MONASH University

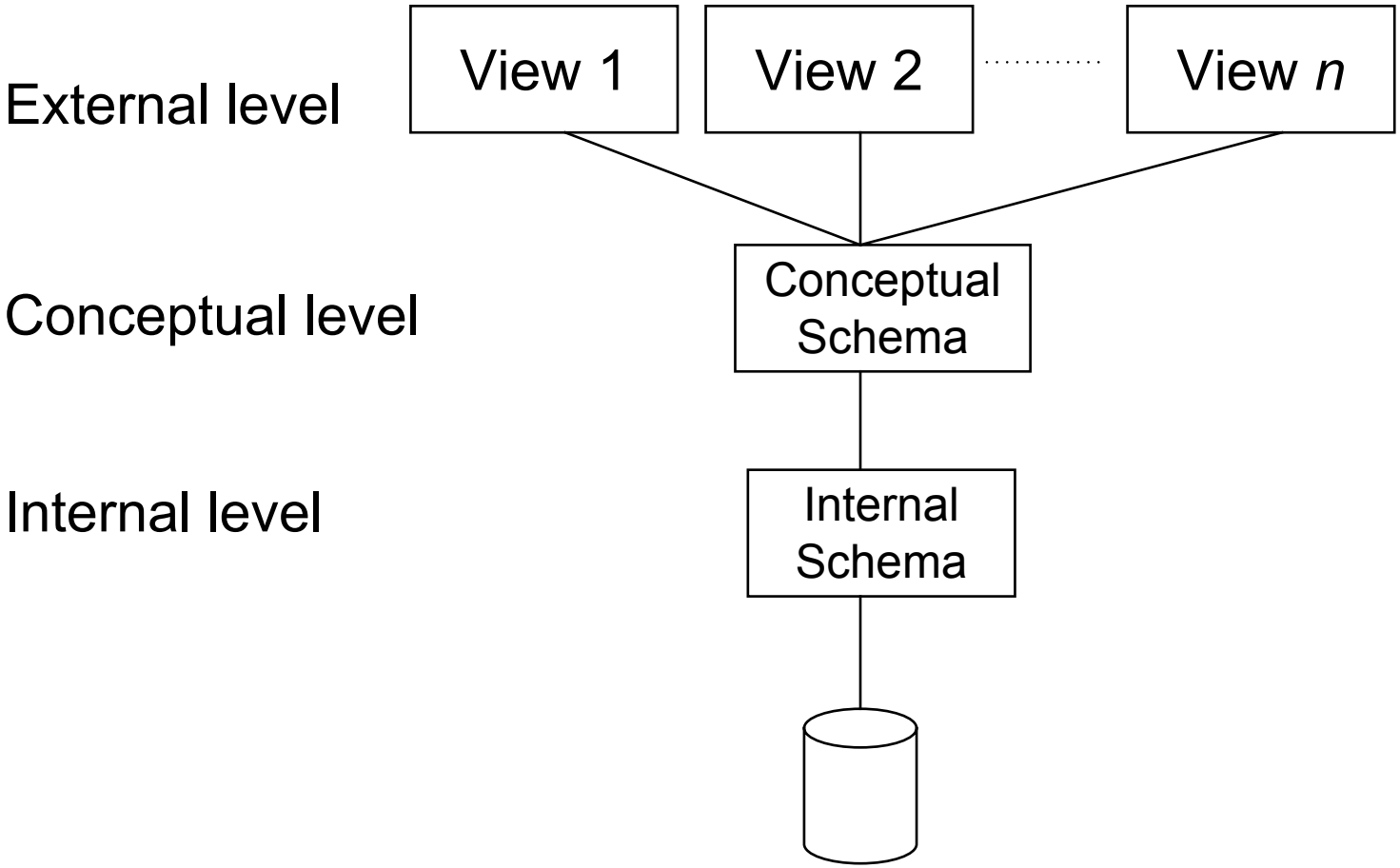
MONASH
INFORMATION
TECHNOLOGY

Database Design 1: Conceptual Modelling

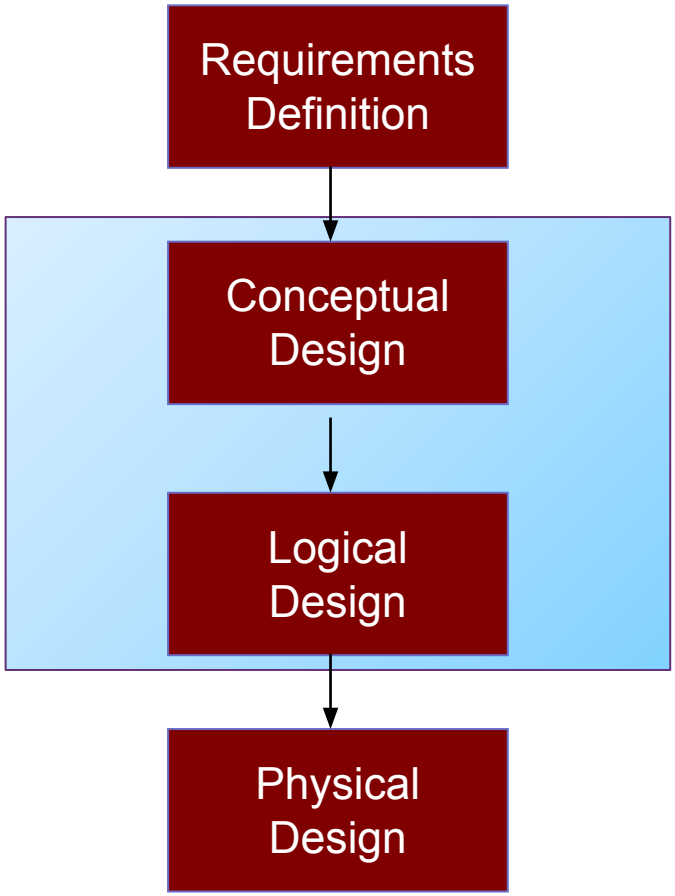
Lindsay Smith

GROUP OF EIGHT AUSTRALIA

ANSI/SPARC architecture



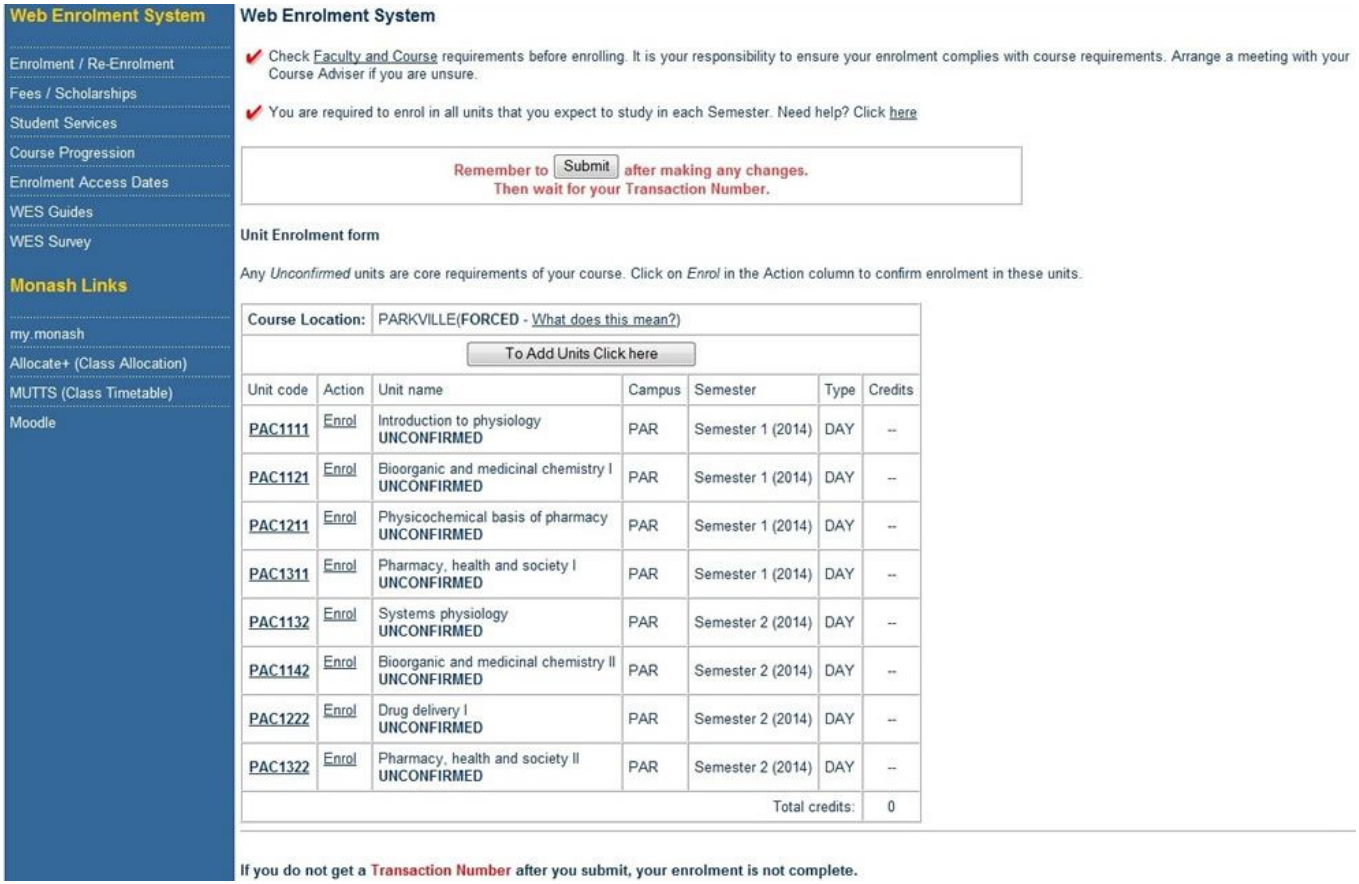
The Database Design Life Cycle



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



Web Enrolment System

- Enrolment / Re-Enrolment
- Fees / Scholarships
- Student Services
- Course Progression
- Enrolment Access Dates
- WES Guides
- WES Survey

