Unit-4

**25. Explain about pumping lemma algorithm**

<https://www.youtube.com/watch?v=KyQc054-BEU>

**26. Write about closure properties of context free language**

**1.Union Property**

If you have two context-free languages, L1 and L2, the union of these two, represented as L1∪L2, will also be a context-free language.

**Example**

Let's say L1 = { axby , x > 0}

The corresponding grammar G1 would be P: S1 → aAb | ab

And if L2 = { czdz , z ≥ 0}

The corresponding grammar G2 would be P: S2 → cBb| ε

The union of L1 and L2 would be L = L1 ∪ L2 = { axby } ∪ { czdz }

Here, the corresponding grammar G would have the additional production, that is, S → S1 | S2

## 2.Concatenation Property

If L1 and L2 are CFLs, then the concatenation of these two, represented as L1L2, will also be a context-free language.

### Example

The concatenation of the languages L1 and L2 would be L = L1L2 = { axbyczdz }

The corresponding grammar G would have the additional production, that is, S → S1 S2

## 3.Kleene Star Property

If L is a CFL, then the Kleene Star of L, represented as L\*, will also be a context-free language.

### Example

If L = { axby , x ≥ 0}

Then, the corresponding grammar G would have P: S → aAb| ε

Thus, the Kleene Star L1 = { axby }\*

Here, the corresponding grammar G1 would have additional productions, and they are S1 → SS1 | ε

However, CFLs are not closed under the following operations:

* **Intersection**− If L1 and L2 are CFLs, then the intersection of these two, represented as L1 ∩ L2, may not be a CFL.
* **Intersection with a regular language**− If L1 is a regular language and L2 is a CFL, then the intersection of these two, represented as L1 ∩ L2, will be a CFL.
* **Complement**− If L1 is a CFL, the complement of L1, represented as L1’, may not be a CFL

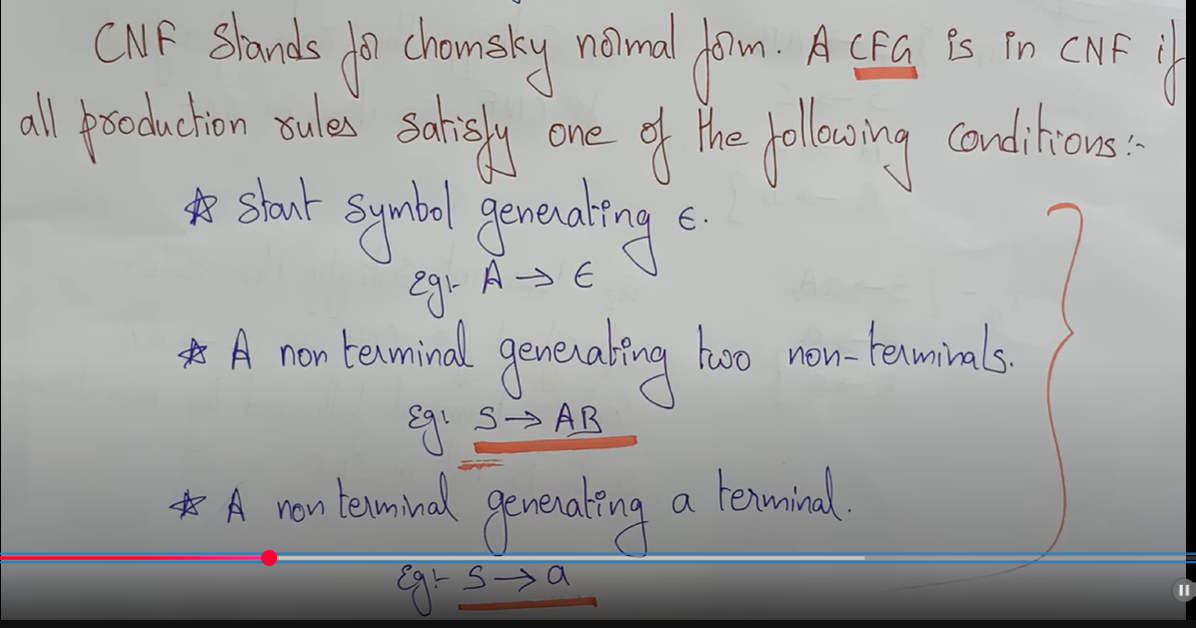
**27. Enumerate normal forms for context free language**

