COMM1822

Term 2 2022

Introduction to Databases for Business Analytics

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Week 10 Course Review

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We acknowledge all Aboriginal and Torres Strait Islander Elders, past and present and their communities who have shared and practiced their teachings over thousands of years including business practices.

We recognise Aboriginal and Torres Strait Islander people's ongoing leadership and contributions, including to business, education and industry.

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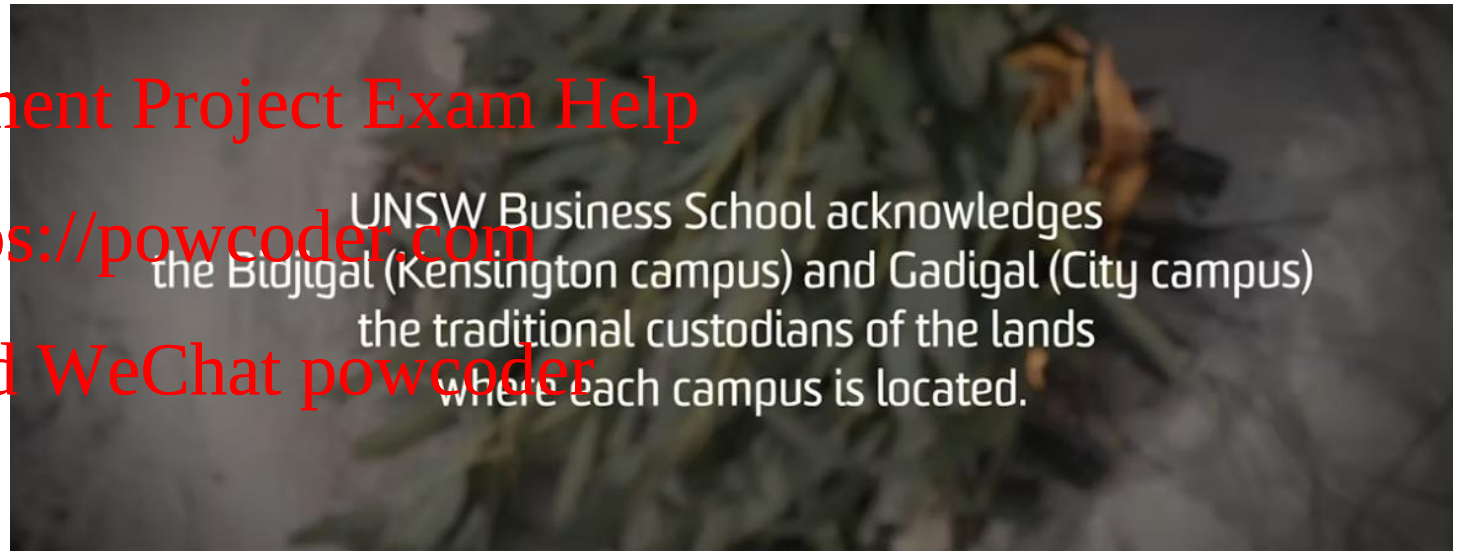

UNSW Business School. (2022, May 7). *Acknowledgement of Country* [online video]. Retrieved from https://vimeo.com/369229957/d995d8087f

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- Express different opinions
- Write your beliefs
- Show your beliefs
- Leave any club or organisation

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It's not acceptable to...

- Attempt to censor opinions
- Use hate speech
- Make threats or instil fear
- Make false accusations
- Access or share others private information without consent

We are here to help...

- Tell a teacher
- Tell UNSW Psychology and Wellness
- Report to UNSW Complaints
- Report to UNSW Security
- Report a crime to police

Find out more

Agenda

- ❑ Housekeeping
- ❑ MyExperience
- ❑ Exam Advice
- ❑ Course Review
- ❑ Thank you and Q&A

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Within-Group Peer Review

- Email the LiC (form on Moodle)

