MONASH University

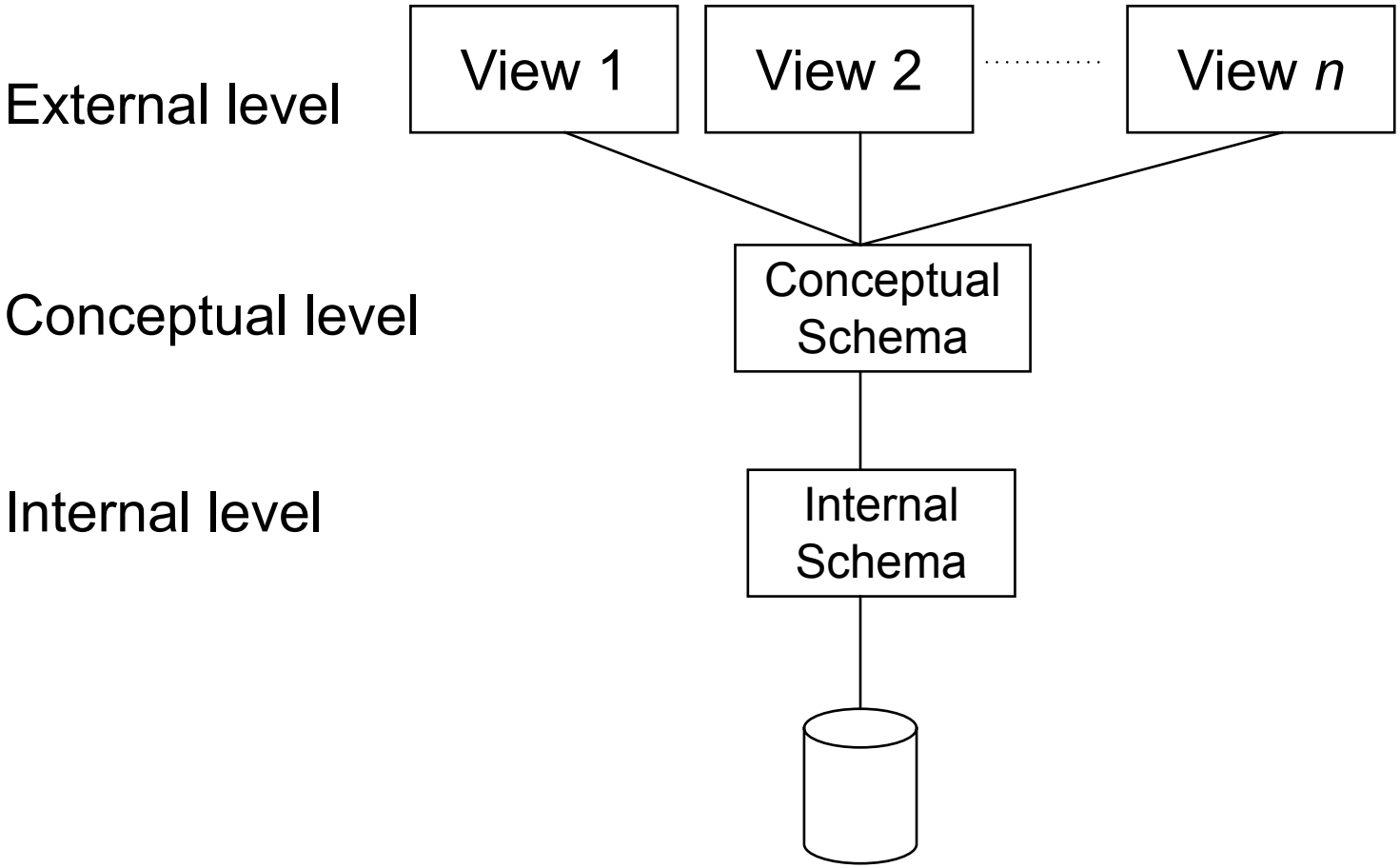
MONASH
INFORMATION
TECHNOLOGY

Database Design 1: Conceptual Modelling

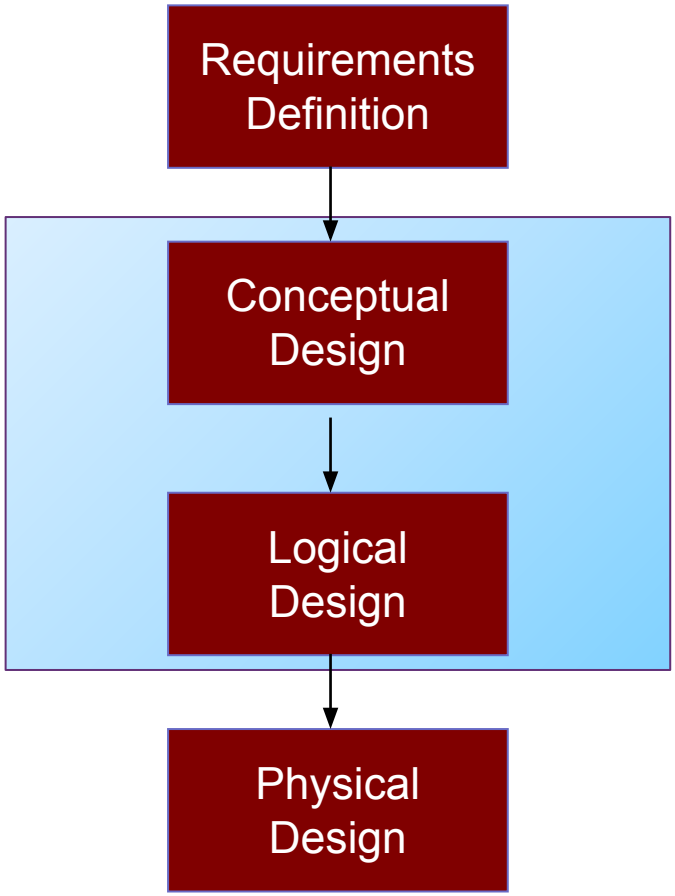
FIT9132

GROUP OF EIGHT AUSTRALIA

ANSI/SPARC architecture



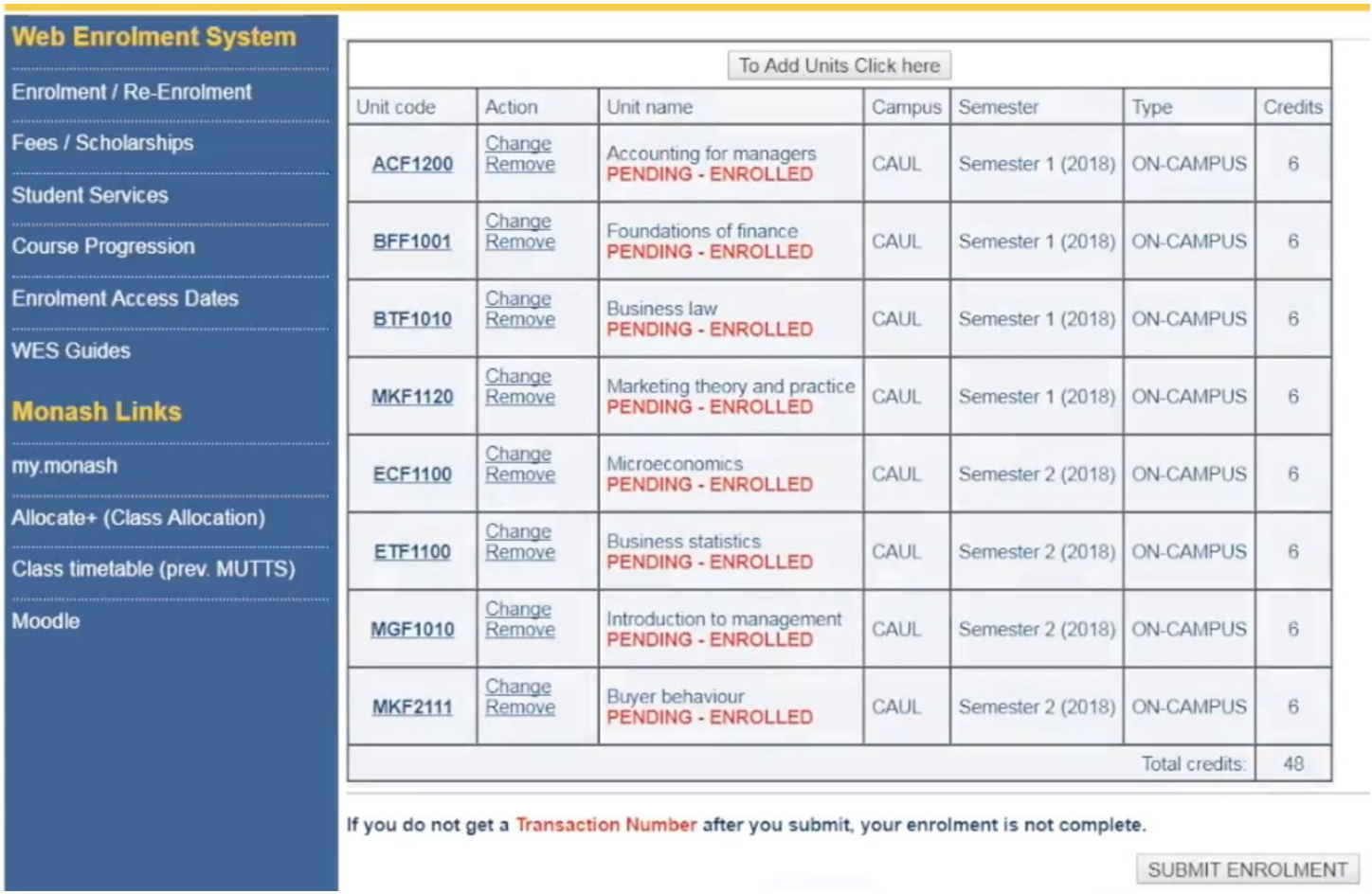
The Database Design Life Cycle



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

Monash Links

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

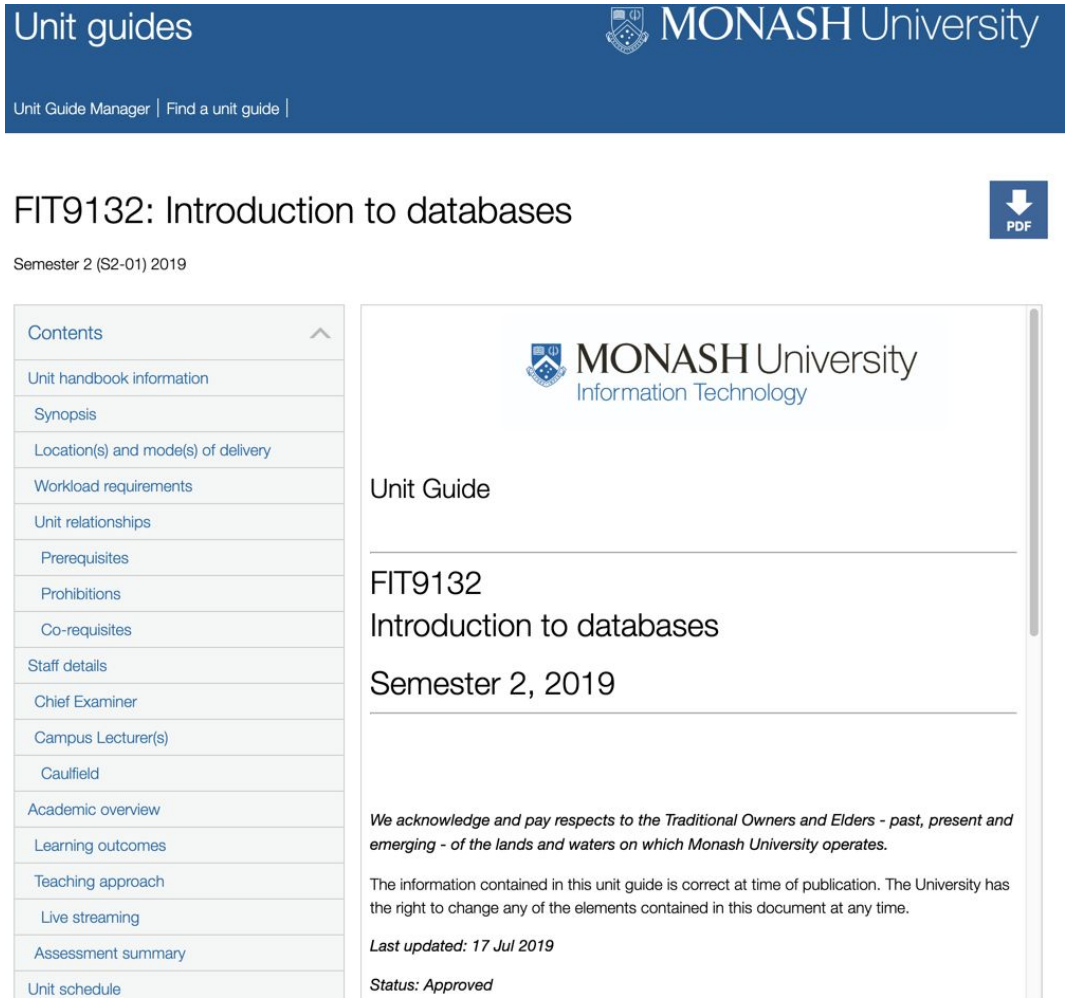
To Add Units Click here

Unit code	Action	Unit name	Campus	Semester	Type	Credits
ACF1200	Change Remove	Accounting for managers PENDING - ENROLLED	CAUL	Semester 1 (2018)	ON-CAMPUS	6
BFF1001	Change Remove	Foundations of finance PENDING - ENROLLED	CAUL	Semester 1 (2018)	ON-CAMPUS	6
BTF1010	Change Remove	Business law PENDING - ENROLLED	CAUL	Semester 1 (2018)	ON-CAMPUS	6
MKF1120	Change Remove	Marketing theory and practice PENDING - ENROLLED	CAUL	Semester 1 (2018)	ON-CAMPUS	6
ECF1100	Change Remove	Microeconomics PENDING - ENROLLED	CAUL	Semester 2 (2018)	ON-CAMPUS	6
ETF1100	Change Remove	Business statistics PENDING - ENROLLED	CAUL	Semester 2 (2018)	ON-CAMPUS	6
MGF1010	Change Remove	Introduction to management PENDING - ENROLLED	CAUL	Semester 2 (2018)	ON-CAMPUS	6
MKF2111	Change Remove	Buyer behaviour PENDING - ENROLLED	CAUL	Semester 2 (2018)	ON-CAMPUS	6
					Total credits:	48

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

SUBMIT ENROLMENT

Staff and Student View



Admin View

Allocate+

Subject Administrator

FIT9132_CA_S2_ON-CAMPUS, INTRO TO DATABASES

Activity Groups: Show Subject | Special Consideration | Update Details | Section Insert

APPLIED_PASS
(ALLOCATION ADJUSTMENT)

Enrolments:	732
