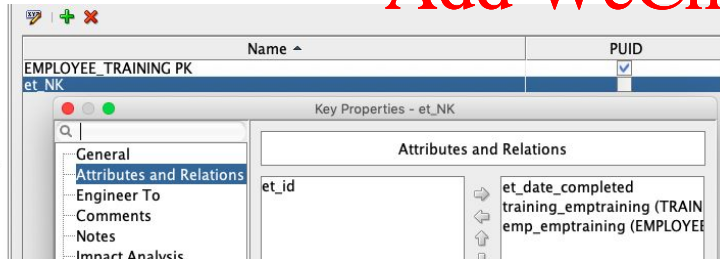
MANUALLY add new PK attribute (here et_no), **DO NOT USE** SQL Developers "Create Surrogate Key" option

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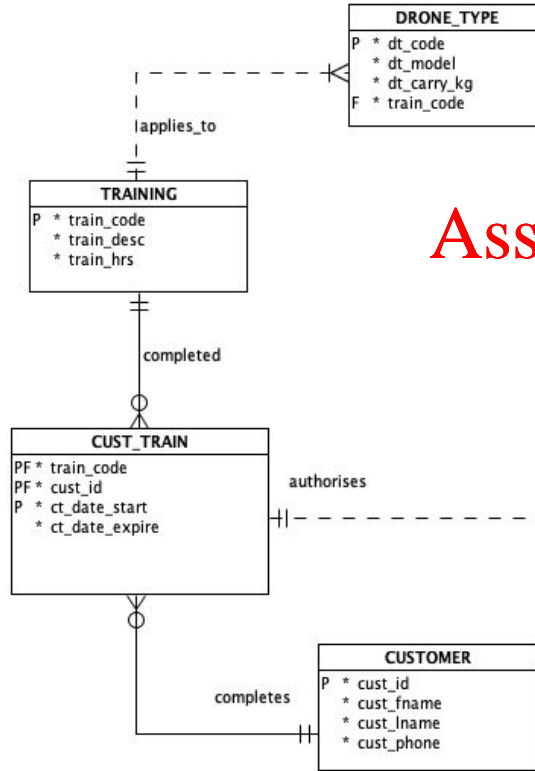
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et_no	emp_no	training_code	et_date_completed
1	101	ORA01	1-Oct-2016
2	101	ORA01	1-Oct-2016
3	101	ORA01	1-Oct-2016

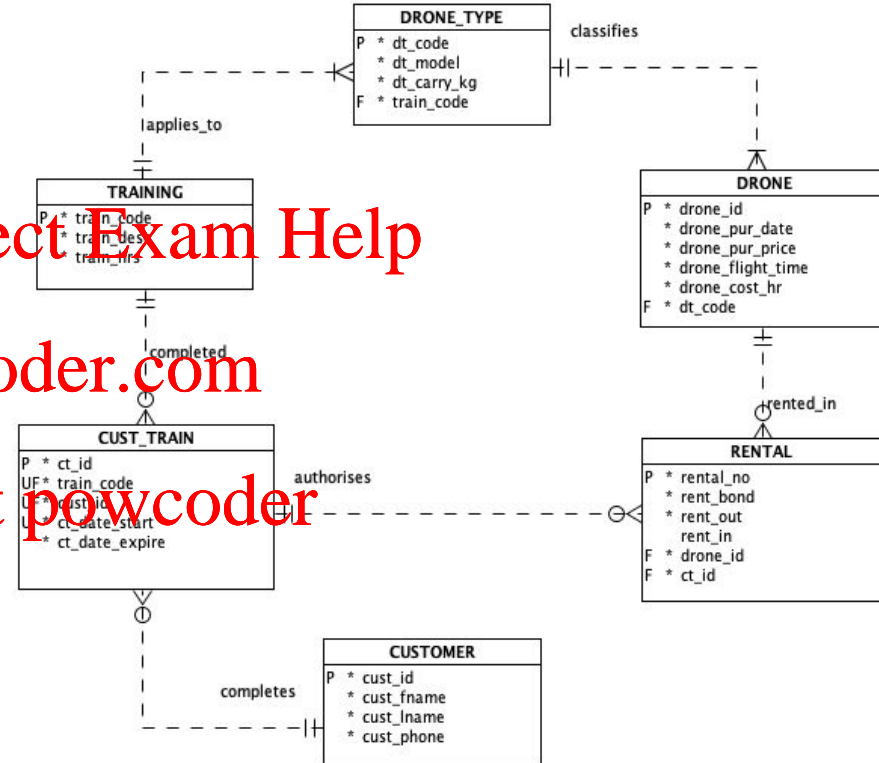
Unique Identifiers
Relationships
Subtypes
Volume Properties
Engineer To
Comments
Comments in RDBMS
Overlapping Attributes
Notes
Impact Analysis
Measurements
Change Requests