Monash Links

- my.monash
- Allocate+ (Class Allocation)
- MUTTS (Class Timetable)
- Moodle

Web Enrolment System

✔ Check Faculty and Course requirements before enrolling. It is your responsibility to ensure your enrolment complies with course requirements. Arrange a meeting with your Course Adviser if you are unsure.

✔ You are required to enrol in all units that you expect to study in each Semester. Need help? Click here

Remember to Submit after making any changes.
Then wait for your Transaction Number.

Unit Enrolment form

Any *Unconfirmed* units are core requirements of your course. Click on *Enrol* in the Action column to confirm enrolment in these units.

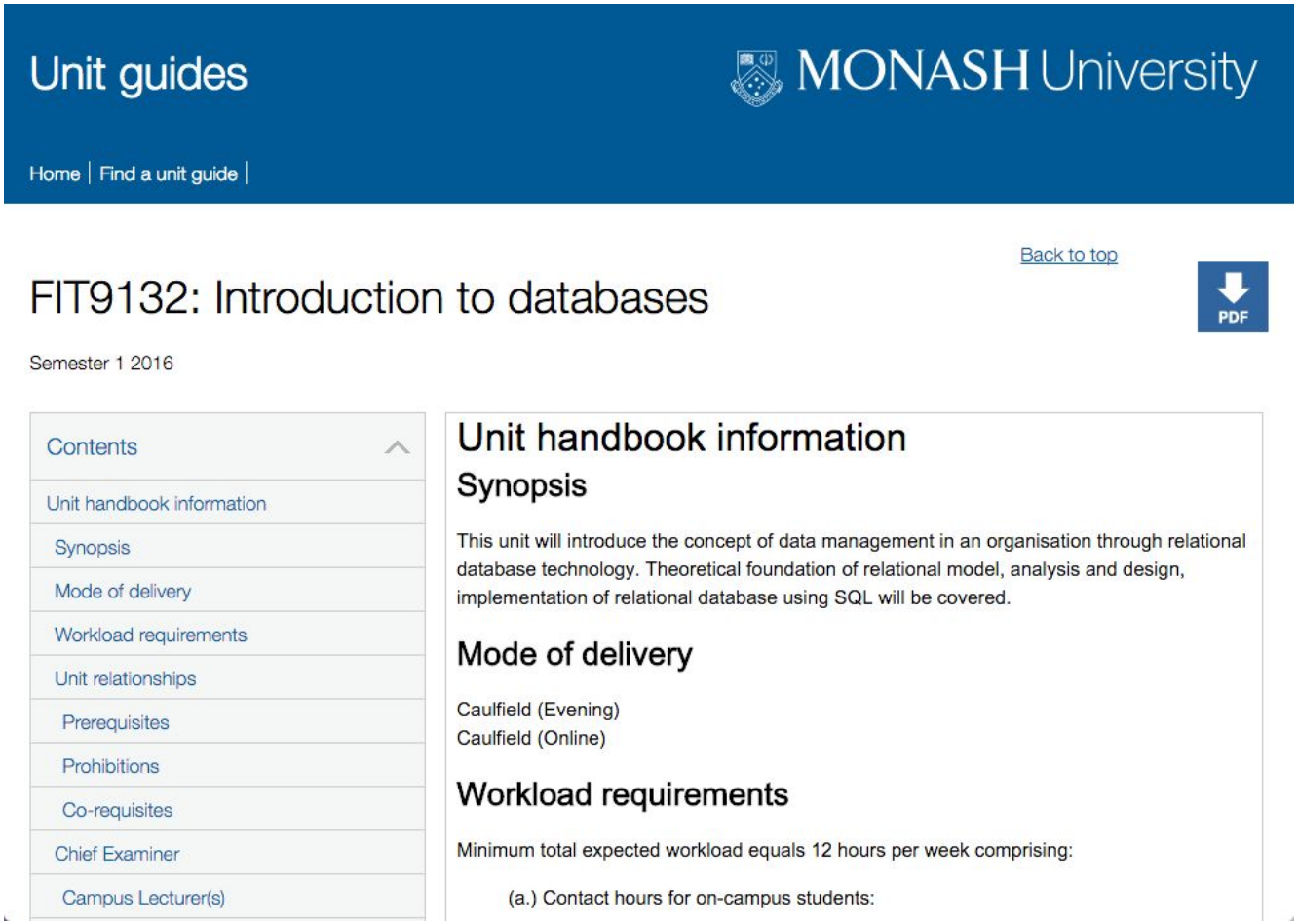
Course Location: PARKVILLE(**FORCED** - What does this mean?)

To Add Units Click here

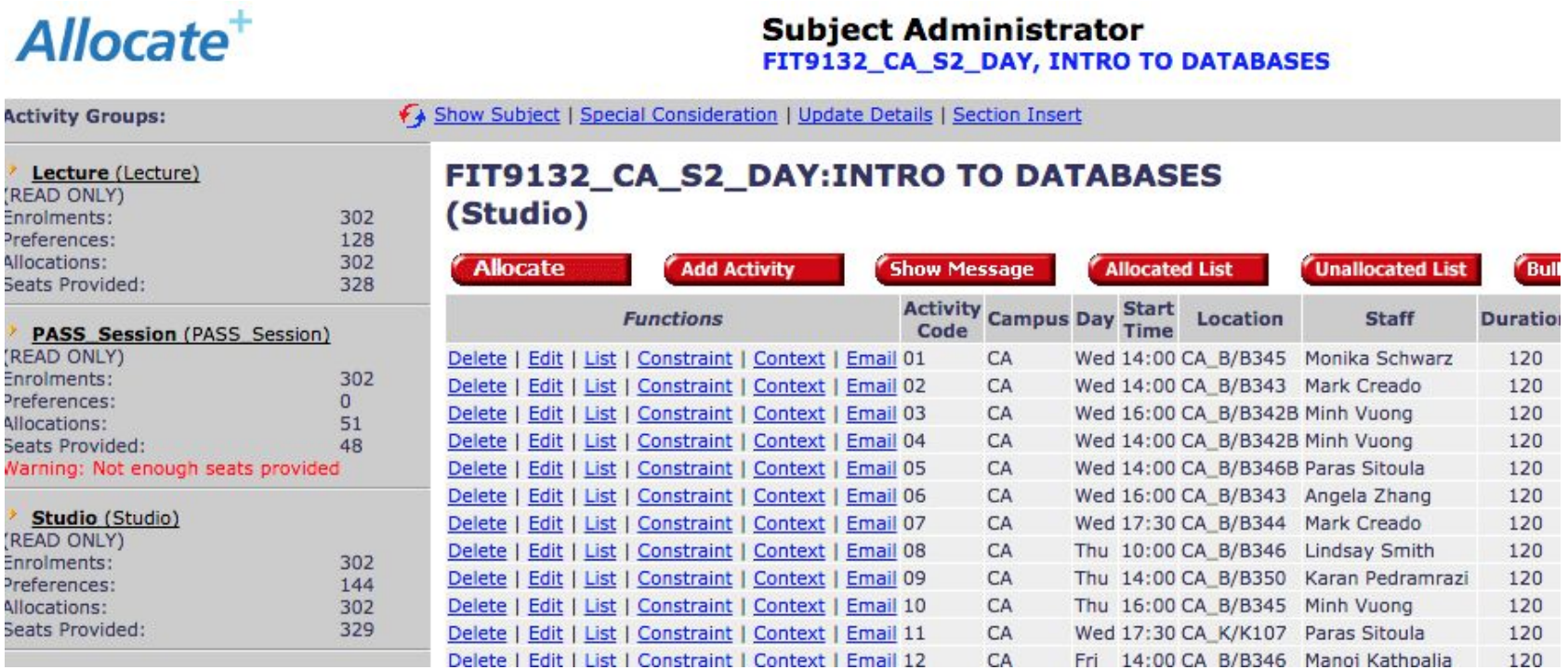
Unit code	Action	Unit name	Campus	Semester	Type	Credits
PAC1111	Enrol	Introduction to physiology **UNCONFIRMED**	PAR	Semester 1 (2014)	DAY	--
PAC1121	Enrol	Bioorganic and medicinal chemistry I **UNCONFIRMED**	PAR	Semester 1 (2014)	DAY	--
PAC1211	Enrol	Physicochemical basis of pharmacy **UNCONFIRMED**	PAR	Semester 1 (2014)	DAY	--
PAC1311	Enrol	Pharmacy, health and society I **UNCONFIRMED**	PAR	Semester 1 (2014)	DAY	--
PAC1132	Enrol	Systems physiology **UNCONFIRMED**	PAR	Semester 2 (2014)	DAY	--
PAC1142	Enrol	Bioorganic and medicinal chemistry II **UNCONFIRMED**	PAR	Semester 2 (2014)	DAY	--
PAC1222	Enrol	Drug delivery I **UNCONFIRMED**	PAR	Semester 2 (2014)	DAY	--
PAC1322	Enrol	Pharmacy, health and society II **UNCONFIRMED**	PAR	Semester 2 (2014)	DAY	--
					Total credits:	0