Preferences:	0
Allocations:	160
Seats Provided:	160

Warning: Not enough seats provided

LECTURE
(ALLOCATION ADJUSTMENT)

Enrolments:	732
Preferences:	0
Allocations:	726
Seats Provided:	4820

TUTORIAL
(ALLOCATION ADJUSTMENT)

Enrolments:	732
Preferences:	0
Allocations:	726
Seats Provided:	1008

FIT9132_CA_S2_ON-CAMPUS:INTRO TO DATABASES TUTORIAL

Allocate | Add Activity | Show Message | Show Allocated | Waitlist | Show Unallocated | Buffers

Functions	Activity Code	Campus	Day	Start Time	Location	Staff	Duration	Planned Size	Buffer
Delete | Edit | List | Constraint | Context | Email	01	CA	Mon	08:00	CA_B/B344	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	02	CA	Mon	12:00	CA_B/B344	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	03	CA	Tue	08:00	CA_B/B344	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	04	CA	Wed	12:00	CA_B/B344	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	05	CA	Fri	14:00	CA_B/B344	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	06	CA	Mon	08:00	CA_B/B342	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	07	CA	Mon	10:00	CA_B/B342	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	08	CA	Mon	16:00	CA_B/B342	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	09	CA	Wed	18:00	CA_B/B345	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	10	CA	Fri	18:00	CA_B/B345	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	11	CA	Tue	08:00	CA_B/B342	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	12	CA	Tue	10:00	CA_B/B342	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	13	CA	Tue	12:00	CA_B/B342	-	120	18	0
Delete | Edit | List | Constraint | Context | Email	14	CA	Tue	14:00	CA_B/B342	-	120	18	0

