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CT60A4304 - BASICS OF DATABASE SYSTEMS

ARCHITECTURE, MODELS, ER-MODELING

Lecture

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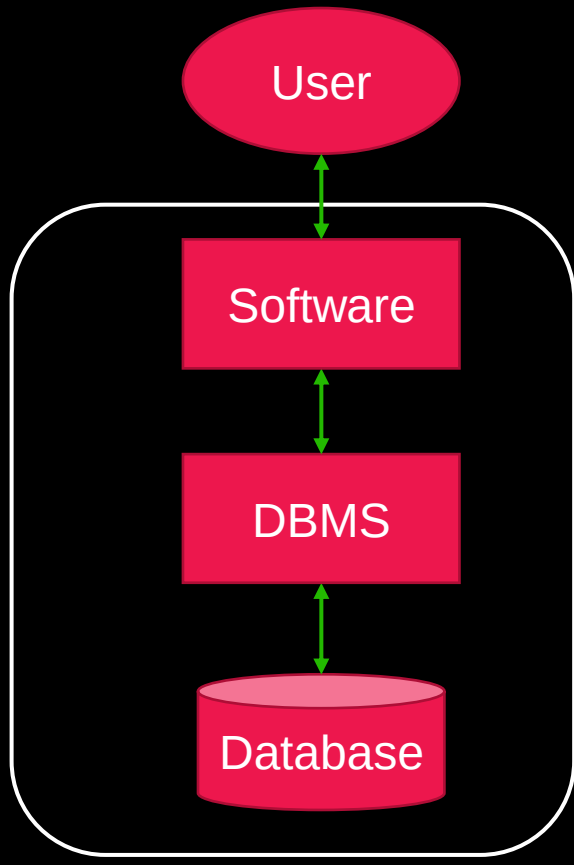
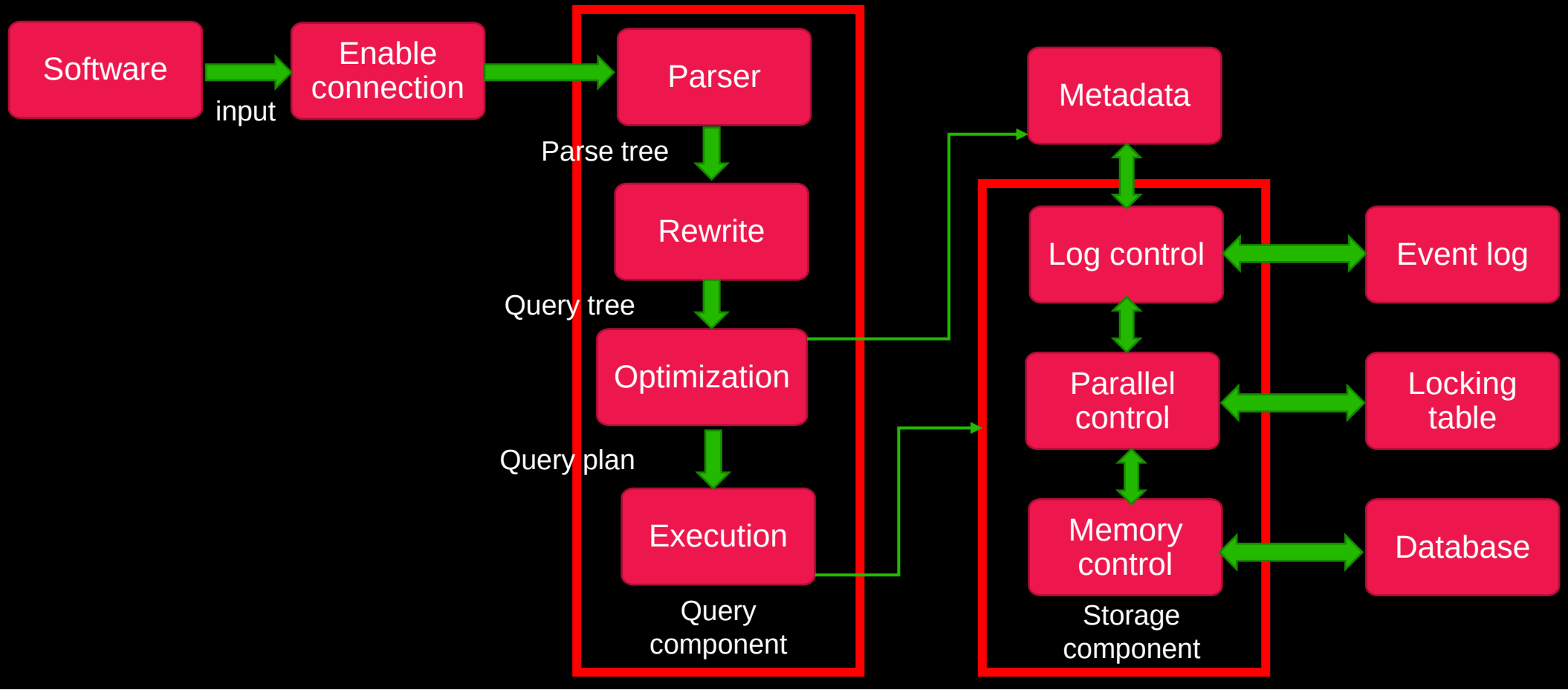
TABLE OF CONTENTS