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Exam Advice

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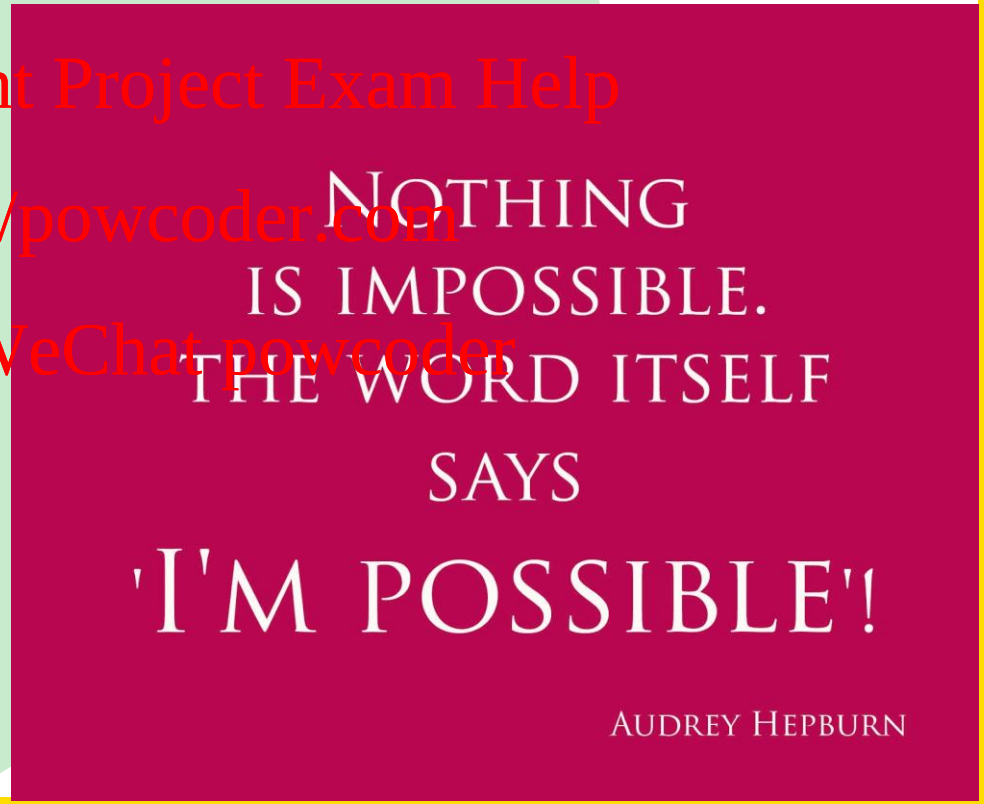
On different slides



Course Review

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Topics and Key Concepts

- Business Rules
- Conceptual Model
- Relation Model
- Normalization
- RDBMS/SQL
- Big Data

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Database Design: Overview

The processes that we follow when designing a database for an organization:

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1. We gather **business requirements** from the organization.
2. We develop a **conceptual model** using ER modelling technique.
3. We convert the conceptual model (ER model) to a **relational model**, a set of relations.
4. We normalize the relation model (relations) to remove any anomalies and convert to **internal model**. (e.g., Oracle)
5. We physically implement this internal model in a **database** by creating a table for each normalized relations.

Conceptual Model

What is a conceptual model?

- A conceptual data model is a **representation of organizational data**.
- **ER modelling** is common modelling technique (use Chen's notation for exam).
- The result of ERM is an **ER model**: a detailed, logical representation of the data for an organization or for a business area.

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What is shown in an ER model?

- An ER model is normally expressed as an **ER diagram**, which is a graphical representation of an ER model.
- The ER model is expressed in terms of **entities** in the business environment.
- The ER model also shows the **relationships** (associations) among those entities.
- The ER model also shows **attributes** of both the entities and their relationships.

Note: In the exam, solve all ER questions without supertype/subtype structures (unless explicitly asked for)!

Relational Model

What is a relation a model?

- A **relational model** represents data in relations.
- A **relation** can be thought of (and implemented as) a two-dimensional **table**.
- The name of a relation and the set of attributes for a relation is called the **relational schema**.

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What is shown in a relation model?

- A relational model shows **relations**, the name and structure of a two-dimensional table.
- A relation model shows **attributes**, the names of the columns of relations.
- A relation model shows **tuples**, the rows of relations.

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Normalization

- **Normalization** is a **process for converting** complex data structures into simple data structures. This can be accomplished in stages.

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- **What is the outcome of normalization?**

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  - **First normal form (1NF):** Any repeating data have been removed, so there is a single value at the intersection of each row and column of the table.

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  - **Second normal form (2NF):** Non-key attributes require the whole key for identification. (No partial dependencies exist.)
  - **Third normal form (3NF):** Non-key attributes do not depend on other non-key data elements (which is called transitive dependencies).
  - **Boyce-Codd Normal Form (BCNF):** If no non-key attribute determines part of the PK.
  - We usually normalize to **3NF**, which is an industry standard.

Relational Languages – Theory

What is the “theory” behind relational databases?

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- **Relational algebra** and **relational calculus** are defined by Codd (1971) as the basis for relational languages. Both languages are not very user-friendly languages.
- **Relational algebra** operations can be classified in three main categories:
  - **Union, Intersection & Difference:** set operations.
  - **Selection & Projection:** choose/remove parts of a relation.
  - **Cartesian Product & Join:** operations combine the tuples of two relations.

