

ER - DIAGRAM

LECTURE 1: Databases

DBMS (Database Management System)

- System designed to define, store and manipulate data.
 - Storage.
 - Retrieval.
 - Updates.
 - ...

DBMS (Database Management System)

- Avoid redundancy, inconsistency.
- Concurrent data access.
- Provides security and recovery.
- Declarative language to manipulate, query, define data and control transactions.
- DDL, DML, DCL.
- Data dictionary: database providing information about database structure.

DBMS (Database Management System)



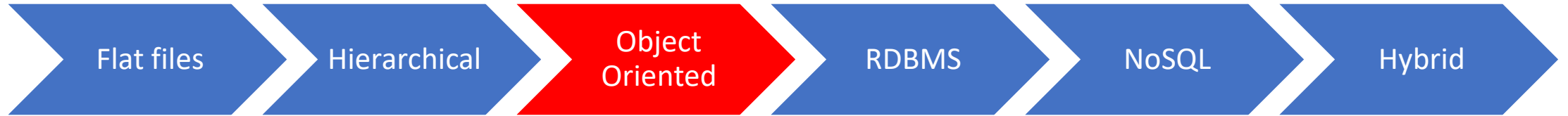
- Text database, example **CSV** format.
- Implemented in 1970 (IBM).
- File = table with a single record on each line.
- Read, store and send.
- Simple structure.
- Inefficient: slow, duplicated values, difficult to update etc.

DBMS (Database Management System)



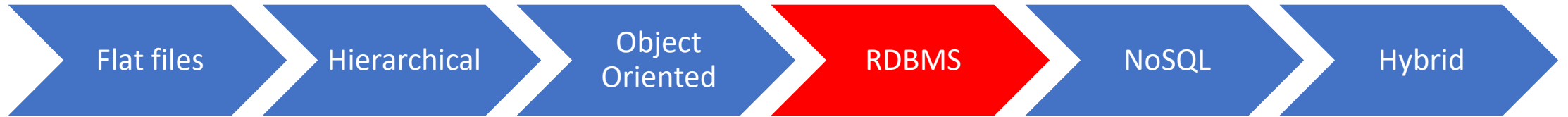
- Tree structure, examples: file system, Windows Registry
- IBM Information Management System (**IMS**)
- XML, XAML
- Used in mainframe era.
- Rigid structure.
- Only *One-to-many* relationship.
- Traversing very easy, moving a node very difficult

DBMS (Database Management System)



- Hybrid relation + objects =>> tables of objects.
- **Realm** database for Android/iOS: classes used as schema definition, alternative for SQLite.
 - Lightweight, doesn't need an ORM
 - MVCC architecture (multi-version concurrency control)
- MongoDB Realm sync data.

DBMS (Database Management System)



- Transaction oriented systems (example financial transactions).
- **ACID**: Atomicity, consistency, isolation, durability.
- Suitable for structured data.

DBMS (Database Management System)



- RDBMS hard to scale (easily scales vertically, horizontal scaling more complex).
- RDB Restrictive schemas =>> NoSql flexible structure.
- **!!!** availability, scalability, performance
- Sharding: distribute data on different servers;
- Replication: copy the same data to many nodes;

DBMS (Database Management System)



- Cloud and bigdata.
- **BASE** (Basically Available, Soft state, Eventually consistent)

Database appears to work most of the time

Replicas are not consistent all the time

At some later point database will be consistent.

DBMS (Database Management System)



- Cloud and bigdata.
- **BASE** (Basically Available, Soft state, Eventually consistent)
- Types:
 - key-value: Redis
 - Document: Mongo, Firestore
 - Column: Apache Cassandra, HBase, MariaDB
 - Graph: Neo4j

Sql or NoSQL

Relational

- Vertical scalability
- Consistency model: ACID
- pre-defined schema
- SQL language
- Normalized data

NoSql

- Horizontal scalability
- Consistency model: BASE
- Flexible schema
- No standard
- Collections, redundancy

DBMS (Database Management System)



- Integration of Relational and NoSQL databases.
- Integration of in-memory DB and on-disk DB
- Altibase, Orient DB

Course roadmap

- Database design (ERD, Relational model, normal forms)
- Transactional systems, consistency models, concurrency control
- NoSql and big-data topics, Mongo and Cassandra
- SQL (LMD, LDD, LCD)
- ... & other topics ...
- Please answer www.menti.com 81 01 83 2 Q1, Q2, Q3, Q4, Q5

