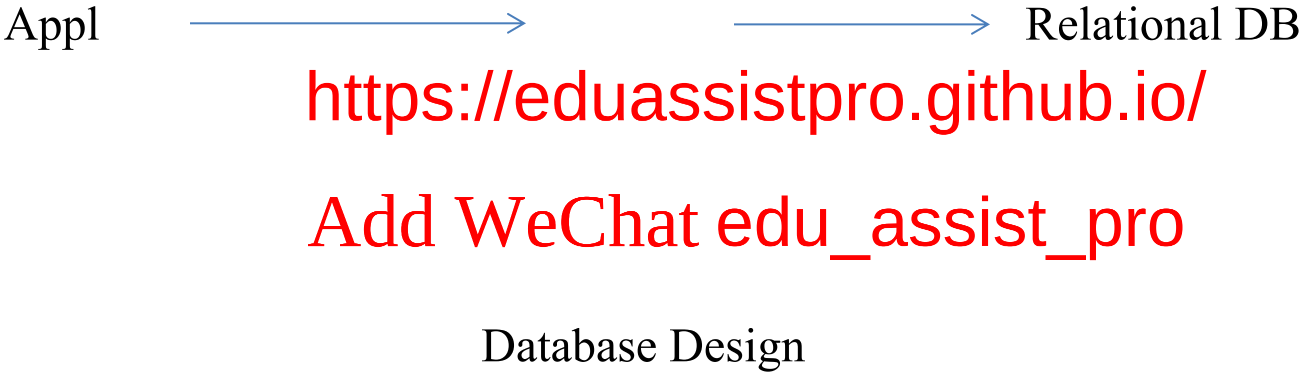
Conce Design

1. Conceptual Database Design



Entity-Relationship Model

- The Entity-Relationship (ER) model is a high-level conceptual data model (Chen in 1966).
- ER is used ool.

Entity-Relationship Model(cont)

- *Entity type*: Group of object with the same properties
- *Entity*: member of an entity type - analogous to an object.
- *Attribute*: a pro
- *Relationship*: among objects
  - ER can model "n-way" relationship,
  - ER models a relationship and its inverse by a single relationship.

1.1 Entity and Attributes

- *Entities* represent things in the real word.
- *Attributes* describe properties of entities.
- Attributes m
  - simple(atomic) e.g. sex =   , or
  - composite e.g. name consists of title (Dr), Initials (C.C.), family name (Chen).

1.1 Entity and Attributes(cont)

- Each entity has values for each attribute.
- Attributes m

  - *single-valu* , name, or

  - *multivalued* e.g. keywords = neural networks, computer graphics, databases.

1.1 Entity and Attributes(cont)

- Each simple attribute has a *value set (domain)*: the set of possible values for that attribute.

- In a composite attribute $A = (A , . . . , A)$, suppose that $V_1, \ldots, V_n$ are the domains of A_1

- The domain V of A is $V_1 \times . . . \times V_n$

- Mathematically, an attribute A of an entity type E is a function

$$A : E \rightarrow \wp(V) .$$

- where V is the domain of A, and $\wp$(V) is the power set of V
- For single-valued attributes, $A(e)$ must be a singleton.

1.1 Entity and Attributes(cont)

- An attribute can have a null value if, for example:
  - there is no suitable value e.g. a student may have no interests: key
  - the true valu rriage date of a person is not known: marriag LL.
- A derived attribute is one whose value can be derived from other attributes and entities. e.g. number of students.

1.1 Entity and Attributes(cont)

- An *entity* type is a set of entities with the same attributes.
- It is describe : a name and a list of attributes.
- The set of individual entity *instances* at a particular moment in time is called an extension of the entity type.

1.1 Entity and Attributes(cont)

Schema (Intension)	RESEACHER Name, Payroll_no, No_of_students, Keywords	DEPARTMENT Name
Instances (Extension)	(Dr C.C. C) (Dr R. Wilkinson, 231-0091, 1	Computer Science Psychology Management

1.1 Entity and Attributes(cont)

- An entity type usually has a *key*: a set of attributes that uniquely identifies an entity. For example:

  – {payroll numb ER,

  – {name} is a k

- There may be more than one p

- An important constraint is the key constraint: in any extension of the entity type, there cannot be two entities having the same values for their key attributes.

