Database Design 1: Conceptual Modelling

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ANSI/SPARC architecture

External level

| View 1 | View 2 | .... | View *n* |

Conceptual level

Conceptual Schema

Internal level

Internal Schema

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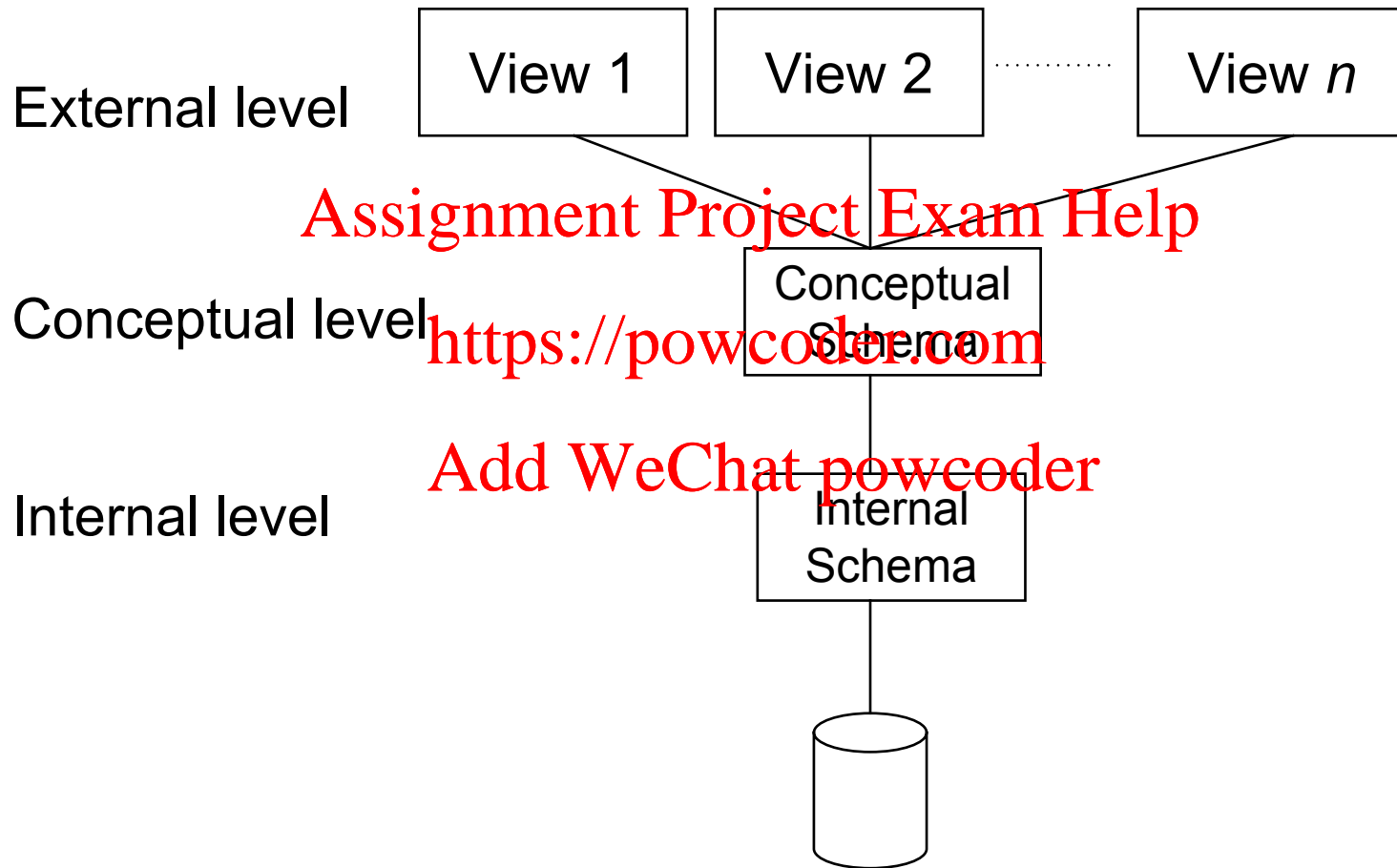
The Database Design Life Cycle

```
┌─────────────────┐
│  Requirements   │