If you do not get a Transaction Number after you submit, your enrolment is not complete.

Staff and Student View



Admin View


Allocate+
Subject Administrator
FIT9132_CA_S2_DAY, INTRO TO DATABASES
Activity Groups:
Show Subject | Special Consideration | Update Details | Section Insert
Lecture (Lecture)
(READ ONLY)
Enrolments: 302
Preferences: 128
Allocations: 302
Seats Provided: 328
PASS_Session (PASS_Session)
(READ ONLY)
Enrolments: 302
Preferences: 0
Allocations: 51
Seats Provided: 48
Warning: Not enough seats provided
Studio (Studio)
(READ ONLY)
Enrolments: 302
Preferences: 144
Allocations: 302
Seats Provided: 329
FIT9132_CA_S2_DAY:INTRO TO DATABASES
(Studio)
Allocate
Add Activity
Show Message
Allocated List
Unallocated List
Functions
Activity Code
Campus
Day
Start Time
Location
Staff
Delete | Edit | List | Constraint | Context | Email 01 CA Wed 14:00 CA_B/B345 Monika Schwarz 120
Delete | Edit | List | Constraint | Context | Email 02 CA Wed 14:00 CA_B/B343 Mark Creado 120
Delete | Edit | List | Constraint | Context | Email 03 CA Wed 16:00 CA_B/B342B Minh Vuong 120
Delete | Edit | List | Constraint | Context | Email 04 CA Wed 14:00 CA_B/B342B Minh Vuong 120
Delete | Edit | List | Constraint | Context | Email 05 CA Wed 14:00 CA_B/B346B Paras Sitoula 120
Delete | Edit | List | Constraint | Context | Email 06 CA Wed 16:00 CA_B/B343 Angela Zhang 120
Delete | Edit | List | Constraint | Context | Email 07 CA Wed 17:30 CA_B/B344 Mark Creado 120
Delete | Edit | List | Constraint | Context | Email 08 CA Thu 10:00 CA_B/B346 Lindsay Smith 120
Delete | Edit | List | Constraint | Context | Email 09 CA Thu 14:00 CA_B/B350 Karan Pedramrazi 120
Delete | Edit | List | Constraint | Context | Email 10 CA Thu 16:00 CA_B/B345 Minh Vuong 120
Delete | Edit | List | Constraint | Context | Email 11 CA Wed 17:30 CA_K/K107 Paras Sitoula 120
Delete | Edit | List | Constraint | Context | Email 12 CA Fri 14:00 CA_B/B346 Manoj Kathpalia 120