Course roadmap



- Proiect – 40% (1p oficiu + 4p cerinte obligatorii + 3p cerinte optionale)
- Teme – 10% (2p)
- Laborator – 50% (test 9p + 1p oficiu + 1p bonus)

ER - Diagram

Entity Relationship model

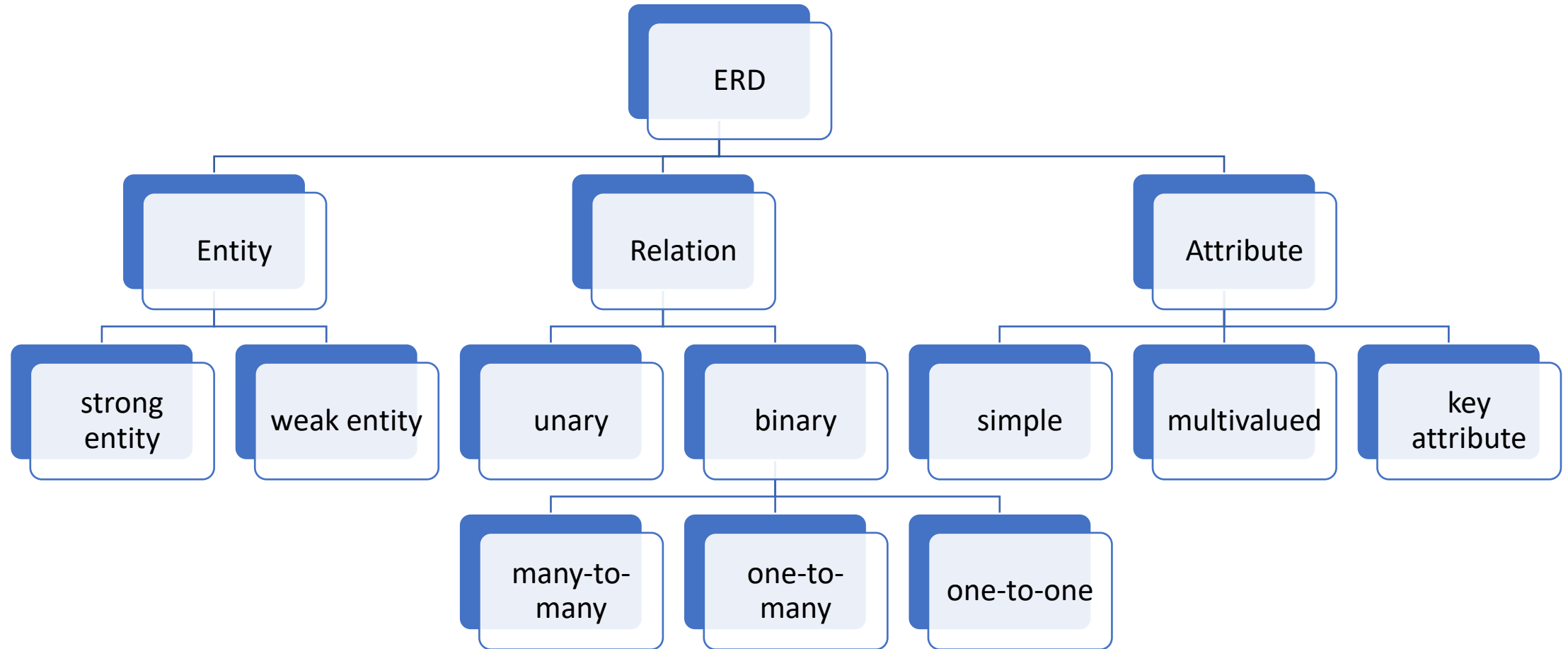
ER - Diagram

- Visual representation of the ER conceptual data model.
- High-level design.
- Not linked to the implementation or hardware.
- Peter Chen proposed ERDs in 1976.

ER - Diagram

- User story/requirement analysis ➔ **ER** ➔ relational database schema.
- Easy to translate into relational tables.
- Describes the logical structure of the (relational) database.
- Suitable for structured systems (fixed, well-defined schema).

