COS 425:  
Database and Information Management Systems

Entity-relationship (ER) model

- Goal: Capture semantics of information objects
- Goal: Capture complexity of relationships between objects
- Used first for database modeling but now expanded use

History

- Developed 1976 by Peter Chen after relational model
- Chen felt relational model not rich enough
  - relational model: everything a (mathematical) relation on collection of domains \( D_i \)
    - e.g. name from domain of strings
    - Relation subset of \( D_1 \times D_2 \times \ldots \times D_k \) (k-ary)
  - ER model differentiate between objects described by attributes and relationships among objects

ER model basics

- **Attributes** are basic / indivisible properties no usable substructure
- An **entity** (object) is a *tuple* (or set) of attributes
  - Attributes describe/define entity
- A **relationship** is a *tuple* of **entities**
  - Entities are thus related
  - A relationship can have its own attributes
    Different from entity attributes

Example

- Entity **course** with attributes: department, number, semester
- Entity **student** with attributes: first name, last name, ID number
- Relationship "take" relating: A student to a course

- Both entities and relationships are tuples but at different granularities
- We choose which are entities and which are relationships
- We choose attributes that best describe entities
- We choose semantics of a relationship between entities
Types

- **Entity type**:  
  - Defined by $A_1 \times A_2 \times \ldots \times A_k$ where $A_1, \ldots, A_k$ are attribute types (for entity with $k$ attributes)  
  - Defines **kind of object** (e.g. student)  
  - Set of entities of same type – entity set  

- **Relationship type**:  
  - Defined by $E_1 \times E_2 \times \ldots \times E_m$ where $E_1, \ldots, E_m$ are entity types (for relationship between $m$ entities)  
  - Defines kind of relationship (e.g. "take")  
  - Set of relationships of same type – relationship set  

- Then have **instances** of entity type and relationship type (e.g. `(fred, smith, 123456)`)

Board Example