DATABASE SYSTEM

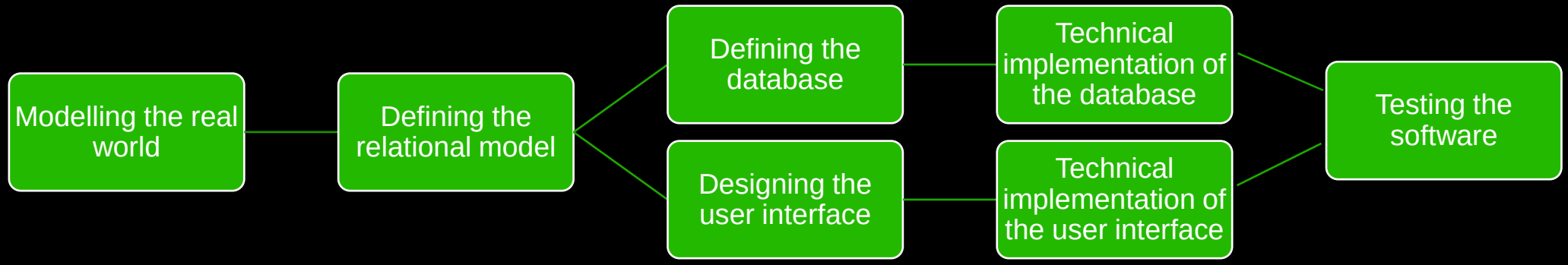
- DBMS components:
  - Query component: Handles the checking, execution and optimization of queries
  - Storage component: How data is stored and transferred from disk to memory to software
  - Interface: To operate the database without a software
- Additional components:
  - Graphical user interface to managing databases, not just console
  - Monitoring tools to check performance, usage and stress
  - Data mining, analysis and reporting tools
  - Middleware to join the DBMS to other tools
  - Backup tools
  - Shared components with OS, diagram tools, and other miscellaneous tools & components



QUERY PROCESSING PHASES



MODELLING STEPS



MODELLING STEPS

1. Define requirements and the need
2. Conceptual modelling – ER-modelling
3. Transaction planning
4. Transforming the conceptual model to a relational structure
5. Implementing the database
    - Concept, usage, structure, user interface
6. Testing

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ENTITY-RELATIONSHIP MODELING

ENTITIES, RELATIONSHIPS AND ATTRIBUTES

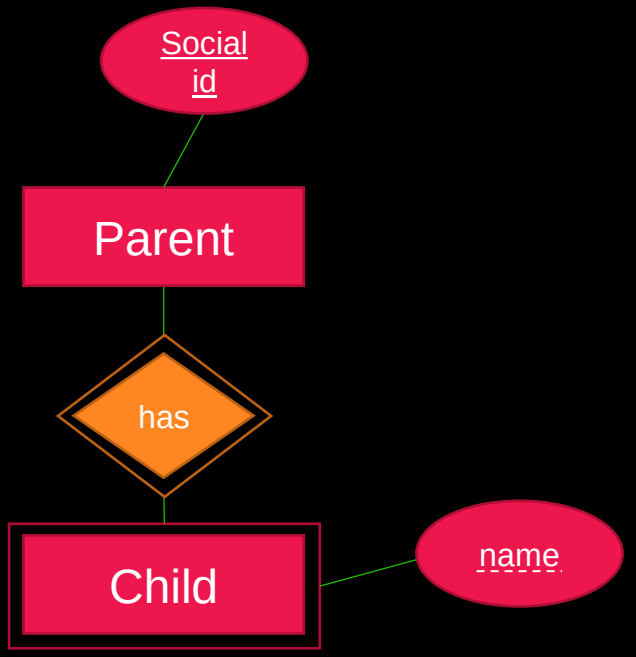
- Entities: Model the real world subjects/objects, items, people etc. on an abstract level
  - Includes attributes and has relationships
  - These become the tables in a database
- Relationships
  - Models the relationship between entities.
  - Does not directly transfer to the database but shows how foreign keys should be stored
- Attributes: A property/feature/trait of an entity or a relationship
  - These are transformed to data in a database