1.1 Entity and Attributes(cont)

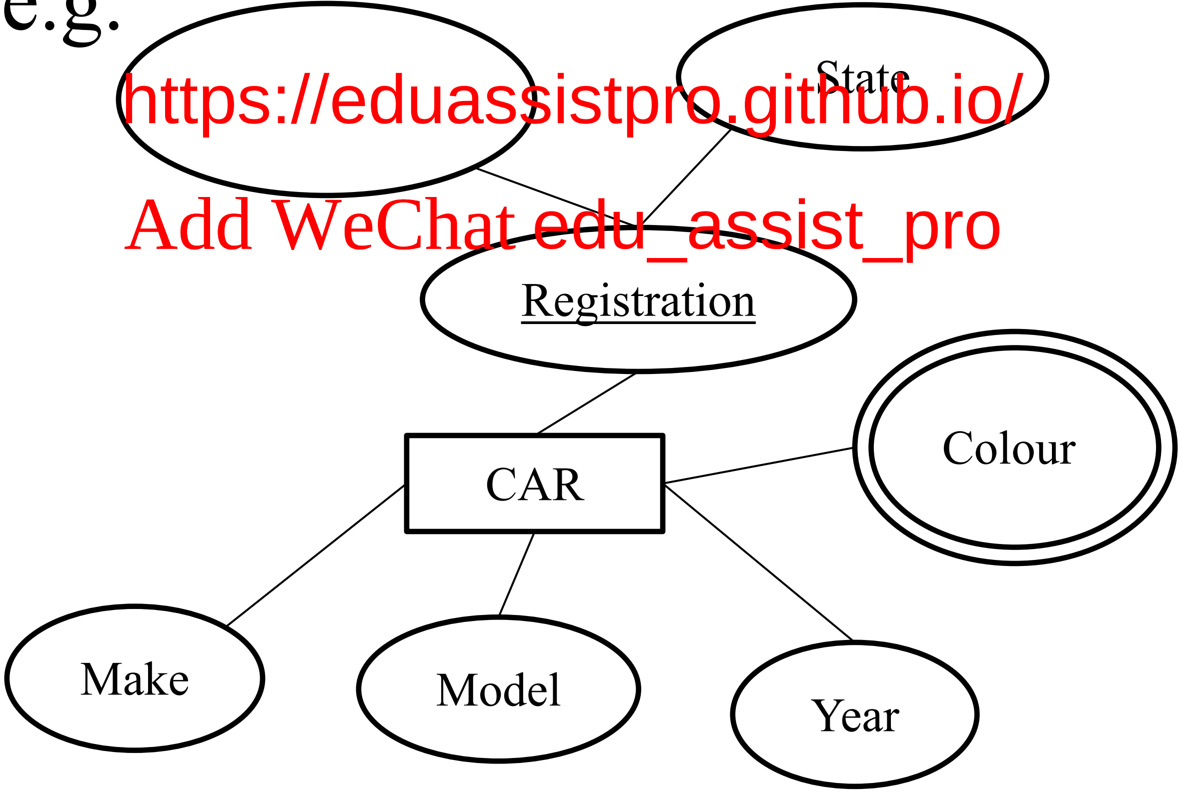
- We can describe schemata with composite attributes using ()'s and with multi-valued attributes us

1.1 Entity and Attributes(cont)

CAR
Registration(Registration No, State), Make, Model, Year, {Colour}
((ARQ) 595, Vic), Datsun, 120Y, 1972, {green})
((8HR) 696, WA), Mazda, 929, 1979, {grey, black})

1.1 Entity and Attributes(cont)

- Entities and their attributes can also be described with Entity-Relationship Diagrams (ERDs). e.g.