Logical



Logical - with Surrogate key



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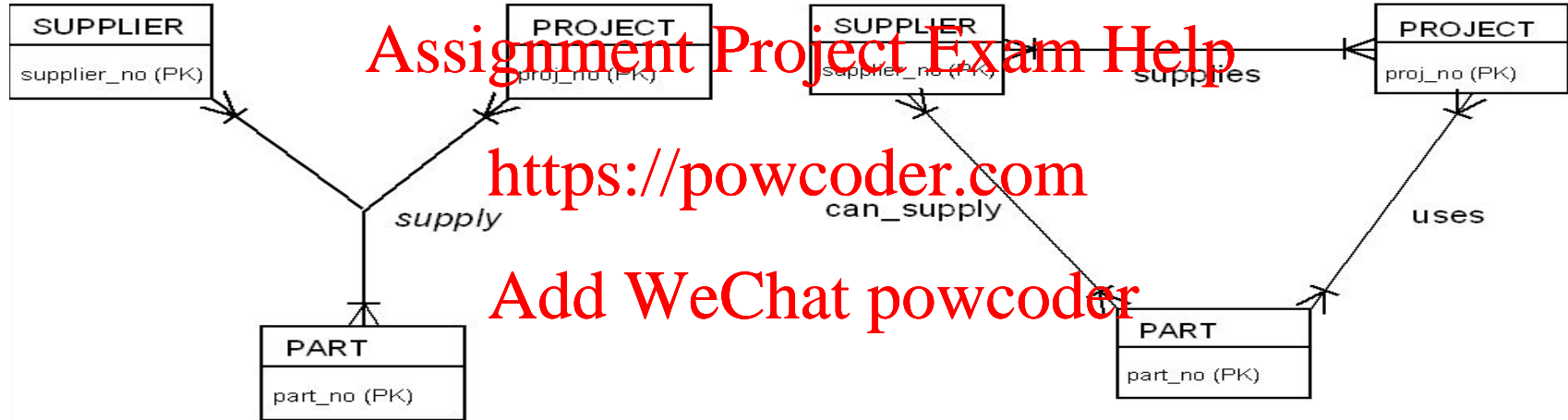
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Ternary Relationships

Ternary

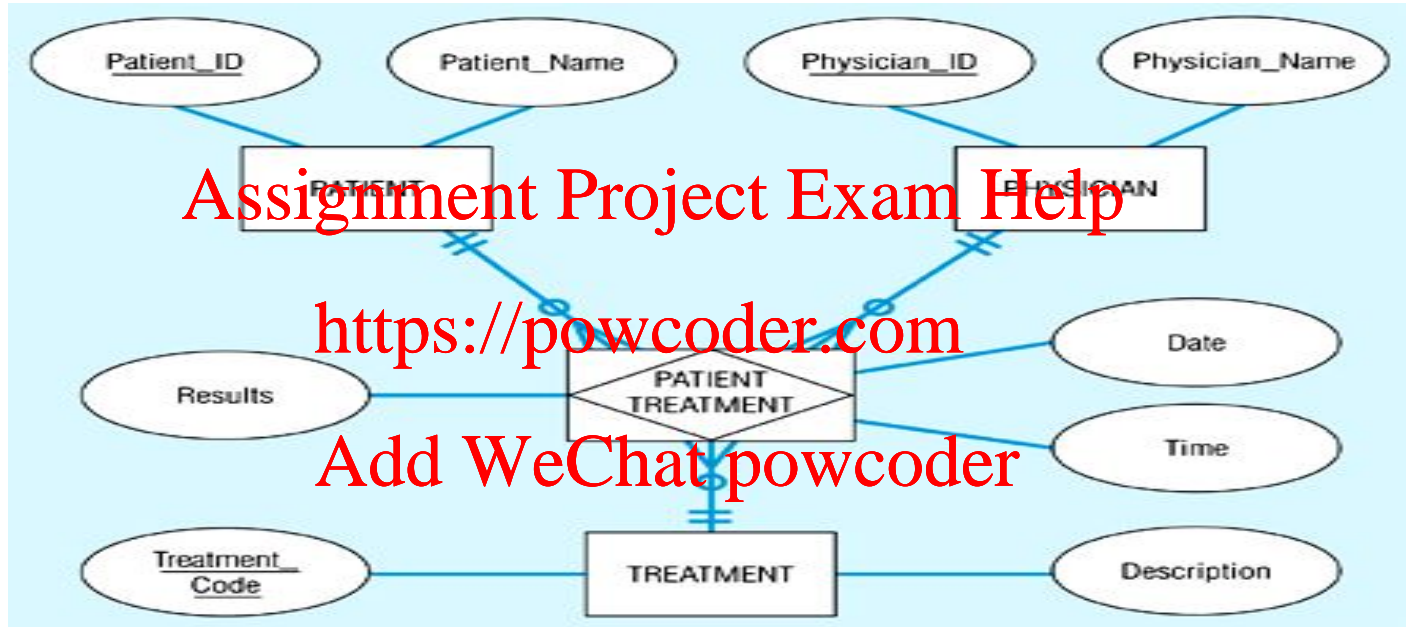
modelled as binary:



Ternary Relationships – model as binary relationships?

- Ternary represents more information than three binary relationships
- For example - Supplier 1 supplies Project 2 with Part 3 -
 - ternary **Assignment Project Exam Help**
 - instance (supplier 1, project 2, part 3) exists
 - binaries **<https://powcoder.com>**
 - instances
 - (supplier 1, project 2) (project 2, part 3) (supplier 1, part 3)
 - BUT does not imply (supplier 1, project 2, part 3)
- How then do we map such relationships?

Mapping a Ternary Relationship



Map Ternary (and n-ary) Relationships

- Ternary relationship should be converted to an associative entity.
 - To map an associative entity type that links three regular entity types, an associative relation is created.
 - The default FK of this relation consists of the three PK attributes for the participating entity types.
 - Any attributes of the associative entity type become attributes of the new relation.

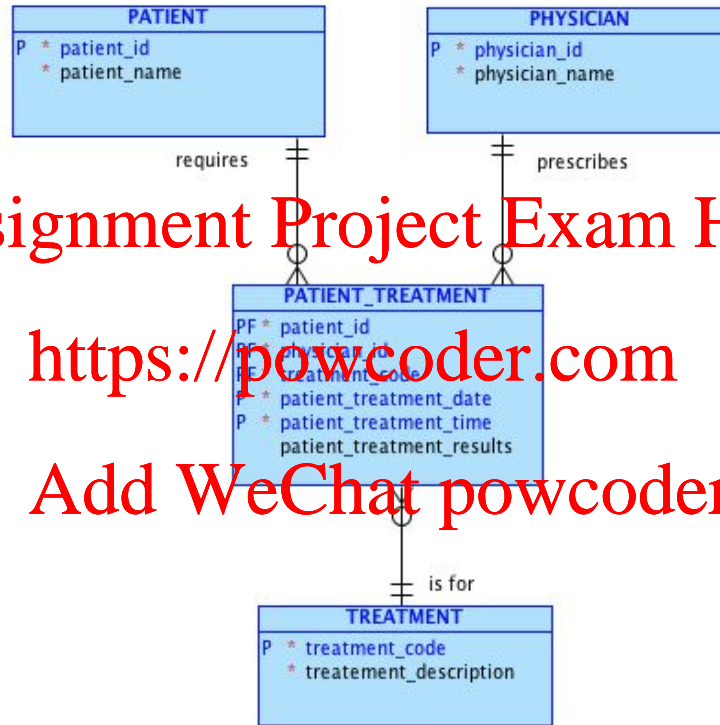
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Mapping a Ternary Relationship

