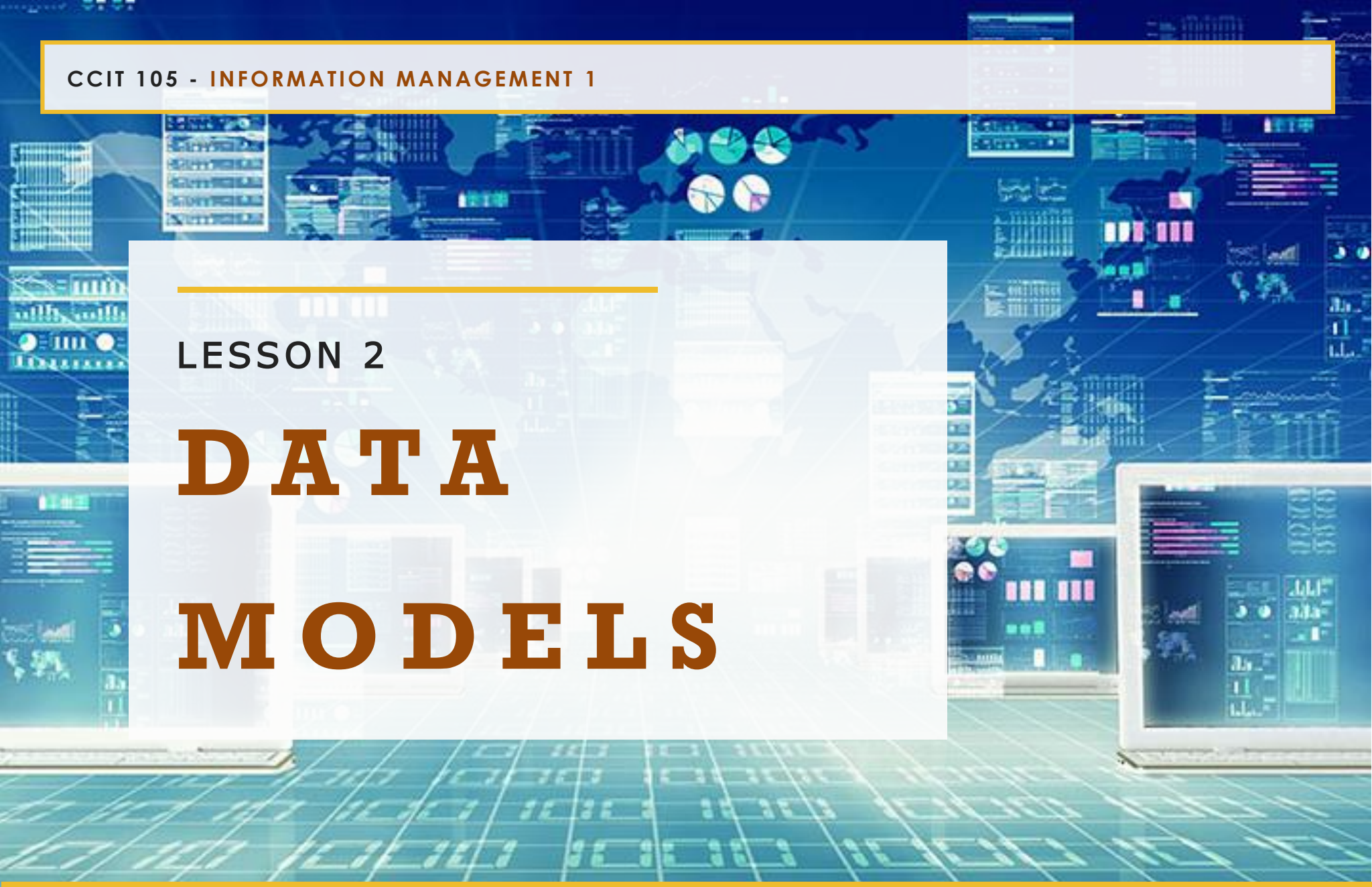


LESSON 2

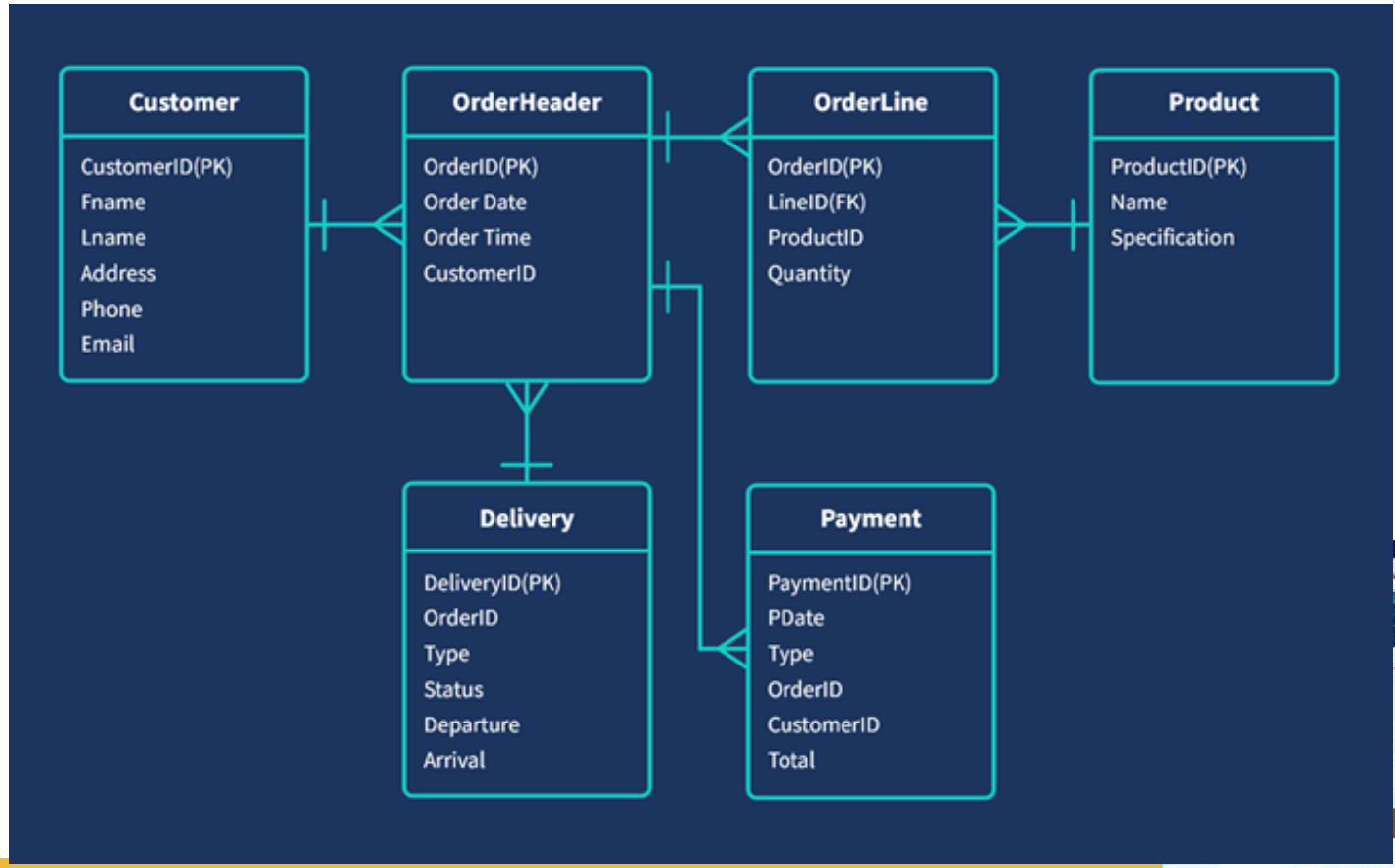
DATA MODELS

DATA MODELING AND DATA MODELS

Data Modeling and Data Models

Data Modeling

- is the process of creating a visual representation of data and its relationships within a system or organization.



Data Modeling and Data Models

Data Modeling

- Data modelling is the first step in the process of database design. This step is sometimes considered to be a high-level and abstract design phase, also referred to as conceptual design. The aim of this phase is to describe:

a. The data contained in the database (e.g., entities: students, lecturers, courses, subjects)

b. The relationships between data items (e.g., students are supervised by lecturers; lecturers teach courses)

c. The constraints on data (e.g., student number has exactly eight digits; a subject has four or six units of credit only)

Data Modeling and Data Models

Data Model

- A data model is a conceptual representation of data structures, relationships, constraints, and rules that govern how data is organized and used within an organization.
- It serves as a blueprint for designing databases, information systems, and applications.
- **Blueprint**. narrative and graphical in nature, meaning that it contains both text descriptions in plain, unambiguous language and clear, useful diagrams depicting the main data elements.
- The data model provides the blueprint for building a new database.

The Importance of Data Models

Here are several key reasons why data models are crucial:

- **Data Organization:** Data models provide a structured way to organize and represent data. They define the entities (objects or concepts), attributes (properties or characteristics), and the relationships between these entities. This structured organization makes it easier to understand and work with complex data.
- **Data Integrity**: Data models define rules and constraints that ensure data integrity. By specifying data types, validation rules, and relationships, data models help prevent errors, inconsistencies, and data corruption. This is critical for maintaining the accuracy and reliability of data.

The Importance of Data Models

- **Communication**: Data models serve as a common language for communication among stakeholders, including business analysts, developers, and database administrators. They provide a visual representation of data requirements and can help bridge the gap between technical and non-technical teams.
- **Database Design**: Data models are essential for designing databases. They help in creating the schema, tables, and indexes required for storing and retrieving data efficiently. A well-designed database based on a sound data model can improve performance and scalability.

The Importance of Data Models

- **Data Integration**: In today's interconnected world, data often needs to be integrated from various sources and systems. Data models provide a framework for mapping and transforming data during the integration process, ensuring that data from different sources can work together seamlessly.
- **Scalability**: As data volumes grow, it becomes increasingly important to have a well-defined data model. It allows for the scaling of databases and systems without sacrificing data consistency or performance.