│   Definition    │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│   Conceptual    │
│     Design      │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│     Logical     │
│     Design      │
└─────────────────┘
         │
         ▼
┌─────────────────┐
│    Physical     │
│     Design      │
└─────────────────┘
```
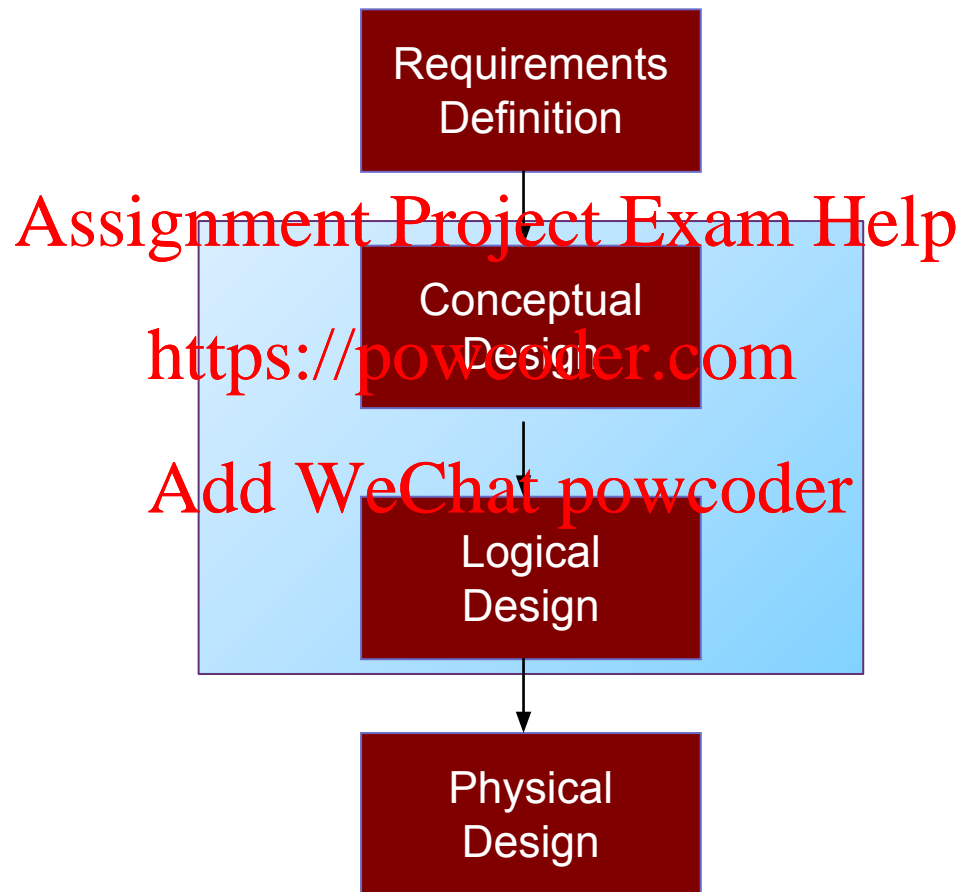
Requirements Definition