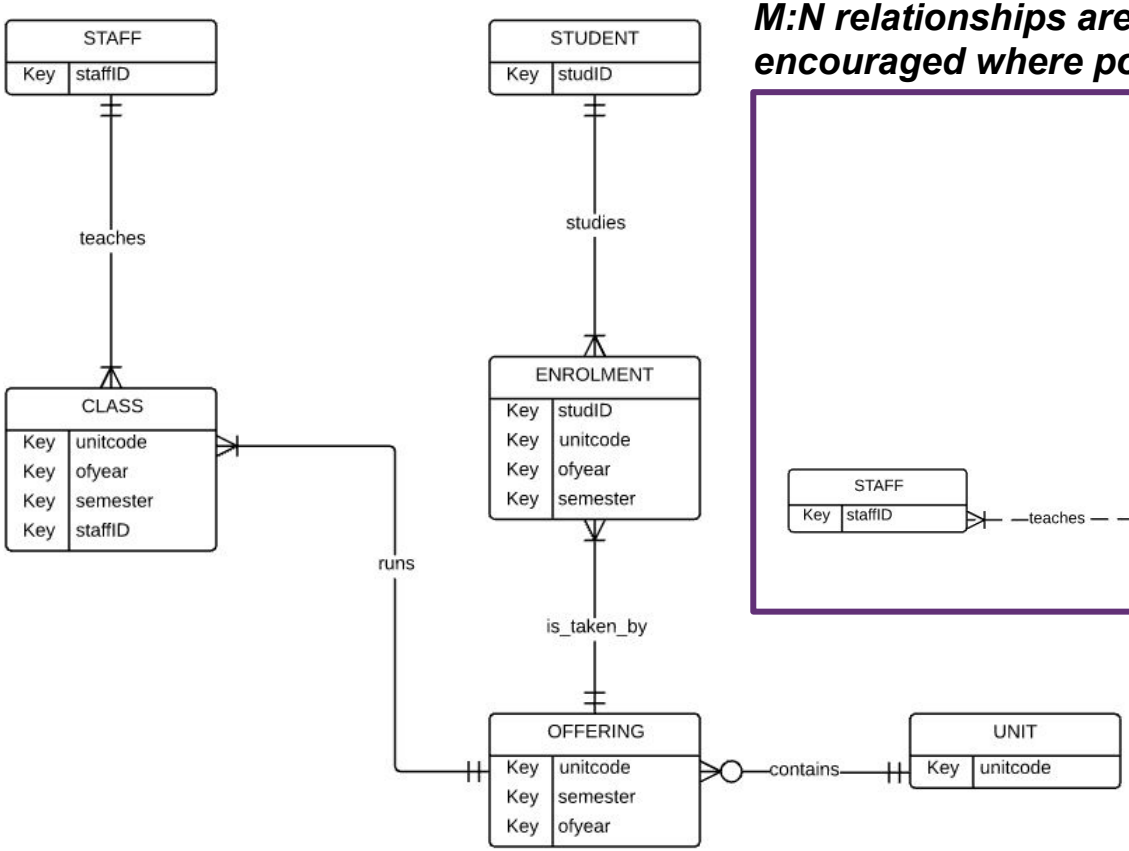
ER Modeling

- 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

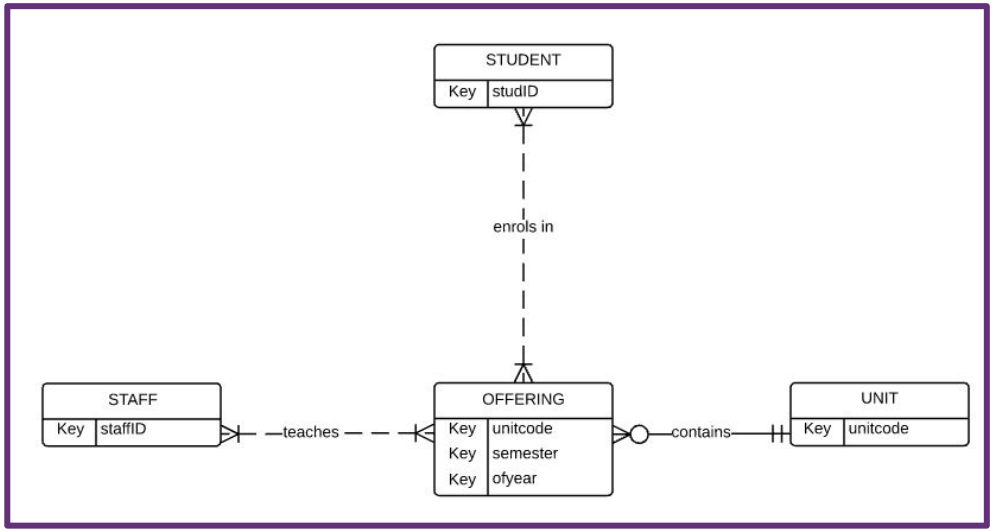
Conceptual Design

- 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.
- ER consists of ENTITIES and RELATIONSHIPS between entities
  - –An ENTITY will have attributes (things we wish to record), one or more of which will identify an entity instance (called the KEY)

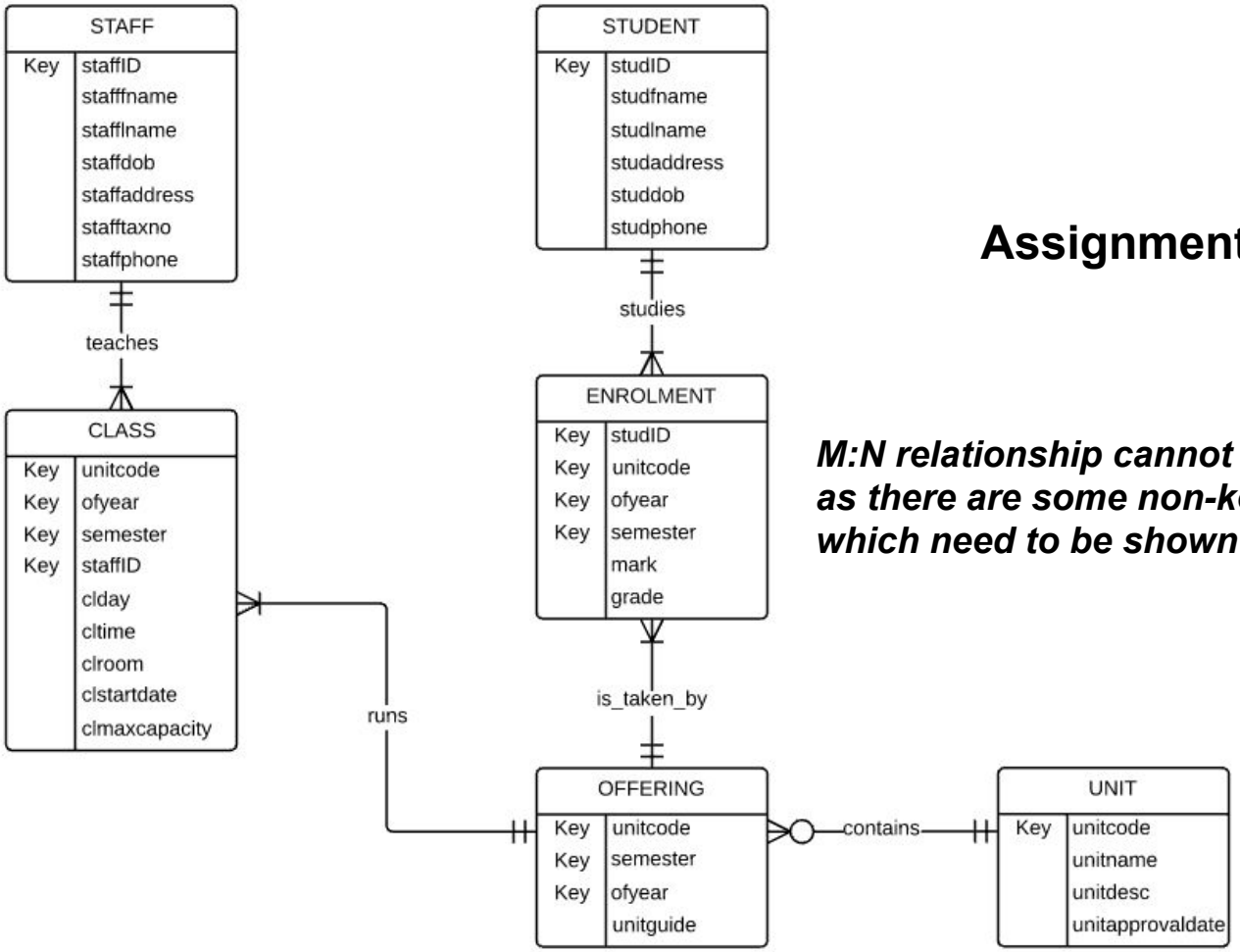
Conceptual Level (ER Model) - Keys only



M:N relationships are fine on a Conceptual model (and encouraged where possible) as they simplify the model:



Conceptual Level (ER Model) – All Attributes



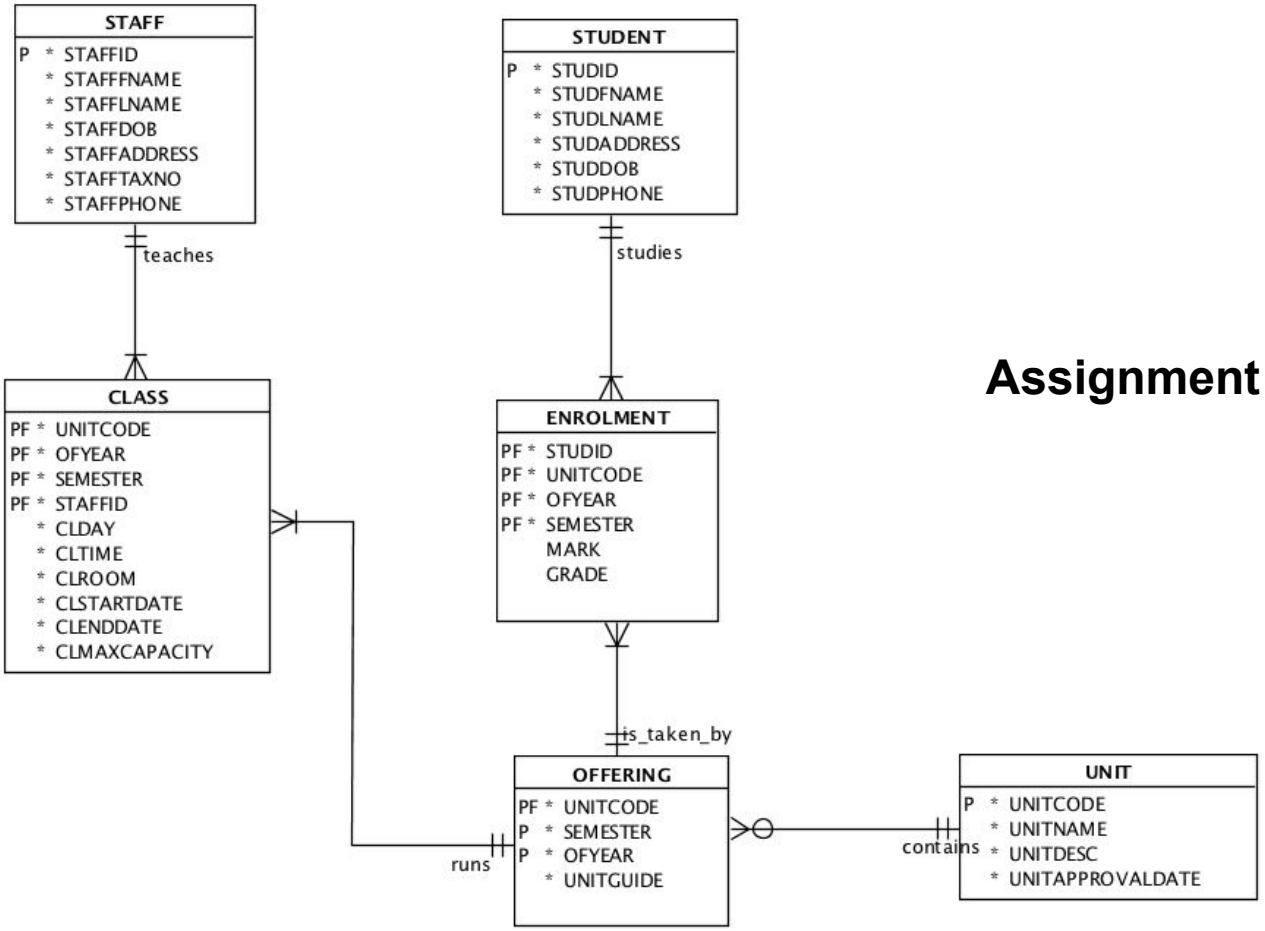
Assignment 1

M:N relationship cannot be used here as there are some non-key attributes which need to be shown

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 - Relational)