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Relational Languages – Practice

What is the practice of relational databases?

- The **RDBMS** – for example Oracle – provides data access via a query language.

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- The RDBMS's query language – most commonly **SQL** – contains three components:
  - **Data Definition Language (DDL)** is used to specify the database schema or modify an existing one.
  - **Data Manipulation Language (DML)** is used to manipulate the data.
  - **Data Control Language (DCL)** is used for controlling the data.

SQL DML

ISO SQL standard uses the terms tables, columns, and rows.

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- **SELECT** clause tell which attributes of the tuples matching the condition are produces as part of the answer.
- **FROM** clause gives the names of relation(s).
- **WHERE** clause is a condition which tuples must satisfy in order to match the query.

SLECT <columns>
FROM <tables>
[WHERE <conditions>]

Database Development

Database Development

- Information systems development overview
- Software development lifecycle (**SDLC**)
- Database development lifecycle (**DBLC**)
- **Interaction** between SDLC and DBLC

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Database Administrator (DBA)

- DBA vs. Data Administrator (DA)
- DBA tasks
- DBA ethics

DBLC & SDLC

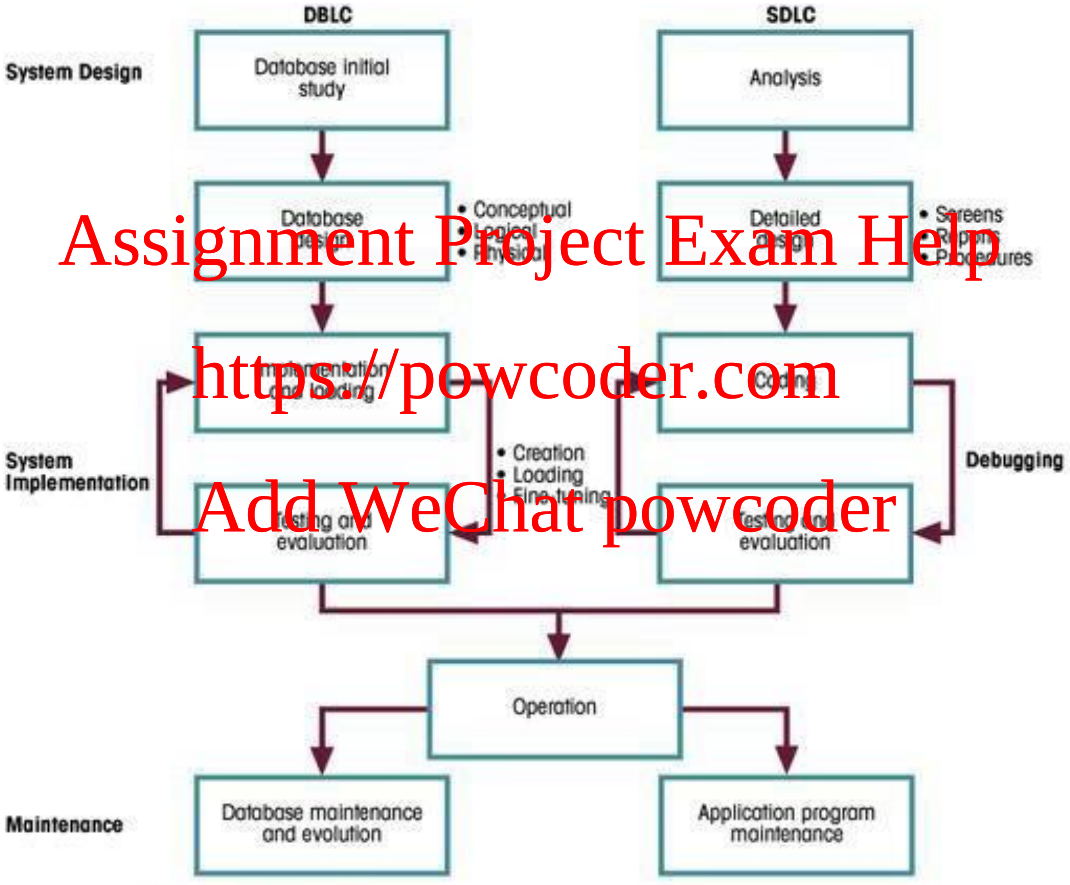

FIGURE 6.13 PARALLEL ACTIVITIES IN THE DBLC AND THE SDLC

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Database Administration (DBA)

When a new DBMS is introduced to an organization, three important aspects have to be addressed.

- **Technological**
- **Managerial**
- **Cultural**

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The person responsible for the control of the database is called the **Database Administrator (DBA)**.

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Database Administration (DBA)

- The **role** and **position** of DBA may **vary** in companies.
- Some of the larger organisations make a distinction between **DA (data administrator)** and **DBA (database administrator)**.
- **DA:** A **high-level** function that is responsible for the **overall management of data resources** in an organization, including maintaining corporate-wide definitions and standards.
- **DBA:** A **technical** function that is responsible for **physical database design** and for dealing with technical issues such as security enforcement, database performance and backup and recovery.

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Big Data

What is Big Data?

- Buzz Word!
- Cannot fit into a USB flash drive
- A large and complex dataset
- Social media
- IoT streaming of data
- Capturing of Media

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3Vs (Volume, Velocity and Variety) and more Vs

Big Data is classified into three types

- Structured
- Unstructured
- Semi-Structured

Views

A view contains no data of its own.

- A view is a logical table based on a table or another view

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A view is stored as a SELECT statement in the data dictionary.

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- The tables on which a view is based are called base tables.

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The two main purposes of using a view are to:

- Reduce the complexity of some queries; and
- Restrict users' access to sensitive data

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Exercise

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Exercise 1 – Aquariums

Each fish belongs to a species. Each fish also has a name, and you also want to register their colour and weight. You would like to store the specific food recommendation for each species. Naturally, the database should be able to tell you which fish is in which tank. Also, the names, volumes, and colours of the tanks should be stored. Finally, there are events involving your fish (birth, fights, etc.) to be stored with date and comment.

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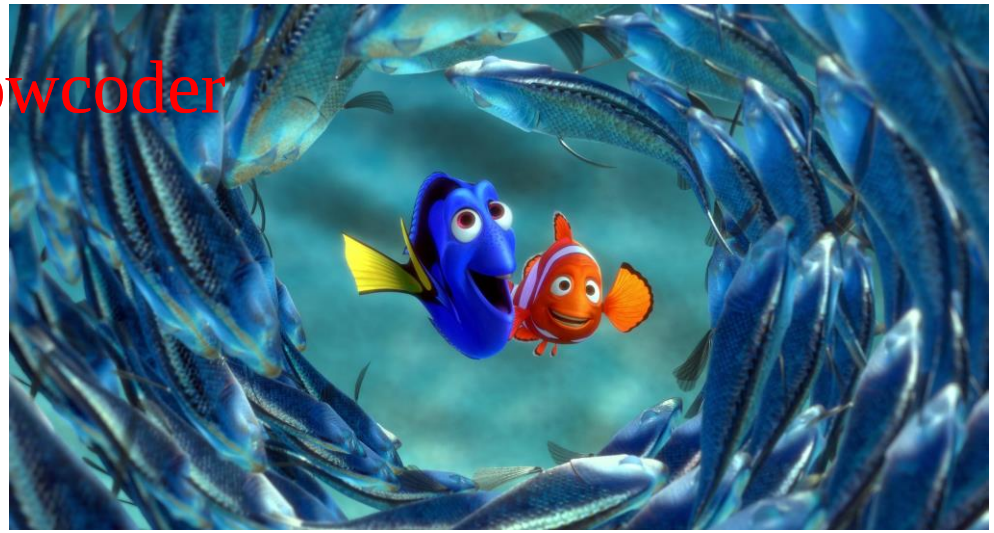
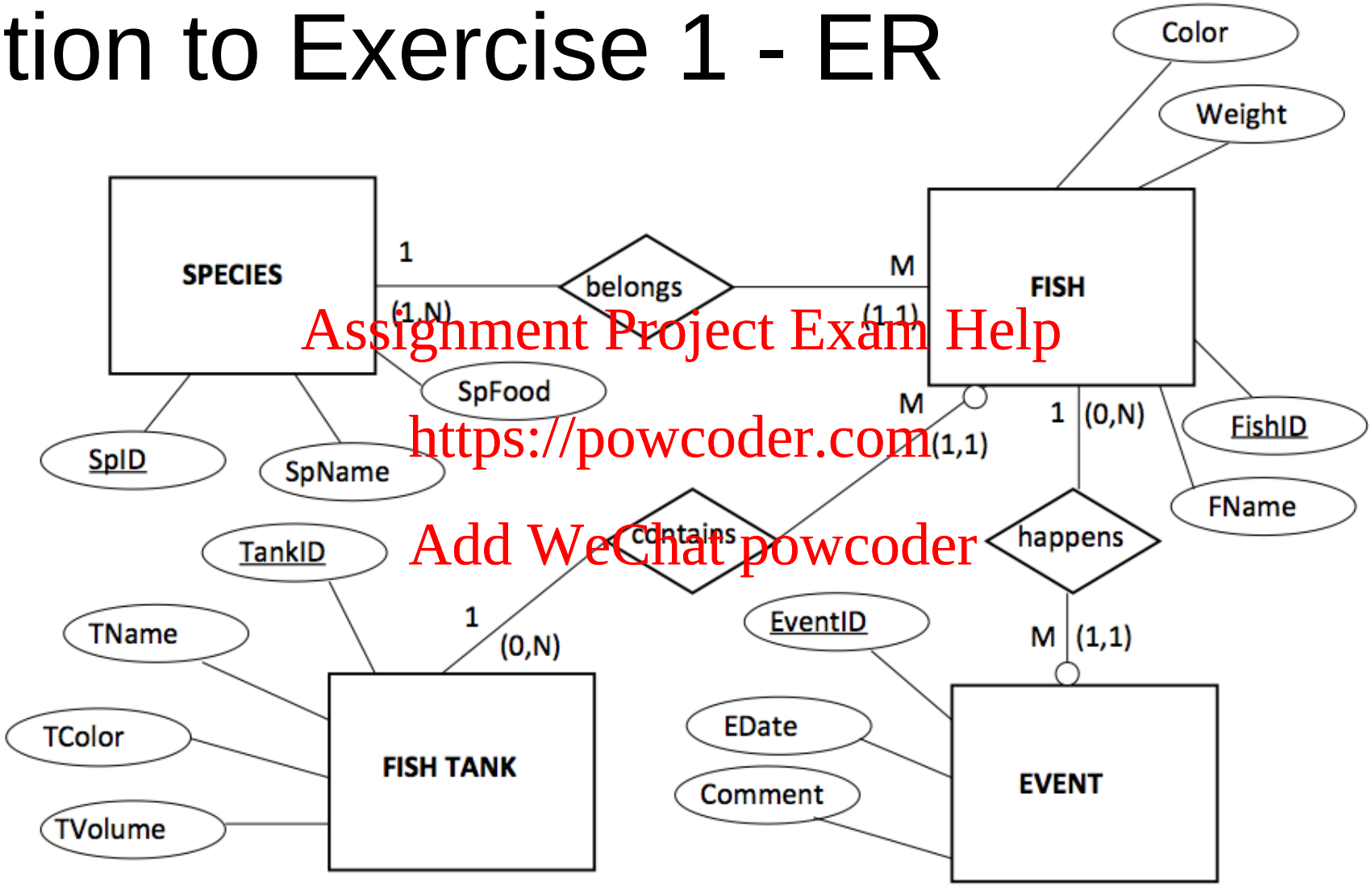
- ❑ Create the ER model.
- ❑ Create the relational model.