The Importance of Data Models

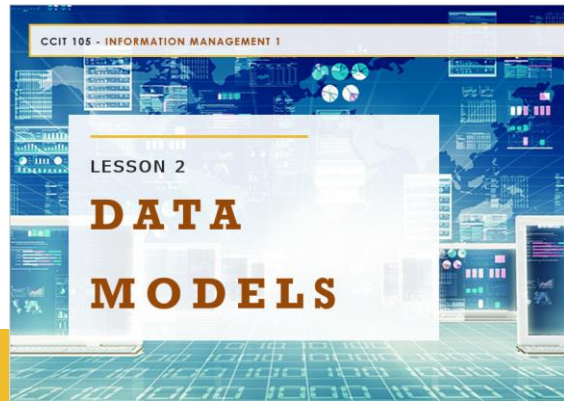
- **Data Analysis**: Data models facilitate data analysis and reporting. When data is organized and structured according to a data model, it becomes easier to query and analyze, enabling organizations to derive valuable insights and make data-driven decisions.
- **Documentation**: Data models serve as documentation for the data architecture of an organization. They provide a reference for understanding data flows, dependencies, and the meaning of data elements, which is especially valuable for maintaining systems and onboarding new team members.

The Importance of Data Models

- **Cost Efficiency**: A well-designed data model can lead to cost savings in terms of development, maintenance, and data storage. It helps avoid unnecessary redundancy and complexity in data structures.

In summary, data models are fundamental tools for organizing, managing, and leveraging data effectively within an organization. They promote data consistency, accuracy, and understanding, making them indispensable for modern businesses and information systems.

DATA MODEL BASIC BUILDING BLOCKS



Entity

- Refers to a person, place, thing, concept, or event for which data can be stored.
- represents a particular type of object in the real world, which means an entity is "distinguishable"—that is, each entity occurrence is unique and distinct.
- may be physical objects, such as customers or products, but entities may also be abstractions, such as flight routes or musical concerts.

▪Some examples of each of these kinds of entities follow:
  - ▪Person: EMPLOYEE, STUDENT, PATIENT
  - ▪Place: STORE, WAREHOUSE, STATE
  - ▪Object: MACHINE, BUILDING, AUTOMOBILE
  - ▪Event: SALE, REGISTRATION, RENEWAL
  - ▪Concept: ACCOUNT, COURSE, WORK CENTER

Attribute

- A characteristic of an entity or object.
- Has a name and a data type.
- Are the equivalent of fields in file systems.
- For Example:
  - a CUSTOMER entity would be described by attributes such as customer last name, customer first name, customer phone number, customer address, and customer credit limit.

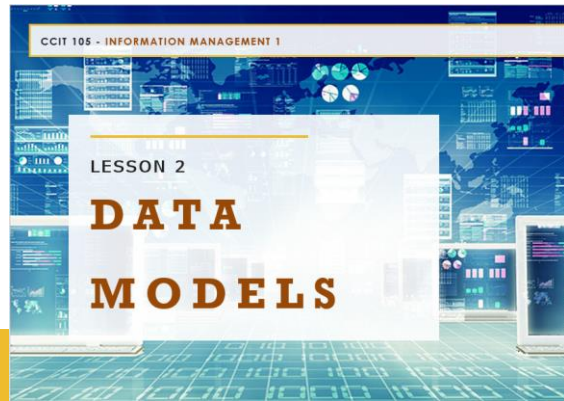
Attributes

(Characteristics of Credit Cards)

Entities

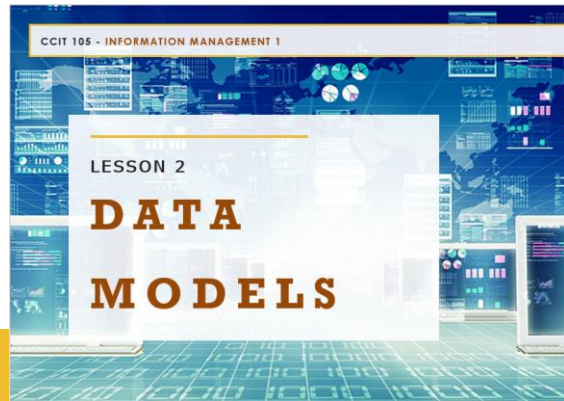
(The individual credit cards)

NameOnCard	Type	Number	ExpMonth	ExpYear
Aaron Jones	VISA	4675458922388650	05	2013
Melissa Riveira	VISA	4876786077953254	11	2015
Felipe Cassandro	MC	5487090034179802	04	2014



