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A Study Guide on Entity Relationship Diagram in DBMS for NET/SET Computer Science Aspirants

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Abstract:

An Entity Relationship Diagram commonly & popularly known as ERD is a diagram that represents relationships among entities in a database. An ER Diagram in DBMS plays a crucial role in designing the database. Today's business organization foresees all the requirements demanded by the users in the form of an ER Diagram. It's later forwarded to the database administrator to design the database. The paper covers the majority of important points and topic wise some solved previous exam questions which can be useful for aspirants preparing for National Eligibility test and state level lectureship test. The main purpose to prepare this paper is to facilitate computer teachers, research scholars and aspirants preparing for competitive exams with a simplified view on the concept of ER Diagram which base a unit covering 4-10 marks in NET /SET exam.

Keywords: *NTA, NET-CSS, ER, Multivalued attribute, Entity Type ,Cardinality.*

1. Introduction:

E-R DIAGRAM/MODEL: It was Introduced in 1976 by Dr Peter Chen, a non-technical design method works on a conceptual level based on the perception of the real world. It is a **high-level data model**. It consists of collections of basic objects, called entities and of relationships among these entities and attributes which defines their properties. An E-R data model was developed to facilitate database design by allowing specification of an enterprise schema that represents the overall logical structure of a database. An E-R model is very useful in mapping the meanings and interactions of real-world enterprises onto a conceptual schema. It is free from ambiguities and

provides a standard and logical way of visualizing the data. As basically it is a diagrammatic representation easy to understand even by a non-technical user.

Q. An Entity - relationship diagram is a tool to represent: ***(NET-JUNE-2005)***

(A) Data model (B) Process model (C) Event model (D) Customer model

Ans A

2. BASICS OF AN E-R MODEL:

• **ENTITY**- An entity is a thing or an object in the real world that is distinguishable from other objects based on the values of the attributes it possesses.

• An entity may be concrete, such as a person or a book, or it may be abstract, such as a course, a course offering, or a flight reservation.

Types of Entity:

1. **Tangible** - These are entities which physically exist in the real world. E.g. - Car, Pen, locker
2. **Intangible** -These are entities which exist logically. E.g. – Account.

• In Entity Relationship diagram, we cannot represent an entity, because an entity is an instant not a schema, and ER diagrams are designed to understand schema.

• In a relational model entity is represented by a row or a tuple or a record in a table.

ENTITY SET- Collection of the same type of entities that share the same properties or attributes.

• In an ER diagram an entity set is represented by a rectangle.

• In a relational model it is represented by a separate table.

Q.An entity instance is a single occurrence of an _____. ***(NET-JULY-2010)***

(A) entity type (B) relationship type (C) entity and relationship type (D) None of these

Ans: A

Q. An entity has: ***(NET-DEC-2008)***

(i) a set of properties

(ii) a set of properties and values for all the properties

(iii) a set of properties and the values for some set of properties may non-uniquely identify an entity

(iv) a set of properties and the values for some set of properties may uniquely identify an entity

Which of the above are valid?

(A) (i) only (B) (ii) only (C) (iii) only (D) (iv) only

Ans: D

Q. The E-R model is expressed in terms of: ***(NET-DEC-2004)***

(i) Entities (ii) The relationship among entities (iii) The attributes of the entities

Then (A) (i) and (iii) (B) (i), (ii) and (iii) (C) (ii) and (iii) (D) None of the above

Ans: B

Q. An ER Model includes ***(NET-DEC-2013)***

I. An ER diagram portraying entity types.

II. Attributes for each entity type

III. Relationships among entity types.

IV. Semantic integrity constraints that reflect the business rules about data not captured in the ER diagram.

(A) I, II, III & IV (B) I & IV (C) I, II & IV (D) I & III

Ans: A

3. ATTRIBUTES

• Attributes are the units defined and describe properties and characteristics of entities.

• Attributes are the descriptive properties possessed by each member of an entity set. For each attribute, there is a set of permitted values called domain.

• In an ER diagram attributes are represented by an ***ellipse or oval*** connected to a rectangle.

• While in a relational model they are represented by independent columns. e.g. Instructor (ID, name, salary, dept_name)

Q. In a relational schema, each tuple is divided in fields called: ***(NET-DEC-2005)***

(A) Relations (B) Domains (C) Queries (D) All the above

Ans: B

3.1 Types of Attributes:

• **Single valued Attributes (SVA)**- Attributes having single value at any instance of time for an entity are called Single valued attributes. E.g. –Aadhar no, dob.

• **Multivalued Attributes (MVA)** - Attributes which can have more than one value for an entity at same time are called multivalued attributes. E.g. - Phone no, email, address.