- Identify and analyse user views.
- A 'user view' may be a report to be produced or a particular type of transaction that should be supported.
- Corresponds to the external level of the ANSI/SPARC architecture.
- Output is a statement of specifications which describes the user views' particular requirements and constraints.

Student view

Staff and Student View

Unit guides

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FIT2094: Databases

Semester 2 (S2-01) 2018

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Unit handbook information
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Chief Examiner
Campus Lecturer(s)

FIT2094

Databases

Semester 2, 2018

The information contained in this unit guide is correct at time of publication. The University has the right to change any of the elements contained in this document at any time.

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Status: Approved

Table of contents

Admin View

ER Modeling

- ER (Entity-Relationship) model developed by Peter Chen in 1976 to aid database design.

- May be used for conceptual (ERD)/logical design (ERD like).

- ER diagrams give a visual indication of the design.

- Basic components:

  – Entity

  – Attribute

  – Relationship

Conceptual Design

- Develop the enterprise data model.

- Corresponds to the conceptual level of the ANSI/SPARC architecture.

- Independent of all physical implementation considerations.

- Various design methodologies may be employed, including the ER (Entity-Relationship) approach.

Conceptual Level (ER Model) - Keys only

STAFF

Key	staffID

teaches

CLASS

Key	unitcode
Key	ofyear
Key	semester
Key	staffID

runs

STUDENT

Key	studID

studies

ENROLMENT

Key	studID
Key	unitcode
Key	ofyear
Key	semester

is_taken_by

OFFERING

Key	unitcode
Key	semester
Key	ofyear

contains

UNIT

Key	unitcode

STUDENT

Key	studID

enrols in

STAFF

Key	staffID

teaches

OFFERING

Key	unitcode
Key	semester
Key	ofyear

contains

UNIT

Key	unitcode

Ass 1 Part A

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Conceptual Level (ER Model) – All Attributes
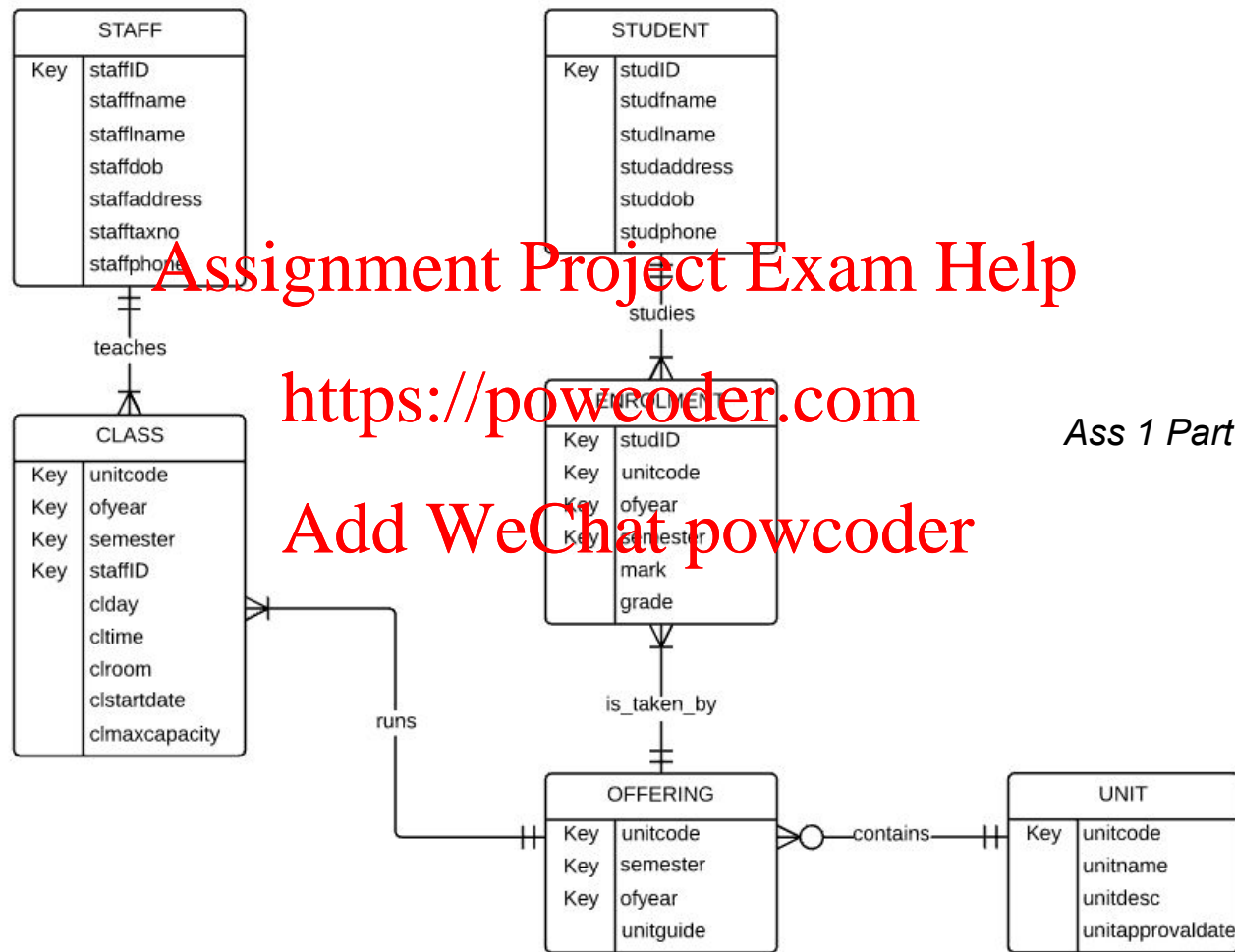
Ass 1 Part B

Logical Design

- Develop a data model which targets a particular database model (e.g. relational, hierarchical, network, object-oriented).