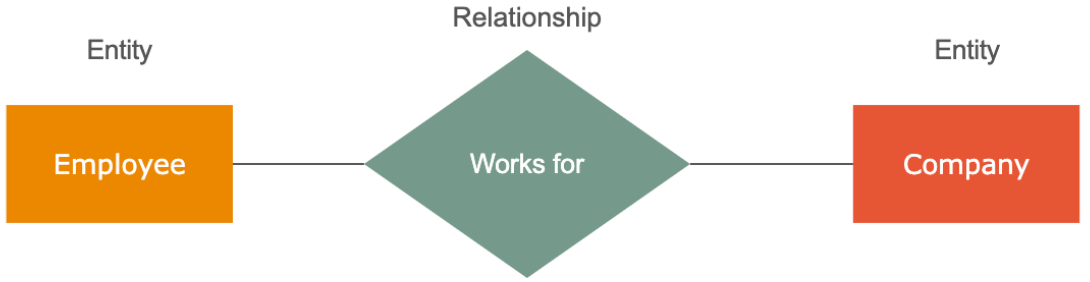
Relationship

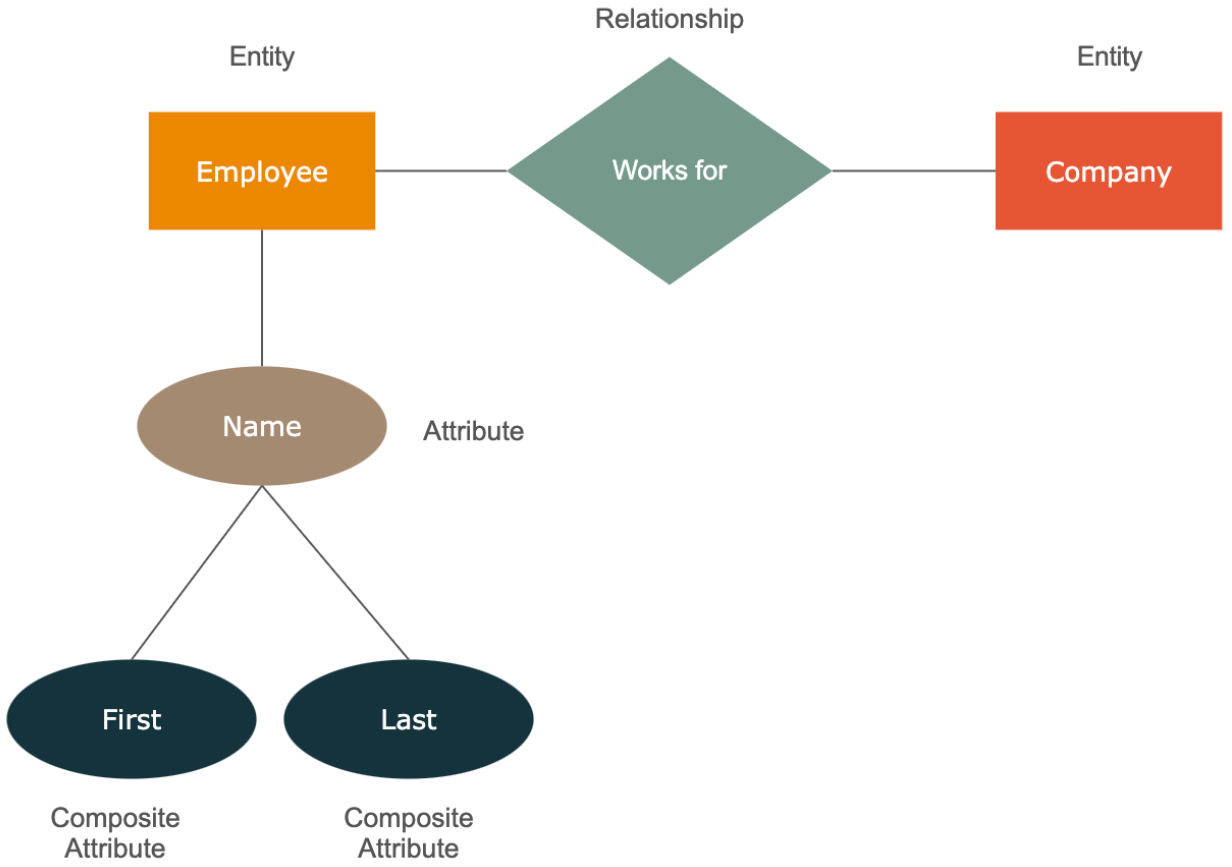
- described an association among entities.
- represent the most complex business rules shown in an ERD.



Relationship

- **Types of Relationships**
  - **One-to-One (1:1)** - When only one instance of an entity is associated with the relationship.
  - **One-to-Many (1:M)** - one entity instance is associated with many instances of the related entity
  - **Many-to-Many (M:N)** - relationship Association among two or more entities in which one occurrence of an entity is associated with many occurrences of a related entity


Relationship
Entity
Entity
Employee
Works for
Company


Relationship
Entity
Entity
Employee
Works for
Company
Name
Attribute
First
Last
Composite Attribute
Composite Attribute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Entity Name

Entity

Person,place,object,event or concept about which data is to be maintained

Example: Car, Student

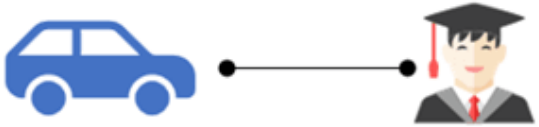
Jack

Attribute Name

Attribute

Property or characteristic of an entity

Example: Color of car Entity Name of Student Entity



Relation

Verb Phrase

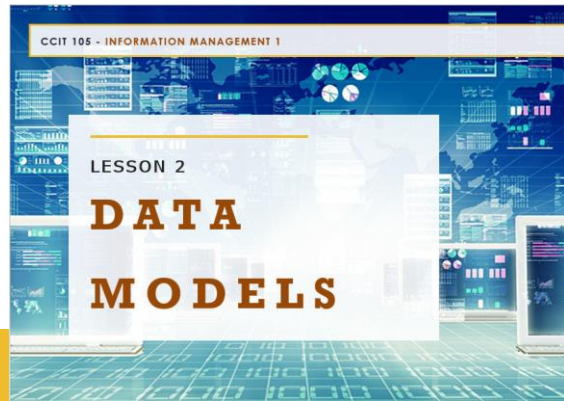
Association between the instances of one or more entity types

