

24 Lecture - CS402

Important Subjective

1. **Define the complement of a language and provide an example.**

Answer: The complement of a language L over an alphabet Σ is the set of all strings in Σ^* that are not in L . For example, if $L = \{a, aa, aaa\}$, then the complement of L is $\{\epsilon, b, ab, ba, bb, \dots\}$ where ϵ is the empty string and b belongs to Σ but not in L .

How can the complement of a language be obtained using an automaton?

Answer: The complement of a language can be obtained by complementing the final and non-final states of the automaton representing the language. That is, if M is an automaton that recognizes L , then the complement of L can be recognized by the automaton $M' = (Q, \Sigma, \delta, q_0, F')$ where $F' = Q - F$.

Is the complement of a regular language always regular? Explain.

Answer: Yes, the complement of a regular language is always regular. This can be shown by constructing a DFA for the complement language using the method described in the previous question.

Can a language and its complement both be regular? Explain.

Answer: No, a language and its complement cannot both be regular. This is because if a language L is regular, then its complement L' is also regular. But if both L and L' are regular, then their intersection (i.e., the empty language) must also be regular. However, the empty language is not regular, so this is a contradiction.

What is the complement of the language Σ^+ ?

Answer: The complement of the language Σ^+ is the set of all non-empty strings over the alphabet Σ .

Can the complement of an infinite language be finite? Explain.

Answer: Yes, the complement of an infinite language can be finite. For example, if $L = \{a^n \mid n \text{ is even}\}$, then its complement is $\{a^n \mid n \text{ is odd}\}$, which is finite.

What is the complement of the language Σ^* ?

Answer: The complement of the language Σ^* is the empty language.

Is the complement of a context-free language always context-free? Explain.

Answer: No, the complement of a context-free language is not always context-free. This can be shown using the pumping lemma for context-free languages.

Can a language and its complement both be context-free? Explain.

Answer: Yes, a language and its complement can both be context-free. For example, consider the language $L = \{a^n b^n \mid n \geq 0\}$. Both L and its complement are context-free.

What is the complement of the language $\{a^n b^n \mid n \geq 0\}$?

Answer: The complement of the language $\{a^n b^n \mid n \geq 0\}$ is the set of all strings that do not have the form $a^n b^n$, i.e., $\{\epsilon, a, b, ab, ba, \dots\}$.