# Structured knowledge

# INTRODUCTION

- The knowledge representation before the topic structured knowledge, had its focus primarily on expressiveness, validity, consistency, inference methods, and other related topics.
- This section focuses on how the knowledge is structured in the memory and the types of data structures which are used internally.
- Structured knowledge includes the following structures:

1. Associative networks
2. Frames
3. Conceptual dependencies & Scripts

# ASSOCIATIVE NETWORKS

- Associative networks (also known as semantic networks) are directed graphs with labelled nodes and arcs or arrows.
- They are used in variety of systems such as **natural language understanding, information retrieval, deductive data bases, learning systems, computer vision, and in speech generation systems**.
- Network representations provide a means of structuring and revealing the structure in knowledge. In a network, pieces of knowledge are clustered together into well organized semantic groups.
- Network also provides a more natural way to map to and from natural language than other representation schemes.
- Network representation gives a pictorial presentation of objects, their attributes, and the relations that exist between them and other entities. The graphical portrayal of knowledge can also be somewhat more expressive than other knowledge representation schemes.

# Contd....

PROFESSION(ramesh, professor)

FACULTY(ramesh, engineering)

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MARRIED(ramesh, kiran)

FATHER-OF(ramesh,suraj,sunil)

DRIVES(ramesh,toyota)

OWNS(ramesh,house)

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Figure 4.1. Facts in a KB given in clausal form

& figure 4.2 depicts graphically some additional concepts not expressed in figure 4.1