Example: Blue Car Belongs to Student Jack

Constraint

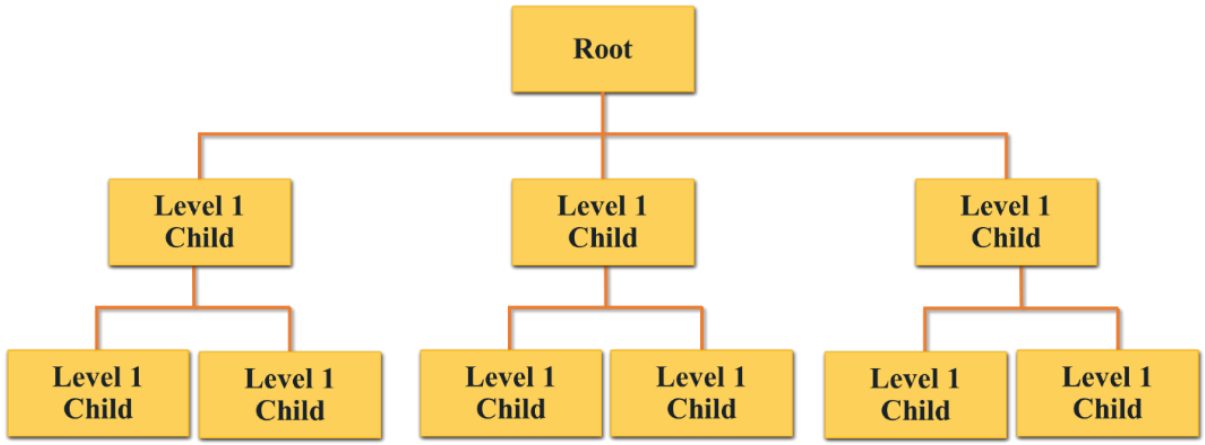
- a restriction placed on data, usually expressed in the form of rules.
- we can put some restrictions like what values are allowed to be inserted in the relation, and what kind of modifications and deletions are allowed in the relation.

THE EVOLUTION OF DATA MODELS



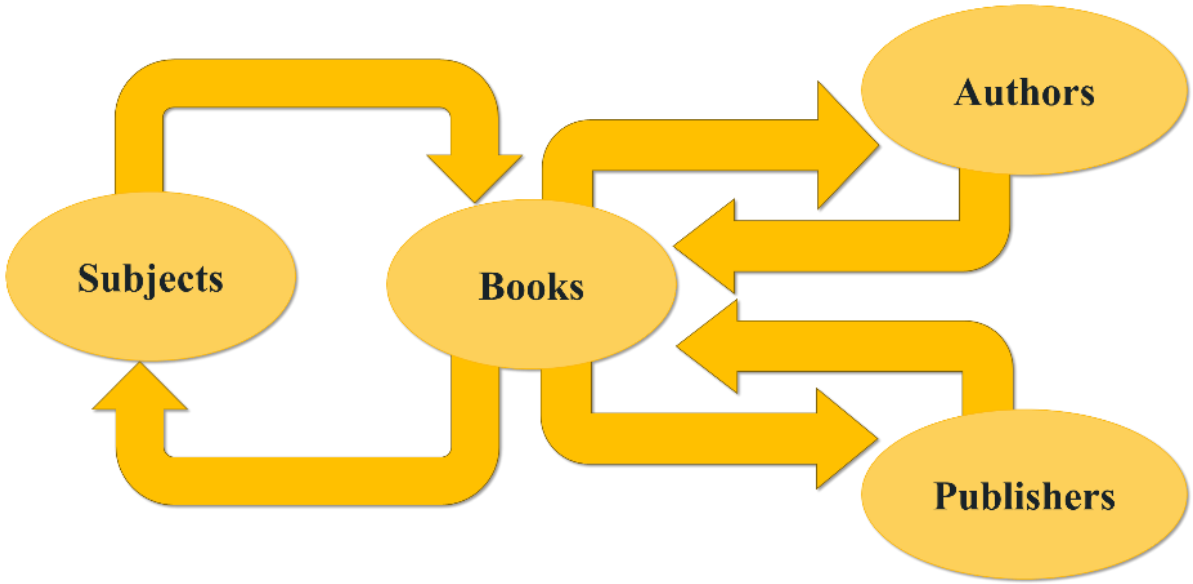
Hierarchical Model

- basic logical structure is represented by an upside-down tree.
- Well suited for data which are in some way related.
- Hierarchically begin with a strictly defined tree of data nodes.
- Each node can contain some identifying data, plus a set of sub nodes of a specific child type.



Network Model

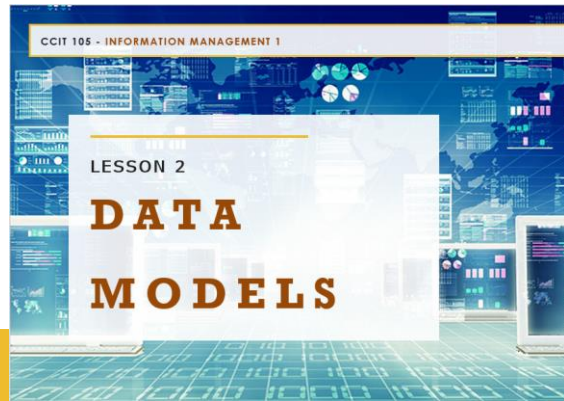
- An early data model that represented data as a collection of record types in 1:M relationships and supports more complex relations.
- Network model allows a record to have more than one parent.