Solution to Exercise 1 - ER



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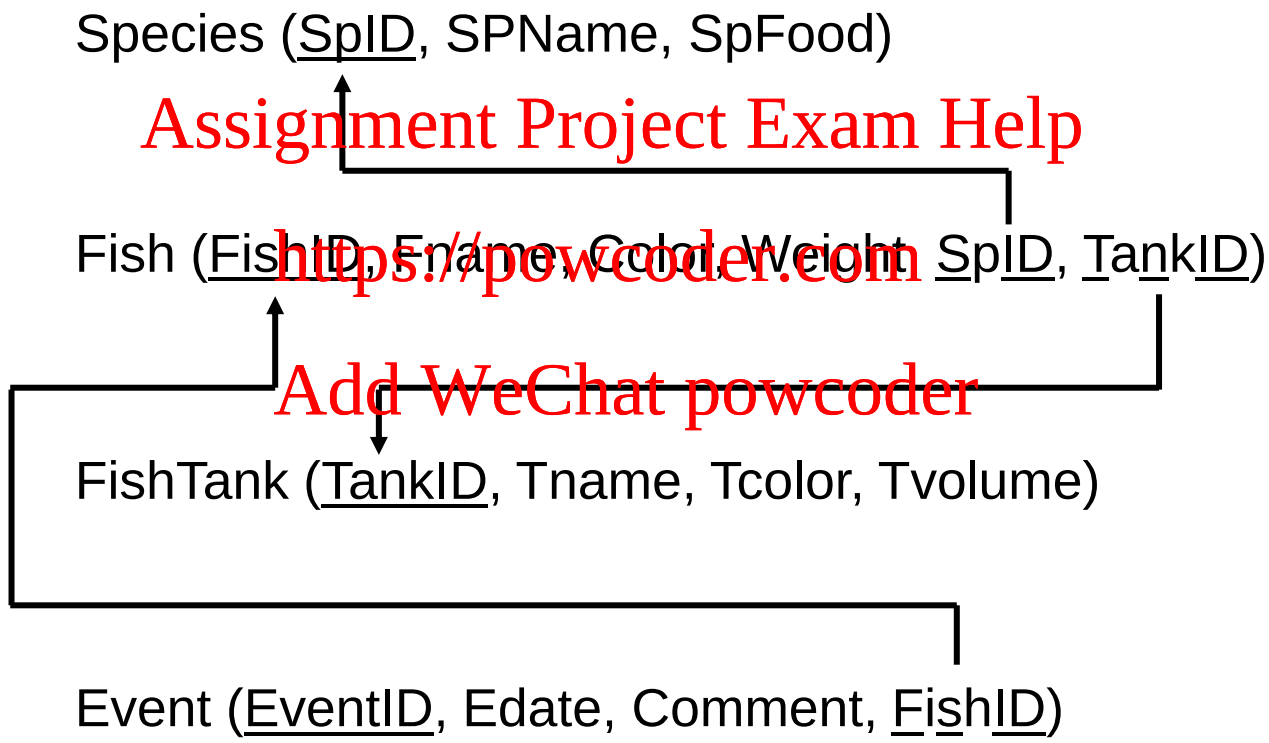
Solution to Exercise 1 – Relational Model