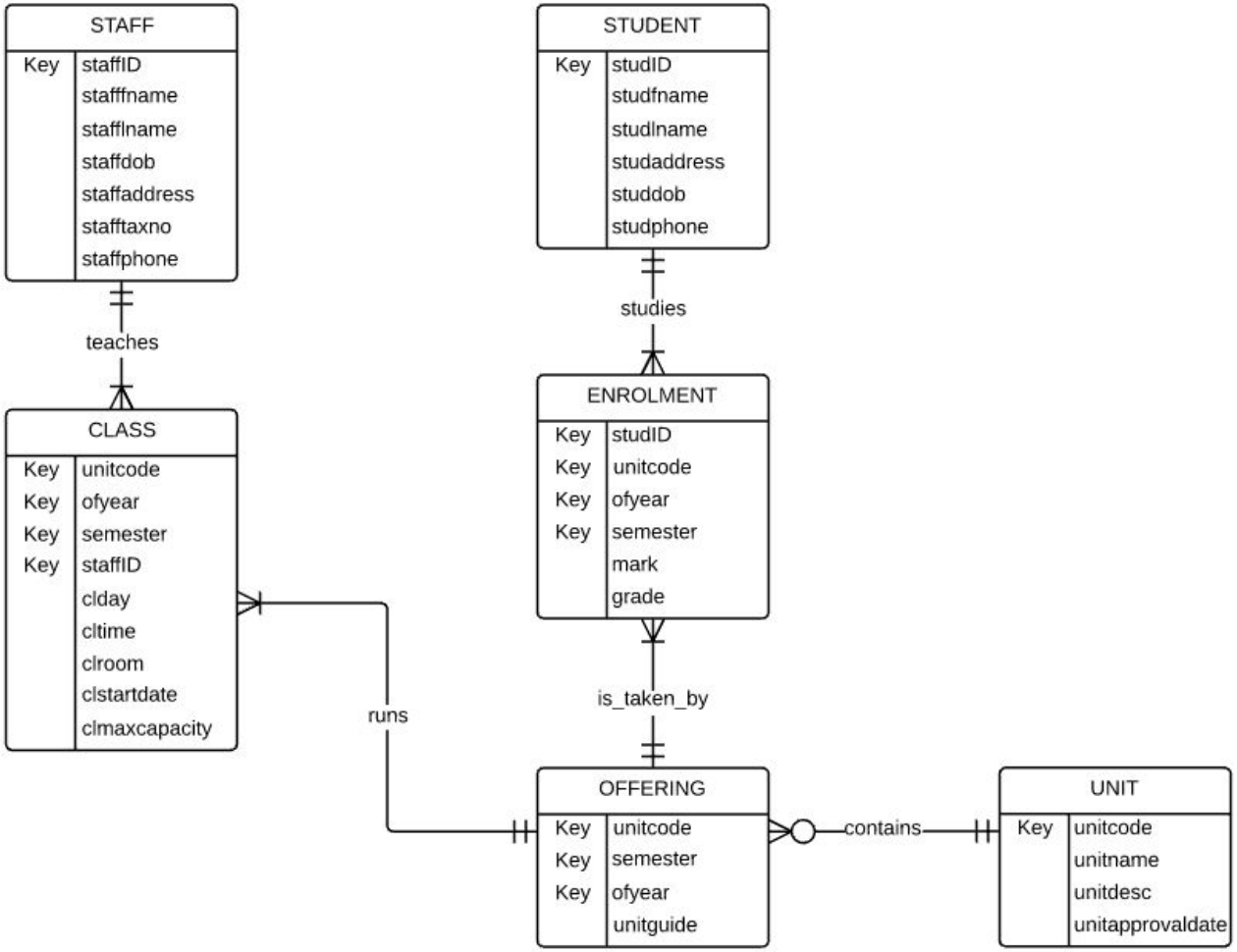
ER Modeling

- 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

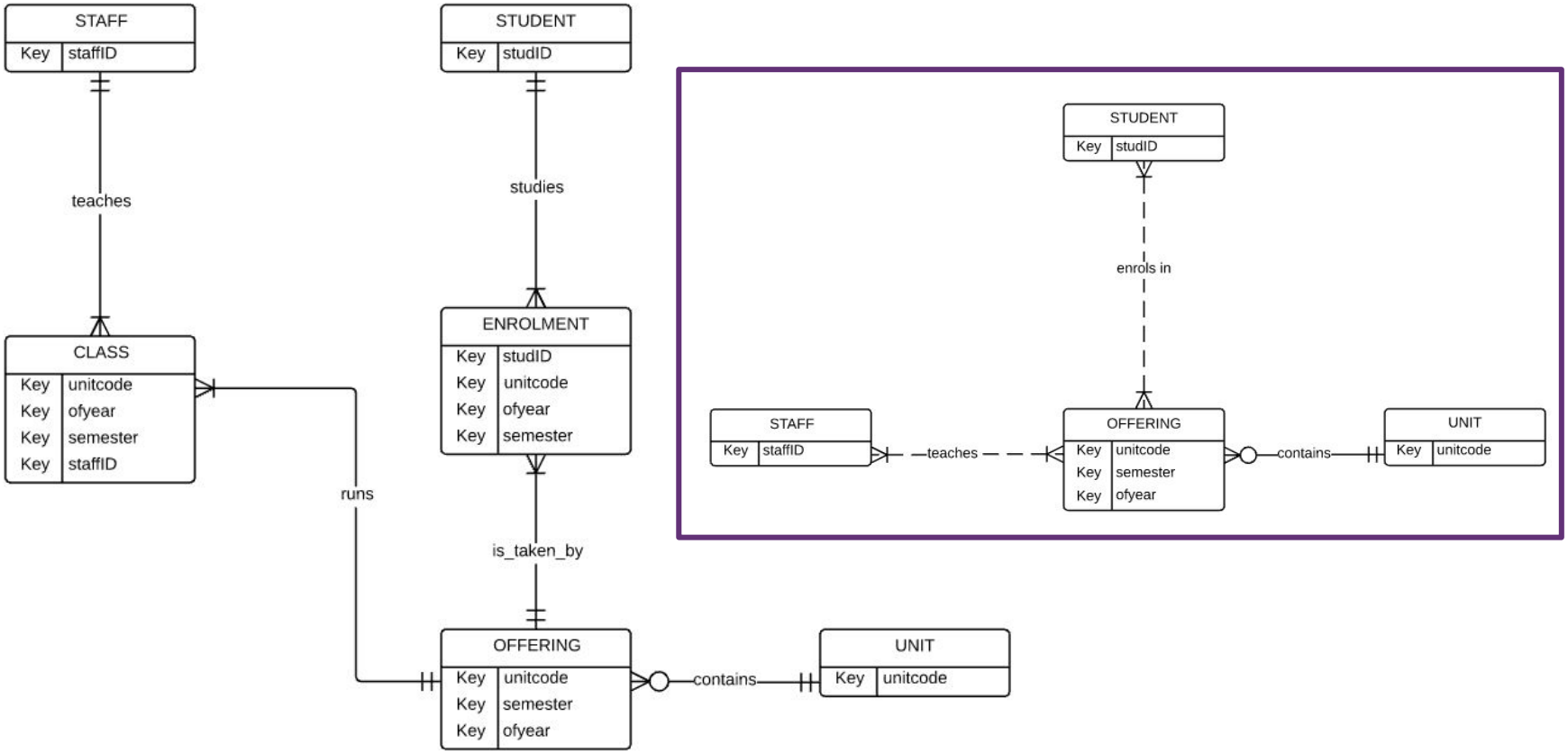
Conceptual Design

- 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)



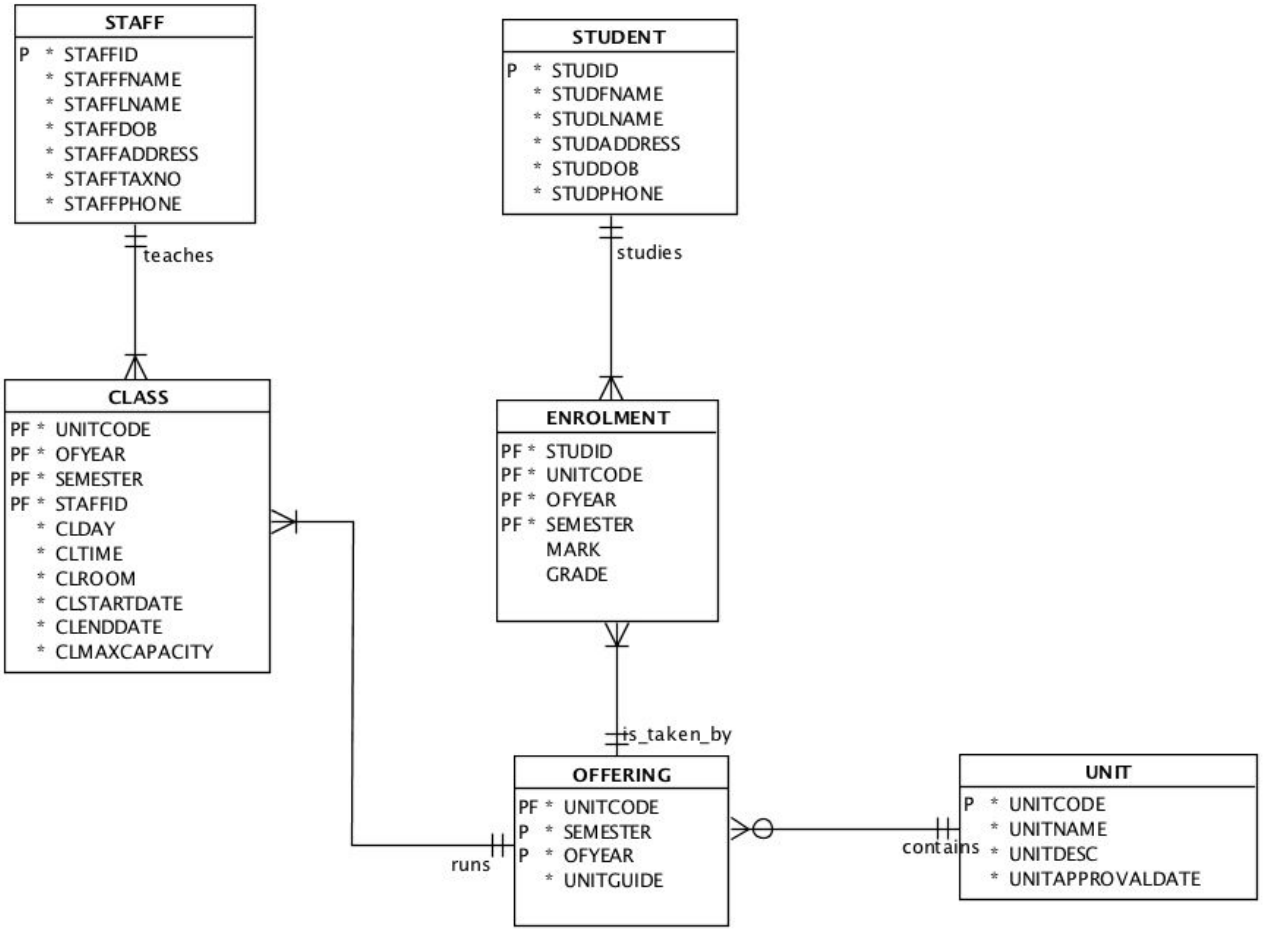
Conceptual Level (ER Model) - Keys only



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.

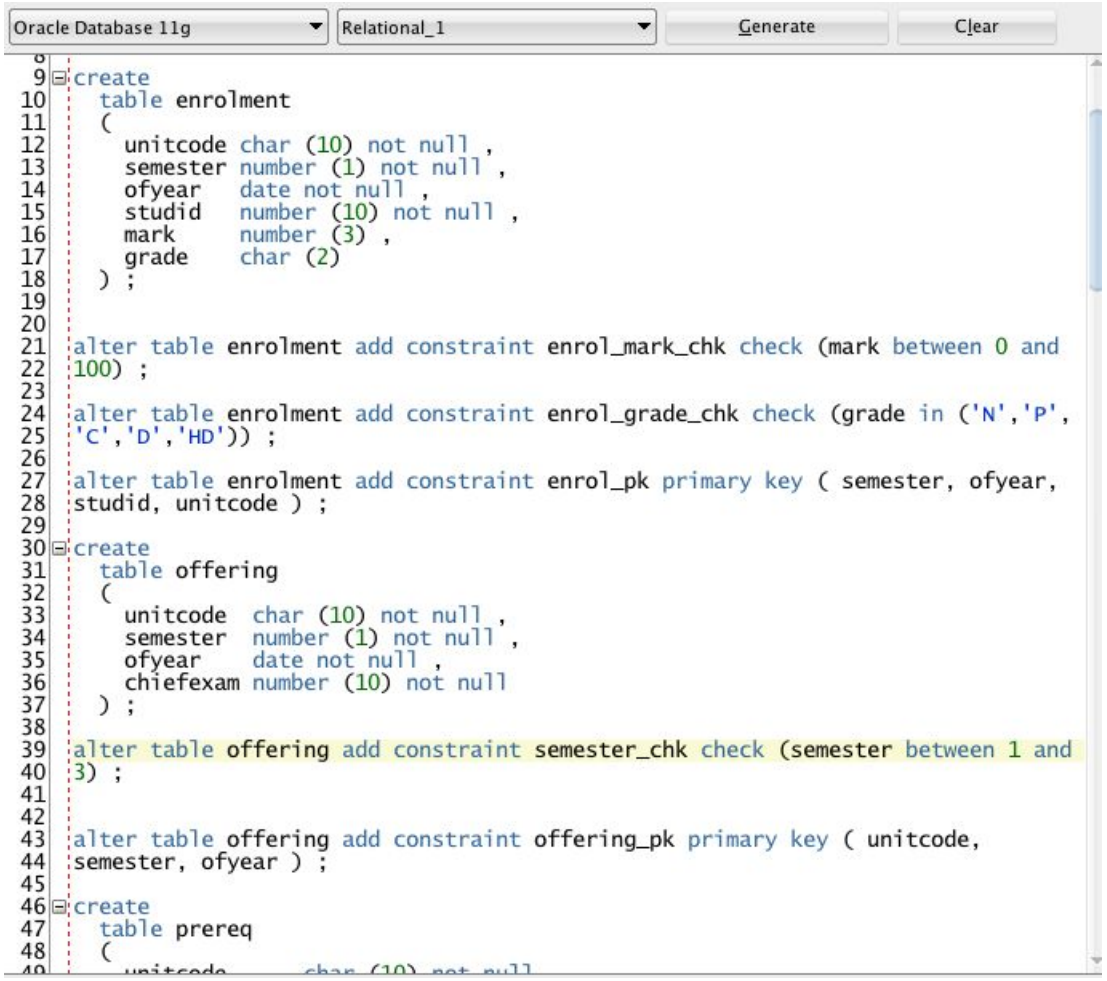
Logical Level (Logical Model)