Relational Model

- Developed by E. F. Codd of IBM in 1970, the relational model is based on mathematical set theory and represents data as independent relations.
- Each relation is conceptually represented as a two-dimensional structure of intersecting rows and columns. **Relation = Table, Rows = Entities/Tuple, Columns = Attributes**

ISBN	Date	Title	Publisher	PubAddress	AuthorName	AuthorBDay
0072465638	2001	Database Management Systems	BP House	Morristown, New Jersey	Arbie Miller	05-Sept-82
0072958863	1995	Database System Concepts	Sowon Publishing	Illinois, Chicago	Mariane Cruz	06-Jan-80
0131672673	1997	Database Processing: Fundamentals & Implementation	Sakura Press	Manchester, England	Sheena Loria	02-Mar-87
0321369572	2015	Fundamentals of Database Systems	Lamia Books	Los Angeles, California	Jonalyn Ryan	25-Oct-92



Relational Database Management System (RDBMS)

- A collection of programs that manages a relational database. The RDBMS software translates a user's logical requests (queries) into commands that physically locate and retrieve the requested data.

AuthorID	AuthorName	AuthorBDay
293-12-1945	Arbie Miller	05-Sept-82
281-12-0419	Mariane Cruz	06-Jan-80
930-01-0023	Sheena Loria	02-Mar-87
123-43-9327	Jonalyn Ryan	25-Oct-92

PubID	Publisher	PubAddress
03-4472822	BP House	Morristown, New Jersey
04-7733903	Sowon Publishing	Illinois, Chicago
03-1331982	Sakura Press	Manchester, England
03-9172481	Lamia Books	Los Angeles, California

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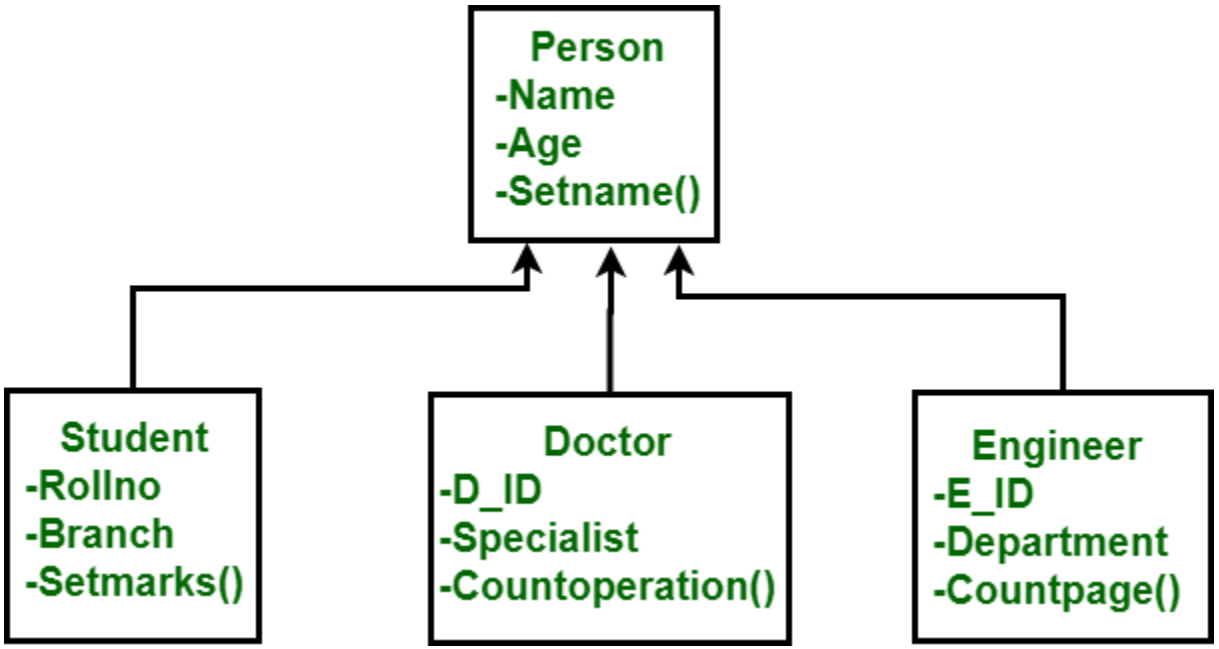
0321369572	123-43-9327	03-9172481	2015	Fundamentals of Database Systems

Entity Relationship (ER) Model (ERM)