1.2 Relationships

- A *relationship* represents an association between things.
- A *relationship* type *R* among *n* entity types $E_1, \ldots, E_n$ is a set of asso from these types.
- Mathematically, a relationsh mong entity types $E_1, \ldots, E_n$ is a subset of $E_1 \times \ldots \times E_n$.
- Each instance $r = (e_1, \ldots, e_n)$ in *R* is a relationship.

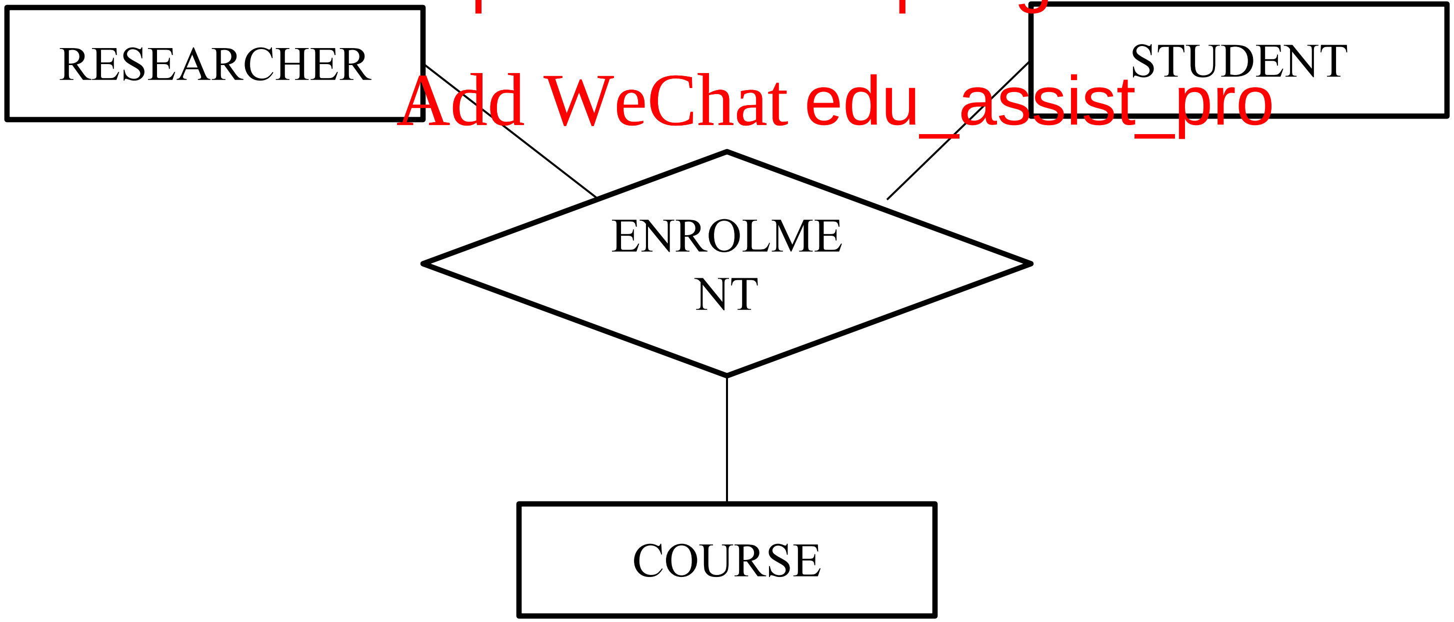
1.2 Relationships(cont)

- We say that $E_1, \ldots, E_n$ participate in R.
- Similarly if $r = (e_1, \ldots, e_n)$ is an instance of R, we say that each e_i participates in r.
- The *degree* of *R* i entity types. For example,
  - ENROLMENT could be a ternary (degree 3) relationship between RESEARCHER, STUDENT and COURSE.

- We can illustrate this using an occurrence diagram:

1.2 Relationships(cont)

- Entities and their relationships can also be represented using Entity-Relationship diagrams:



1.2 Relationships(cont)

- Each entity type that participates in a relationship plays a particular *role* in the relationship.
- An entity type can play
  - different roles in
  - more than one role in a relationship.
- A role name can be used to distinguish these.
- For example, ENROLMENT could be a relationship between PERSON(as researcher), PERSON(as student) and COURSE as in the diagram below:

1.2 Relationships(cont)

- Or, using an ERD:

- This is called a recursive relationship.