KEY ATTRIBUTE

- Key attribute is used to uniquely identify one entity from another
- If one attribute is not enough, use multiple attributes
  - Only the minimum required
- Cannot be empty or null
- Underlined attribute

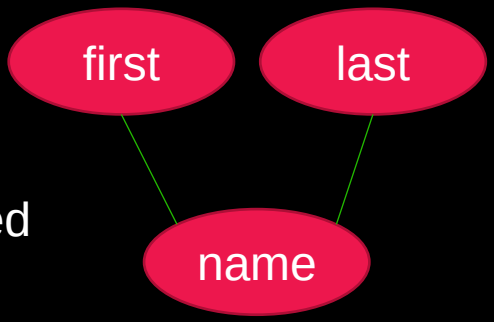
STRONG AND WEAK ENTITY

- Strong (normal) entity has a unique identifier (key attribute)
- Weak entity cannot be uniquely identified alone
  - Requires the key attribute of the connected strong entity
- Relationship between the strong and weak entity can be recognized with the double diamond



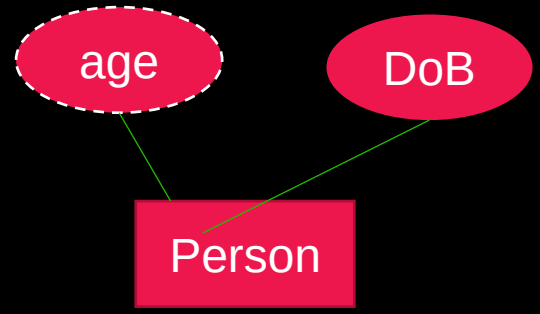
COMPOSITE ATTRIBUTE

- Attribute of attributes
- Composite attribute is composed of other attributes
- Justified if both parts and the whole attribute are often needed
- If attribute is not composite, it is simple
- Can be extensive hierarchies



DERIVED ATTRIBUTE

- Derived attribute has a value from
  - Value(s) of other attribute(s)
  - Number of related entities
- Dotted line surrounds the attribute

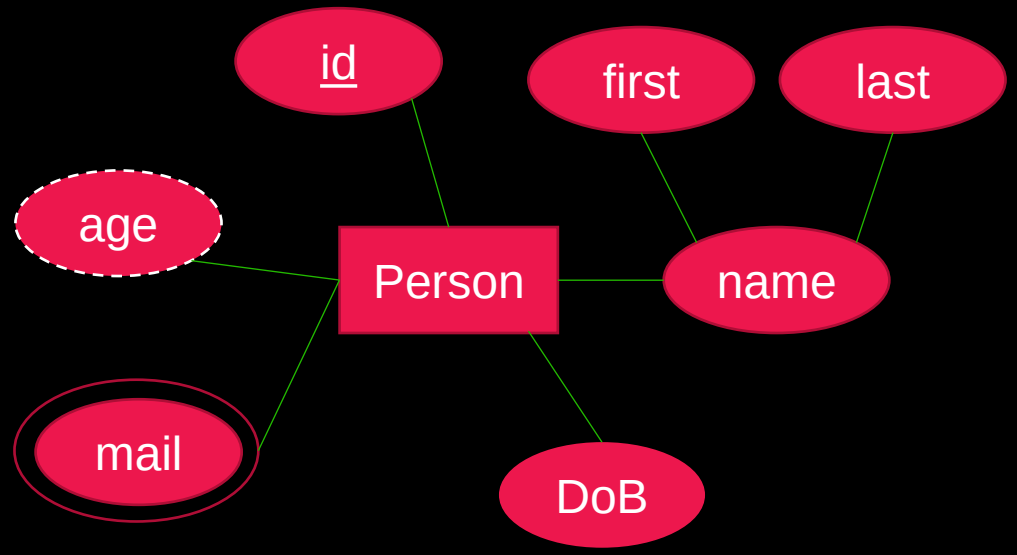


MULTIVALUED ATTRIBUTE

- Normal attribute has one value
  - They are *atomic*
- Attributes can have multiple values
  - Such as emails, phone numbers, bank accounts, etc.
- Multivalued attribute is marked with double ellipse

