CONCEPTUAL DEPENDENCIES

Module 3

Conceptual Dependency

- Conceptual Dependency (CD) theory in Artificial Intelligence (AI), developed by Roger Schank in 1969, aims to enable machines to understand human language.
- The main goal of Conceptual Dependency is to represent the meaning of natural language sentences in a way that is independent of the specific words or syntax used—focusing instead on the underlying concepts.

Key Objectives of Conceptual Dependency Theory

- **Meaning Representation:** CD helps machines represent the **meaning** of sentences in a way that works across different languages, no matter how the sentence is phrased. The goal is to focus on the core ideas rather than just the specific words.
- **Logical Inference:** CD allows machines to make **logical decisions** based on the relationships in a sentence. For example, if a machine knows that "John gave Mary a book," it can figure out that Mary now has the book.
- **Language Independence:** CD is designed to work across different languages by focusing on **concepts** rather than the grammar or vocabulary of any specific language. This helps AI understand sentences in any language, keeping the meaning the same.
- For example:
  - *"John gave Mary a book."*
  - *"Mary received a book from John."*
    Both would be represented using the same CD structure

Key Components of Conceptual Dependency

1. Primitive Acts
2. Conceptual Cases
3. Modifiers
4. Conceptual Tenses
5. Dependencies
6. State Descriptions

Key Components of Conceptual Dependency

1. Primitive Acts

- Primitive acts are the basic actions in a sentence. They help us understand what is happening.
- ATRANS (Transfer Action): when one person give something to other person. For example, in "Alice gives Bob a book," Alice is giving the book to Bob. This example is of ATRANS.
- PTRANS (Physical Movement): When a person moving from one place to another then it comes under PTRANS. For example, in "John goes to the park," it tells us that John is moving to the park.
- MTRANS (Mental Action): when we thinking or telling something then it is a part of MTRANS. For example, in "She told him a story," it shows that she is sharing information with him.

- PROPEL: The application of physical force to an object, causing it to move.
- MOVE: A self-motivated change in position by an animate object.
- INGEST: Taking something into the body, such as eating or drinking.
- EXPEL: Forcing something out of the body, such as exhaling or vomiting.
- SPEAK: Producing verbal output.
- ATTEND: Directing sensory organs towards a stimulus (like looking or listening).

2. Conceptual Cases (Cases)

- Conceptual Cases (Cases) portray the jobs played by various substances in an activity. They assist with determining who is doing what to whom, with what, and under what conditions. Normal theoretical cases include:
- Agent(AG): The substance playing out the activity.
- Object (OB): The substance that is impacted by the activity.
- Recipient (RE): The substance that gets the after effect of the activity.
- Instrument (IN): The means or device used to play out the activity.
- Experiencer (EX): The element that encounters a sensation or feeling.

3. Modifiers

- Modifiers provide additional details about actions, objects, or other elements in the CD structure, such as time, location, manner, and purpose

4. Conceptual Tenses

- Conceptual tenses show the transient parts of activities, for example, when they happen and their term. This aids in figuring out the timing and arrangement of occasions. Instances of applied tenses include:
- Past: Activities that have previously happened.
- Present: Activities that are as of now happening.
- Future: Activities that will happen.
- Constant: Activities that are progressing.
- Finished: Activities that have been done.

5. Dependencies

- These are connections between activities that show how activities are connected.
- **For example:**
- Causal Dependency: One activity causes another.
- Temporal Dependency: The arrangement of activities in time.
- Conditional Dependency: One activity is subject to the event of another activity.

6. State Descriptions

- State descriptions tell us about how things are at certain times during actions:
- **Physical States**: What something looks like (e.g., "The door was open").
- **Mental States**: How someone feels or thinks (e.g., "He felt happy").

- "John gave a book to Mary."
- In this example, we can break it down into four parts:
- First, the action is **ATRANS**, which means it’s a transfer action (giving something).
- Next, the **Agent** is John, who is the one doing the giving.
- The **Object** is the book, which is the item being given.
- Finally, the **Recipient** is Mary, who is receiving the book.
- This way of breaking down the sentence helps us understand its meaning without focusing on the specific words used. It shows that no matter how we say it, the main idea of John giving a book to Mary stays the same.

Limitations of CD

Limitation	**Description**
Scalability	Limited set of primitives may not cover all actions
Ambiguity	Hard to choose the correct primitive consistently
Domain Restriction	Doesn't handle rich, open-domain language well
Labor-Intensive	Requires detailed manual design and representation
Outdated by Modern AI	Replaced in many areas by data-driven NLP models
Lack of Standardization	Inconsistent implementations across systems