1.3 Weak entity types

- Some entity types do not have a key of their own.
- Such entity types are called weak entity types.
- Entities of a we tified by a partial key and by being related to ano ype - *owner.*
- The relationship type between a weak entity type to its owner is the *identifying relationship* of the weak entity type.

1.3 Weak entity types(cont)

- For example, a TAX PAYER entity may be related to several DEPENDENT, identified by their names.

- In this exampl [illegible] ed a weak entity, {Name} is a partial key for i[illegible]tifying relationship between DEPENDENT and TAX PAYER is IS DEPENDENT OF. TAX PAYER is said to *own* DEPENDENT.

1.4 Constraints on relationship types

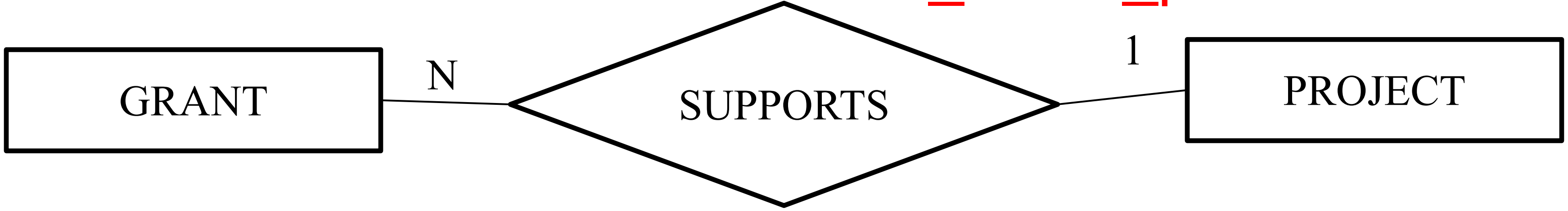
- Relationship types usually have certain constraints that limit the possible combinations of entities participating in relationship instances.
- They should reflect the correct factors
- *Cardinality ratio c* [illegible] f relationship instances an entity can participate in.
- Example: A research grant supports only one research project, but a research project may be supported by many grants. PROJECT:GRANT is a 1 : N relationship.

1.4 Constraints on relationship types(cont)

- This is illustrated in the occurrence diagram below:

1.4 Constraints on relationship types(cont)

- We can also show this in an ERD:

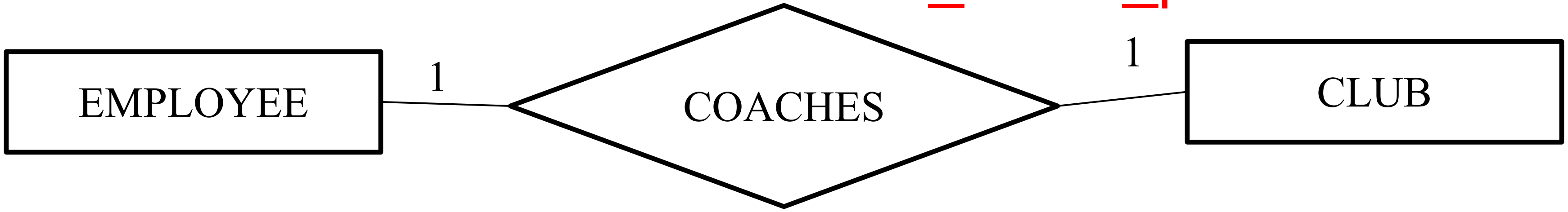


1.4 Constraints on relationship types(cont)

- Example: Consider a database of AFL (here substitute your favourite team sport) statistics. The relationship of head coaches to clubs is an example of a 1 : 1 relationship.