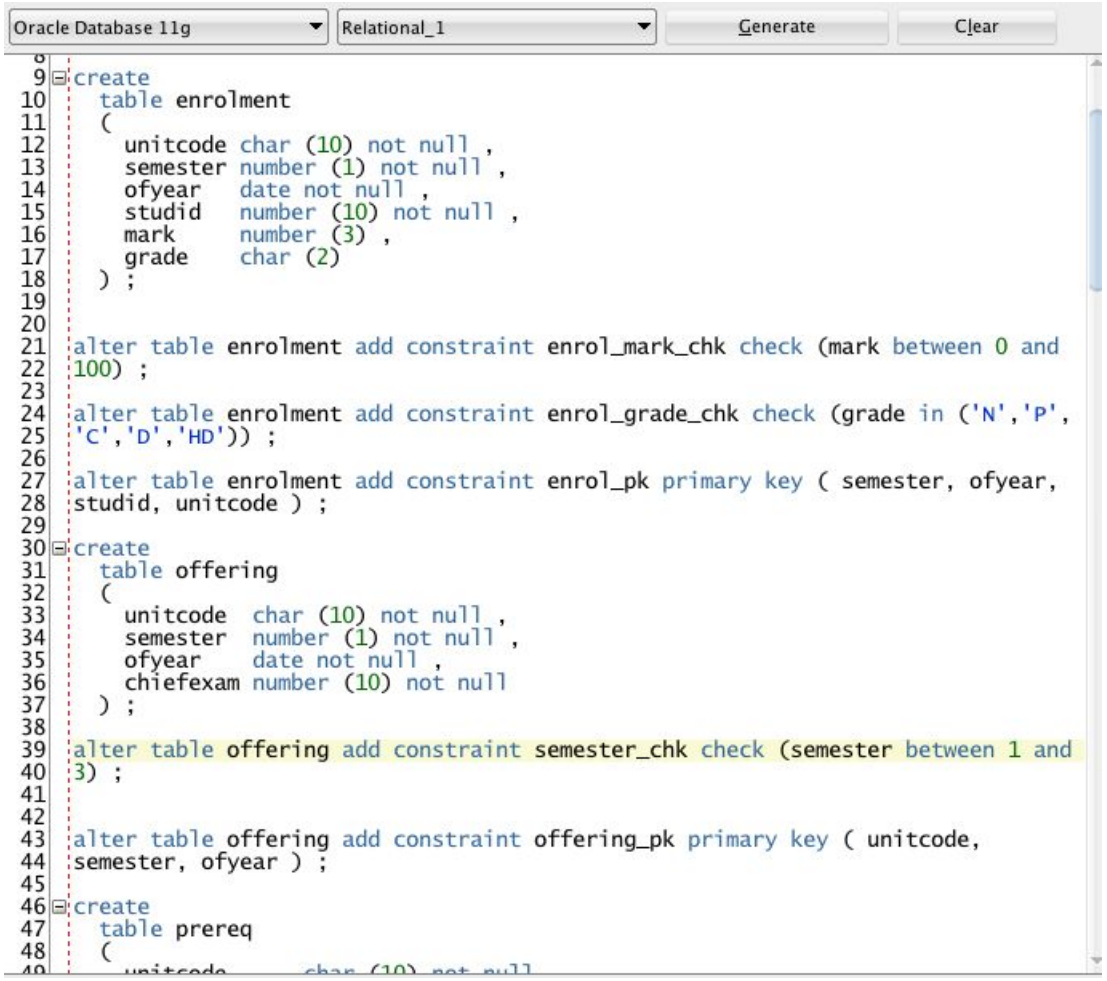


Assignment 2

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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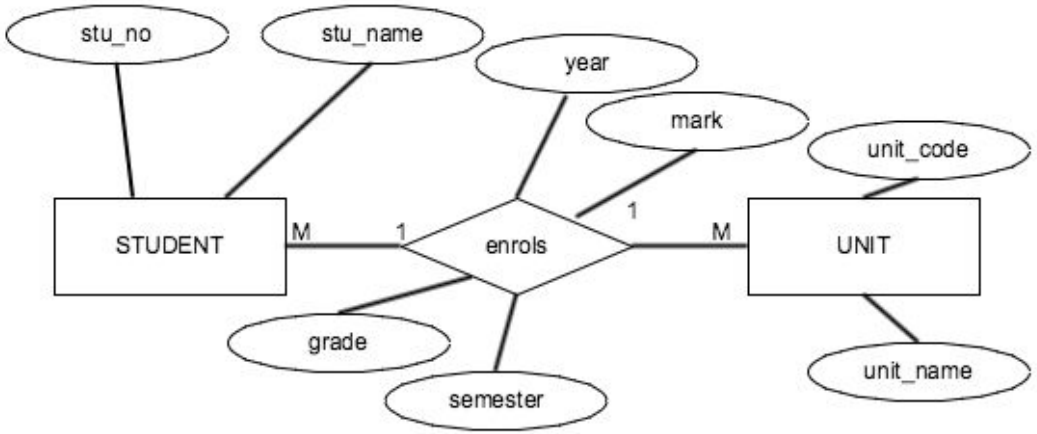
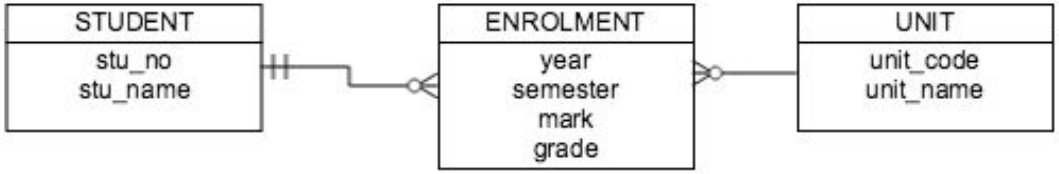
ENTITY RELATIONSHIP DIAGRAM

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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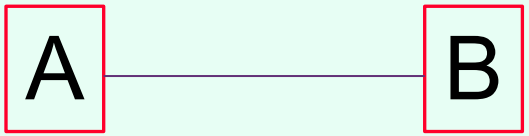
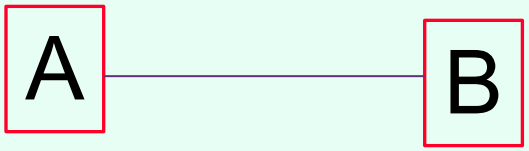
Entity, Attributes and Relationships



Please note this diagram is incomplete

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

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



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) ?

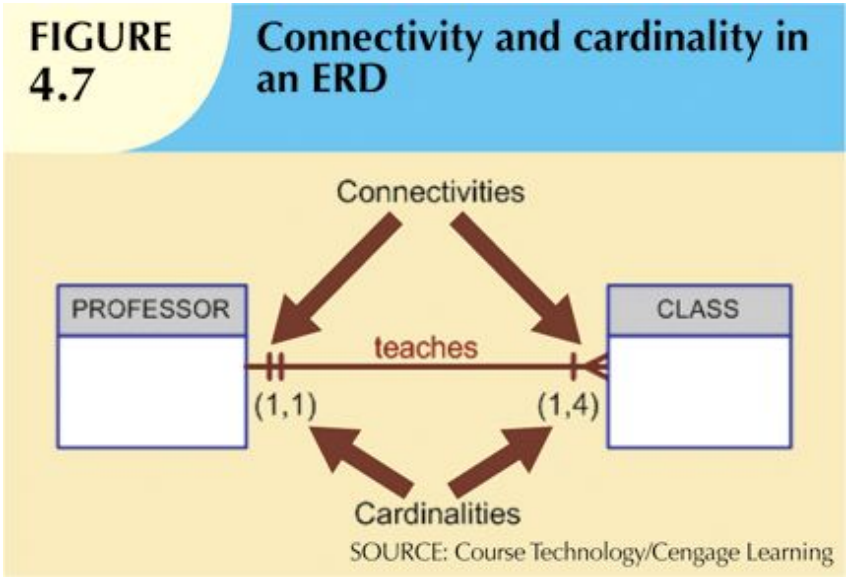
A. 1, unary
B. 2, binary
C. 1, binary
D. 3, ternary

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. place each on a separate line - use SHIFT+ENTER for a new line.

Q4. How many relationships connect TEAM and EMPLOYEE?

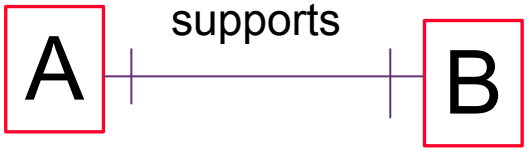
A. 1
B. 2
C. 3
D. 4



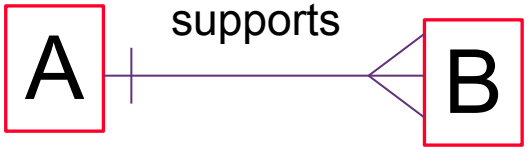
In general for Crows Foot notation specific cardinalities are not shown as above eg. (1,4), instead participation is depicted via min and max participation using the standard symbols (Inside symbol = min, outside symbol = max)

CONNECTIVITY

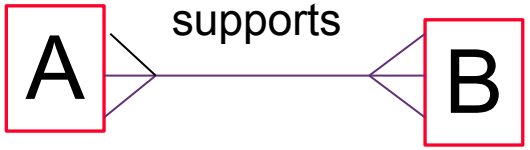
one to one



one to many



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."

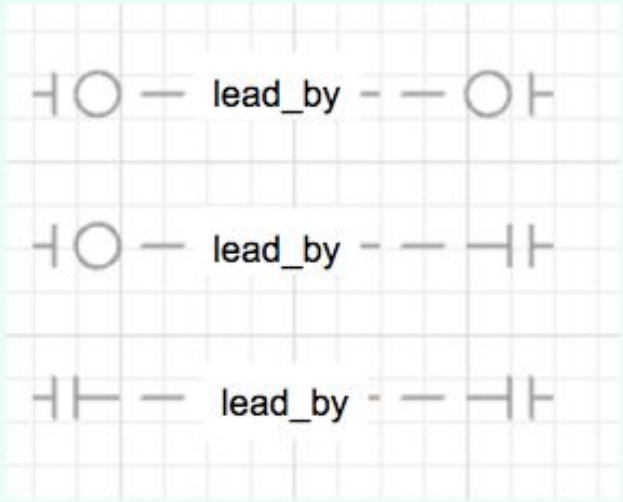
What is the relationship participation of the relationship

TEAM --- lead_by --- EMPLOYEE

A.

B.

C.

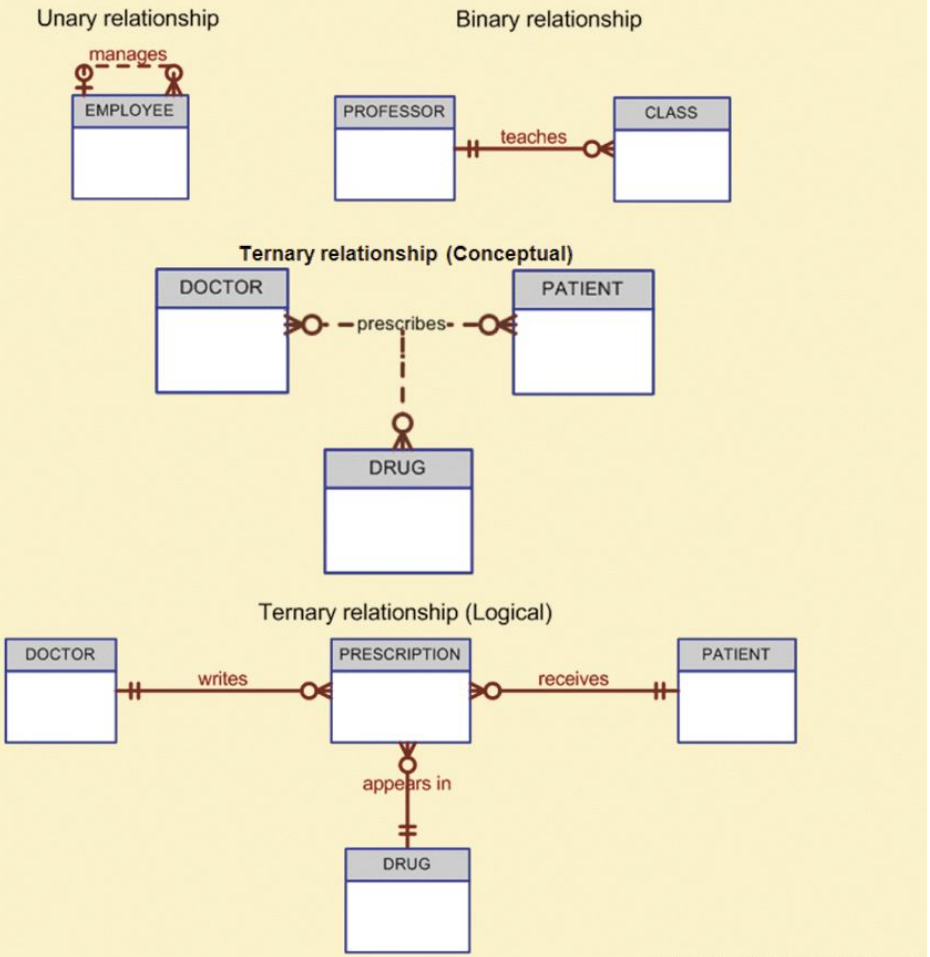


Q6. "The company also introduced a mentoring program, whereby a new employee will be paired with someone who has been in the company longer."

