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 ? is the set of all strings in ?* that are not in L. For example, if L = {a, aa, aaa}, then the complement of L is {?, b, ab, ba, bb, ...} where ? is the empty string and b belongs to ? 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, ?, ?, q0, 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 {?}?
   Answer: The complement of the language {?} is the set of all non-empty strings over the alphabet ?.
   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 | n is even}, then its complement is {a^n | n is odd}, which is finite.
   What is the complement of the language ?*?
   Answer: The complement of the language ?* 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 | n >= 0}. Both L and its complement are context-free.
   What is the complement of the language {a^n b^n | n >= 0}?
   Answer: The complement of the language {a^n b^n | n >= 0} is the set of all strings that do not have the form a^n b^n, i.e., {?, a, b, ab, ba, ...}.