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Exercise 2 – SQL

Create SQLs for the following questions:

1. List all details about the fish stored in the fish table, sorted by fish name in ascending order.
2. What is the average volume of a fish tank?
3. You have called your Clownfish "Sharky". How many events involving Sharky have occurred between 1 January 2012 and 1 April 2013? List the name of the fish and the number of events!
4. How can you find about Sharky's are of which type species? List the species name and food.
5. What colours are the fish tanks? Do not include duplicates.

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Solution to Exercise 2 – SQL

1. List all details about the fish stored in the fish table, sorted by fish name in ascending order.

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```
SELECT      *
FROM        FISH
ORDER BY    Fname;
```

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2. What is the average volume of a fish tank?

```
SELECT      AVG (Tvolume) “Average Volume”
FROM        FISH_TANK;
```

Solution to Exercise 2 – SQL

3. You have called your Clownfish “Sharky”. How many events involving Sharky have occurred between 1 January 2012 and 1 April 2013? List the name of the fish and the number of events.

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```
SELECT      Fname, COUNT(*) “Number of Events”
FROM        FISH JOIN EVENT USING (FishID)
WHERE       Fname = ‘Sharky’
AND         Edate BETWEEN DATE ‘2012-01-01’ AND ‘2013-04-01’
GROUP BY    Fname;
```


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Solution to Exercise 2 – SQL

4. How can you find about Sharky's are of which type species? List the species name and food.

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```
SELECT    Fname, SPName, SpFood
FROM      FISH JOIN SPECIES USING(SpID)
WHERE     Fname = 'Sharky';
```

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5. What colours are the fish tanks? Do not include duplicates.