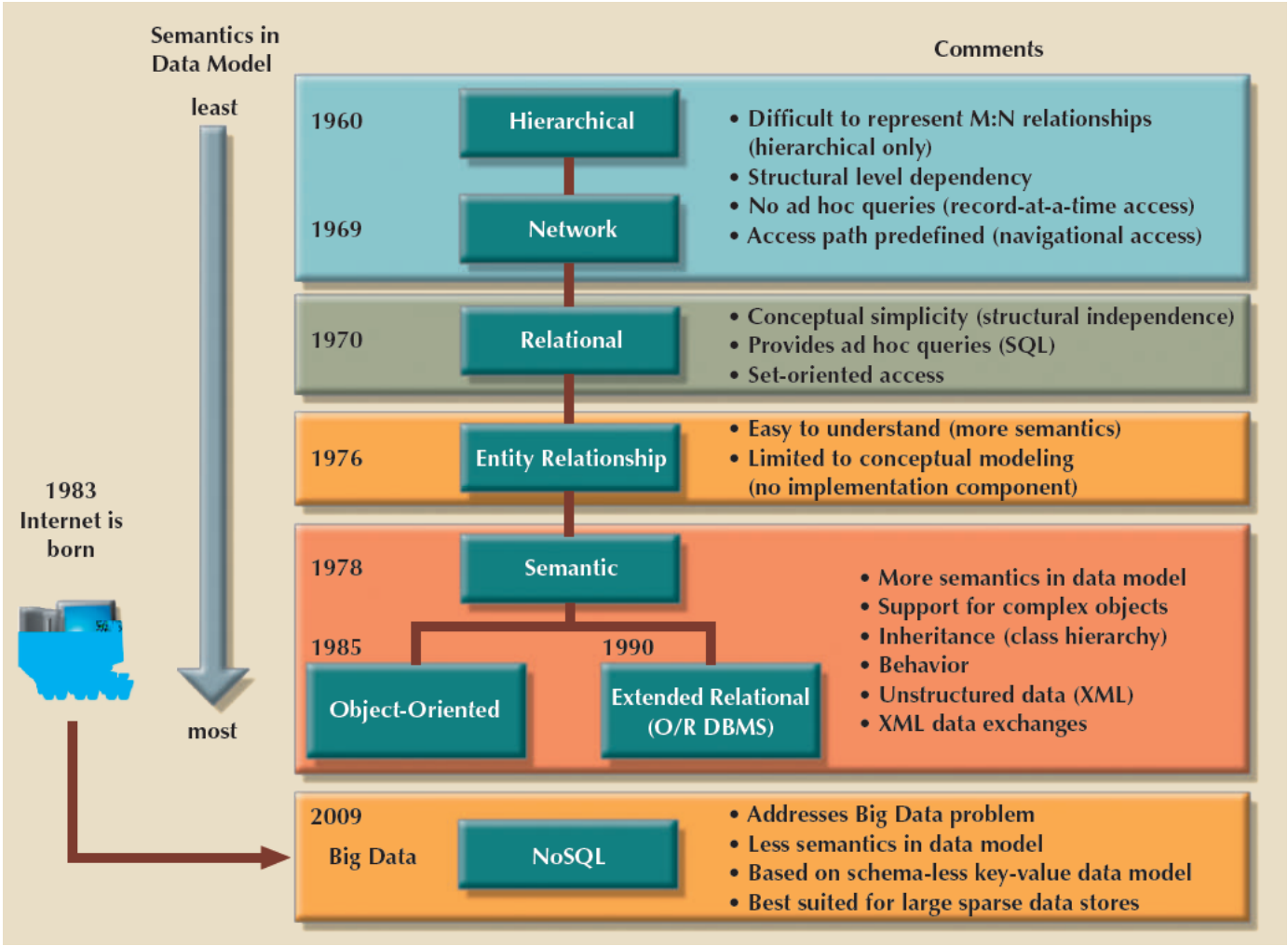
- A data model that describes relationships (1:1, 1:M, and M:N) among entities at the conceptual level with the help of ER diagrams.
- **Entity Relationship Diagram (ERD).** A diagram that depicts an entity relationship model's entities, attributes, and relations. Can be designed using:
  - Chen Notation
  - Crow's Foot Notation

The Object-Oriented Model

- A data model whose basic modeling structure is an object.



Data Models


Semantics in Data Model
least
most
Comments
1960
Hierarchical
1969
Network
• Difficult to represent M:N relationships (hierarchical only)
• Structural level dependency
• No ad hoc queries (record-at-a-time access)
• Access path predefined (navigational access)
1970
Relational
• Conceptual simplicity (structural independence)
• Provides ad hoc queries (SQL)
• Set-oriented access
1976
Entity Relationship
• Easy to understand (more semantics)
• Limited to conceptual modeling (no implementation component)
1983
Internet is born
1978
Semantic
1985
Object-Oriented
1990
Extended Relational (O/R DBMS)
• More semantics in data model
• Support for complex objects
• Inheritance (class hierarchy)
• Behavior
• Unstructured data (XML)
• XML data exchanges
2009
Big Data
NoSQL
• Addresses Big Data problem
• Less semantics in data model
• Based on schema-less key-value data model
• Best suited for large sparse data stores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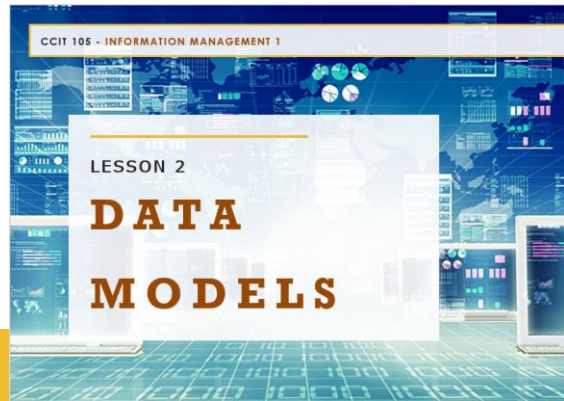
FUNCTIONAL DECOMPOSITION