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"

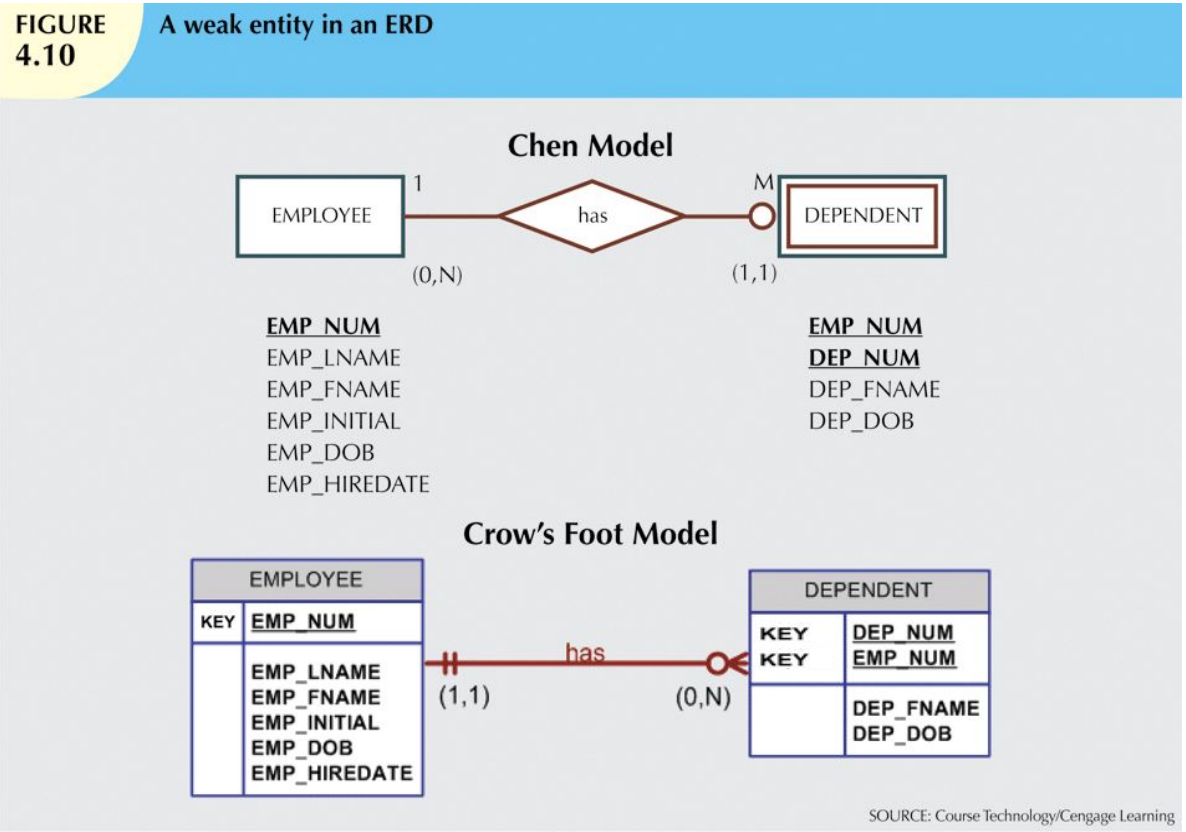
Choose a TRUE statement.

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)

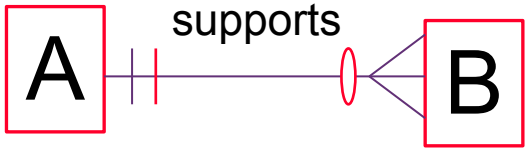
Weak vs Strong Entity



Note the Crow's Foot model shown here has been modified from the text version

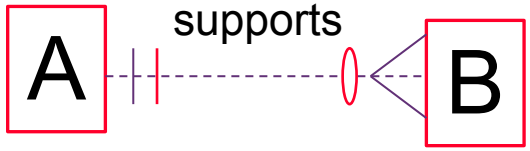
Identifying vs Non-Identifying Relationship

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



  - Shown with solid line
  - ENROLMENT - STUDENT Enrolment key 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
- Attribute classification is driven by Client requirements
  - Phone Number?

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, MongoDB, etc

Choose a TRUE statement.

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

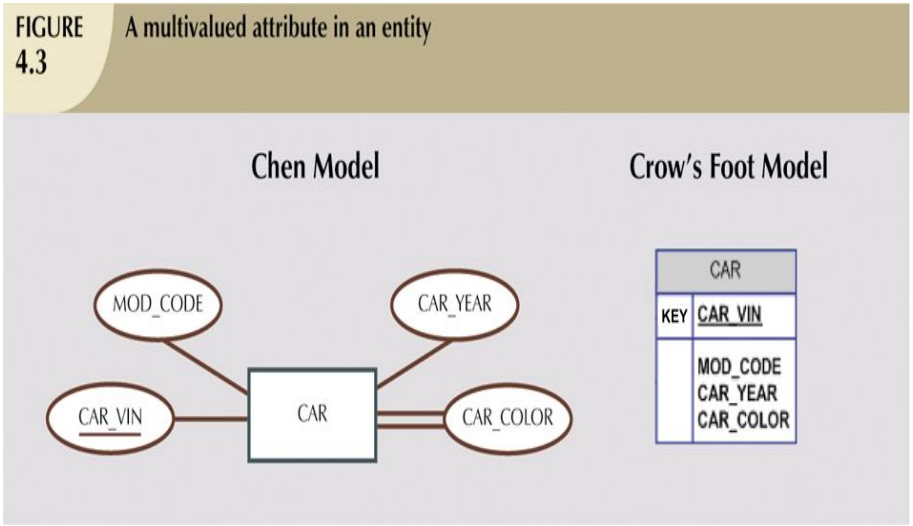
B. ADDRESS is a composite attribute and SKILL is a composite attribute.

