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UNIT-IV

Predicate-Argument structure:

* NLP refers to the syntactic and semantic relationship between a predicate (verb) and its arguments (Noun phrases, pronouns). It helps to represent underlying the meaning of a sentence by identifying the role's played by different elements.

Ex:1 The cat chased the mouse

chased (cat, mouse) = f(x, y) fn passing two arguments

predicate: chased

arguments: the cat, the mouse
(sub) (obj)

* Understanding predicate-argument structure is crucial for task like information extraction, semantic role labelling and machine translation

Ex:2 she gave him a book

predicate (gave)

Direct object: book

Indirect object: him

Ex: 3 The students discussed the assignments in groups

predicate {discussed}

subject: {students}

object: {assignments}

Adverbial phrase: {groups}

Ex:4 They laughed at the joke

predicate: laughed

Subj: They

Adverbial phrase: joke

Although the cat slept peacefully the dog bark loudly, waking everyone in the house

Main clause:- The dog bark loudly, waking everyone in the house

Sub-ordinate clause:- Although the cat slept peacefully

predicate: slept, bark, waking

subject: cat, dog

object: everyone

Ex:-5 While she cooked dinner, he set the table and their children finished their homework

Main clause:- he set the table and their children finished their homework

sub-ordinate clause:- while she cooked dinner

predicate: cooked, set, finished

subject: she, he, children

object: dinner, table, homework

Ex:-6 Despite the changes they successfully completed the project on time

Main clause: they successfully completed the project on time

Subordinate clause : Despite the changes

Predicate : completed

subject : they

object (phrase) : the project

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Meaning Representation Systems :

Meaning representation system in NLP aims to capture the semantic context of a language in a structured form, making it easier for machines to understand and manipulate.

>>> The methods used for meaning representation system are:

1. Propositional logic
2. First order predicate logic
3. Semantic Role Labelling
4. Dependency Grammar
5. Abstract meaning representation
6. Head Driven phrase structure Grammar

1. Propositional logic :

Propositional logic represents meaning using logical prepositions and relationships connectives:

AND - $\wedge$	Implication - $\Rightarrow$
OR - $\vee$	Biimplication - $\leftrightarrow$, $\Leftrightarrow$
NOT - $\neg$	

P_1	P_2	$P_1 \wedge P_2$	$P_1 \vee P_2$	$P_1 \rightarrow P_2$	$P_1 \leftrightarrow P_2$	$\neg P_1$	$\neg P_2$
T	T	T	T	T	T	F	F
T	F	F	T	F	F	F	T
F	T	F	T	T	F	T	F
F	F	F	F	T	T	T	T

② First order Predicate logic (FOPL)

First order Predicate logic extension of proposition logic. It includes variables, quantifiers and more complex relationships

Example for $\exists$ (existence quantifier)

some apples are red

$\exists x$.

Example for $\forall$ (for all)

All humans are mortal

$\forall x$

③ Semantic Role Labelling:

Semantic Role Labelling identifies predicate-argument structure of a sentence

The cat chased the mouse

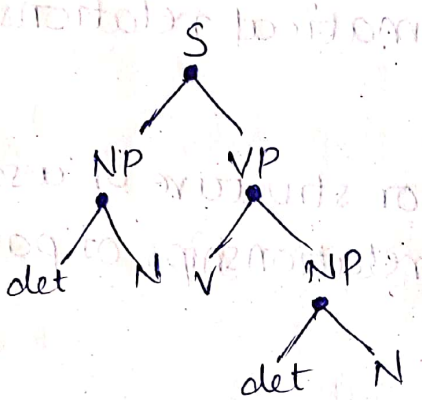
chased (the cat, the mouse)

$f(x, y)$

④ Dependency grammar :

Dependency grammar represents the syntactic structure of a sentence in terms of dependency between words and providing relationships b/w words in terms of grammatical sentence.

Ex:



⑤ Abstract meaning Representation :

It represents the meaning of a structure in a graph based structure, capturing entities, events and relationships between them.

Ex: John eats an apple

AMR representation is

eat is argument-0

John is name of the person

Apple is argument-1

⑥ Head driven phrase structure grammar:

It represents the syntactic and semantic structure of a sentence using a framework that emphasizes the head of the phrase

Relation between syntactic frames and semantic frames lies in how language structure and meaning are related.

Syntactic Frame:

Syntactic Frame refers the grammatical structure of a sentence including the arrangement of words, phrases and clauses.

It focus on how the elements in a sentence are organized to convey grammatical relationships.

semantic Frame:

It involves meaning or structure of a sentence. It captures the roles and relationships of participants and events

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Syntactic frame

Active voice:

she teaches mathematics to the students

Passive voice: syntactic frame

Mathematics ~~was~~ taught by her to the students

Active voice (semantic frame)	Passive voice (semantic frame)
Agent: she	Agent: Her
Action: teaches	Action: taught
Theme: mathematics	Theme: Mathematics
Recipient: The students	Recipient: the students

Syntactic Frame:

Active voice

They discuss the plan in the meeting

→ semantic Frame

Agent: They
Action: discuss
Theme: plan
~~Recipient~~: in the meeting
Location:

Passive voice (syntactic frame)

The plan was discussed by them in the meeting.

Semantic Frame:-

Agent: Them

Action: ~~plan~~ discuss

Theme: plan

Location: in the meeting.

Software used for Predicate Argument structure:

Several NLP tools and libraries can assist in identifying and extracting predicate argument structures from text.

① Spacy :-

It is a library for advanced NLP in python. It provides pre-trained models for various languages and includes functionality for dependency parsing.

② NLTK:-

It is a library for NLP for python which includes modules for parsing, tokenization and syntactic analysis.

③ standford core NLP:-

It is a tool developed by standford, it includes modules for POS tagging, NER and dependency parsing.

(4) Allen NLP:

It is An open source NLP library built on pytorch, it provides tools for various NLP task including dependency parsing and semantic Role Labelling.

(5) Open NLP:

A machine learning based toolkit for processing natural language text which includes tools for pos tagging and parsing