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 phase 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




```
create
  table enrolment
  (
    unitcode char (10) not null ,
    semester number (1) not null ,
    ofyear   date not null ,
    studid   number (10) not null ,
    mark     number (3) ,
    grade    char (2)
  ) ;


alter table enrolment add constraint enrol_mark_chk check (mark between 0 and
100) ;

alter table enrolment add constraint enrol_grade_chk check (grade in ('N','P',
'C','D','HD')) ;

alter table enrolment add constraint enrol_pk primary key ( semester, ofyear,
studid, unitcode ) ;

create
  table offering
  (
    unitcode  char (10) not null ,
    semester  number (1) not null ,
    ofyear    date not null ,
    chiefexam number (10) not null
  ) ;

alter table offering add constraint semester_chk check (semester between 1 and
3) ;


alter table offering add constraint offering_pk primary key ( unitcode,
semester, ofyear ) ;

create
  table prereq
  (
    unitcode      char (10) not null
```

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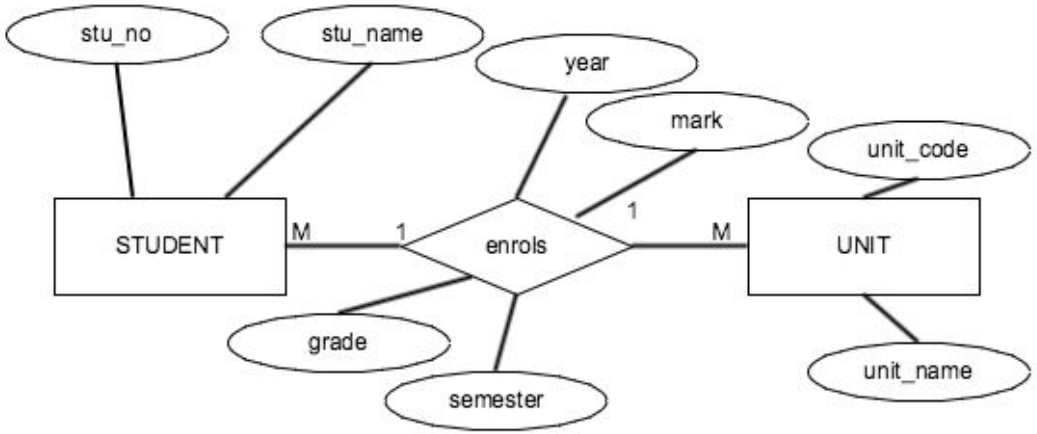
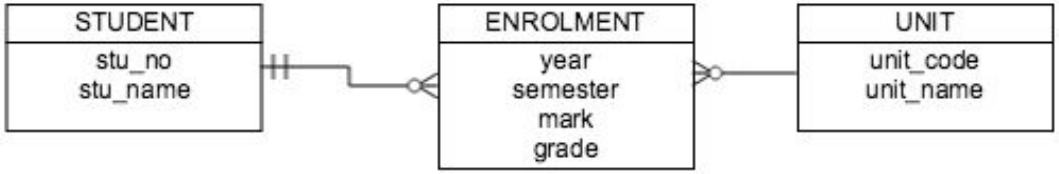
ENTITY RELATIONSHIP DIAGRAM

ERD - Notation



Chen



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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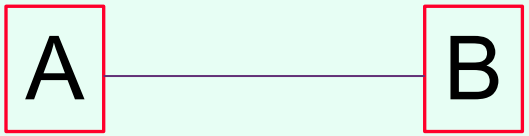
Entity, Attributes and Relationships

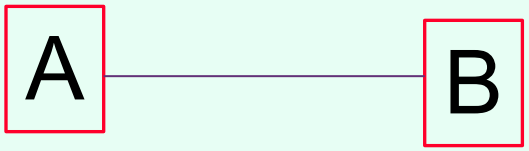


Please note this diagram is incomplete

Q1. How many entities are there in the above diagram?

A. 1
B. 2
C. 3
D. 4

mars.mu
Feed Code: F5CQAT



Please note this diagram is incomplete

Q2. How many relationship are there on the above diagram?

What is the degree of the relationship (the number of entities participating in the relationship) ?

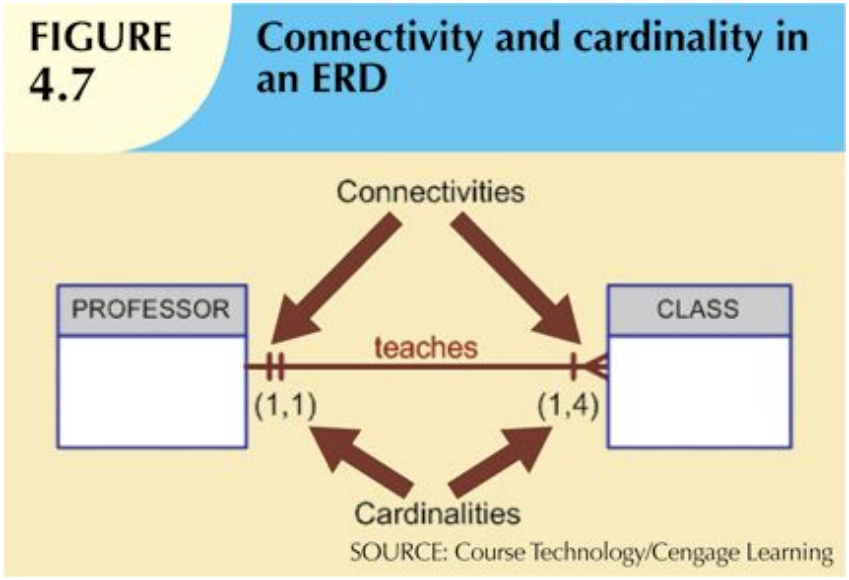
A. 1, unary
B. 2, binary
C. 1, binary
D. 3, ternary

Q3. "An employee is assigned to be a member of a team. A team with more than 5 members will have a team leader. The members of the team elect the team leader."

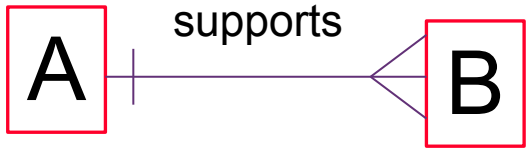
List the entity(s) which you can identify in the above statement. Enter them one by one - select the tick for each and then use the X to add a second entity if required.

Q4. How many relationships connect TEAM and EMPLOYEE?

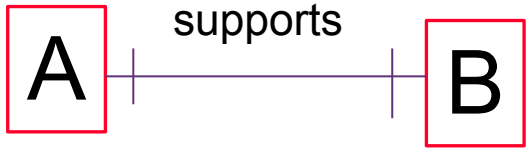
A. 1
B. 2
C. 3
D. 4



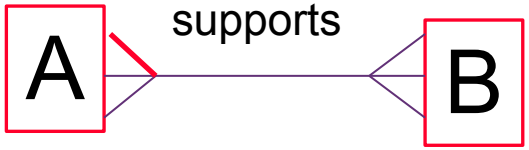
one to many



one to one



many to many



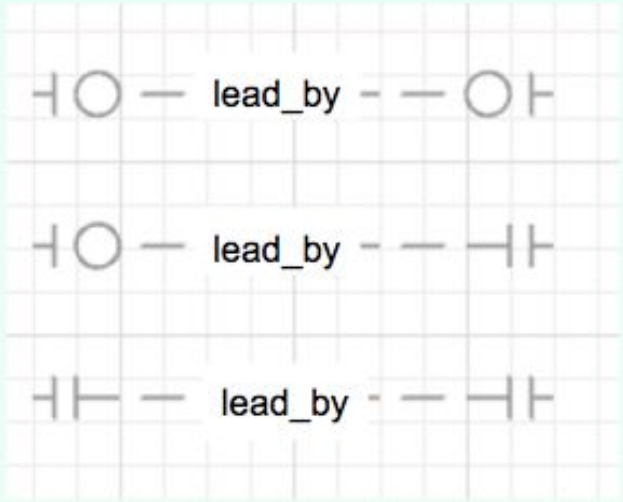
Relationship Participation

Q5. "A Team with more than 5 members will have a team leader. The members of the team elect the team leader."

