Semantic model allows the user to come up good initial description of the data in an enterprise.

E.g. entity-relationship (ER) model, SOM model

• The Relational Model
  Level of abstraction in a DBMS

  1. Conceptual (logical) schema - all relations stored in the data base

  Course(cid: string, cname: sting, credit: integer)
  Faculty(fid: string, fname: string, sal: real)
  Student(sid: string, name: string, login: string,
         age: integer, gpa: real)
2. Physical schema - additional storage details for fast retrieval.
   indexes

3. External schema - collection of views or relations from conceptual schema tailored for individual users.
   Courseinfo(cid: string, fname: string, enroll: integer)
- Conceptual Design
  Requirement Analysis
  - What information to store
  - What business rules to apply

Discussion with user groups, current operating environment, analysis of available documentation on existing application.

Develop high-level description/abstraction of data with the constraints (Business rules) in collection of relations
E-R Model

- Schema consists of **tables, relationships, domains**, and business rules. E-R models provides first three.

- Entity: An object in the user’s work environment that is distinguishable from other objects.
  Example: STUDENT, EMPLOYEE, CUSTOMER

- Entity Class (Set): Group of entities of same type

- Instance: A particular entity

  Example: EMPLOYEE

  EMPLOYEE 123456789   EMPLOYEE 987654321
• Example of an Entity
EMPLOYEE:
  EmpNumber
  EmpName
  Department
  PhoneNumber

Instances of EMPLOYEE
123456789     987654321
John Doe       John Smith
Computing Services  Registrar
596-1234      596-6789
• **Attributes:** Properties
• **Identifiers:** attribute(s) that helps to identify instances of an entity
  
  - Unique, Non unique
  - Composite identifier
    
    Example: [AreaCode, LocalNumber]

• **Relationships:** Association among two or more entities.

  - **Degree:** Number of entities in a relationship
    
    - 2: Binary most commonly used
      
      1:1 binary
      1:N binary
      N:M binary
    
    - 3: Ternary
- Cardinality
  * Minimum
  * Maximum

- EMPLOYEE
- HEALTH PLAN
  - EMPLOYEE-HEALTH BENEFIT

- MANAGER
- DEPARTMENT
  - MANAGER-DEPARTMENT

- EMPLOYEE
- COMMITTEE
  - EMPLOYEE-COMMITTEE
- recursive relationship: relationships among entities of a single class
Weak Entities:
* Special Type of entity.
* Existence of such entity depends on other entity.
* Example: rounded corners

* ID-dependent entity - Special type of weak entity
  the identifier of one entity includes the identifier of another entity.

Identifier of EDITION: [ISBN, EDITION NUMBER]
- Subtype entities
  - Classification based on optional sets of attributes
  - Example:
    - CLIENT
      - ClientNumber, ClientName, AmountDue
    - INDIVIDUAL-CLIENT
      - Address, SocialSecurityNumber
    - PARTNERSHIP-CLIENT
      - ManagingPartnerName, Address, TaxIdNum
    - CORPORATE-CLIENT
      - ContactPerson, Phone, TaxIdNumber

  * CLIENT is **specialized** into subtypes. INDIVIDUAL-CLIENT, PARTNERSHIP-CLIENT, and CORPORATE-CLIENT are **generalized** by CLIENT.
- HAS-A relationship
- IS-A relationship

• Examples: