Entity-Relationship model - informal way to communicate/model information structure
- 1st step towards defining the database
- Concepts are standard, but pictorial representations are not.
- We'll use Chen's notation

I. Basic Concepts

1) Entity - an "object." Examples: Bob, Boston, the country whose capital is Paris

2) Relationship - entities participate in relationships. Example: Alice & Boston are in relationship "likes"

3) Attribute - a property example: age is an attribute of Person; size is an attribute of city

An entity set is a collection of similar entities. E.g. Employees, Person

Can be tough to pick the right entity set. E.g. - partition people by sex?
- yes, if we are talking about things that can give birth
- no, if we are talking employment

E.g. - concrete vs. abstract objects. All Ford cars = models of cars (abstract)? manufactured cars (concrete)?

II. Details and Pictorial Representations

II.1. Entity
- Rectangle
  - Single noun
  - Capitalized
  - Has a key

II.2. Attribute
- Each entity has 0 or more attributes
- Each attribute has a domain (i.e. set of values it can take) which may include NULL
- Written with ellipses
- All entities in the same entity set have same attributes

Attributes can be:
- Simple - E.g. D.O.B
  - Derived - dashed ellipse E.g. age and D.O.B
- Single vs. composite - has component attributes E.g. Address (number and street)
- Single valued - D.O.B
  - Multi valued - unspecified number, thick line ellipse E.g. child

D.O.B. (Age) Address Child
sets
A subset of B
A = 2, 3, 6, 3
B = 2, 3, 4, 5, 6
A is a subset of B
A = 2, 3, 6
B = 2, 3, 4, 5, 6

Keys
A super key is a set of attributes
that for any two entities, they must differ
in the values of the attributes
A minimal super key is a key
or candidate key
E.g., social and name is super key, not
longitude and latitude for city is a key,
but just longitude is not.

If there is more than one key, pick
one to be primary (underline in ER)

II.3 Relationship
- Association between (one or more)
etties
- Diamonds
- Capitalized verb, 3rd person singular

Binary Relationships
- Not every person has to like a product
- Not every product has to be liked
by a person
- A person may like many products
  - A product may be liked by many people

Formally
R is a relationship among entity sets
E_1, E_2, E_3, \ldots, E_n
iff R \subseteq \prod E_i \times E_1 \times E_2 \times \ldots \times E_n

R is a set of ordered tuples
E_1 = \{(Bob, Alice)\} \quad \text{important}
E_2 = \{(Computer, Phone)\}
E_3 = \{(Alice, Computer)\}
E_1 \times E_2 = \ldots

Ternary Relationships
E.g., Alice buys Computer from Apple

Non-distinct entity sets!
E.g., Bob likes Alice
Alice does not like Bob
order matters

May give Roles e.g., Liker, Likee
written in diagram
Date

Person

Born

Country

 ISA Relationship

- ISA is a subset relation
- Subset entities have all attributes of the super set
- May participate in relationships that super set cannot
- May have additional attributes

[Diagram showing ISA relationship with entities and relationships]

- Note, Student, Professor, and Salary are weak entity sets with no discriminants.
An ISA can be:
- **Disjoint** - no entity can be in more than one subclass
- **Overlapping** - can be in more than one subclass
- **Total** - every entity is in at least one subclass
- **Partial** - an entity need not be in a subclass

**Example:**

```
    Person
     ↓
    D.P
      ↓
     Student  Prof
```

- Some people are professors
- Some people are students
- Some people are neither
- No one is both

Cardinality Constraints
- Specify how many times an entity participates in a relationship
  - `i..j` means `0 ≤ i ≤ j`
  - `i..*` means `[i, ∞)`
  - `0..*` means no constraint or don't write it

```
    Person 1..1 Likes 2..3 Country
```
- Every person likes exactly 1 country
- Every country is liked by 2 or 3 people

**Notations:**

```
    Person Born Country
```

- One person can be born in one country
- One country can be born by two or three people

```
    Person 0.1 Likes 0..1 Country
```
- One person can like one country
- One country can be liked by zero or one person

```
    Person Likes Country
```
- One person can like any number of countries
- Any number of countries can be liked by one person