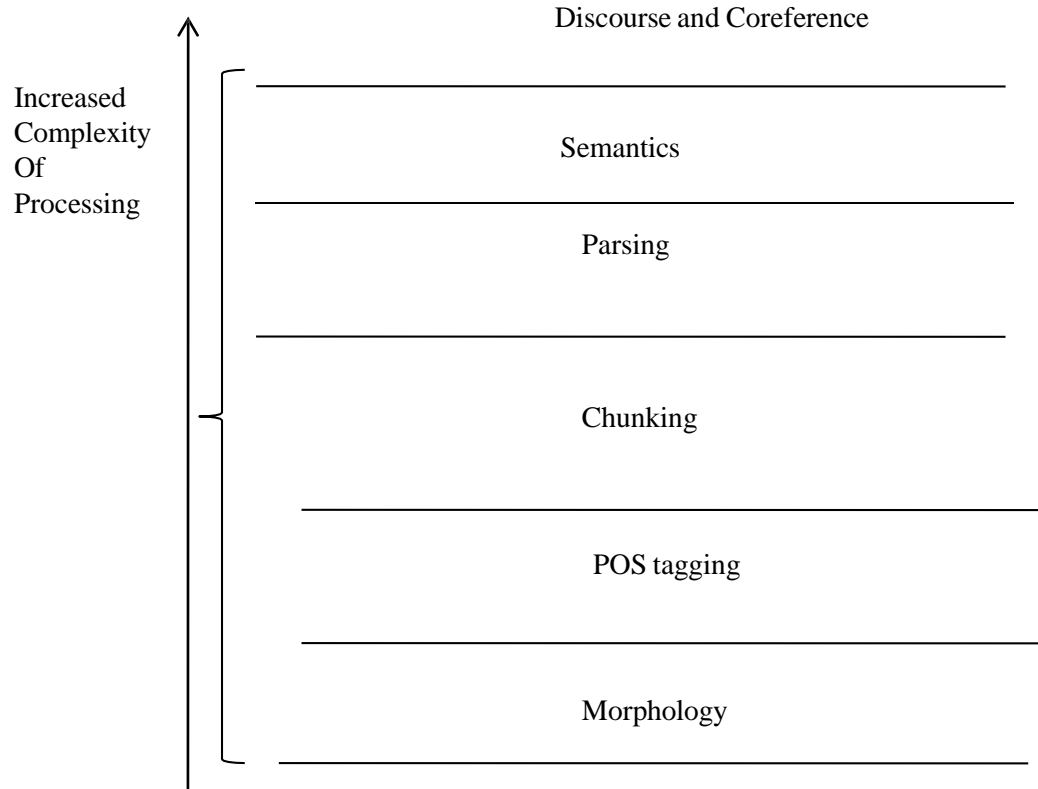


Natural Language Processing

Lecture -

Layers of Language Processing



Different Levels of Language Analysis

1. Phonetic and phonological knowledge

- Words are related to sound

2. Morphological Knowledge

- Word are constructed from morphemes

3. Syntactic Knowledge

- Words put together to form correct sentence
- Structural role played by each word

4. Semantic Knowledge

- What word means
- Context independent meaning- meaning the sentence has regardless of the context in which it is used

Different Levels of Language Analysis

5. Pragmatic Knowledge

- How sentences are used in different situations and how use affects the interpretation of the sentence

6. Discourse Knowledge

- How the immediately preceding sentences affects the interpretation of next sentence

7. World Knowledge

- Includes general language about the structure of the world that language users must have in order to maintain a conversation.

Sequence Labeling

Sequence Labeling Task of NLP

1. Words

- POS tagging
 - placing label on smallest unit of the sentence.
- Named-Entity tagging
 - Detecting proper nouns and understanding their categories.
- Sense marking
 - Assigning words the sense label.