ERD - components



ER - Diagram



person, place, activity, event, concept, real world object etc.
usually a noun



ER - Diagram



ENTITY

person, place, activity, event, concept, real world object etc.
usually a noun



RELATION

links entities (unary, binary, ternary).
usually a verb



ATTRIBUTE

ER - Diagram



ENTITY

person, place, activity, event, concept, real world object etc.
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RELATION

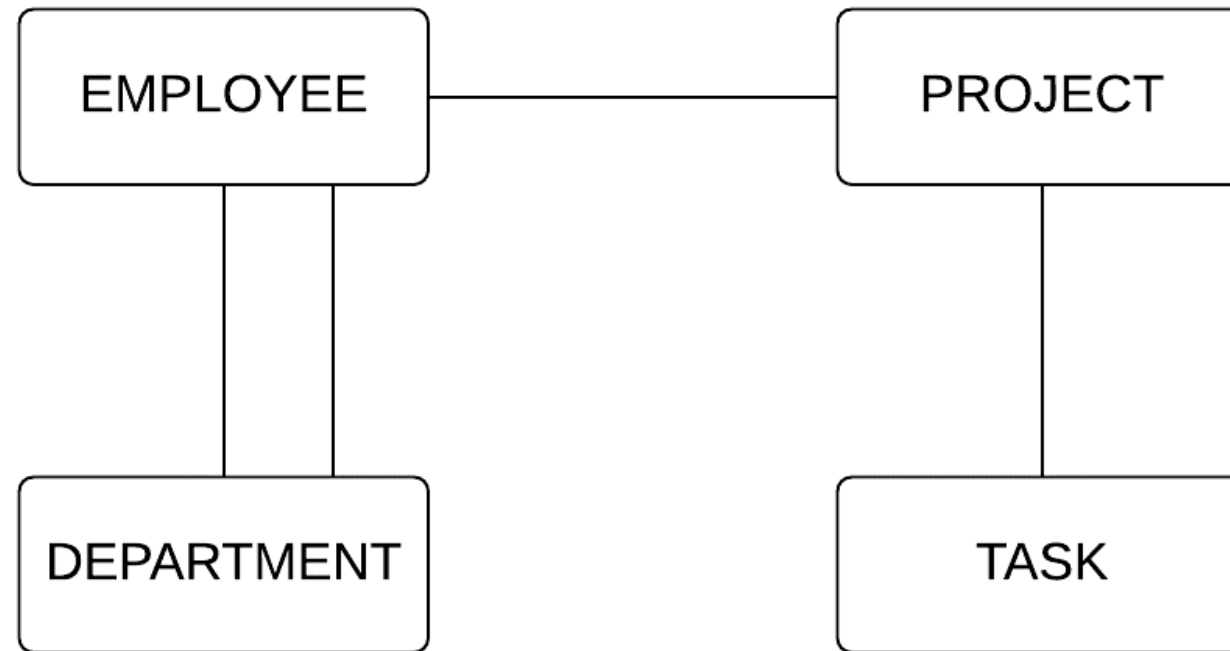
links entities (unary, binary, ternary).
usually a verb



