Context-free languages are **closed** under −

* Union
* Concatenation
* Kleene Star operation

Union

Let L1 and L2 be two context free languages. Then L1 ∪ L2 is also context free.

Example

Let L1 = { anbn , n > 0}. Corresponding grammar G1 will have P: S1 → aAb|ab

Let L2 = { cmdm , m ≥ 0}. Corresponding grammar G2 will have P: S2 → cBb| ε

Union of L1 and L2, L = L1 ∪ L2 = { anbn } ∪ { cmdm }

The corresponding grammar G will have the additional production S → S1 | S2

Concatenation

If L1 and L2 are context free languages, then L1L2 is also context free.

Example

Union of the languages L1 and L2, L = L1L2 = { anbncmdm }

The corresponding grammar G will have the additional production S → S1 S2

Kleene Star

If L is a context free language, then L\* is also context free.

Example

Let L = { anbn , n ≥ 0}. Corresponding grammar G will have P: S → aAb| ε

Kleene Star L1 = { anbn}\*

The corresponding grammar G1 will have additional productions S1 → SS1 | ε

Context-free languages are **not closed** under −

* **Intersection** − If L1 and L2 are context free languages, then L1 ∩ L2 is not necessarily context free.
* **Intersection with Regular Language** − If L1 is a regular language and L2 is a context free language, then L1 ∩ L2 is a context free language.
* **Complement** − If L1 is a context free language, then L1’ may not be context free.