2. Phrases – chunking

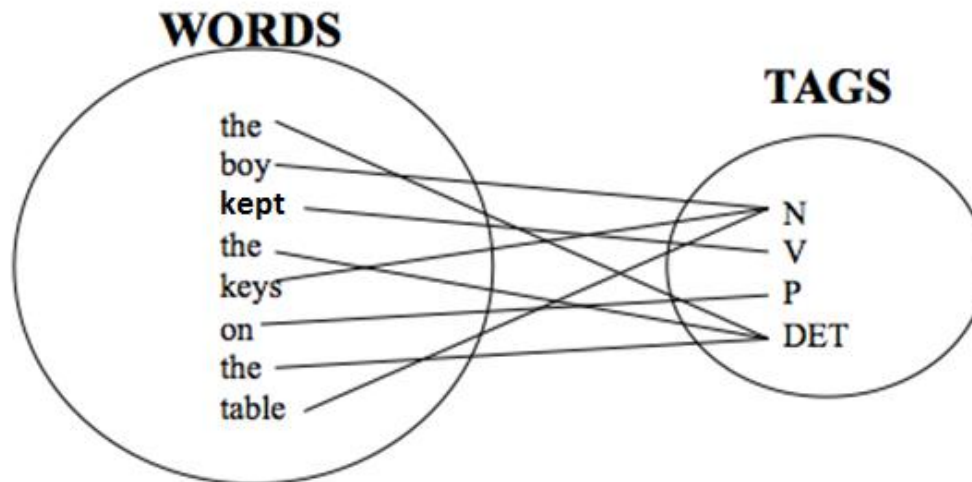
3. Sentences – parsing

4. Paragraphs – co-reference annotation

POS tagging

What it is?

- POS tagging is a process of assigning to each word in a sentence a suitable category from a given set of categories.
- The set of tags is called the Tag-set.
- Standard Tag-set : **Penn Treebank (for English).**



PENN TAGSET

Number	Tag	Description	Number	Tag	Description
1.	CC	Coordinating conjunction	19.	PRP\$	Possessive pronoun
2.	CD	Cardinal number	20.	RB	Adverb
3.	DT	Determiner	21.	RBR	Adverb, comparative
4.	EX	Existential there	22.	RBS	Adverb, superlative
5.	FW	Foreign word	23.	RP	Particle
6.	IN	Preposition or subordinating conjunction	24.	SYM	Symbol
7.	JJ	Adjective	25.	TO	<i>to</i>
8.	JJR	Adjective, comparative	26.	UH	Interjection
9.	JJS	Adjective, superlative	27.	VB	Verb, base form
10.	LS	List item marker	28.	VBD	Verb, past tense
11.	MD	Modal	29.	VBG	Verb, gerund or present participle
12.	NN	Noun, singular or mass	30.	VBN	Verb, past participle
13.	NNS	Noun, plural	31.	VBP	Verb, non-3rd person singular present
14.	NNP	Proper noun, singular	32.	VBZ	Verb, 3rd person singular present
15.	NNPS	Proper noun, plural	33.	WDT	Wh-determiner
16.	PDT	Predeterminer	34.	WP	Wh-pronoun
17.	POS	Possessive ending	35.	WP\$	Possessive wh-pronoun
18.	PRP	Personal pronoun	36.	WRB	Wh-adverb

Definition

Tagging is the assignment of a single part-of-speech tag to each word (and punctuation marker) in a corpus.

Example:

<s> Come in August, and usually the COEP campus is abuzz with new and returning students. </s>

After POS tagging :

<s> Come_VB in_IN August_NNP ,_, and_CC usually_RB the_DT COEP_NNP campus_NN is_VBZ abuzz_JJ with_IN new_JJ and_CC returning_VBG students_NNS.</s>

Named-Entity tagging

Named-Entity tagging

- Detecting proper nouns and understanding their categories.

Example1:

Washington₁ voted Washington₂ to power.

Named-Entity tagging

Example2:

पूजा ने पूजा के लिए फुल
खरीदा

- First pooja is proper noun, **person name**
- Second pooja is **not a proper noun**, it is worshipping

Named-Entity tagging

English translation:

Pooja bought flowers for **worshipping**

- If we do not detect the first pooja as Named-entity, proper noun, then the translation would be improper.