```
SELECT    DISTINCT (TColor)
FROM      FISHTANK
```

Species (SpID, SPName, SpFood)
Fish (FishID, Fname, Color, Weight, SpID, TankID)
FishTank (TankID, Tname, Tcolor, Tvolume)
Event (EventID, Edate, Comment, FishID)

Exercise 3 – Normalization

Scenario: Using the INVOICE table structure below:

a. Normalize the table to 1NF, and draw the dependency diagram. Assume that the table does not contain repeating groups and that an invoice-number references more than one product.

b. Normalize the table to its 2NF, and indicate functional dependencies.

c. Normalize the table to its 3NF, and indicate functional dependencies.

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Attribute Name	Sample Value	Sample Value	Sample Value	Sample Value	Sample Value
Invoice-Nb	211347	211347	211347	211348	211348
Product-Nb	AA-E3422QW	QD-300932X	RU-995748G	AA-E3422QW	GH-778345P
Sale-Date	15-Jan-2016	15-Jan-2016	15-Jan-2016	15-Jan-2016	16-Jan-2016
Product-Desc	Rotary sander	0.25-in. drill bit	Band saw	Rotary sander	Power drill
Vendor-Code	211	211	309	211	157
Vendor-Name	NeverFail, Inc.	NeverFail, Inc.	BeGood, Inc.	NeverFail, Inc.	ToughGo, Inc.
Quantity-Sold	1	8	1	2	1
Product-Price	$49.95	$3.45	$39.99	$49.95	$87.75

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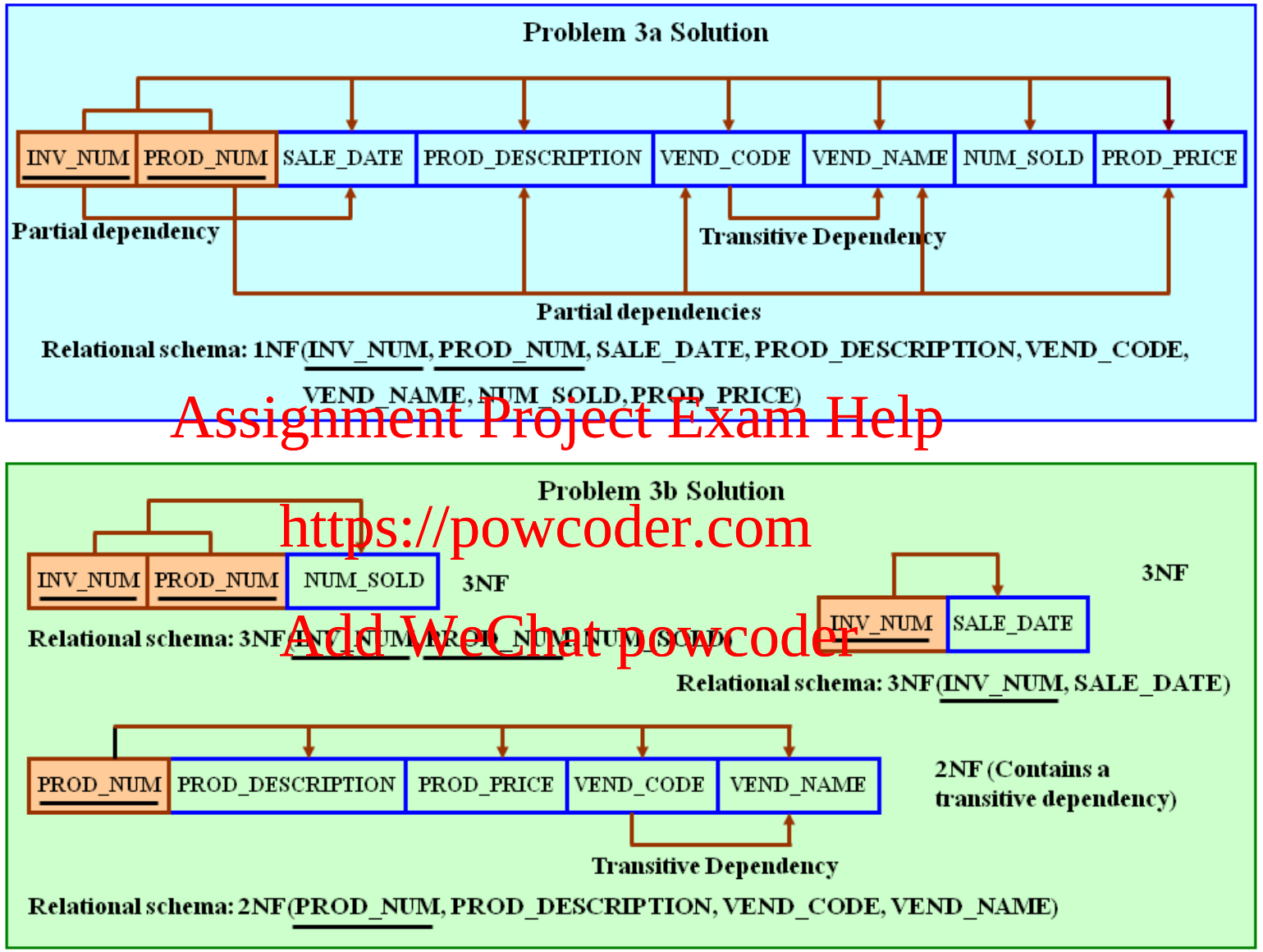
Solution to Exercise 3



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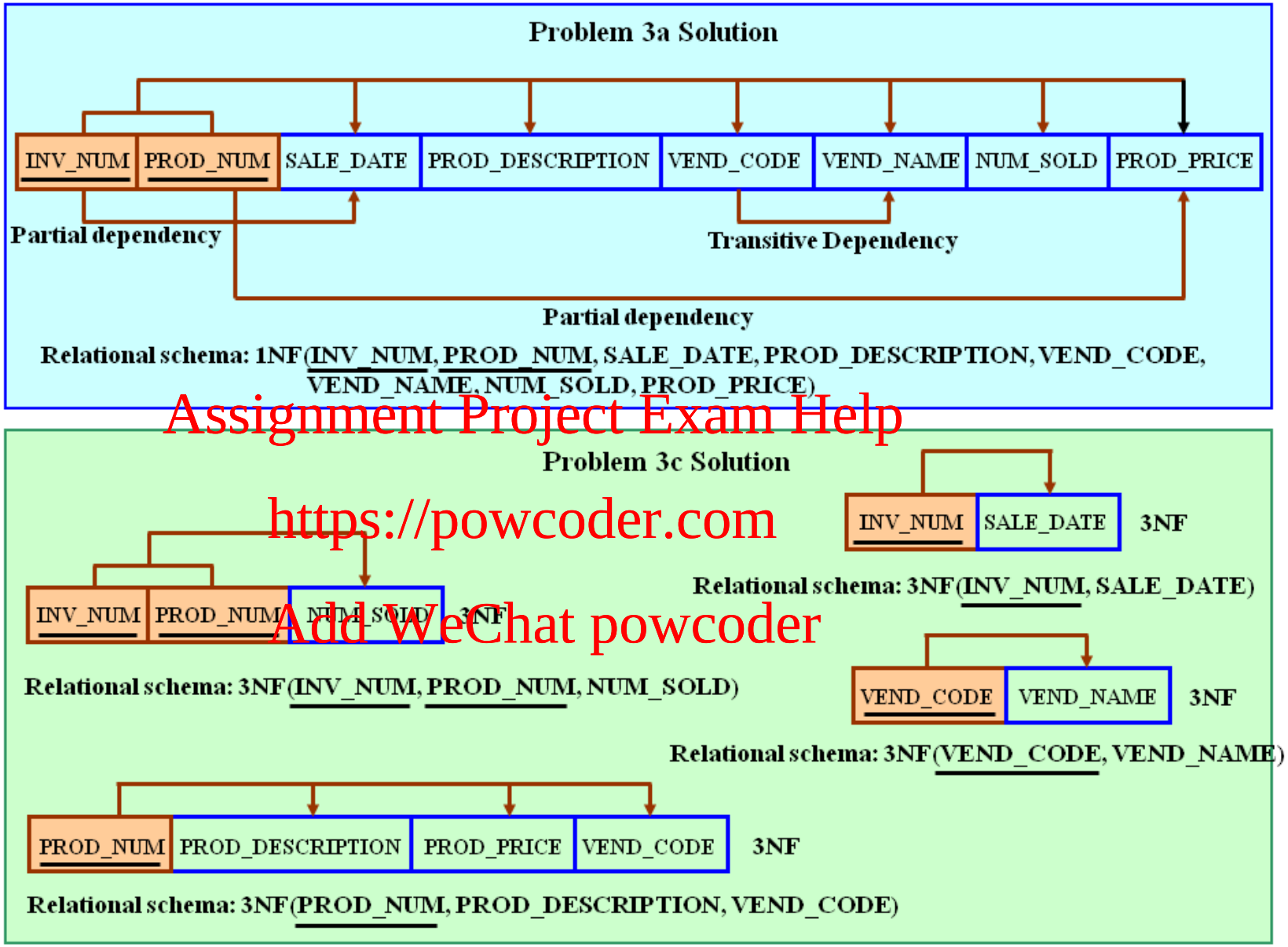
Solution to Exercise 3



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Exercise 4 – Functional Dependency