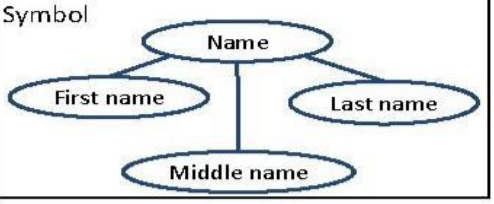
o A multivalued attribute is represented by a ***double ellipse*** in an ER diagram and by an independent table in a relational model.

•To work on MVA, Separate table for each multivalued attribute, by taking multivalued attribute and primary key of main table as foreign key in new table.

Single-valued Attribute	Multi-valued Attribute
Has **single value**	Have **multiple value**
E.g. Rollno, CPI	E.g. Phoneno (person may have multiple phone nos) EmailID (person may have multiple emails)
Symbol 	Symbol 

• **Simple Attributes** - Attributes which cannot be divided further into sub parts are called Simple Attributes. Example: Age

• **Composite Attributes** - Attributes which can be further divided into sub parts, as simple attributes are called Composite Attributes. A composite attribute is represented by an ellipse connected to an ellipse and in a relational model by a separate column.

Simple Attribute	Composite Attribute
Cannot be divided into subparts	**Can be divided** into subparts
E.g. RollNo, CPI	E.g. Name (first name, middle name, last name) Address (street, road, city)
Symbol 	Symbol 

• **Stored Attributes-**Main attributes whose value is permanently stored in the database are stored Attributes. Example: Date_of_birth

• **Derived Attributes**- value of these types of attributes can be derived from values of other Attributes. E.g. - Age attribute can be derived from date_of_birth and Date attribute.

Stored Attribute	Derived Attribute
It's value is **stored manually** in database	It's value is **derived** or **calculated** from other attributes.
E.g. Birthdate	E.g. Age (can be calculated using current date and birthdate)
Symbol 	Symbol 

Descriptive attribute - Attribute of relationship is called descriptive attribute.

• An attribute takes a null value when an entity does not have a value for it. The null value may indicate "not applicable"— that is, that the value does not exist for the entity.

• Null can also designate that an attribute value is unknown. An unknown value may be either missing (the value does exist, but we do not have that information) or not known.(we do not know whether or not the value actually exists).

4. Relationship / Association:

• It is an association between two or more entities of the same or different entity set.

• In ER diagram we cannot represent individual relationships as it is an instance or data.

Note: - Normally people use word relationship for relationship type so don't get confused.

Q. The E-R model is expressed in terms of _____. ***(NET-DEC-2009)***

I. Entities II. The relationship among entities.

III. The attributes of the entities. IV. Functional relationship.

(A) I, II (B) I, II, IV (C) II, II, IV (D) I, II, III

Ans: d

Q. A schema describes: ***(NET-DEC-2005)***

(A) data elements (B) records and files (C) record relationship (D) all of the above

Ans: D

In an ER diagram it is represented by a diamond, while in a relational model sometimes through foreign key and other times by a separate table.

• Every relationship type has three components. Name, Degree, Structural constraints (cardinalities ratios, participation)

• NAME- every relation must have a unique name.

• Degree of a relationship/relationship set: - Means number of entities set(relations/tables) associated (participate) in the relationship set. Most of the relationship sets in a database system are binary. Occasionally however relationship sets involve more than two entity sets. Logically, we can associate any number of entities set in a relationship called N-ary Relationship.

• **Unary Relationship -** Here, One single entity set participates in a relationship, means two entities of the same entity set are related to each other. These are also called self -referential Relationship sets. Example - A member in a team may be the manager of another member in the team.

• **Binary Relationship** - Here, Two entity sets participate in a relationship. It is the most common Relationship.

• **Ternary Relationship -** Here, three entities participate in a relationship. E.g. The University might need to record which teachers taught which subjects in which courses.

• **Quaternary Relationship** - When four entities participate in a relationship it becomes a Quaternary Relationship.

• **N-ary relationship** – Here n number of entities participate in a relationship where n number of entity sets are associated.

But the most common relationships in ER models are Binary.

5. Structural constraints (Cardinalities Ratios, Participation)

• An E-R enterprise schema may define certain constraints to which the contents of a database must conform.

5.1 MAPPING CARDINALITIES / CARDINALITY RATIOS:

• It expresses the number of entities to which another entity can be associated via a relationship set.

Four possible categories are-

• One to One (1:1) Relationship.

• One to Many (1: M) Relationship.

• Many to One (M: 1) Relationship.

• Many to Many (M: N) Relationship.

a) One to One (1:1) Relationship- An entity in A is associated with at most one entity in B, and an entity in B is associated with at most one entity in A.