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

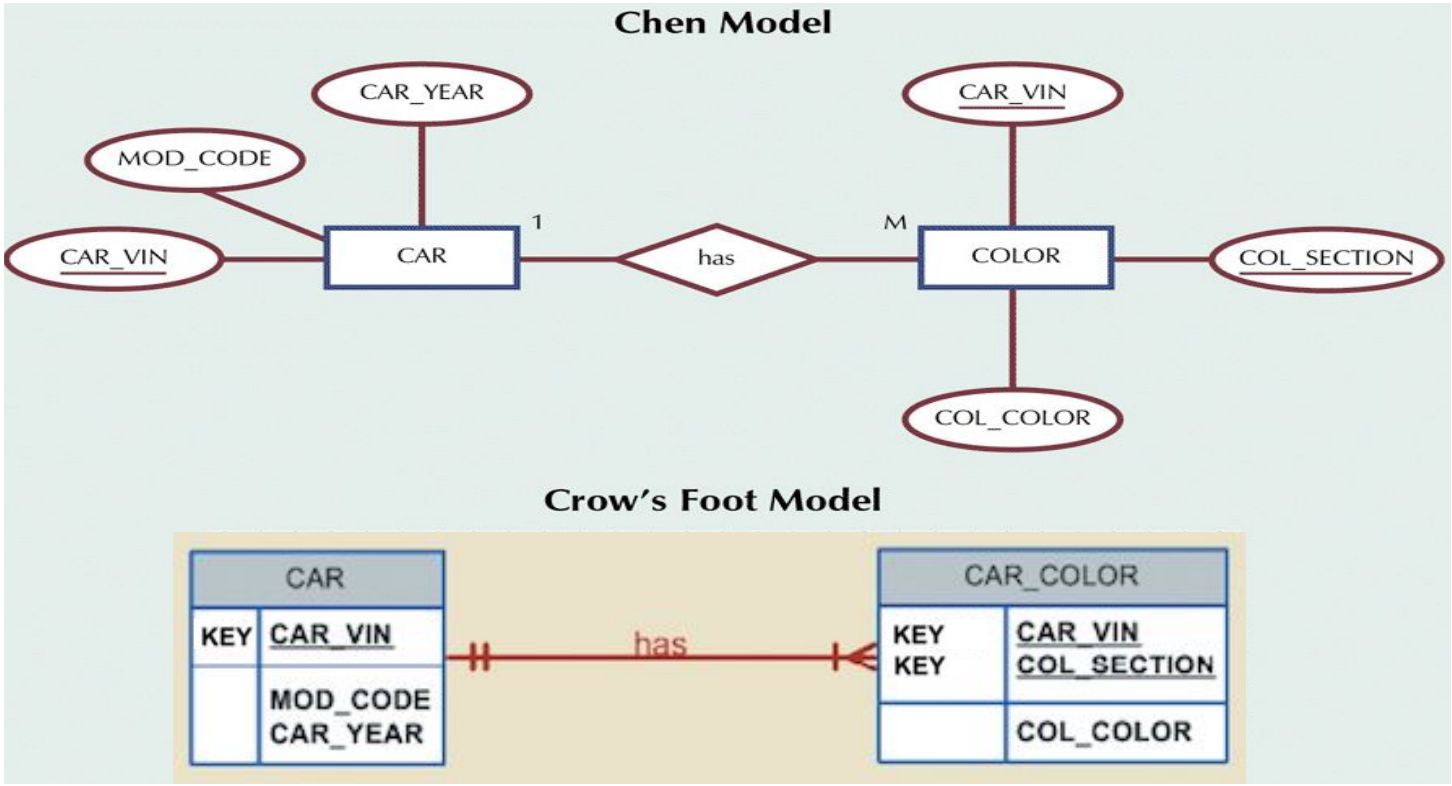
D. ADDRESS is a multi-valued attribute and SKILL is a composite attribute.

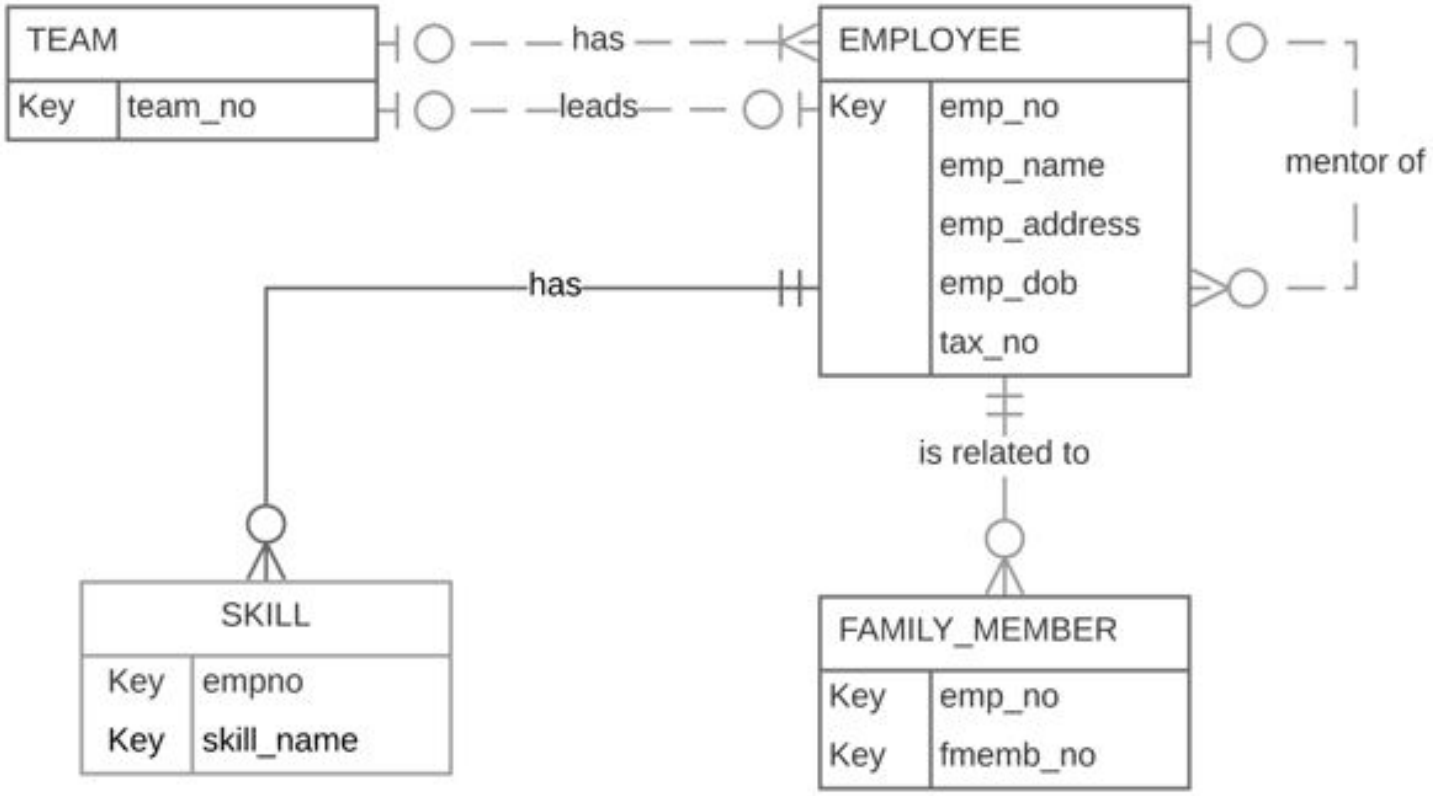
Multivalued Attribute

- 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

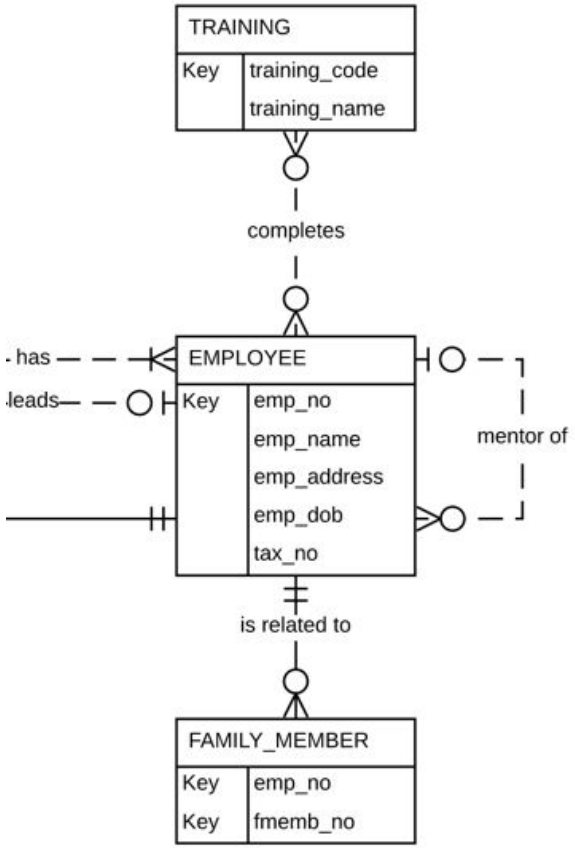



TEAM
Key
team_no
has
leads
EMPLOYEE
Key
emp_no
emp_name
emp_address
emp_dob
tax_no
mentor of
has
is related to
SKILL
Key
empno
Key
skill_name
FAMILY_MEMBER
Key
emp_no
Key
fmemb_no

...*"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.*

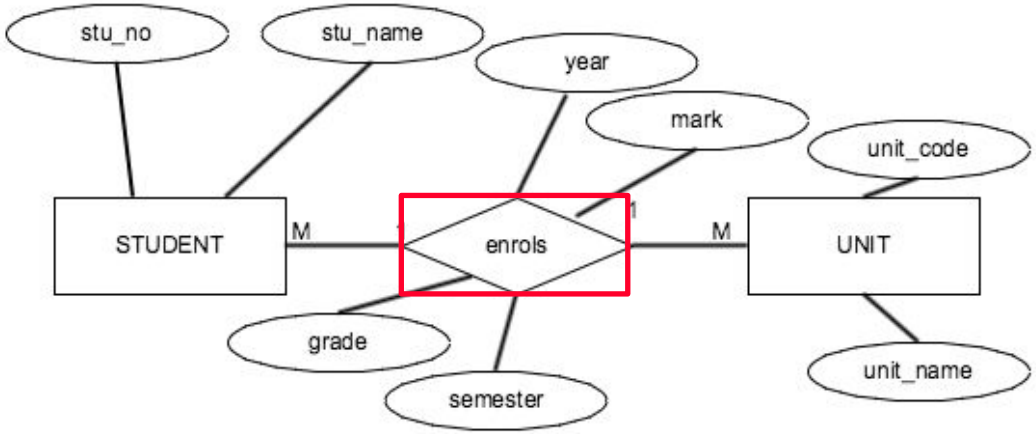
At the completion of a training, a certificate will be provided to the employee containing the training name and the completion date."...