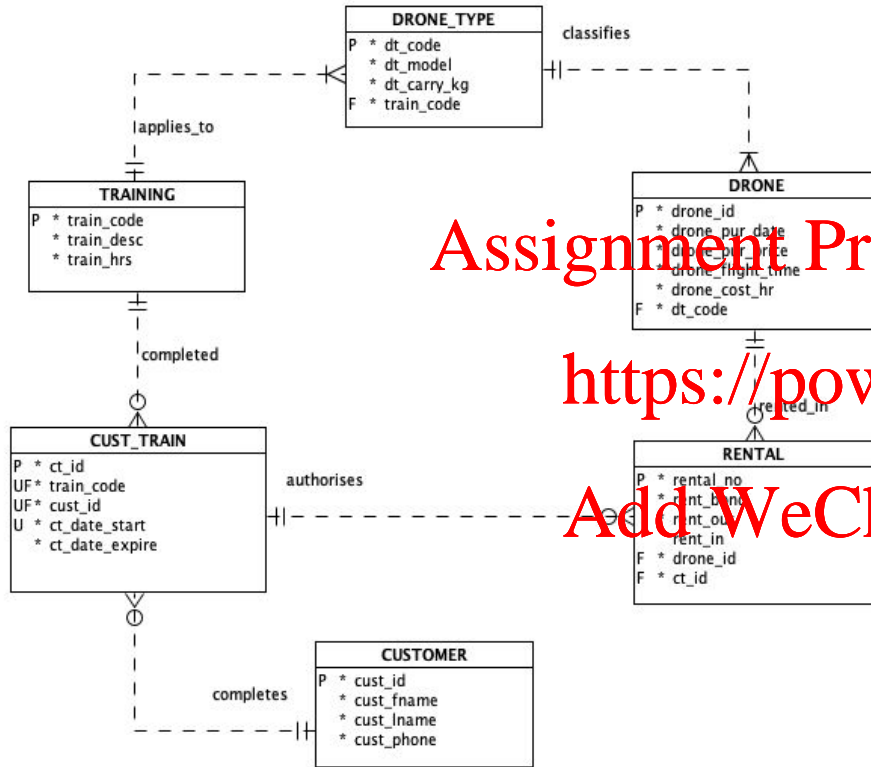


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Consolidation of Normalisation and Logical Model



3NF:

TRAINING (train_code, train_desc, train_active_mnths)

DRONE_TYPE (dt_code, dt_model, dt_manuf, train_code)

TRAINER (trainer_id, trainer_rego, trainer_fname, trainer_lname, trainer_category)

TRAINING_COURSE (train_code, traincourse_date, trainer_id)

CUSTOMER (cust_id, cust_fname, cust_lname)

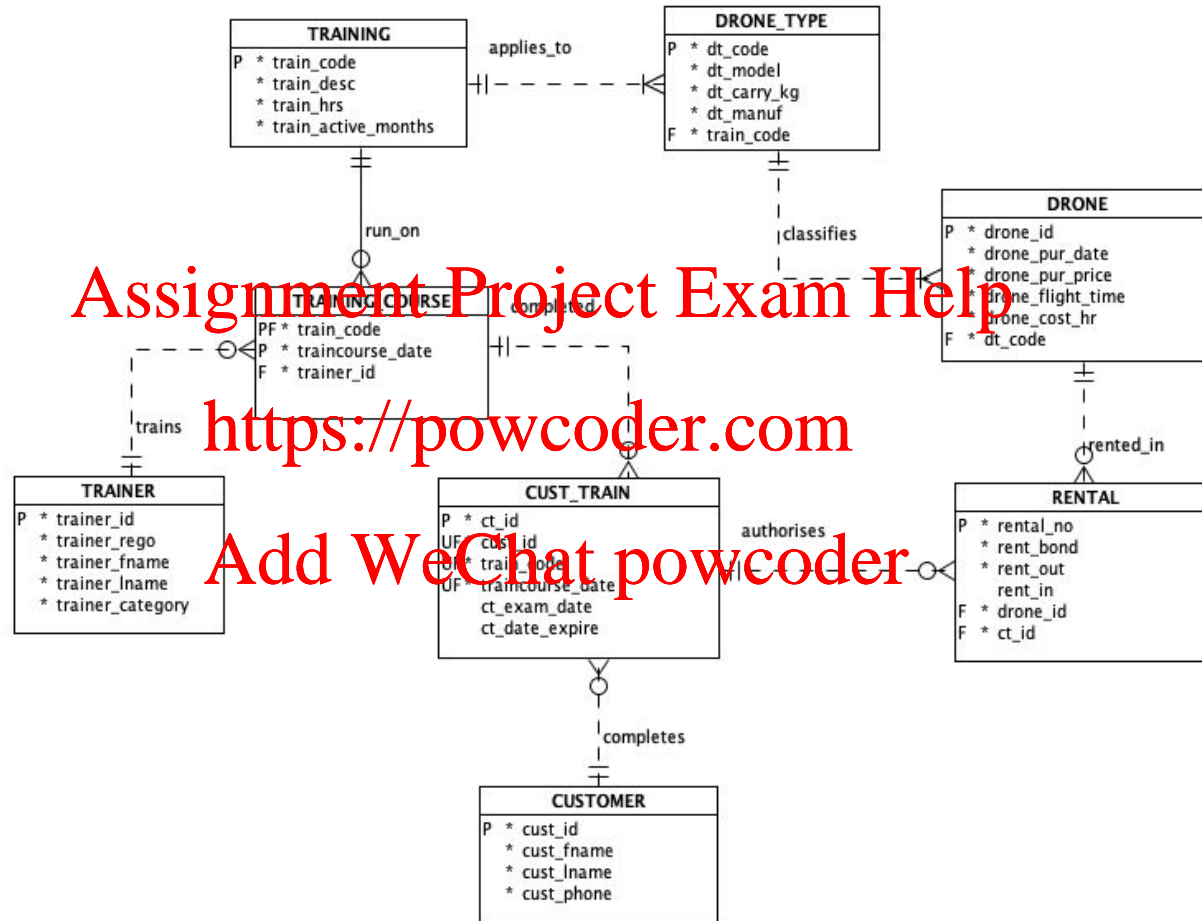
CUST_TRAINING (train_code, traincourse_date, cust_id, ct_exam_date, ct_date_expire)