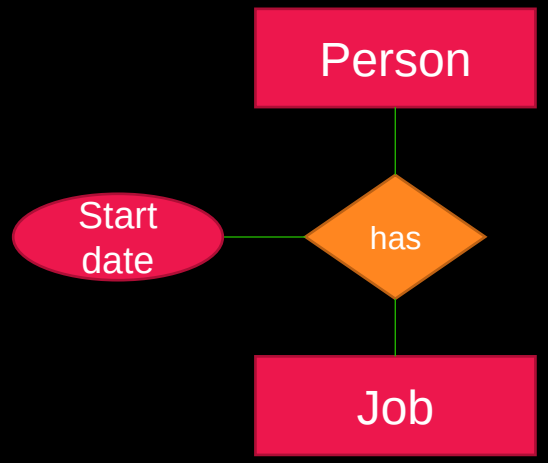
ATTRIBUTES SUMMARY

- Attribute
- Key attribute
- Composite attribute
- Derived attribute
- Multivalued attribute



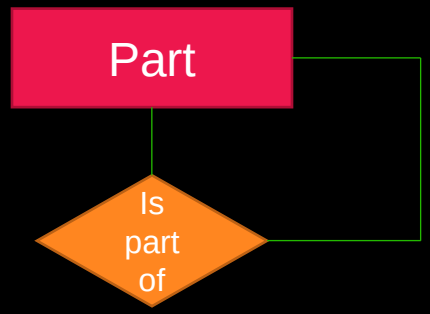
RELATIONSHIPS

- Exists between 1...n entities
- Dependency or other interesting context
- Can have attributes
- Entities can have multiple relationships

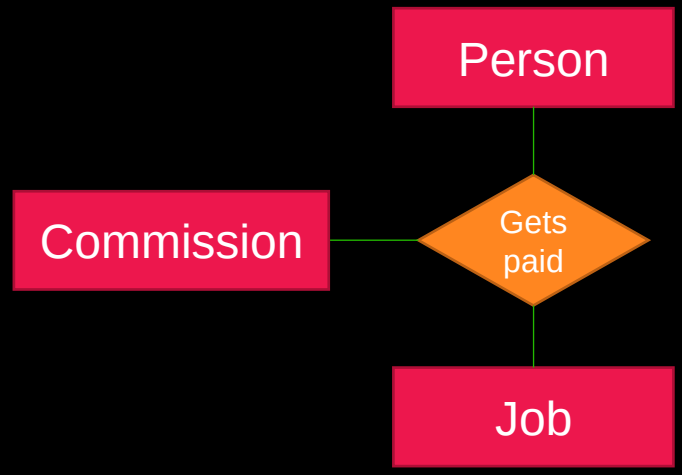


NON-BINARY RELATIONSHIPS

- Can be any degree from 1...n
- Unary relationship



- Tertiary relationship

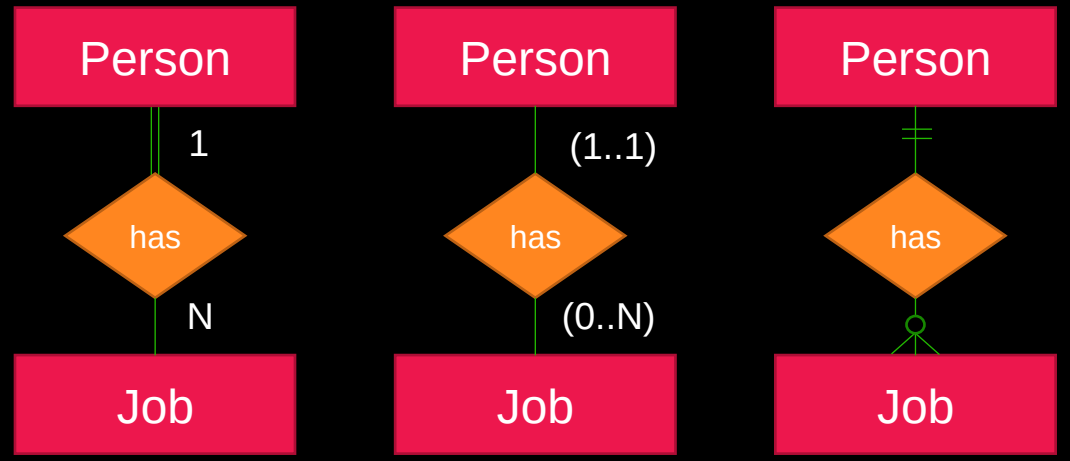


CARDINALITIES

- Tells the minimum and maximum amount of entities participating in the relationship
- Most often cardinalities are
  - One-to-one
  - One-to-many
  - Many-to-many
- Some notations can mark zero-to-one or zero-to-many existence