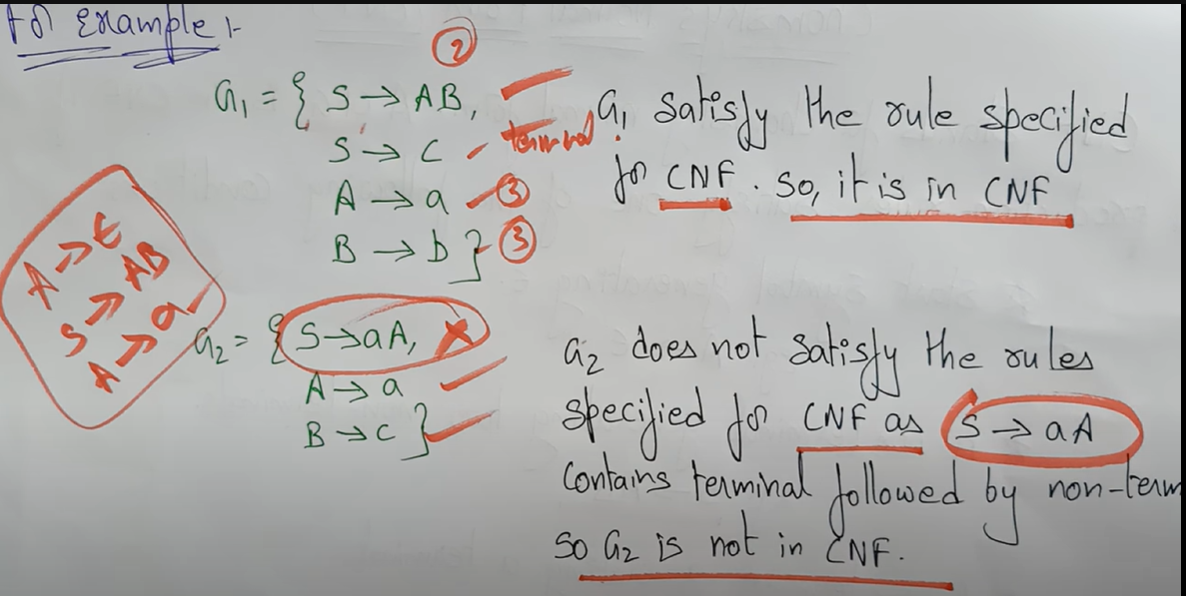
Ans:

There are two primary normal forms for Context-Free Grammars (CFGs) that are:

1. **Chomsky Normal Form (CNF)**
2. **Greibach Normal Form (GNF)**

**1.Chomsky Normal Form(CNF)**





**28. Convert the following context free language to**

**CNF**

**S -> ABC**

**A -> Aa/epsilon**

**B -> bB/epsilon**

**C -> cC/epsilon**

**29.** **Convert the following CFG into GNF.**

**S->AB**

**A->a**

**B-> CA**

**C->AB/b**

**30.** **Construct a PDA for accepting a language**

**{L=a^nb^n | n ≥ 1}**

<https://www.youtube.com/watch?v=NEhCALWlfLY>

**31. Construct PDA for the given CFG**

**S→0BB**

**B→0S|1S|0**

**Test whether 01044 is accepted by this PDA**

[**https://www.naukri.com/code360/library/cfg-to-pda-conversion**](https://www.naukri.com/code360/library/cfg-to-pda-conversion)

**Unit-5**

**40. short notes on:**

**i) P ii) NP iii) NP Hard iv) NP Complete with example**

**41. Illustrate the process of Recursive languages and Recursively enumerable Languages with suitable examples?**

[**https://www.tutorialspoint.com/automata\_theory/recursive\_and\_recursively\_enumerable\_language\_in\_toc.htm**](https://www.tutorialspoint.com/automata_theory/recursive_and_recursively_enumerable_language_in_toc.htm)