Prove or disprove the following property using **Armstrong's Axioms Primary Rules** only.

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If $V \rightarrow W$, $V \subseteq Y$ and $\{T, K\} \rightarrow Y$, then $\{Y, K\} \rightarrow \{T, W\}$.

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If the property is held, you have to clearly state the rules used. If a property is NOT held, disprove it by giving a counter example (a set of sample instance).

Solution to Exercise 4

If $V \rightarrow W$, $V \subseteq Y$ and $\{Y, K\} \rightarrow T$, then $\{Y, K\} \rightarrow \{T, W\}$.

The property holds. The proof is as follows:

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$(1) \{Y, K\} \rightarrow T$ (Given)

$(2) \{Y, K, V\} \rightarrow \{T, V\}$ (Augmentation of Y and (1))

$(3) V \rightarrow W$ (Given)

$(4) \{T, V\} \rightarrow \{T, W\}$ (Augmentation of T and (3))

$(5) \{Y, K, V\} \rightarrow \{T, W\}$ (Transitivity of (2) and (4))

$(6) V \subseteq Y$ (Given)

$(7) \{Y, K, V\} = \{Y, K\}$ (Trivial with (6))

$(8) \{Y, K\} \rightarrow \{T, W\}$ (Trivial with (5) and (7))

$V \subseteq Y$, i.e., V is part of Y.
Thus, $\{Y, V\} = Y$.

Armstrong's Axioms Primary Rules

i. Inclusion (Reflexive) rule: If $Y \subseteq X$, then $X \rightarrow Y$.
ii. Augmentation rule: If $X \rightarrow Y$, then $\{W, X\} \rightarrow \{W, Y\}$.
iii. Transitivity rule: If $X \rightarrow Y$ and $Y \rightarrow Z$, then $X \rightarrow Z$.

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Questions

Source: metlifepetinsurance.com