1.4 Constraints on relationship types(cont)

- With an ERD:

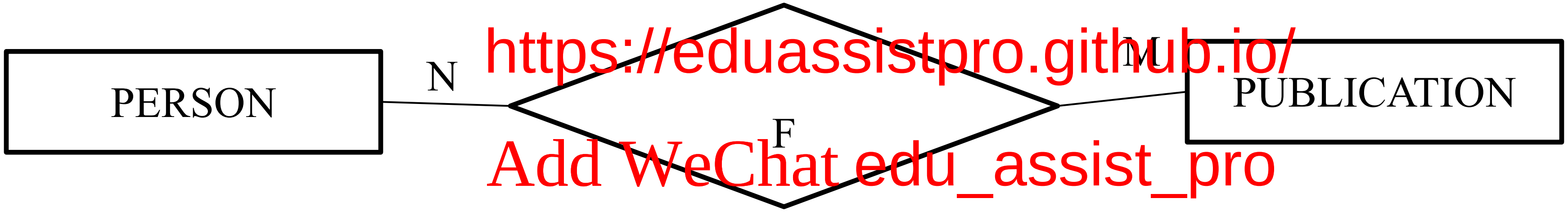


1.4 Constraints on relationship types(cont)

- Example: An example of an N : M relationship is authorship of publications:

1.4 Constraints on relationship types(cont)

- The equivalent ERD:

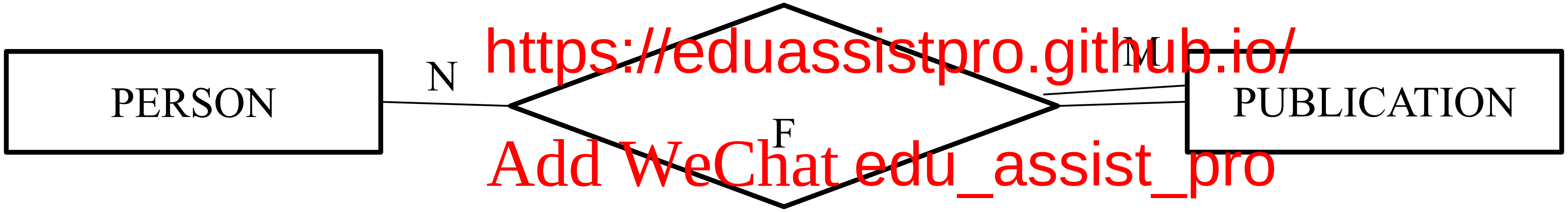


1.2.4 Constraints on relationship types(cont)

- Another kind of constraint that can be represented using the ER model is a
  - *Participation* [illegible] of an entity in a relationship can be:
    - *total*: every entity must participate e.g. every publication has an author.
    - *partial*: not necessarily total. e.g. not every person has publications.

1.4 Constraints on relationship types(cont)

- This can be shown with an ERD like the one below:



1.5 Attributes of relationship types

- Relationship types can have attributes – for example, [illegible]
  - a researcher [illegible] ojects. The fraction of her time devote [illegible] ular project could be an attribute of the WORKS ON relationship type.
- This can be shown in an ERD as below:

1.5 Attributes of relationship types(cont)

1.5 Attributes of relationship types(cont)

- The notation used for ERDs is summarised in Elmasre/Navathe Figure 3.15.

1.6 Enhanced ER (EER) model

- Designers must use additionally modelling concepts to
  - represent the ations as accurately and explicitly as possible

1.6 Enhanced ER (EER) model(cont)

- There are many extensions to the ER model. We will look at one:

  - *Specialisatio* a set of subclasses of an entity type; this entity typ e superclass of the specialization.
  - *Generalisation*: a reverse process of specialisation.
- A subclass inherits all the attributes of the superclasses.

1.6 Enhanced ER (EER) model(cont)

- A specialisation involves the following aspects:
  - Define a set of subclasses of an entity type.
  - Associate additional specific attributes with each subclass.
  - Establish additio een each subclass and other entity types, or other subclasses.
- A subclass may have multiple supercla
- A specialisation:
  - may be either total or partial; and
  - may be either disjoint or overlapping.

1.7 Design Principles

- Faithfulness: reflect reality.
- Avoid redundancy.
- Picking the ri