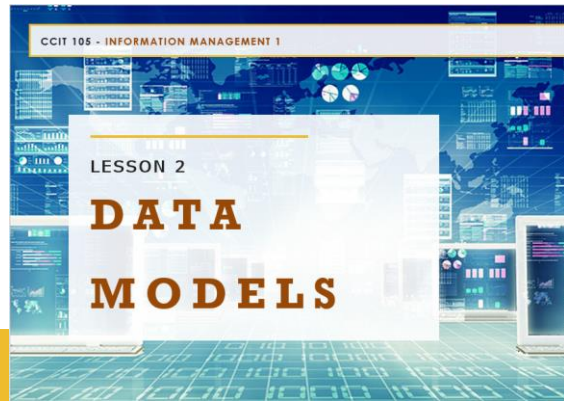


Functional Decomposition

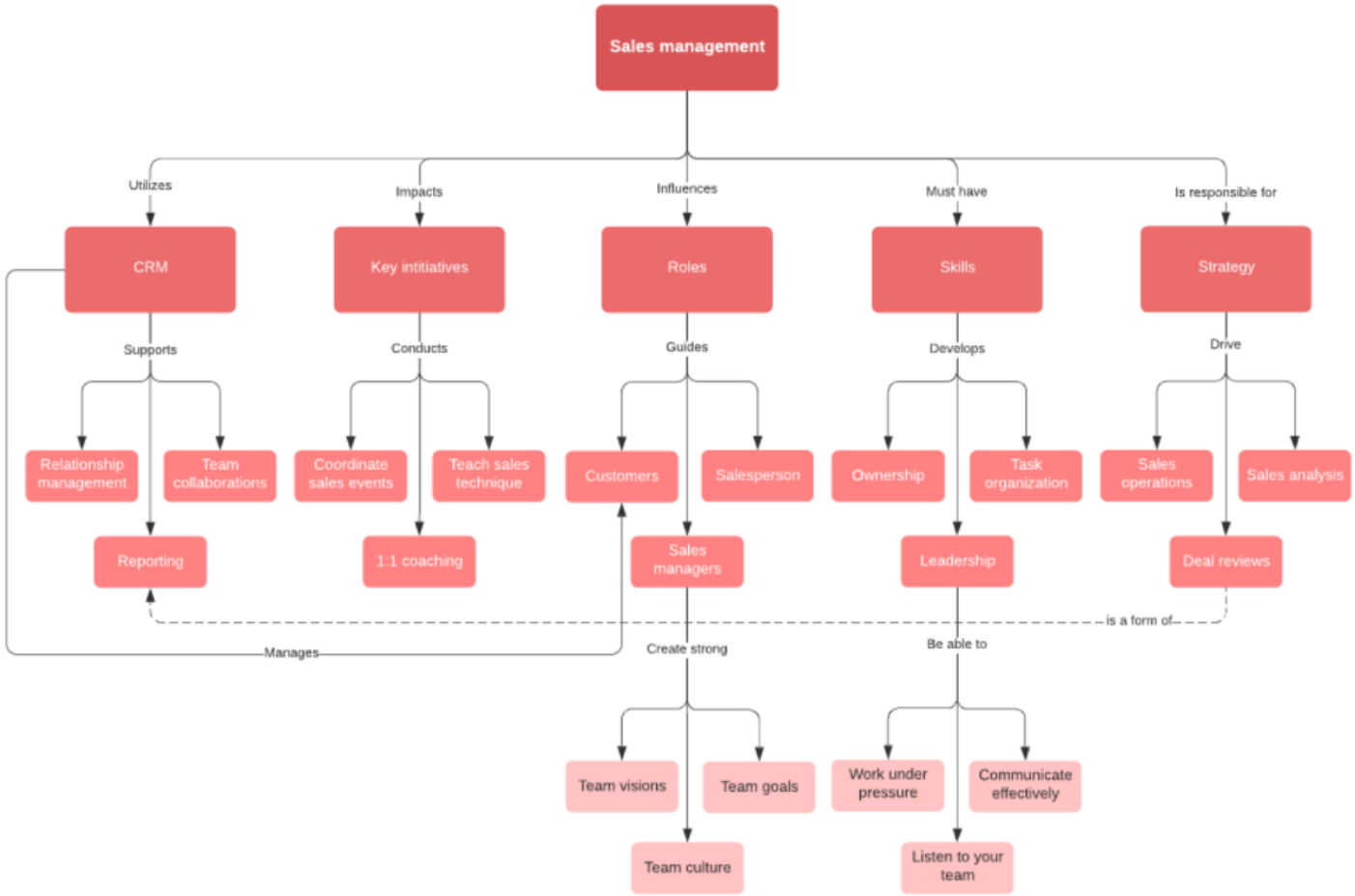
- a term used to describe a set of steps in which they break down the overall function of a device, system, or process into its smaller parts.
- usually accomplished through thoughtful analysis and team discussions of project information and the result is a chart that describes the problem and or solutions in increasing detail.

Functional Decomposition

- A ***function*** is simply a task that is performed by a device, system, or process.
- ***Decomposition*** is a process of breaking down. In this lesson, we will be breaking down functions into their smaller parts.
- A ***general function*** is one that relies on other functions to function. A general function can be a sub function because it depends on other functions.
- A ***subfunction*** is a function that must work in order for a more general function to work. Remember that a subfunction can be a general function.
- A ***basic function*** is a function that has no smaller subfunctions.



Functional Decomposition



Functional Decomposition Diagram (FDD)