What effect will this have on the logical model?

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check constraint

Default and Constraint

Constraint Name:

Default Value:

Use Domain Constraints: ☐ ☒ ☐

trainer_category List Of Values

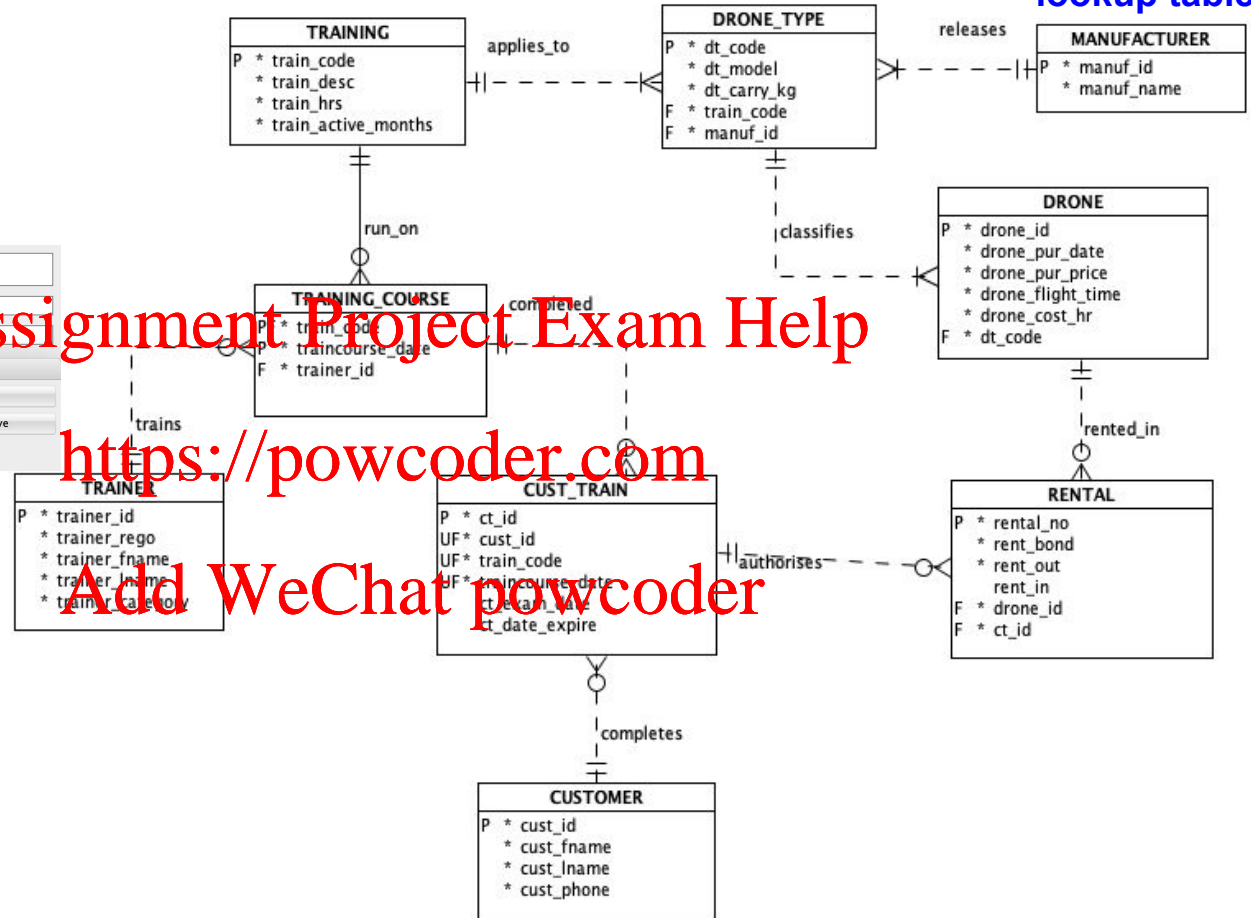
Value	Description
C	Casual
F	Fixed

List Of Values

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TRAINING		
P	* train_code	CHAR (5)
	* train_desc	VARCHAR2 (100)
	* train_hrs	NUMBER (2)
	* train_active_months	NUMBER (2)
TRAINING_PK (train_code)		

DRONE_TYPE		
P	* dt_code	CHAR (4)
	* dt_model	VARCHAR2 (50)
	* dt_carry_kg	NUMBER (3)
F	* train_code	CHAR (5)
F	* manu_id	NUMBER (5)
DRONE_TYPE_PK (dt_code)		
manufacturer_dronetype (manuf_id)		
training_dronetype (train_code)		

MANUFACTURER		
P	* manuf_id	NUMBER (5)
	* manuf_name	VARCHAR2 (25)
MANUFACTURER_PK (manuf_id)		

TRAINING COURSE		
PF	* train_code	CHAR (5)
P	* traincourse_date	DATE
F	* trainer_id	NUMBER (3)
TRAINING_COURSE_PK (train_code, traincourse_date)		
trainer_trainingcourse (trainer_id)		
training_trainingcourse (train_code)		

DRONE		
P	* drone_id	NUMBER (5)
	* drone_pur_date	DATE
	* drone_pur_price	NUMBER (7,2)
	* drone_flight_time	NUMBER (6,1)
	* drone_cost_hr	NUMBER (6,2)
F	* dt_code	CHAR (4)
DRONE_PK (drone_id)		
dronetype_drone (dt_code)		

TRAINER		
P	* trainer_id	NUMBER (3)
	* trainer_rego	CHAR (12)
	* trainer_fname	VARCHAR2 (25)
	* trainer_lname	VARCHAR2 (25)
	* trainer_category	CHAR (1)
TRAINER_PK (trainer_id)		

CUST_TRAIN		
P	* ct_id	NUMBER (7)
UF	* cust_id	NUMBER (4)
UF	* train_code	CHAR (5)
UF	* traincourse_date	DATE
	* ct_exam_date	DATE
	* ct_expire_date	DATE
CUST_TRAIN_PK (ct_id)		
CUST_TRAIN_UQ (cust_id, train_code, traincourse_date)		
customer_custtrain (cust_id)		
traincourse_custtrain (train_code, traincourse_date)		

RENTAL		
P	* rental_no	NUMBER (8)
	* rent_bond	NUMBER (6,2)
	* rent_out	DATE
	* rent_in	DATE
F	* drone_id	NUMBER (5)
F	* ct_id	NUMBER (7)
RENTAL_PK (rental_no)		
custtrain_rental (ct_id)		
drone_rental (drone_id)		

CUSTOMER		
P	* cust_id	NUMBER (4)
	* cust_fname	VARCHAR2 (25)
	* cust_lname	VARCHAR2 (25)
	* cust_phone	CHAR (12)
CUSTOMER_PK (cust_id)		

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