What is the relationship participation of the relationship

TEAM --- lead_by --- EMPLOYEE

A.



B.

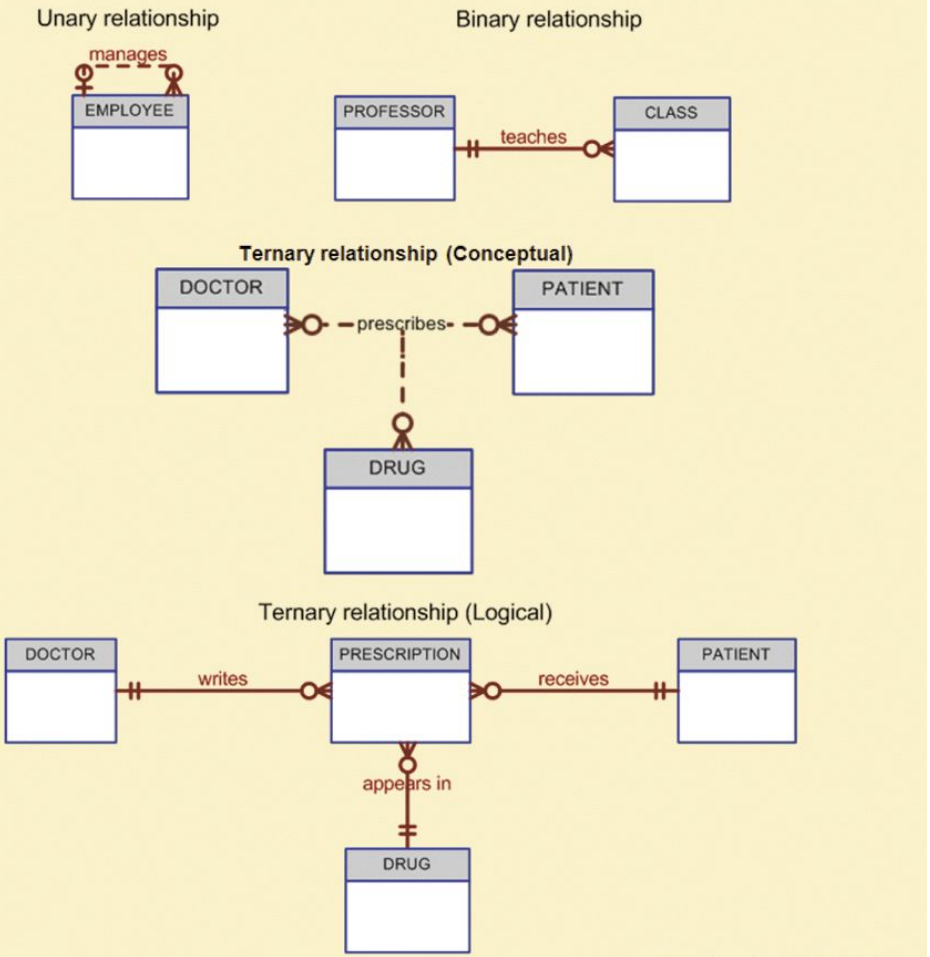
C.

Q6. "The company also introduced a mentoring program, whereby a new employee will be paired with someone who has been in the company longer."

How many entity/ies do you need to model the mentoring program?

A. 1
B. 2
C. 3

FIGURE 4.15 Three types of relationship degree



SOURCE: Course Technology/Cengage Learning

Q7. "To attract high calibre talent, the company provides generous remuneration package as well as health insurance support for the employees and their family. To do this, the HR team needs to know the details of the family members. The family information will be recorded"

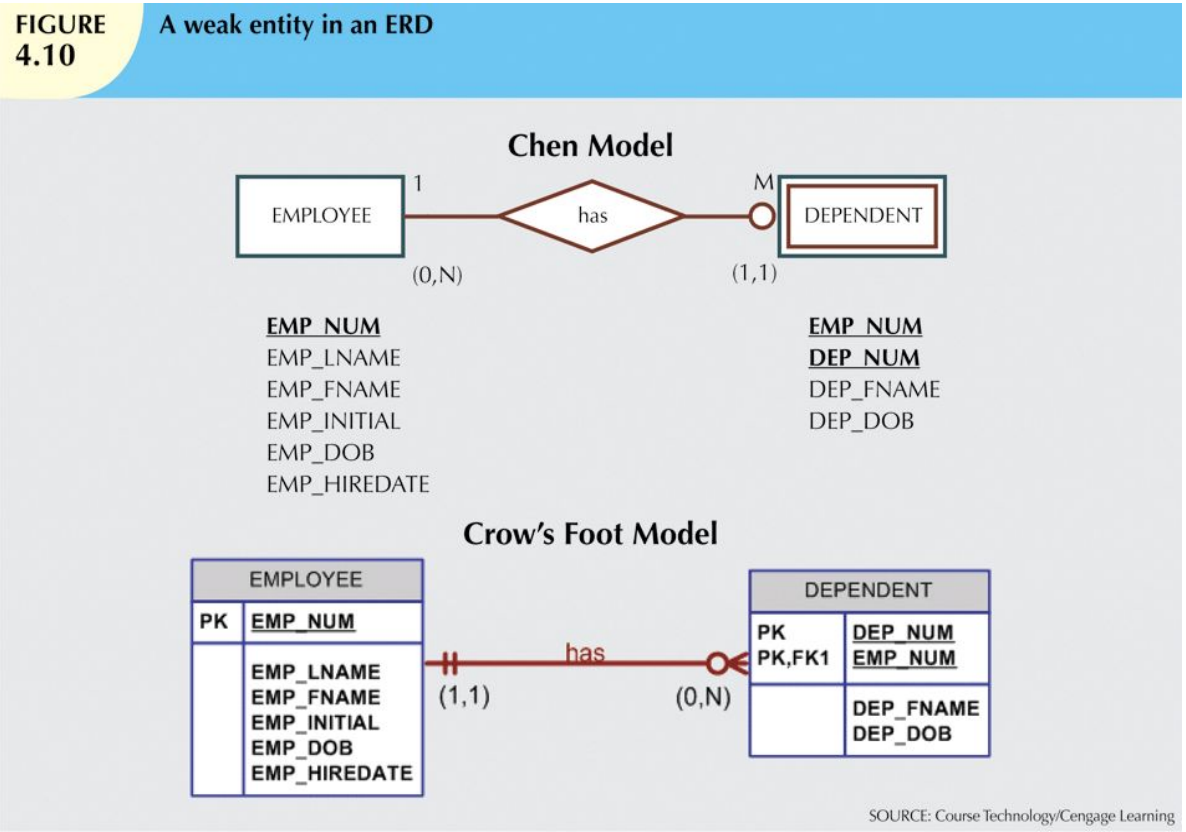
Choose a TRUE statement.

A. EMPLOYEE entity is a strong entity and FAMILY is a strong entity.
B. EMPLOYEE entity is a weak entity and FAMILY is a strong entity.
C. EMPLOYEE entity is a strong entity and FAMILY is a weak entity.
D. EMPLOYEE entity is a strong entity and FAMILY is strong entity.

Weak vs Strong Entity

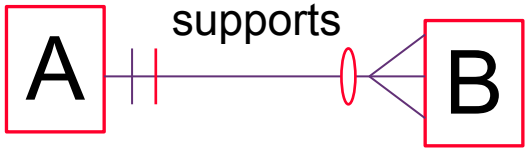
- Strong entity
  - Has a key which may be defined without reference to other entities.
  - For example EMPLOYEE entity.
- Weak entity
  - Has a key which requires the existence of one or more other entities.
  - For example FAMILY entity - need to include the key of employee to create a suitable key 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



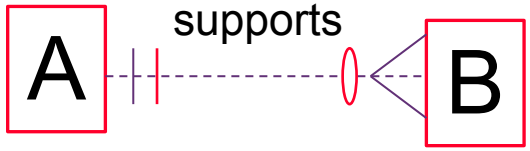
Identifying vs Non-Identifying Relationship

- **Identifying**
  - Identifier of A is part of identifier of B.



  - Shown with solid line
  - Enrolment's PK includes student id, which is an identifier of student.

- **Non-identifying**
  - Identifier of A is NOT part of identifier of B.



  - 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

Q8. The employee details that will be recorded are: Employee number, Full name, Address, Date of birth, Tax file number and Skill(s). Examples of skills are Java, Python, UNIX, Relational db, Mongo db, etc

Choose a TRUE statement.