- Independent of any implementation details which are specific to any particular DBMS package.

- Normalisation technique (see week 5) is used to test the correctness of the logical model.

- May also be considered to correspond to the conceptual level of the ANSI/SPARC architecture.

Logical Level (Logical Model)

STAFF
P	*	STAFFID
	*	STAFFFNAME
	*	STAFFLNAME
	*	STAFFDOB
	*	STAFFADDRESS
	*	STAFFTAXNO
	*	STAFFPHONE

STUDENT
P	*	STUDID
	*	STUDFNAME
	*	STUDLNAME
	*	STUDADDRESS
	*	STUDDOB
	*	STUDPHONE

CLASS
PF	*	UNITCODE
PF	*	OFYEAR
PF	*	SEMESTER
PF	*	STAFFID
	*	CLDAY
	*	CLTIME
	*	CLROOM
	*	CLSTARTDATE
	*	CLENDDATE
	*	CLMAXCAPACITY

ENROLMENT
PF	*	STUDID
PF	*	UNITCODE
PF	*	OFYEAR
PF	*	SEMESTER
		MARK
		GRADE

teaches

is_taken_by

Ass 1 Part B

OFFERING
PF	*	UNITCODE
P	*	SEMESTER
P	*	OFYEAR
	*	UNITGUIDE

runs

contains

UNIT
P	*	UNITCODE
	*	UNITNAME
	*	UNITDESC
	*	UNITAPPROVALDATE

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Physical Design

- Develop a strategy for the physical implementation of the logical data model.

- Choose appropriate storage structures, indexes, file organisations and access methods which will most efficiently support the user requirements.

- Physical design is dependent on the particular DBMS environment in use.

- ANSI/SPARC internal level.