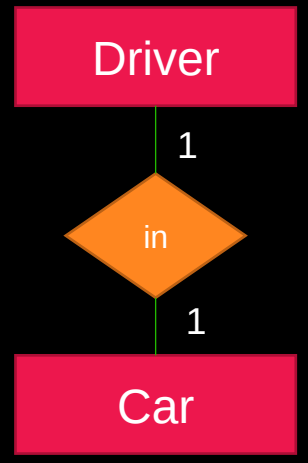
CARDINALITY RELATIONSHIP STYLES

- There area different styles to mark cardinalities in ER models
- Chen
  - Minimum cardinality is marked with lines
  - Maximum cardinality is written
- Martin
  - Minimum cardinality is written
  - Maximum cardinality is written
- Hoffer, Prescott & McFadden
  - Minimum cardinality is marked with lines
  - Maximum cardinality is marked with lines



ONE-TO-ONE

- Entities relate to one entity on the other side at most
  - 0...1
- A car can have only one driver
  - Co-driver does not count (passenger on the front seat)
- A driver can only be in one car at a time
  - Clones do not exists

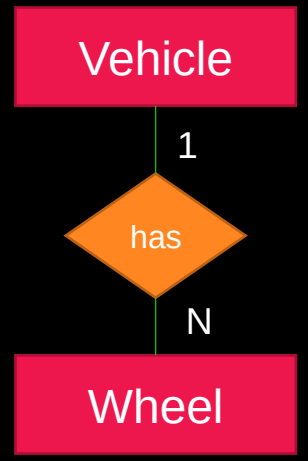


- In a database, either entity can store the foreign key to the other entity

ONE-TO-MANY

- One entity can be connected to many entities and vice-versa
  - Many entities are connected to one specific entity
- Vehicle can have multiple wheels

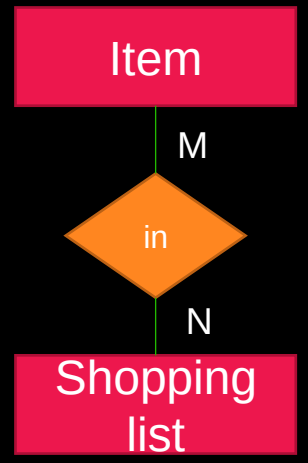
  ←→
- Multiple wheels are connected to one vehicle



- In a database, the entity connecting to one entity, store the foreign key
  - In this example, wheel table stores the foreign key