E.g.- The directed line from relationship set advisor to both entities set indicates that 'an instructor may advise at most one student, and a student may have at most one advisor'.

• Conversion of 1-1 relationship (binary).

• No separate table is required, take the primary key of one side as primary key on the other side, priority must be given to the side having total participation.

b) One to Many (1: M) Relationship - An entity in A is associated with any number (zero or more) of entities in B. An entity in B, however, can be associated with at most one entity in A.

E.g.- An instructor may advise many students, but a student may have at most one advisor.

• Conversion of 1-n or n-1 relationship (binary)

• No separate table is required, modify n side by taking primary key of 1 side a foreign key on n side

c) Many to One (M: 1) Relationship- An entity in A is associated with at most one entity in B. An entity in B, however, can be associated with any number (zero or more) of entities in A.

E.g.- Student may have many instructors but an instructor can advise at most one student

d) Many to Many (M:N) Relationship- An entity in A is associated with any number (zero or more) of entities in B, and an entity in B is associated with any number (zero or more) of entities in A.

E.g.- Student may have many advisors and an instructor may advise many students.

• In a Relationship there are two methods to represent cardinalities: either we write the numbers or an edge.

• Conversion of n-n relationship (binary)

• Separate table is required to take the primary key of both tables and declare their combination as a primary key of the new table.

6. Participation constraints

• It defines participation of entities of an entity type in a relationship.

• Participation constraint specifies whether the existence of an entity depends on its being related to another entity via the relationship type.

• These constraints specify the minimum and maximum number of relationship instances that each entity must/can participate in.

• **Max cardinality** – It defines the maximum number of times an entity occurs participating in a relationship.

• **Min cardinality -** It defines the minimum number of times an entity occurs participating in a relationship.

6.1 Types of Participation Constraints -

• Partial participation

• Total Participation

PARTIAL PARTICIPATION (**min cardinality zero**) - In Partial participation only some entities of entity set participate in Relationship set, that is there exists at least one entity which do not participate in a relation.

TOTAL PARTICIPATION (**min cardinality at least one**) - In total participation every entity of an entity set participates in at least one relationship in the Relationship set.

• Double lines indicate total participation of an entity in a relationship set.

• A line may have an associated minimum and maximum cardinality, shown in the form l..h, where l is the minimum and h the maximum cardinality.

Q. In an Entity-Relationship (ER) model, suppose R is a many-to-one relationship from entity set E1 to entity set E2. Assume that E1 and E2 participate totally in R and that the cardinality of E1 is greater than the cardinality of E2. ***(GATE-2018)***

Which one of the following is true about R?

(a) Every entity in E1 is associated with exactly one entity in E2.

(b) Some entity in E1 is associated with more than one entity in E2.

(c) Every entity in E2 is associated with exactly one entity in E1.

(d) Every entity in E2 is associated with at most one entity in E1

Ans: a

Q. An ER model of a database consists of entity types A and B. These are connected by a relationship R which does not have its own attribute. Under which one of the following conditions, can the relational table for R be merged with that of A? (GATE-2017)

(a) Relationship R is one-to-many and the participation of A in R is total.

(b) Relationship R is one-to-many and the participation of A in R is partial.

(c) Relationship R is many-to-one and the participation of A in R is total.

(d) Relationship R is one-to-many and the participation of A in R is partial.

Ans: c

Q. Let M and N be two entities in an E-R diagram with simple single value attributes. R1 and R2 are two relationships between M and N, whereas R1 is one-to-many and R2 is many-to-many. The minimum number of tables required to represent M, N, R1 and R2 in the relational models are _____. (NET-JAN-2017)

(A) 4 (B) 6 (C) 7 (D) 3

Ans: D

Explanation: Two tables are created for entities M and N and third table is created for relationships R2 (many to many). For R1 no need of separate table (one to many).

Q. Given the basic ER and relational models, which of the following is INCORRECT? (GATE2012)

(A) An attribute of an entity can have more than one value.

(B) An attribute of an entity can be composite.

(C) In a row of a relational table, an attribute can have more than one value.

(D) In a row of a relational table, an attribute can have exactly one value or a NULL value.

Ans: C

Q. Let E1 and E2 be two entities in an E/R diagram with simple single-valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many and R2 is many-to-many. R1 and R2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model? (GATE-2005) & (NET-DEC-2015)

a) 2 b) 3 c) 4 d) 5

Ans: b

Explanation:

One table for each entity: 2

R1 is one-to-many (No separate Table): 0

R2 is many-many and requires one separate table: 1

Total No of tables: 3

7. STRONG AND WEAK ENTITY SET:

• A key for an entity is a set of attributes that suffice to distinguish entities from each other. The concepts of super key, candidate key, and primary key are applicable to entity sets just as they are applicable to relation schemas.