- Shown in SQL Developer Data Modeller as the Relational Model

Physical Level – Starting point

```
Oracle Database 11g ▼   Relational_1 ▼        Generate        Clear

 9 ⊟ create
10     table enrolment
11     (
12        unitcode  char (10) not null ,
13        semester  number (1) not null ,
14        ofyear    date not null ,
15        studid    number (10) not null ,
16        mark      number (3) ,
17        grade .   char (2)
18     );
19
20
21   alter table enrolment add constraint enrol_mark_chk check (mark between 0 and
22   100) ;
23
24   alter table enrolment add constraint enrol_grade_chk check (grade in ('N','P',
25   'C','D','HD') ;
26
27   alter table enrolment add constraint enrol_pk primary key ( semester, ofyear,
28   studid, unitcode ) ;
29
30 ⊟ create
31     table offering
32     (
33        unitcode  char (10) not null ,
34        semester  number (1) not null ,
35        ofyear    date not null ,
36        chiefexam number (10) not null
37     ) ;
38
39   alter table offering add constraint semester_chk check (semester between 1 and
40   3) ;
41
42
43   alter table offering add constraint offering_pk primary key ( unitcode,
44   semester, ofyear ) ;
45
46 ⊟ create
47     table prereq
48     (
49        unitcode      char (10) not null
```
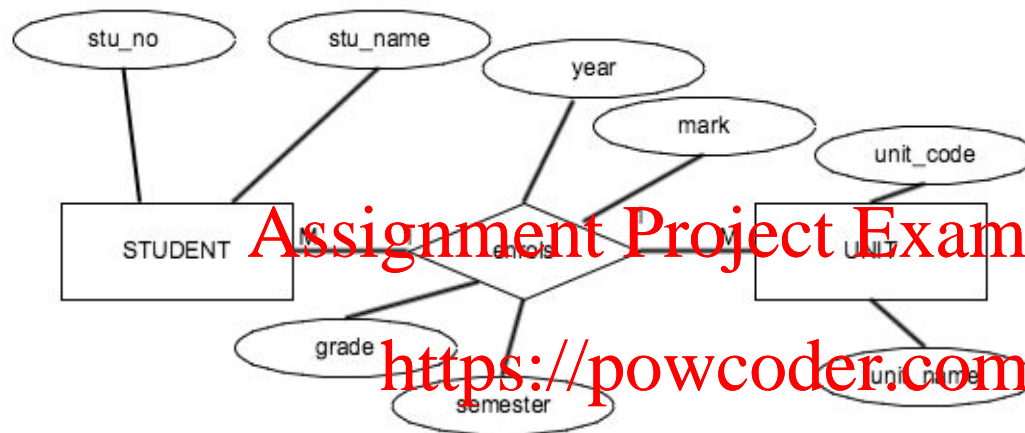
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ENTITY RELATIONSHIP DIAGRAM
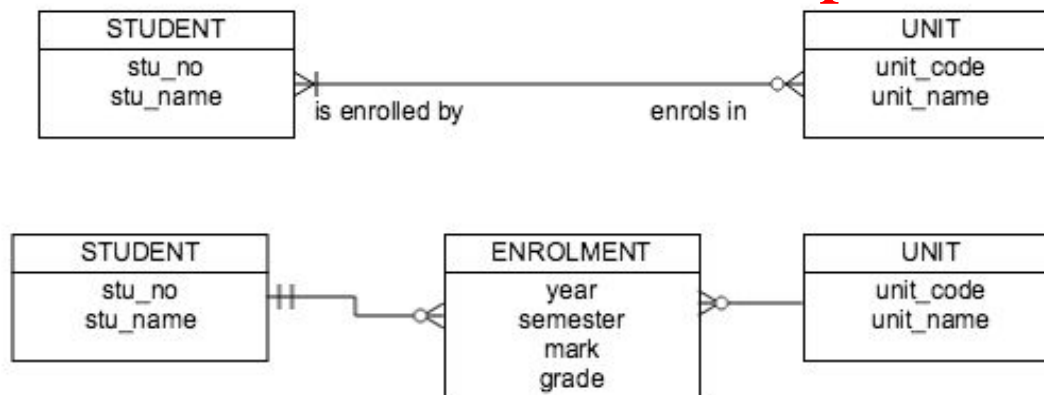
ERD - Notation

Information Engineering/James Martin/Crows foot

ERD – Notation cont'd

Chen's Notation

- Semantically rich.
- Complex diagram.
- 'Pure' conceptual level.

Information Engineering

- Less semantics.
- Simpler diagram.
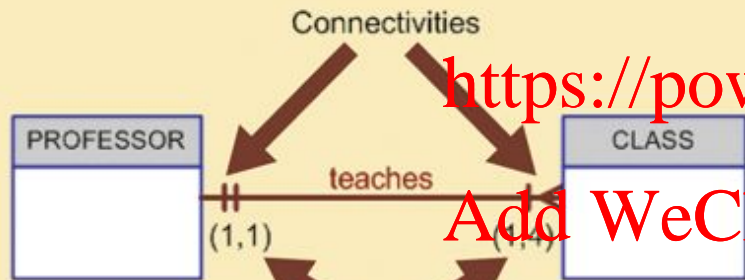- Mix between conceptual and logical levels.

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Entity, Attributes and Relationships

FIGURE 4.7 Connectivity and cardinality in an ERD

Connectivities

PROFESSOR

teaches

CLASS

(1,1)

Cardinalities

SOURCE: Course Technology/Cengage Learning

one to many

supports

A ——|——< B

one to one

supports

A ——————|— B

many to many

supports

A >——————< B
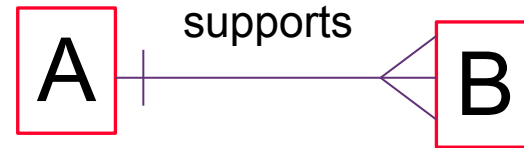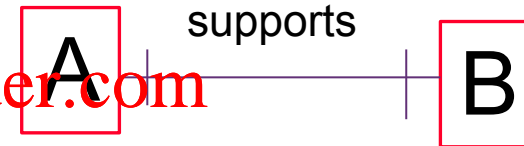
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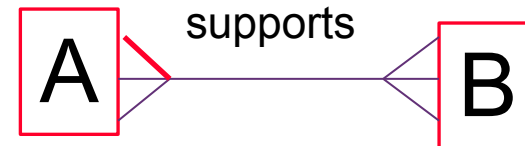
FIGURE 4.15 — Three types of relationship degree