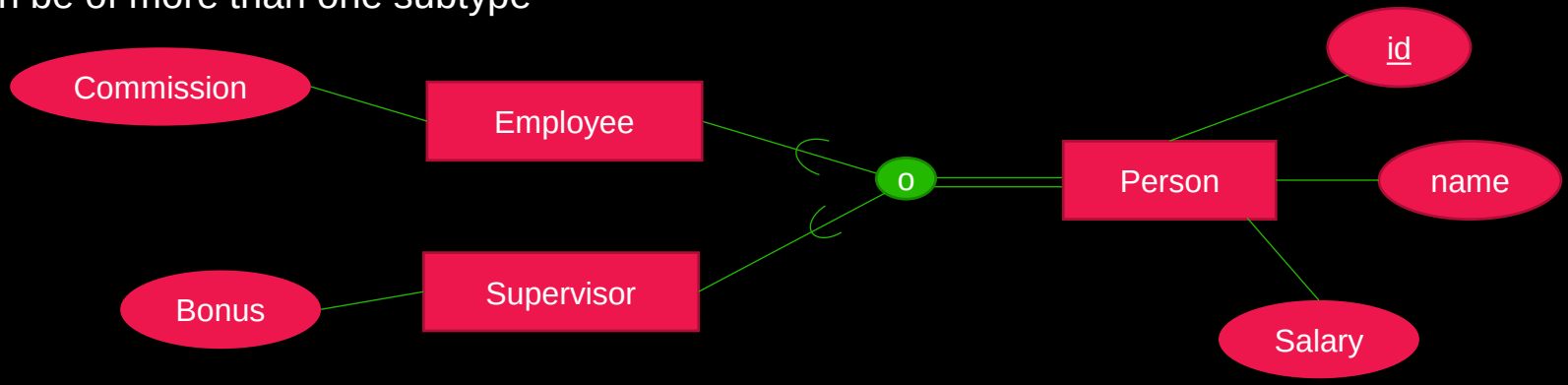
MANY-TO-MANY

- Both entities can be related to multiple entities
- Shopping list can have multiple items
- An item can be on multiple shopping lists
- In a database, cannot be directly implemented as-is
  - *Intersection table* is required
  - Transforms the M:N relationship into two 1:N relationships

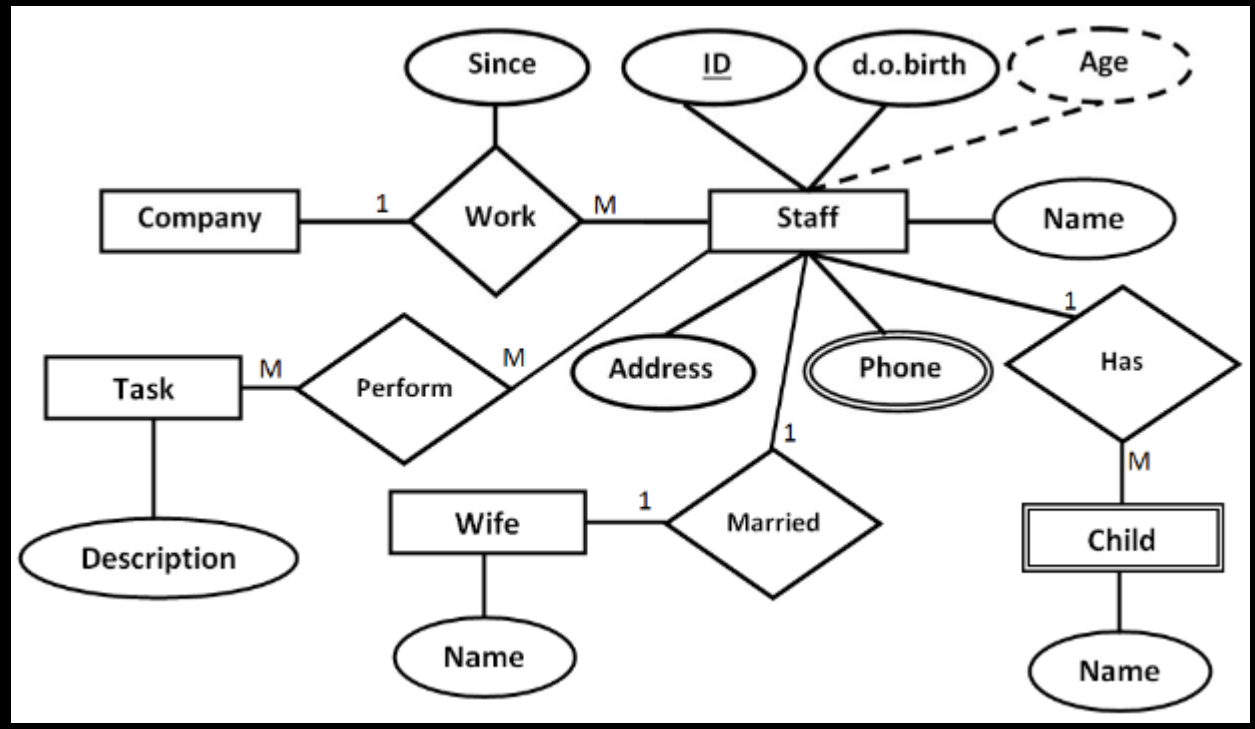


EER (EXTENDED / ENHANCED ER)

- The traditional ER-model has been extended / enhanced in various ways
- One is the so called EER-notation
- Enables abstraction and hierarchies, useful to model inheritance (similar to object-oriented modelling)
- Inside the circle is either the letter ***o*** or ***d***
  - Overlapping: Entity can be of more than one subtype
  - Disjoint:
    Entity can be of
    only one subtype



EXAMPLE ER MODEL

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