

Software systems

Xin Wang

I. OVERVIEW

A. Analysing software systems

- Aspects to consider:
 - System high-level functions
 - System nodes
 - Types of data managed and processed
 - Data movement within the system
- Usually expressed with pictures

B. Modelling data (Database)

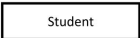


- Data is always stored, transformed and analysed
- Abstract Data Model** used to understand process
- Database theory** creates the Abstract Data Model
- Database theory considers:
 - Important entities in Database
 - Attributes** of these entities
 - Relationships** between these entities
- Entity modelling** formally expresses database theory
- Database systems** implements the Abstract Data Model

C. Moving data (Network)

- Process of data moving between nodes
- Network models** defines the type of network structure
- Network protocol** and **API** implements the model

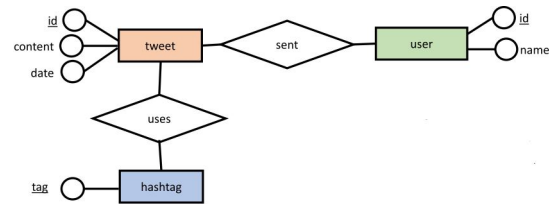
II. ENTITY RELATION MODELLING

- Creates **Entity Relationship Diagram**
- Establishing **relationships** in a given system:
 - Entities**: Aspects within a given system
 - Relationships**: How entities are related
 - Attributes**: Properties of an entity or relationship
- Captures constraints and requirements on data
- Used as a guide to *implement* relations

Entity Sets	A set of distinguishable entities that all have the same set of properties (attributes). Could be physical things, events, conceptual, ... Normally correspond to nouns	Rectangle 
Relationship	A relationship set describes how two or more entity sets are related to each other. Some times correspond to verbs : owns, has, drives, Entity sets can be involved in many relationship sets	Diamond 
Attributes	Properties or attributes of an entity or relationship set. Underlined attributes are primary keys .	Small circles 

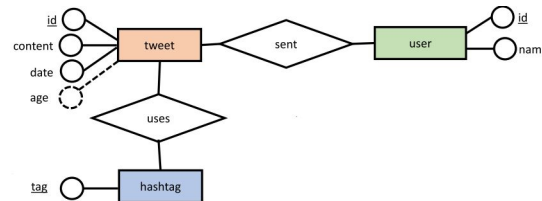
A. Primary keys

- An attribute that **uniquely identifies** an entity
- Properties:
 - There will never be two entities with the same key
 - Can contain **multiple** attributes if needed
 - Shown on ERD as underlined attributes
- Two types of primary keys:
 - Natural keys**: Attributes from application data
 - Surrogate keys**: *Invented* attributes

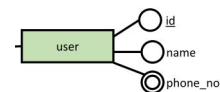


B. Complex attributes

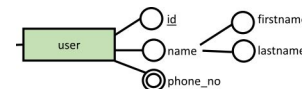
- Computed attributes**: Calculated from other attributes



- Multi-valued attributes**: Sets or lists of multiple values

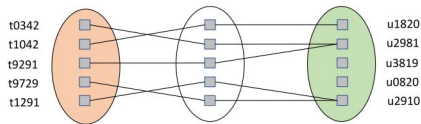
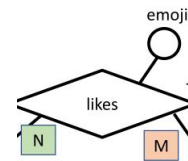


- Composite attributes**: Properties that has sub-attributes



III. RELATIONSHIPS: SETS OF RELATIONS

- Entity sets contain distinct entities
- Relationships** contain sets of relations
- Each **relation** is a *pair of links* to an entity in the two entity sets



D. Three-way relationships

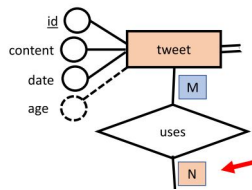
- Some relationships have more than two entity sets
- Example: User can *watch* for new retweets

A. Relation constraints

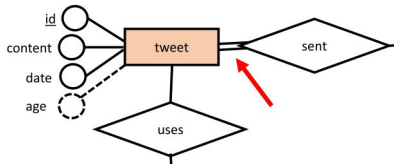
- Cardinality constraint:** Number of times entity appears
 - One-to-one
 - One-to-many



- Many-to-many

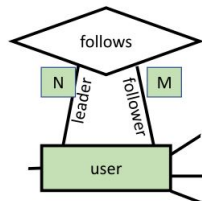


- Total participation:** Entities **must** appear in relationships



B. Self relations

- Label the two connecting lines to show **roles**



- Cardinality constraints still apply

C. Relations with attributes

- Example: User can like a tweet with emojis