SOURCE: Course Technology/Cengage Learning

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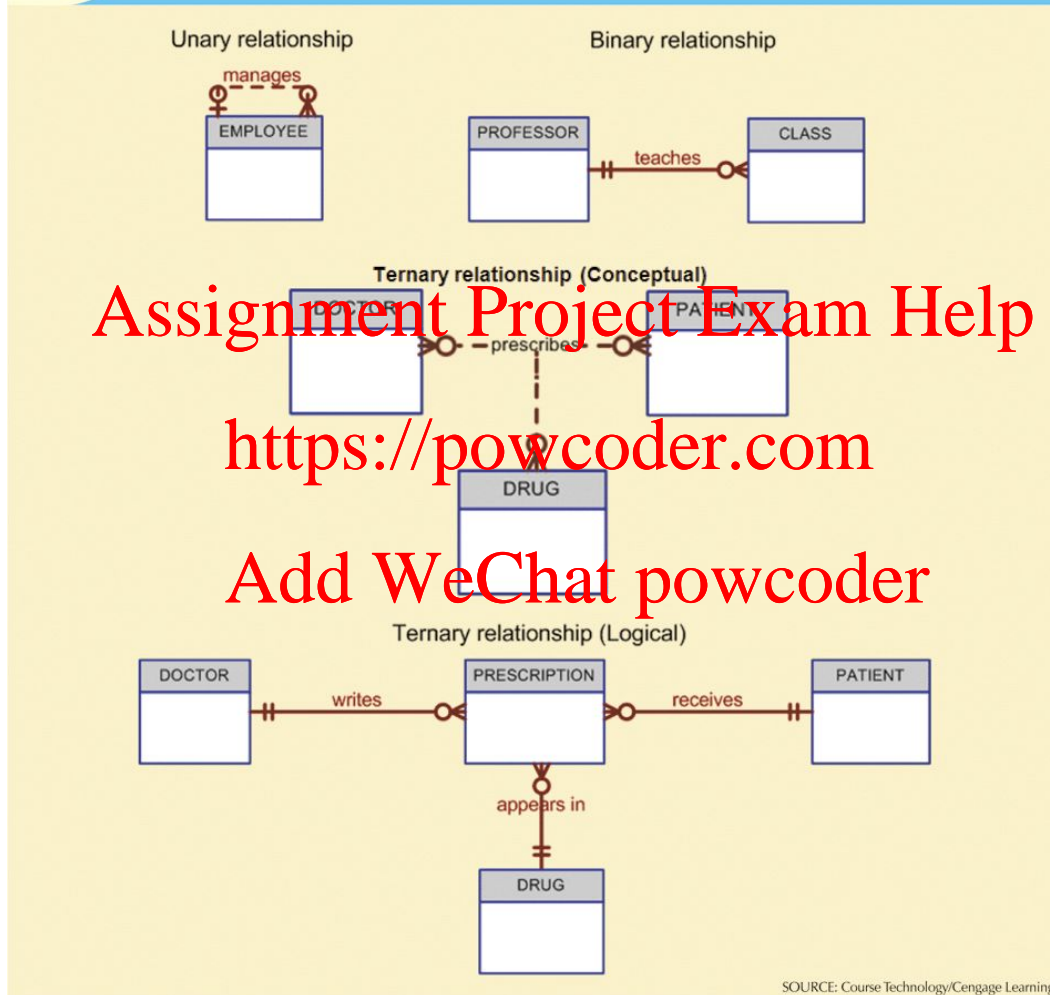
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Weak vs Strong Entity