• An entity set is called a strong entity set; if it has a primary key, all the tuples in the set are distinguishable by that key.

• An entity set that does not process sufficient attributes to form a primary key is called a weak entity set. It contains discriminator attributes (partial key) which contain partial information about the entity set, but it is not sufficient enough to identify each tuple uniquely. It is represented by a double rectangle.

• The discriminator of a weak entity set is also called the partial key of the entity set.

• The discriminator of a weak entity is underlined with a dashed, rather than a solid, line.

For a weak entity set to be meaningful and converted into a strong entity set, it must be associated with another entity set called the identifying or owner entity set i.e. weak the entity set is said to be existence dependent on the identity set.

• The identifying entity set is said to own the weak entity set that identifies the primary; the key of a weak entity set will be the union of primary key and discriminator attributes.

• The relationship associating the weak entity set with the identifying entity set is called the identifying relationship (double diamonds).

• The identifying relationship is many to one from the weak entity set to the identifying entity set, and the participation of the weak entity set in the relationship is always total.

• The identifying relationship set should not have any descriptive attributes, since any such attributes can instead be associated with the weak entity set.

• A weak entity set may participate as an owner in an identifying relationship with another weak entity set.

7.1 REASONS TO HAVE WEAK ENTITY SET:

• Weak entities reflect the logical structure of an entity being dependent on another.

• Weak entities can be deleted automatically when their strong entity is deleted.

• Without a weak entity set it will lead to duplication and consequent possible inconsistencies.

Q. For a weak entity set to be meaningful, it must be associated with another entity set in combination with some of their attribute values, is called as: ***(NET-DEC-2015)***

(1) Neighbor Set (2) Strong Entity Set (3) Owner Entity Set (4) Weak Set

Ans. 3

Q. Which of the following statements is FALSE about weak entity set? ***(NET-DEC-2015)***

a) Weak entities can be deleted automatically when their strong entity is deleted.

b) Weak entity set avoids the data duplication and consequent possible inconsistencies caused by duplicating the key of the strong entity.

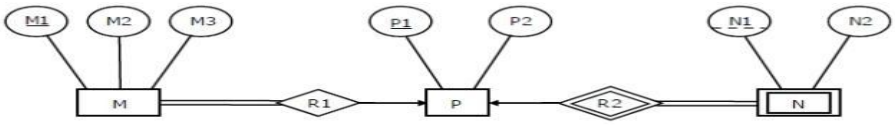
c) A weak entity set has no primary keys unless attributes of the strong entity set on which it depends are included.

d) Tuples in a weak entity set are not partitioned according to their relationship with tuples in a strong entity set.

Ans. d

Q.

Consider the following ER diagram



The minimum number of tables needed to represent M, N, P, R1, R2 is **(GATE 2008)**

Ans: 3

Explanation: M, P are strong entities; hence, they must be represented by separate tables. M table is modified to include primary key of P side (i.e. P1). N is weak entity, and it is modified to include primary key of P (i.e. P1).Therefore there would be minimum of 3 tables with schema given below :

M (M1, M2, M3, P1)

P (P1, P2)

N (P1, N1, N2)

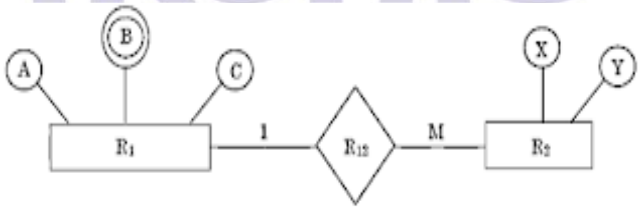
Q. The entity type on which the ..... type depends is called the identifying owner.

(NET-DEC-2004)

(A) Strong entity (B) Relationship (C) Weak entity (D) E – R

Ans: C

Q.Find minimum number of tables required for converting the following entity relationship diagram into relational database? (NET-DEC-2019)



a) 2 b) 4 c)3 d) 5

Ans: c

Explanation: Here we have 1 to Many relation so we require two tables.

Attribute B being multi-valued, we need to remove the multi-valued attribute B to convert a given entity relationship diagram into relational database.As relational databases do not allow multi-valued attributes. We have to introduce a new table.

So, number of tables are as below:

R1, R12R2, A table for B (Multi-valued attribute)

So, a total of 3 tables are required for the given entity relational diagram.

CONCLUSION:

From all above points discussed it can be concluded that ER diagram covers a significant part in DBMS and is one of the important topics that comes in an competitive exam covering descriptive and logical structure.

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