We would say:

- **Worshipping** bought flowers for **worshipping**

Named-Entity tagging

English translation:

Pooja bought flowers for **worshipping**

- If we do not detect the first pooja as Named-entity, proper noun, then the translation would be improper.

We would say:

- **Worshipping** bought flowers for **worshipping**
- **Pooja** bought flowers for **pooja**.

Applications of NER

- Machine translation
- Information extraction(IR)
- Summarization
- Question-Answering system

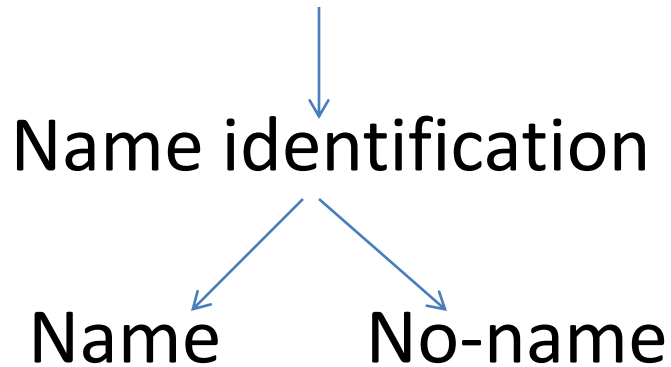
Example of NE tagging

<month-name> **August** </month-name>

<organization-name> **COEP** </organization-name>

Proper-noun tagging: Name identification

Proper noun detection



Eg, come in August

Come – No-name

in – No-name

August – Name (NNP)

Name Recognition

- Type of name identified
- Detect name to that level of categorization
 - **August** is month-name and it has time property associated with it.
 - **COEP** is organization-name and it has place property associated with it.

Name recognition

- Type of name identified
- Detect name to that level of categorization
 - July is month-name and it has time property associated with it.
 - COEP is organization-name and it has place property associated with it.

- **Why it is important ?**

< Come in August, and the COEP campus is abuzz with new and returning students.>

Question asked: What is abuzz with students?

Example of word labeling: Sense marking

Word	Synset	WN-Synset-no
Come	{arrive, come, get}	01947900
..		
..		
..		
abuzz	{abuzz, buzzing, droning}	01859419

Phrase labeling-chunking

Come in August, and usually **the COEP campus** is abuzz with **new and returning students** .

<the COEP campus> and **<new and returning students>** are noun phrases, and are called chunks.

What is difference between chunk and phrases

- Chunks are somewhat convenient phrases.
- These phrases are non-recursive, that means, noun chunk will not contain noun-chunk within it.
- They are simple coherent units of text.

Examples:

- **the COEP campus**
- **new and returning students**

Example of noun phrase not a chunk

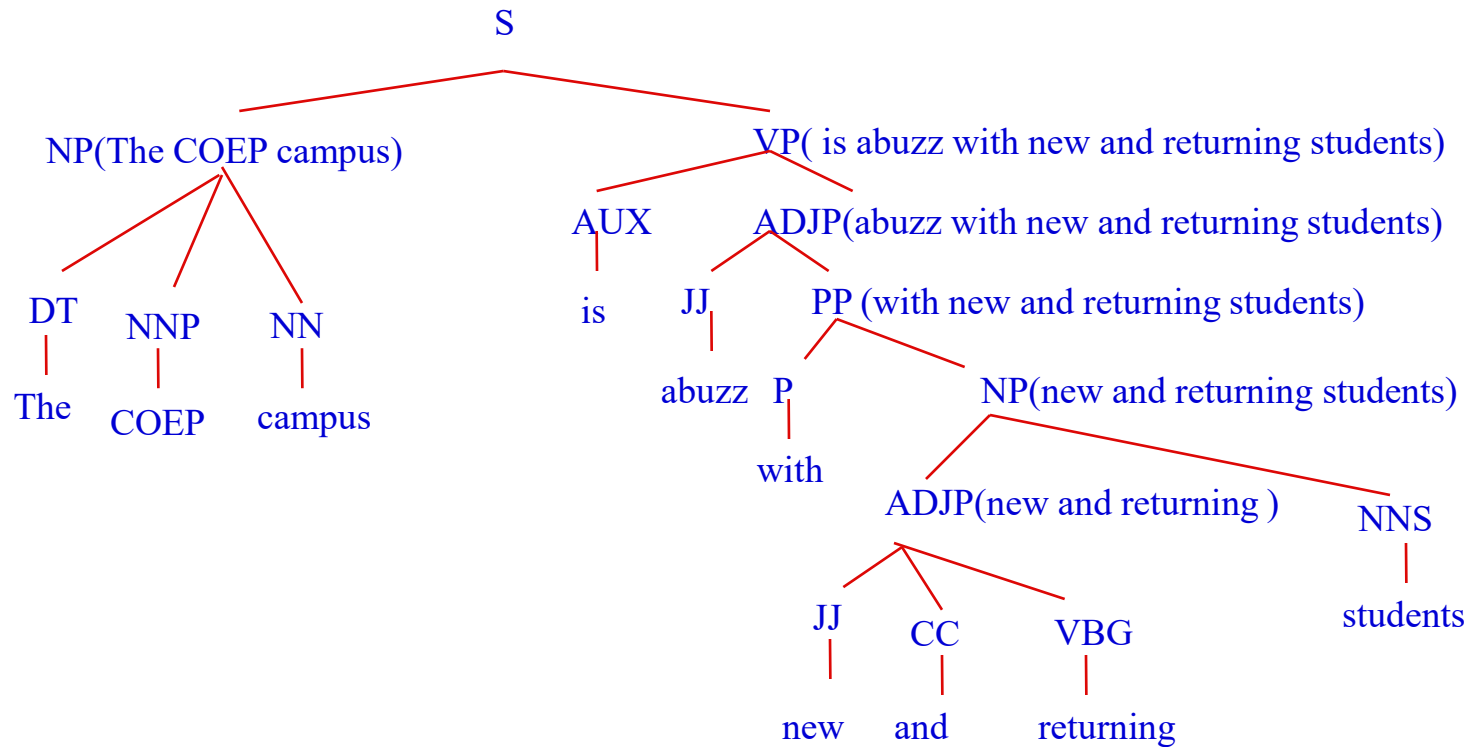
- The COEP campus situated in historic Pune city was visited by Dr.Kalam.

Phrases:

- The COEP campus
- Historic Pune city
- The COEP campus situated in historic Pune city

Non-chunk phrase (Noun Phrase) : The COEP campus situated in historic Pune city.

Sentence labeling: Parsing



Paragraph Labeling with reference resolution

- **Reference resolution:**
 - Which words/phrases refer to some word/phrase?
 - How are they related
- **Anaphora versus Cataphora**
 - Anaphora: an **anaphor** is a word/phrase that refers back to another phrase: the **antecedent** of the anaphor

Example: **Mary** thought that **she** lost **her** keys.




Paragraph Labeling with reference resolution

- **Anaphora versus Cataphora**

- Cataphora: an **cataphor** is a word/phrase that refers forward to another phrase: its **precedent**

Example:

She was at playground, when Riya realized that she lost her keys.



Note: Anaphora is often used as a synonym for reference resolution.

Example

“I went with my friend to the bank to withdraw some money, but was disappointed to find it closed”

1. First layer of processing: POS tagging

I-pronoun went-verb with-pre my-possessive pro
friend-noun to-pre the-art bank-Noun/verb to-pre
withdraw-noun/verb some-adj money-noun,
but-conjunction was-aux-verb
disappointed-Ajd/verb to-pre find-noun/verb
it-pronoun closed-adj/verb.