- Strong entity
  - Has a key which may be defined without reference to other entities.
  - For example EMPLOYEE entity.
- Weak entity
  - Has a key which requires the existence of one or more other entities.
  - For example FAMILY entity - need to include the key of employee to create a suitable key for family
- Database designer often determines whether an entity can be described as weak based on business rules
  - customer pays monthly account
    - Key: cust_no, date_paid, or
    - Key: payment_no (surrogate? – not at conceptual level)
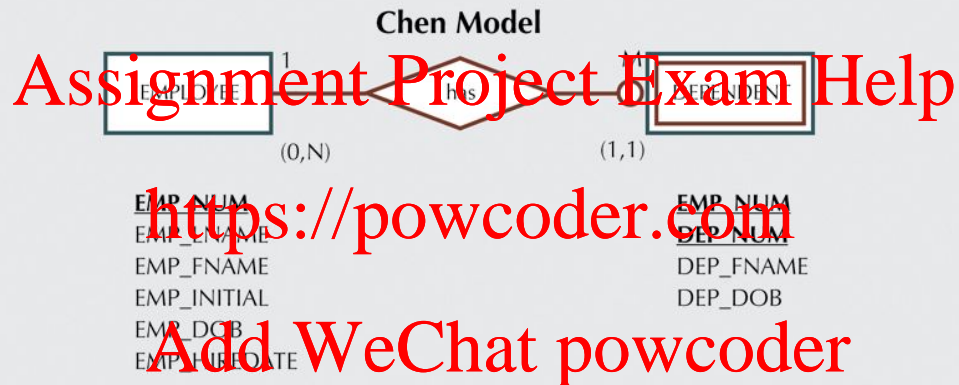
Weak vs Strong Entity

FIGURE 4.10 A weak entity in an ERD

SOURCE: Course Technology/Cengage Learning

Identifying vs Non-Identifying Relationship

Identifying

- Identifier of A is part of identifier of B.

Non-identifying

- Identifier of A is NOT part of identifier of B.

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- Shown with solid line
- Enrolment's PK includes student id, which is an identifier of student.
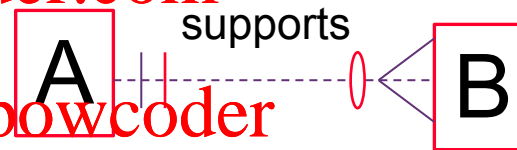
- Shown with broken line
- Department no (identifier of department) is not part of Employee's identifier.

Types of Attributes

- Simple
  - Cannot be subdivided
  - Age, sex, marital status
- Composite
  - Can be subdivided into additional attributes
  - Address into street, city, zip
- Single-valued
  - Can have only a single value
  - Person has one social security number

- Multi-valued
  - Can have many values
  - Person may have several college degrees
- Derived
  - Can be derived with algorithm
  - Age can be derived from date of birth

Multivalued Attribute

- An attribute that has a list of values.

- For example:
  - Car colour may consist of body colour, trim colour, bumper colour.

- Crow's foot notation does not support multivalued attributes. Values are listed as a separate attribute.