# Contd....

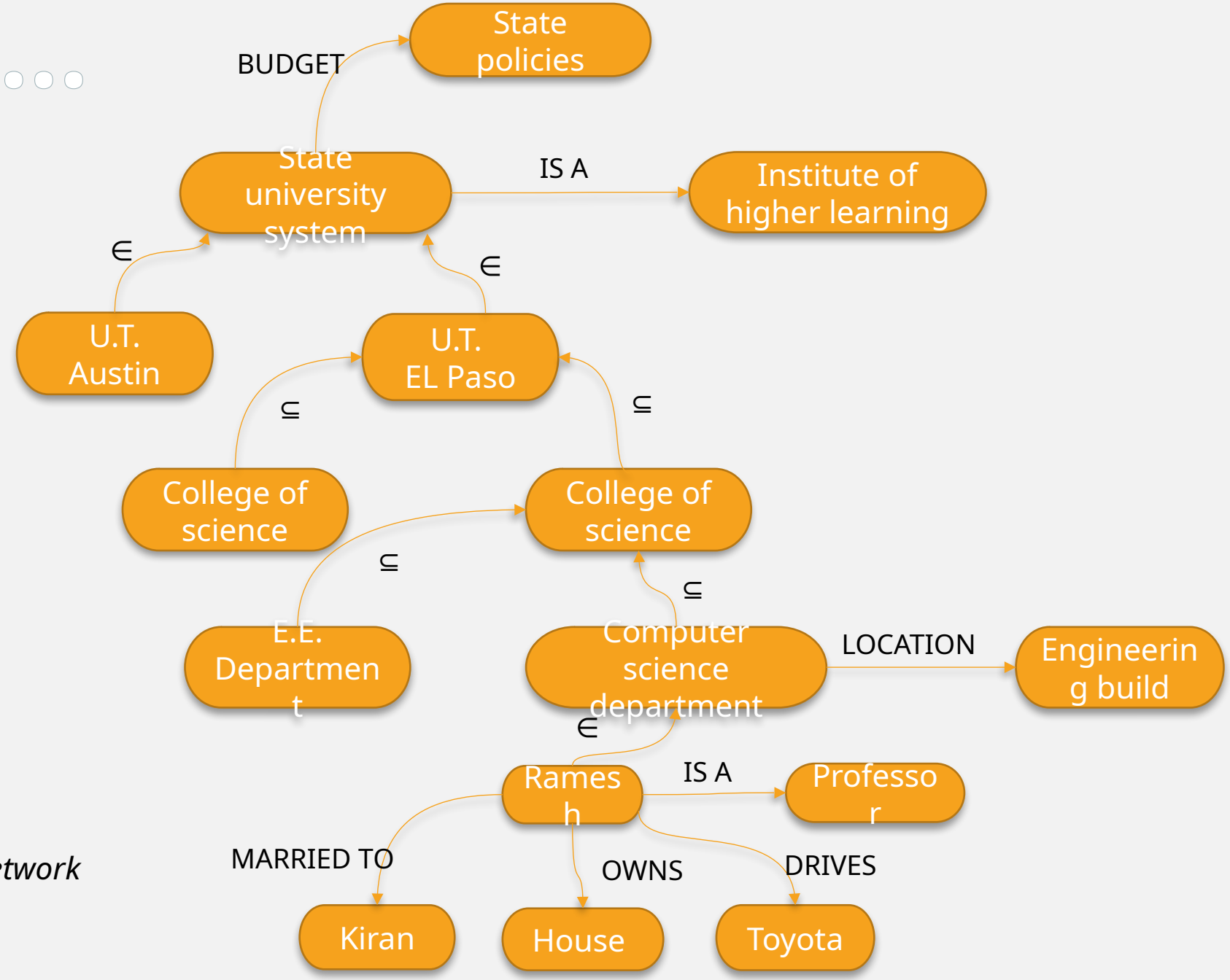



*Figure 4.2. Associative network node and arc types.*

# FRAME STRUCTURES

- Frames were first introduced as a data structure to represent a mental model of a stereotypical situation such as driving a car, attending a meeting, or eating in a restaurant.
- In this data structure the **knowledge about an object or event is stored together in memory as a unit**. Then when a new situation is encountered, an appropriate frame is selected from the memory for use in reasoning about the situation.
- Frames are general record like structures which consist of a collection of slots an slot values. The slots can be of any size and type. Slots specify the general or specific characteristics of the entity which the frame represents and sometimes they include instructions on how to apply or use the slot values.
- Slots have name and values or subfields called facets. Facets may also have names and any number of values.

<frame name>
(<slot 1> (<facet 1><value 1><value 2>....<value $k_1$>)
(<facet 1><value 1><value 2>....<value $k_2$>)
.
.
.
(<slot 2> (<facet 1><value 1><value 2>....<value $k_m$>)
.
.
. )

Figure 5. A general frame structure

(Ramesh
(PROFESSION (VALUE professor))
(AGE (VALUE 42))
(WIFE (VALUE kiran))
(CHILDREN (VALUE rohit suraj))
(ADDRESS (STREET (value 170))
(CITY (VALUE shimla))
(STATE (VALUE himachal))
(ZIP (VALUE 171001))))

Figure 6. A simple instantiated person frame

# CONCEPTUAL DEPENDENCIES

- Conceptual dependencies theory is based on the use of a limited number of primitive concepts and rules of formation to represent any natural language statement as the concepts such as dreaming, thinking, bellowing, or scheming can not be described in terms of primitives.
- This theory states that different sentences which have the same meaning should have same unique CD representation.
- In CD theory five different types of building blocks are distinguished.

**ENTITIES**

Picture producers (PP) are actors or physical objects (including human memory) that perform different acts.

Picture aiders (PA) are the supporting properties or attributes of producers.

**ACTIONS**

Primitive actions(ACTs) are as follows:

# Contd....

| Primitive actions | Intended meaning |
|---|---|
| ATRANS | Transfer of an abstract entity |
| ATTEND | Focusing attention on an object |
| CONC | To think about something |
| EXPEL | Expulsion of anything from the body |
| GRASP | Grasping of holding an object ambiguity |
| INGEST | Ingesting something |
| MBULD | Building on information |
| MOVE | Moving a part of the body |
| MTRANS | Transfer of mental information |
| PROPEL | Application of the force |
| PTRANS | Physical transfer from one location to another |
| SPEAK | Emitting a sound |

# Contd....

**CONCEPTUAL CASES** (all the actions involve one or more of these)

1. Objective case
2. Directive case
3. Instrumental case
4. Recipient case

**CONCEPTUAL DEPENDENCIES**

Semantic rules for formation of dependency structures such as the relationship between the actor and an event or between a primitive action and an instrument. Following are the examples of conceptual dependencies:

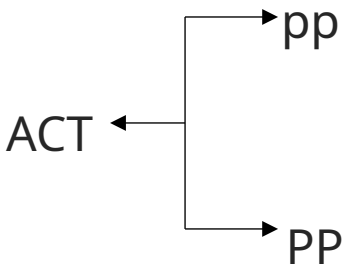
# Contd....

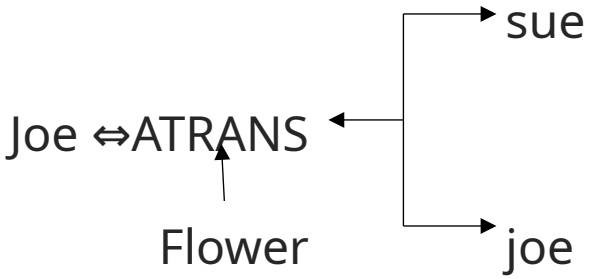
**CONCEPTUAL TENSES**

- Conditional (c)
- Continuing (k)
- Finished transition (tf)
- Future (f)
- Interrogative (?)
- Negative (/)
- Past (p)
- Present (nil)
- Start transition (ts)
- Timeless (delta)
- Transition (t)

# Contd....

| | | |
|---|---|---|
| PP⇔ACT | Bird⇔PTRANS | Bird flew |
| PP⇔PP | Joe⇔student | Joe is a student |
| ACT←PP | Joe⇔PROPEL←door | Joe pushed the door |




Joe gave sue a flower