“I went with my friend to the bank to withdraw some money, but was disappointed to find it closed”

2. Second layer of processing: Sense Disambiguation

I-pronoun

went-**verb** , past tense -go(very ambiguous depending on senses of go)

Noun

- **S: (n) go, spell, tour, turn** (a time period for working (after which you will be relieved by someone else)) *"it's my go"; "a spell of work"*
- **S: (n) Adam, ecstasy, XTC, go, disco biscuit, cristal, X, hug drug** (street names for methylenedioxymethamphetamine)
- **S: (n) crack, fling, go, pass, whirl, offer** (a usually brief attempt) *"he took a crack at it"; "I gave it a whirl"*
- **S: (n) go, go game** (a board game for two players who place counters on a grid; the object is to surround and so capture the opponent's counters)

go meaning for verb category:

Verb

- S: (v) travel, **go**, move, locomote (change location; move, travel, or proceed, also metaphorically) *"How fast does your new car go?"*; *"We travelled from Rome to Naples by bus"*; *"The policemen went from door to door looking for the suspect"*; *"The soldiers moved towards the city in an attempt to take it before night fell"*; *"news travelled fast"*
- S: (v) **go**, proceed, move (follow a procedure or take a course) *"We should go farther in this matter"*; *"She went through a lot of trouble"*; *"go about the world in a certain manner"*; *"Messages must go through diplomatic channels"*
- S: (v) **go**, go away, depart (move away from a place into another direction) *"Go away before I start to cry"*; *"The train departs at noon"*
- S: (v) become, **go**, get (enter or assume a certain state or condition) *"He became annoyed when he heard the bad news"*; *"It must be getting more serious"*; *"her face went red with anger"*; *"She went into ecstasy"*; *"Get going!"*
- S: (v) **go** (be awarded; be allotted) *"The first prize goes to Mary"*; *"Her money went on clothes"*

“I went with my friend to the bank to withdraw some money, but was disappointed to find it closed”

2. Second layer of processing: Sense Disambiguation

... with-**pre** my-**possessive pro**

friend-**noun** to-**pre** the-**art**

bank-**Noun/verb**

- noun-financial institution/river bank

- verb- bank

to-**pre**

withdraw-**noun/verb**.

Withdraw-verb category

Verb

- **S: (v) withdraw, retreat, pull away, draw back, recede, pull back, retire, move back** (pull back or move away or backward) *"The enemy withdrew"; "The limo pulled away from the curb"*
- **S: (v) retire, withdraw** (withdraw from active participation) *"He retired from chess"*
- **S: (v) disengage, withdraw** (release from something that holds fast, connects, or entangles) *"I want to disengage myself from his influence"; "disengage the gears"*
- **S: (v) recall, call in, call back, withdraw** (cause to be returned) *"recall the defective auto tires"; "The manufacturer tried to call back the spoilt yoghurt"*
- **S: (v) swallow, take back, unsay, withdraw** (take back what one has said) *"He swallowed his words"*
- **S: (v) seclude, sequester, sequestrate, withdraw** (keep away from others) *"He sequestered himself in his study to write a book"*
- **S: (v) adjourn, withdraw, retire** (break from a meeting or gathering) *"We adjourned for lunch"; "The men retired to the library"*
- **S: (v) bow out, withdraw** (retire gracefully) *"He bowed out when he realized he could no longer handle the demands of the chairmanship"*
- **S: (v) withdraw, draw, take out, draw off** (remove (a commodity) from (a supply source)) *"She drew \$2,000 from the account"; "The doctors drew medical supplies from the hospital's emergency bank"*
- **S: (v) retire, withdraw** (lose interest) *"he retired from life when his wife died"*
- **S: (v) retreat, pull back, back out, back away, crawfish, crawfish out, pull in one's horns, withdraw** (make a retreat from an earlier commitment or activity) *"We'll have to crawfish out from meeting with him"; "He backed out of his earlier promise"; "The aggressive investment company pulled in its horns"*
- **S: (v) remove, take, take away, withdraw** (remove something concrete, as by lifting, pushing, or taking off, or remove something abstract) *"remove a threat"; "remove a wrapper"; "Remove the dirty dishes from the table"; "take the gun from your pocket"; "This machine withdraws heat from the environment"*