ATTRIBUTE

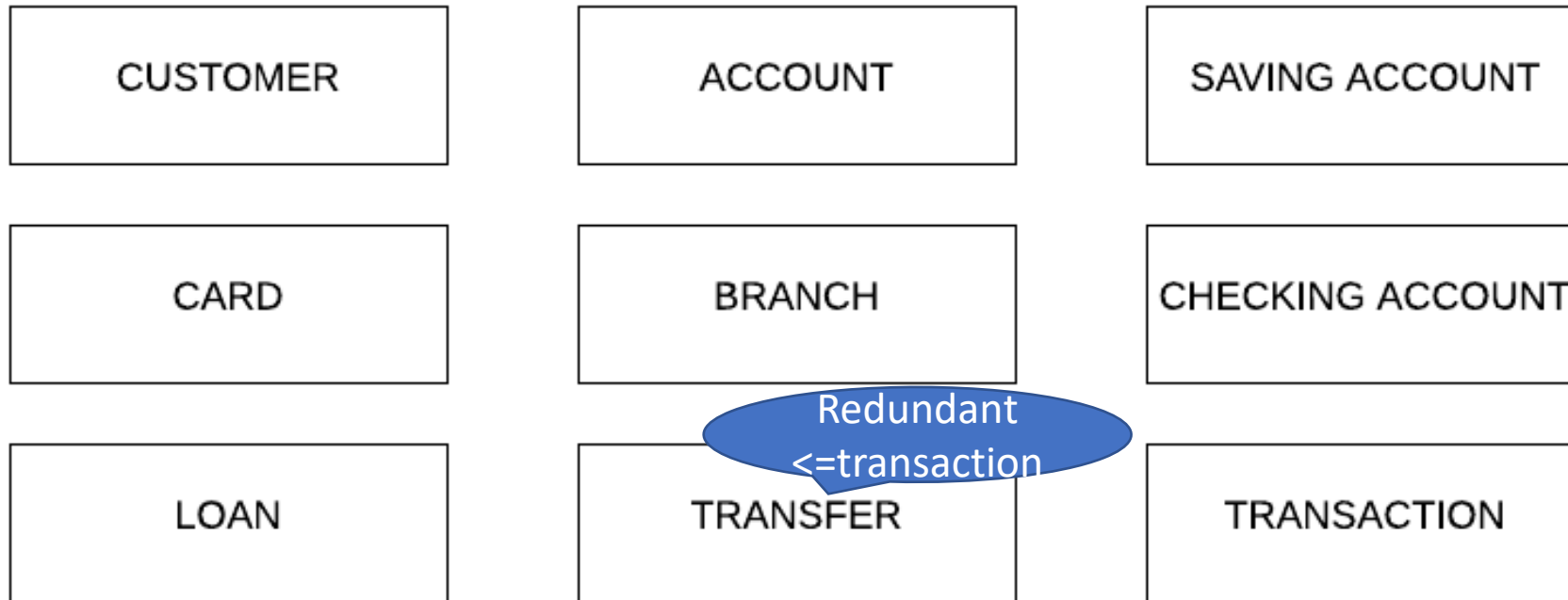
describes entities or relations

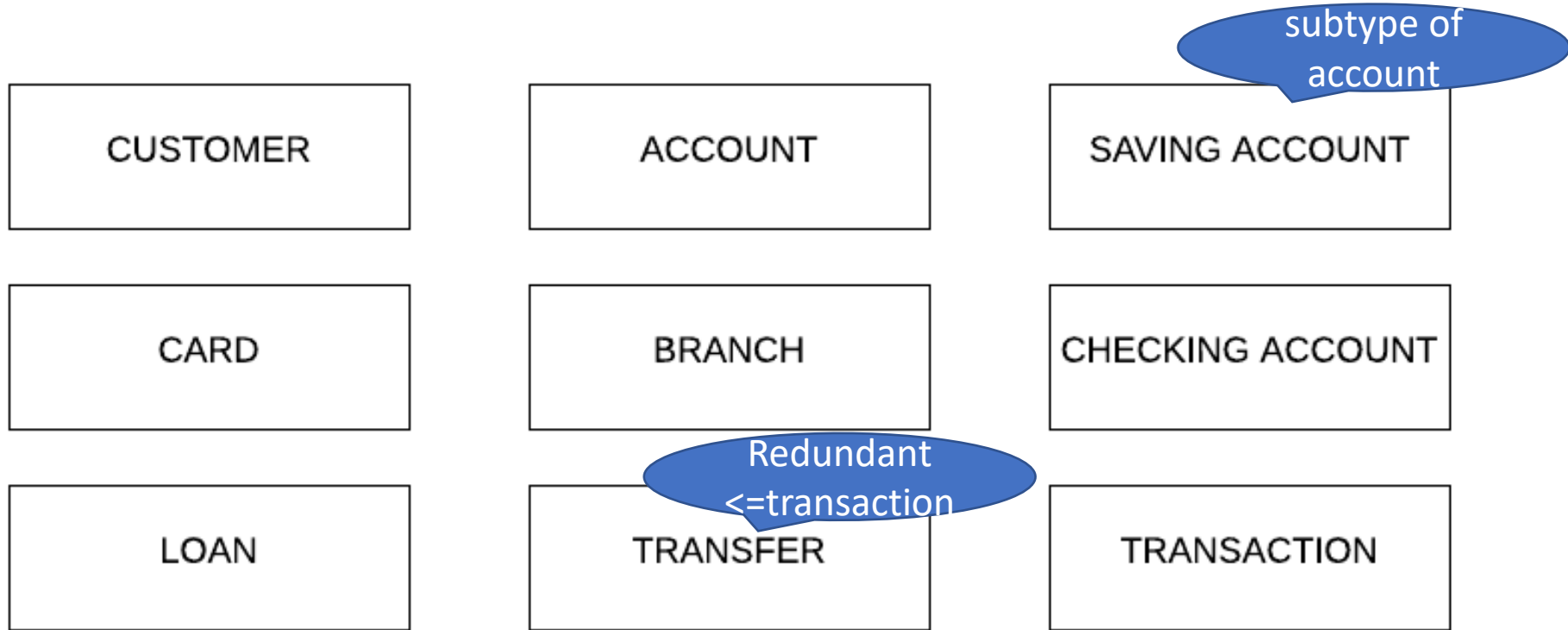
Entities

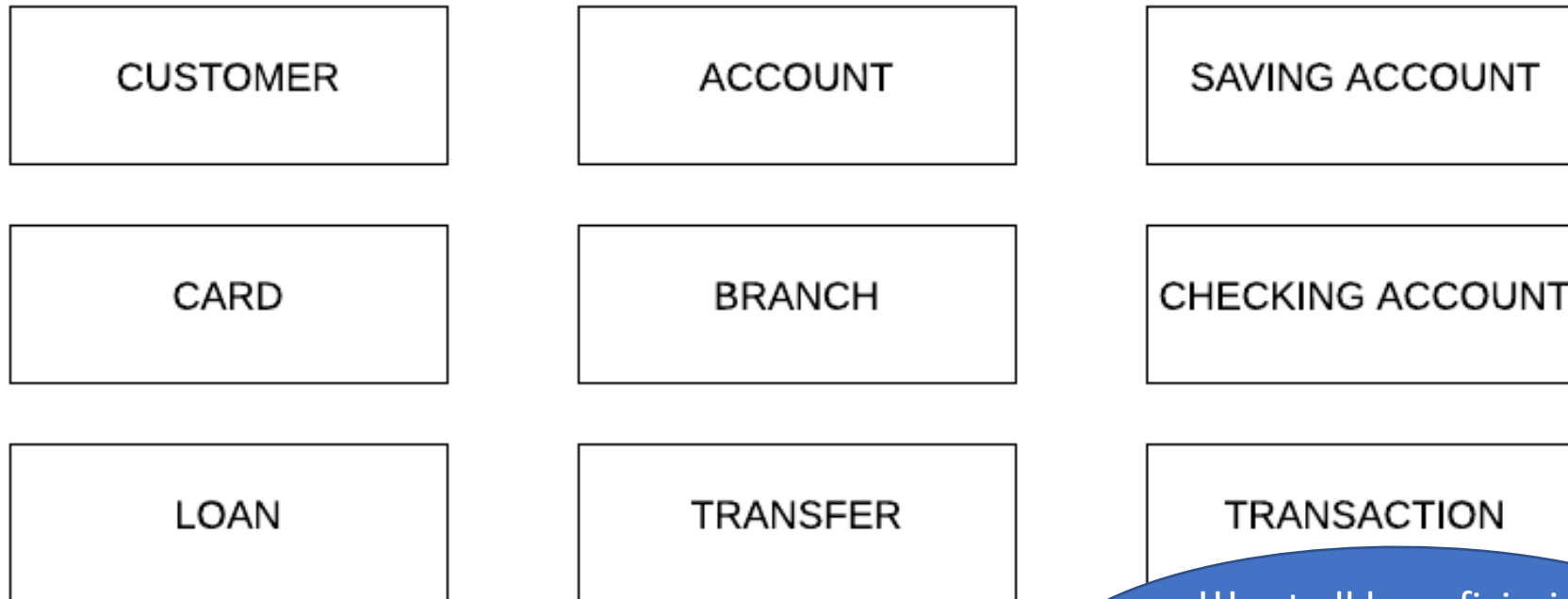


Banking (1)Entities

- A customer opens a saving account or a checking account, at a bank branch. He may also access loans. For each checking account he has a card. Periodically he may withdraw money from his account or partially pay his loans. He may also transfer money from one account to another.
- Please answer [www.menti.com](https://www.menti.com/join/8101832) 8101 832 Q6, Q7







!!!not all beneficiaries
(missing from story) are
customers of the same
bank

Entities

- Unique names, uppercase characters
- Graphical representation: rectangles
- Relational database: entity ➔ table (line & columns)
- Primary key: attribute or group of attributes that uniquely identifies an entity instance

Primary key

- **Unique** identifier
 - Must be known at any moment (**not null**)
 - Simple
 - No ambiguities
 - Immutable
-
- Composed keys may be replaced with an *artificial key*.
 - In many RDBMS we may use autoincremented values.