A. ADDRESS is a multi-valued attribute and SKILL is a multi-valued attribute.

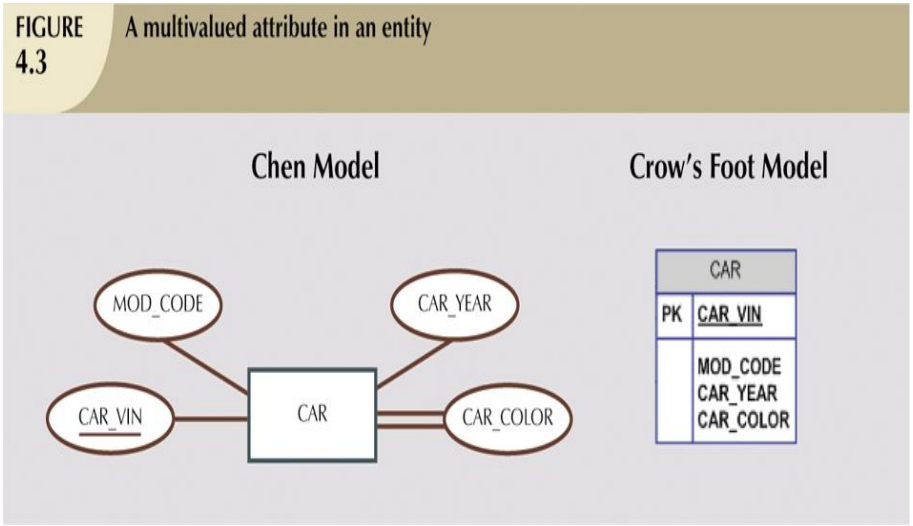
B. ADDRESS is a composite attribute and SKILL is a composite attribute.

C. ADDRESS is a composite attribute and SKILL is a multi-valued attribute.

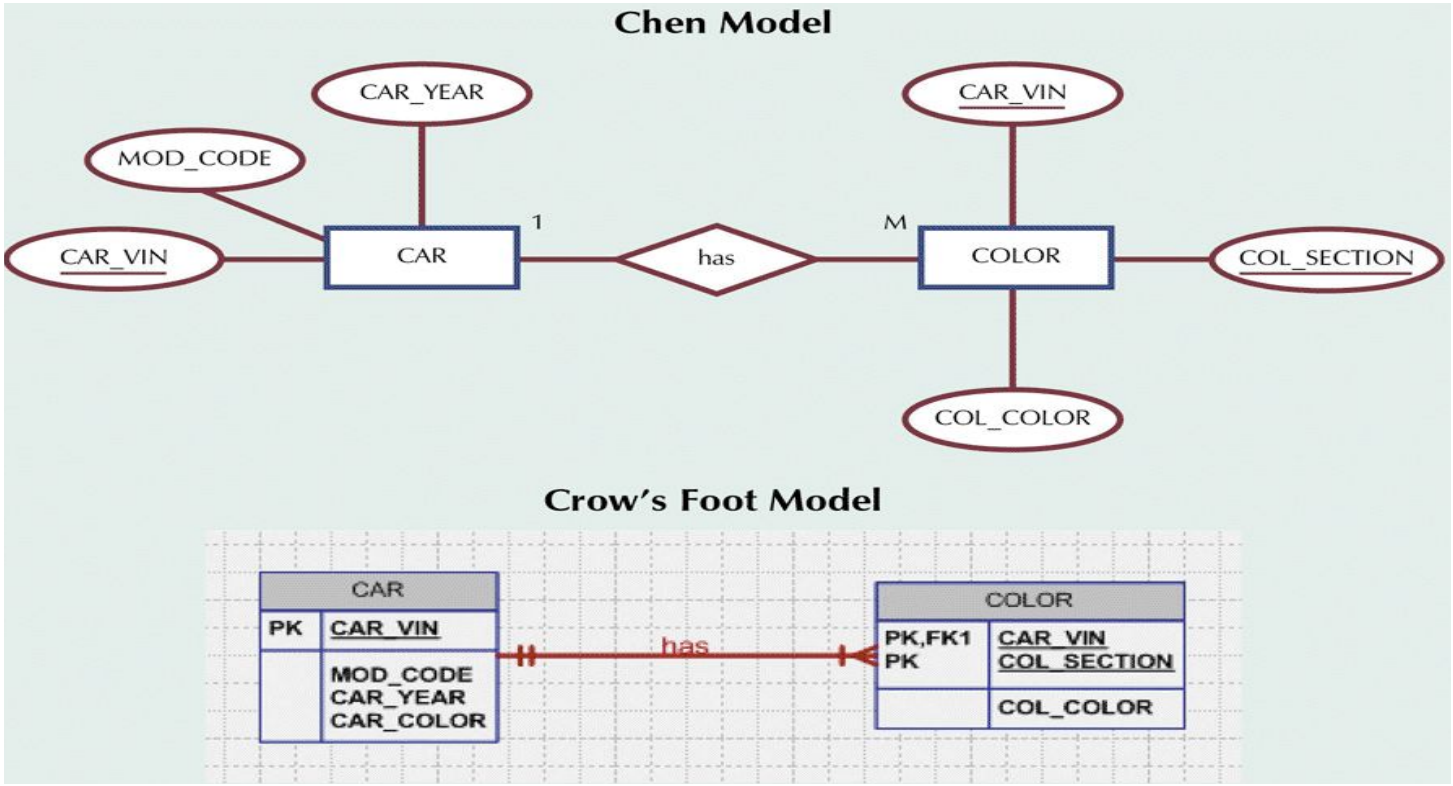
D. ADDRESS is a multi-valued attribute and SKILL is a composite attribute.

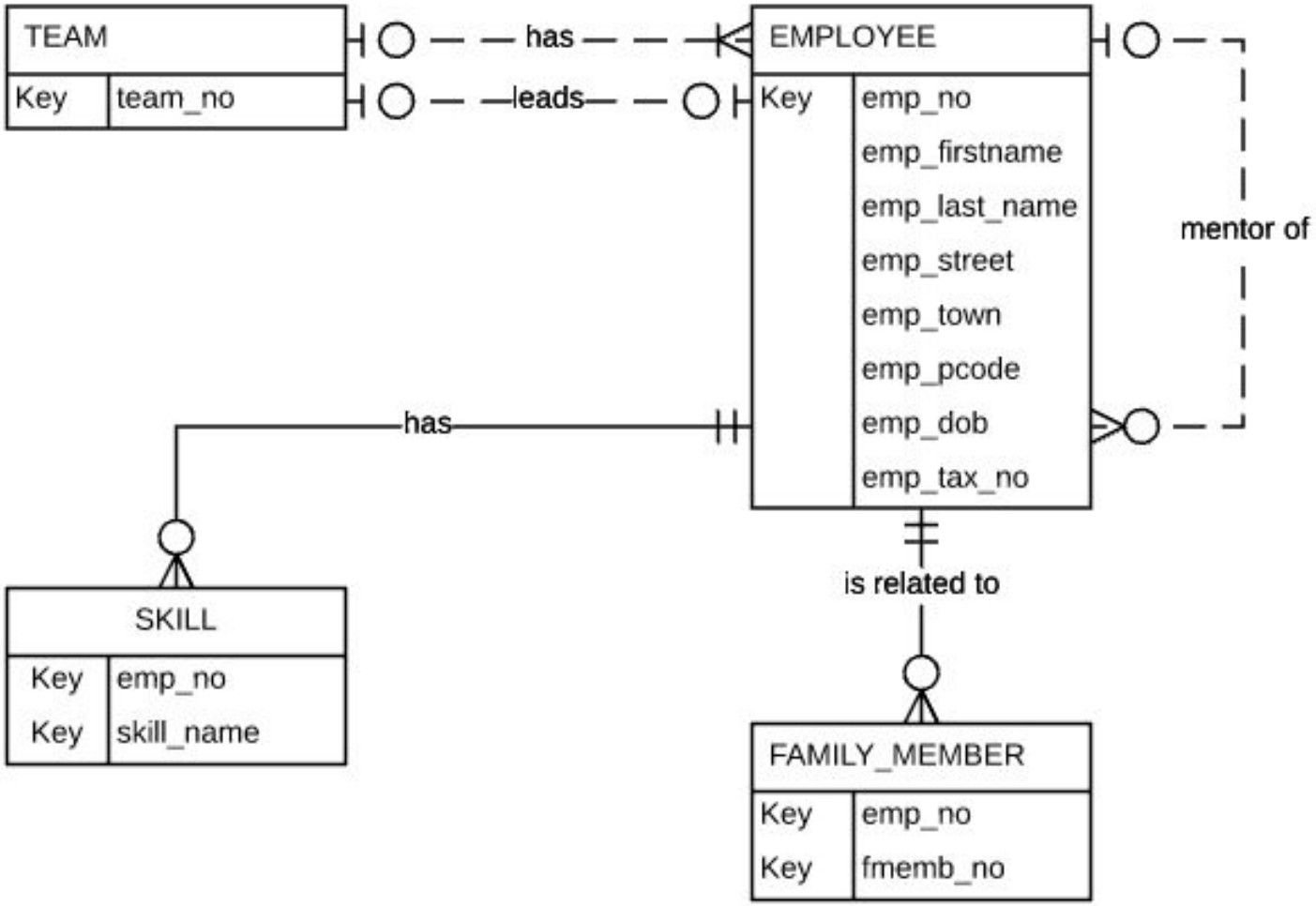
Multivalued Attribute

- 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.