“I went with my friend to the bank to withdraw some money, but was disappointed to find it closed”

2. Second layer of processing: Sense Disambiguation

... some-**adj** money-**noun**,
but-**conjunction** was-**aux-verb**
disappointed-**Ajd/verb**

Verb

- **S: (v)** disappoint, let down (fail to meet the hopes or expectations of) *"Her boyfriend let her down when he did not propose marriage"*

Adjective

- **S: (adj)** defeated, **disappointed**, discomfited, foiled, frustrated, thwarted (disappointingly unsuccessful) *"disappointed expectations and thwarted ambitions"; "their foiled attempt to capture Calais"; "many frustrated poets end as pipe-smoking teachers"; "his best efforts were thwarted"*

“I went with my friend to the bank to withdraw some money, but was disappointed to find it closed”

2. Second layer of processing: Sense Disambiguation

...to-**pre** find-**noun/verb**

it-**pronoun** closed-**adj/verb**.

Close –verb category

Verb

- S: (v) close, shut (move so that an opening or passage is obstructed; make shut) *"Close the door"; "shut the window"*
- S: (v) close, shut (become closed) *"The windows closed with a loud bang"*
- S: (v) close up, close, fold, shut down, close down (cease to operate or cause to cease operating) *"The owners decided to move and to close the factory"; "My business closes every night at 8 P.M."; "close up the shop"*
- S: (v) close (finish or terminate (meetings, speeches, etc.)) *"The meeting was closed with a charge by the chairman of the board"*
- S: (v) conclude, close (come to a close) *"The concert closed with a nocturne by Chopin"*
- S: (v) close (complete a business deal, negotiation, or an agreement) *"We closed on the house on Friday"; "They closed the deal on the building"*
- S: (v) close (be priced or listed when trading stops) *"The stock market closed high this Friday"; "My new stocks closed at \$59 last night"*
- S: (v) close (engage at close quarters) *"close with the enemy"*
- S: (v) close (cause a window or an application to disappear on a computer desktop)
- S: (v) close (change one's body stance so that the forward shoulder and foot are closer to the intended point of impact)
- S: (v) close, come together (come together, as if in an embrace) *"Her arms closed around her long lost relative"*
- S: (v) close (draw near) *"The probe closed with the space station"*
- S: (v) close (bring together all the elements or parts of) *"Management closed ranks"*
- S: (v) close (bar access to) *"Due to the accident, the road had to be closed for several hours"*

Close –Adjective category

Adjective

S: (adj) **closed** (not open or affording passage or access) *"the many closed streets made travel difficult"; "our neighbors peeped from behind closed curtains"*

S: (adj) **closed** ((set theory) of an interval that contains both its endpoints)

S: (adj) shut, unopen, **closed** (not open) *"the door slammed shut"*

S: (adj) **closed**, shut (used especially of mouth or eyes) *"he sat quietly with closed eyes"; "his eyes were shut against the sunlight"*

S: (adj) **closed** (requiring union membership) *"a closed shop"*

S: (adj) **closed** (with shutters closed)

S: (adj) **closed** (not open to the general public) *"a closed meeting"*

S: (adj) **closed**, unsympathetic (not having an open mind) *"a closed mind unreceptive to new ideas"*

S: (adj) **closed**, closed in (blocked against entry) *"a closed porch"*

Pronoun Drop

Pronoun drop for this sentence, but I was disappointed to find it closed”

Whether – I/ friend / money/bank was disappointed

Scope Ambiguity

With is preposition .

What is scope of with ?

How much text it demands to complete with phrase.

“I went **with** my friend to the bank to withdraw some money, but was disappointed to find it closed”

Co-referencing

It is pronoun. It refers to what?

“I went with my friend to the bank to withdraw some money, but was disappointed to find it closed”

POS	Bank (N/V)	closed (V/ adj)
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Sense	Bank (financial institution)	withdraw (take away)
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Pronoun drop	But	I/friend/money/bank	was disappointed
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SCOPE	With	my friend
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Co-referencing	It -> bank
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