Airline (1)Entities

- The airline has one or more airplanes. An airplane has a model number, and capacity. Each flight is carried out by airplanes. An airplane is uniquely identified by its Registration_no and a flight is identified by its Flight_no. A passenger can book a ticket for a flight.

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Q8, Q9

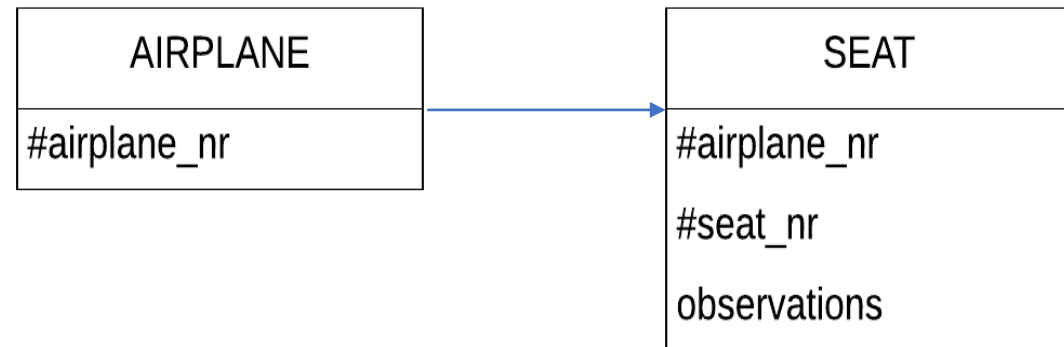
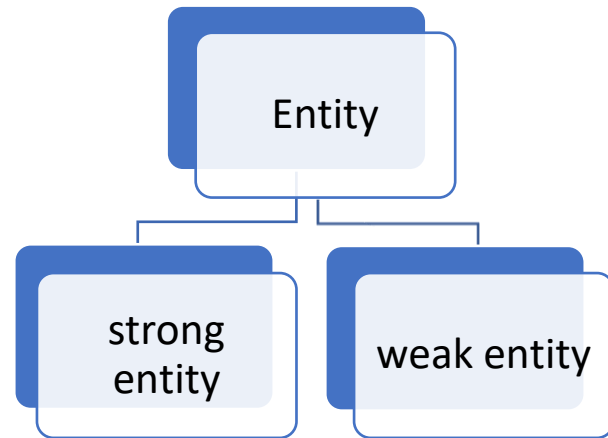
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Q10, Q11

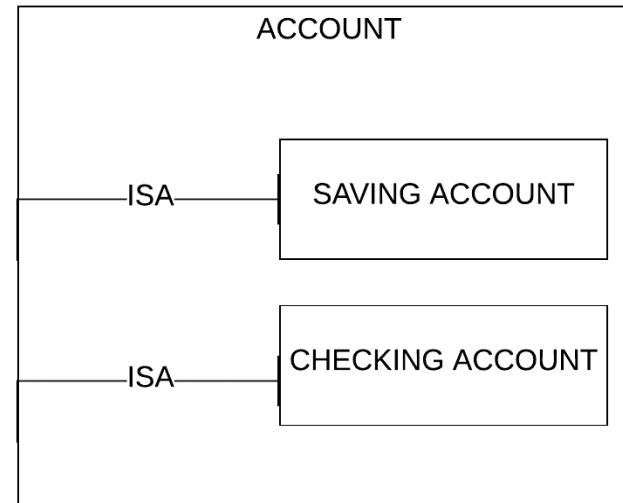
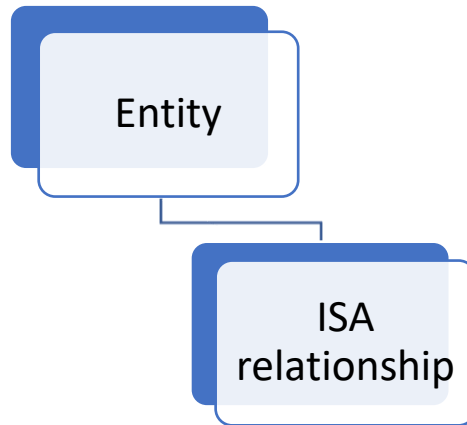
Entities



- Weak entity is an entity that depends on another entity.
- The primary key of a weak entity contains the primary key of the strong entity that it depends on + description/partial key.

Please answer www.menti.com 81 01 83 2 Q10, 11

Entities



- A sub-entity has the same key as the *super*-entity and all its attributes and relationships.

Please answer www.menti.com 81 01 83 2

Q12