FIGURE 4.9   A multivalued attribute in an entity
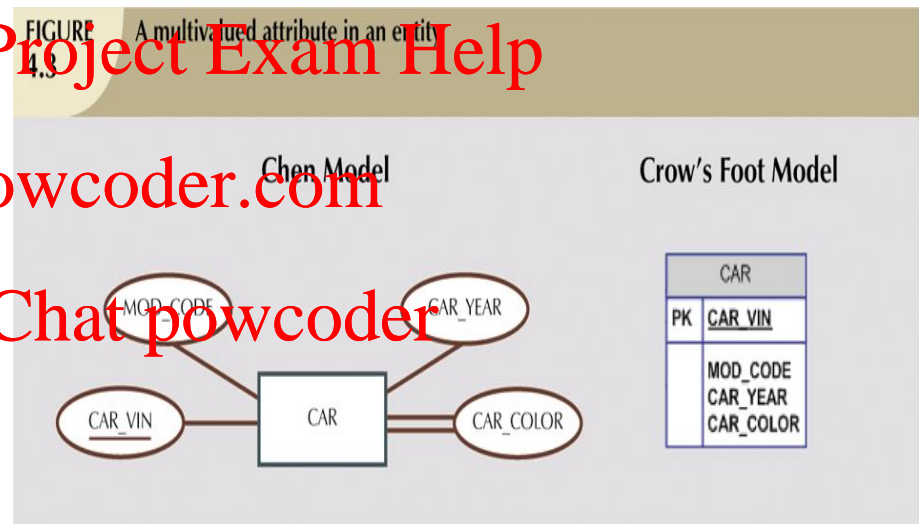
Resolving Multivalued Attributes
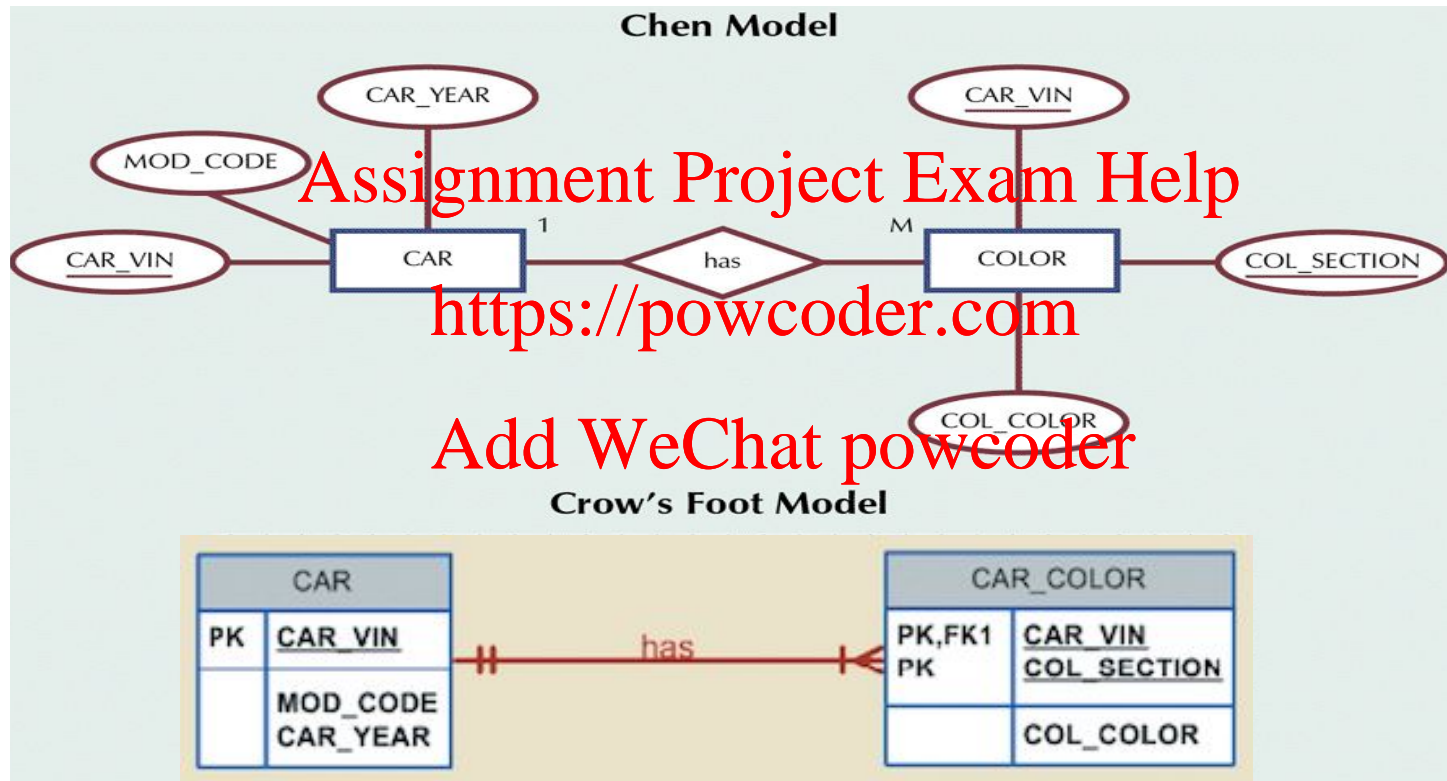
Associative (or Composite) Entity