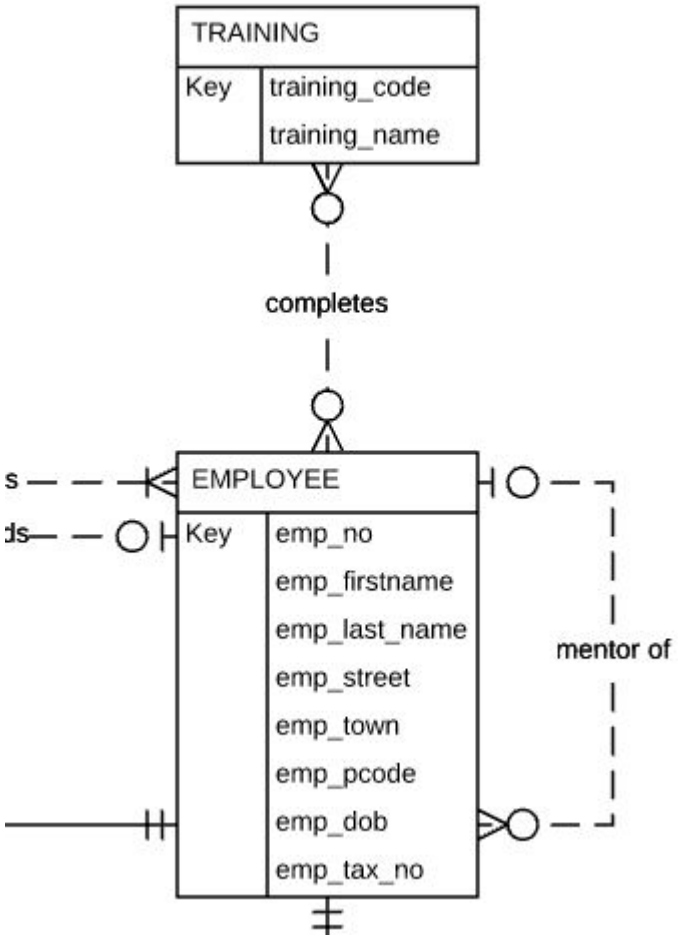
Resolving Multivalued Attributes




TEAM
Key
team_no
has
leads
EMPLOYEE
Key
emp_no
emp_firstname
emp_last_name
emp_street
emp_town
emp_pcode
emp_dob
emp_tax_no
mentor of
has
SKILL
Key
emp_no
Key
skill_name
is related to
FAMILY_MEMBER
Key
emp_no
Key
fmemb_no

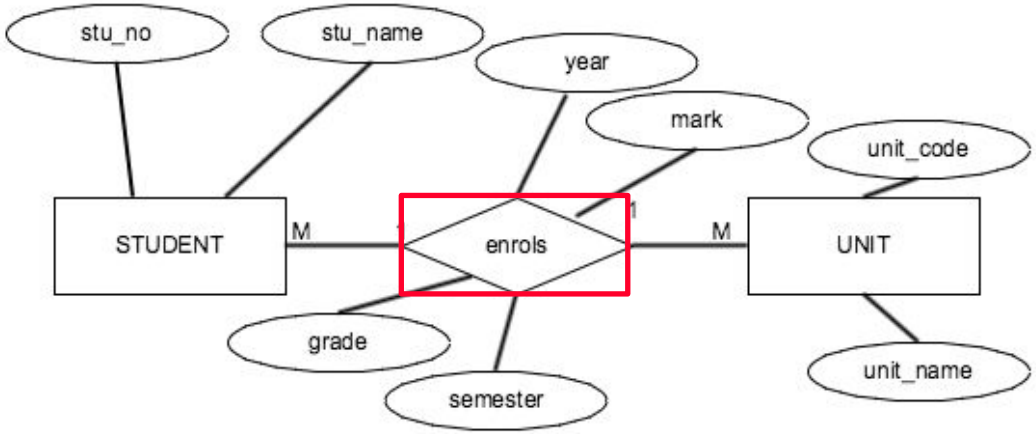
..."the company provides several in-house training programs. The HR team needs to keep track of the details about who has done what. An employee can do several training programs.

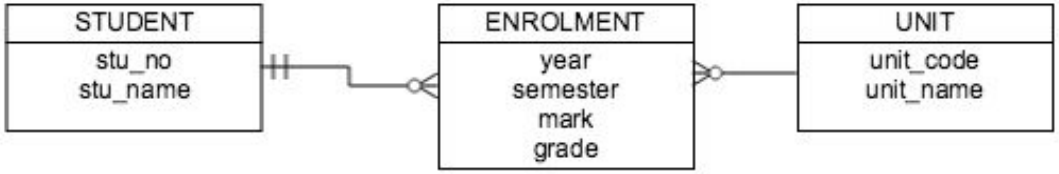
At the completion of a training, a certificate will be provided to the employee containing the training name and the completion date."...

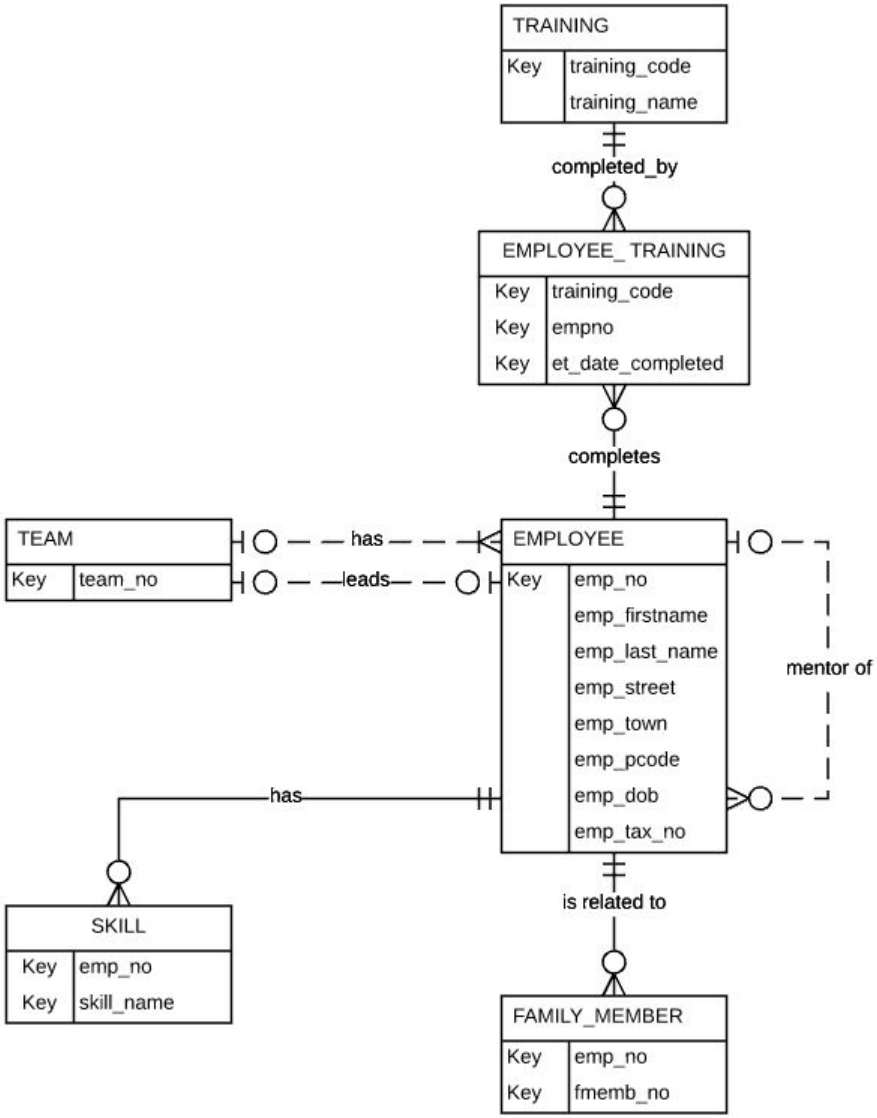


Incomplete model

Associative (or Composite) Entity






TRAINING
Key
training_code
training_name
completed_by
EMPLOYEE_ TRAINING
Key
training_code
Key
empno
Key
et_date_completed
completes
TEAM
Key
team_no
has
leads
EMPLOYEE
Key
emp_no
emp_firstname
emp_last_name
emp_street
emp_town
emp_pcode
emp_dob
emp_tax_no
mentor of
has
SKILL
Key
emp_no
Key
skill_name
is related to
FAMILY_MEMBER
Key
emp_no
Key
fmemb_no