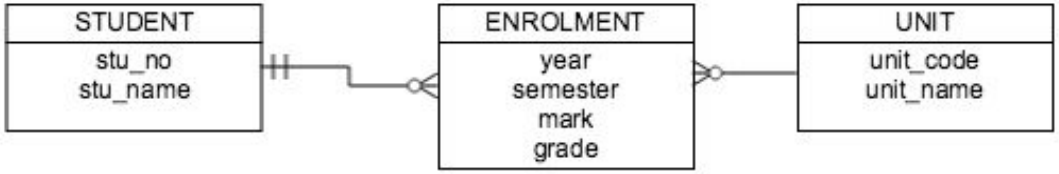
Incomplete model

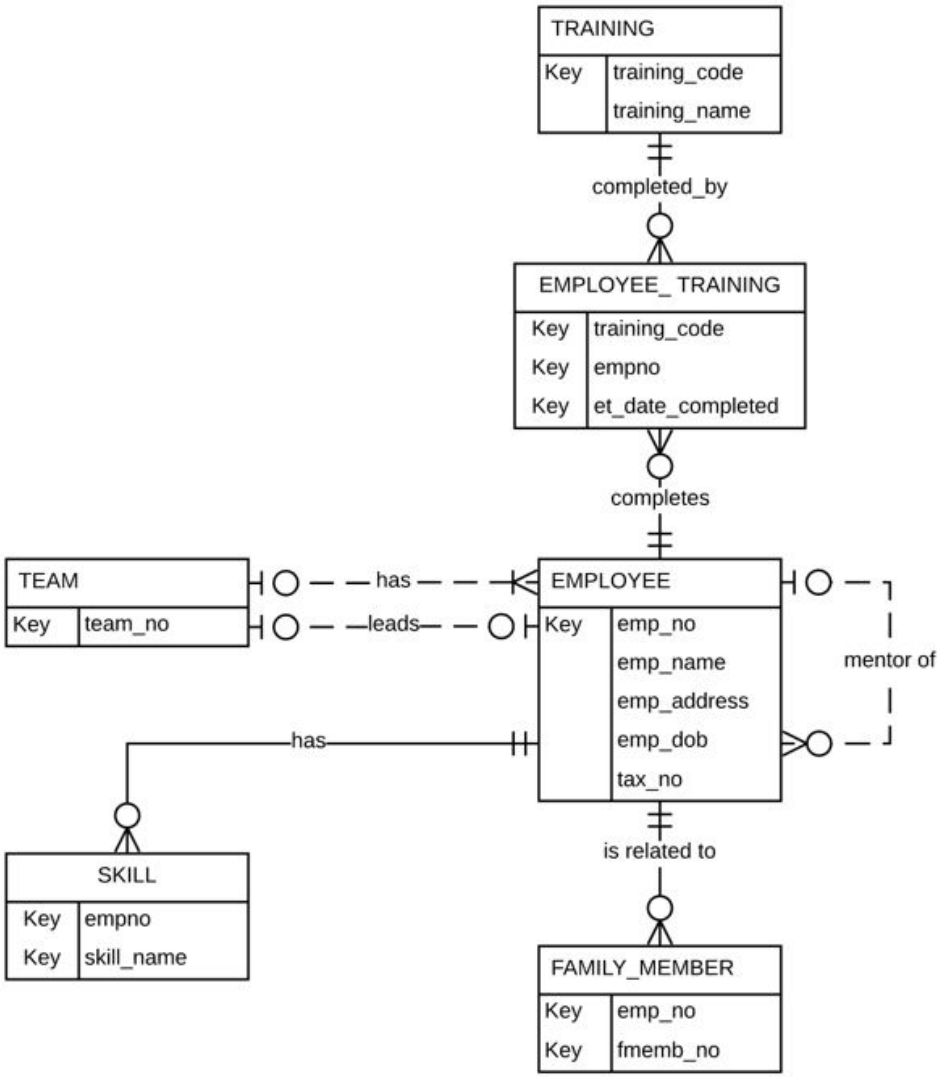


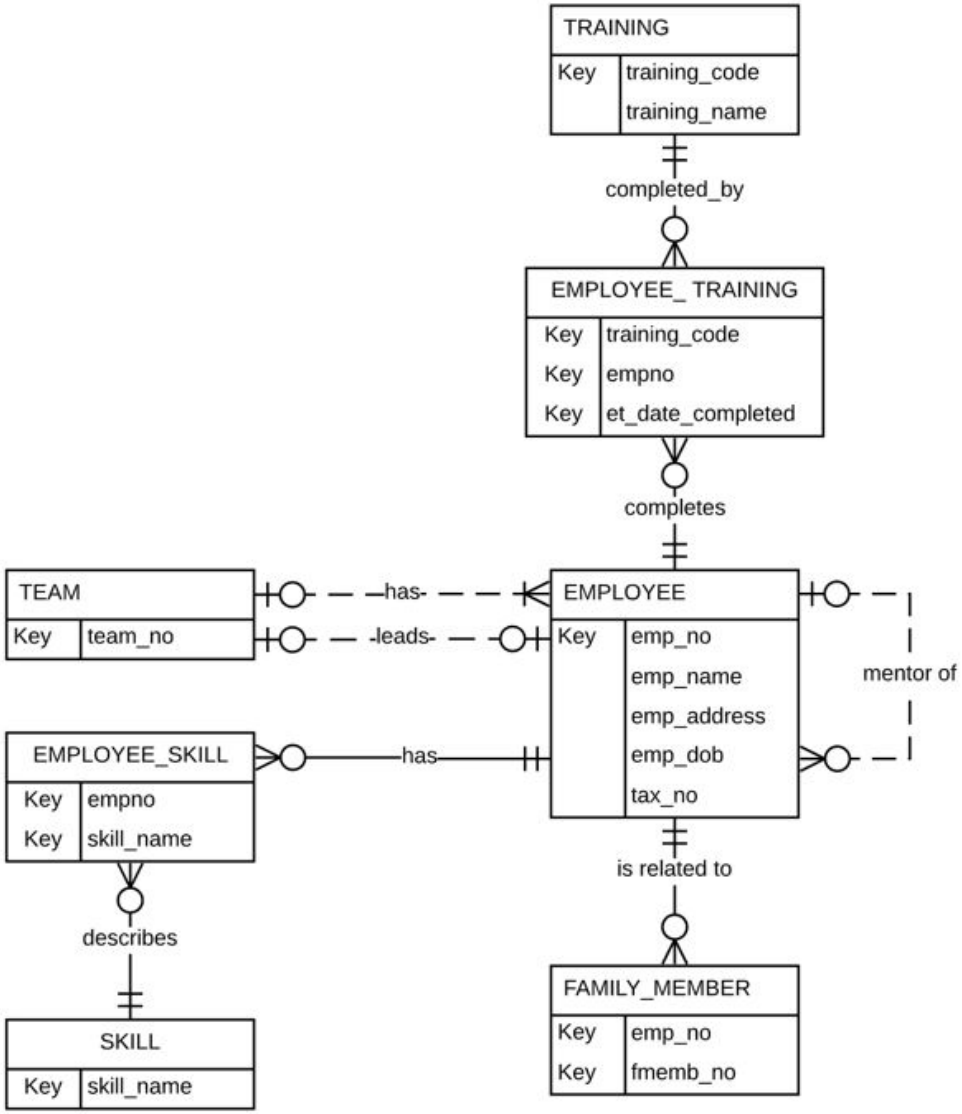
Incomplete model

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_name
emp_address
emp_dob
tax_no
mentor of
has
SKILL
Key
empno
Key
skill_name
is related to
FAMILY_MEMBER
Key
emp_no
Key
fmemb_no



Note cannot add skill_no since this would be a SURROGATE key, there is no skill_no in the described case