2021-2022 resit

2022年10月17日 16:10

1 Indicate **true or false** of the following statements and briefly justify your answer.

a) If L is a regular language, then any subset of L is a regular language. **3**

b) If L is a regular language, then L can be accepted by a PDA. **3**

c) Turning machine can accept regular languages, context free languages, recursive languages. **3**

d) If L1 ∩ L2 is a regular language, then L1 and L2 are regular languages. **3**

e) The regular expressions *cab(ab)** and *c(aba)*b* denotes the same language. **3**

f) The regular expressions *c(ab)⁺* and *ca(ba)*b* denotes the same language. **3**

2 Let L be a language over {0, 1}, strings of which contain 01 as a substring.

a) Give a regular expression that defines L. **5**

b) Give a NFA by diagram that accepts L. **5**

c) Convert the NFA to an equivalent DFA. **5**

d) Is the DFA obtained by the subset construction in c) a minimum-state DFA? If yes, justify it. If not, minimise it. **7**

3 **a)** State the Pumping Lemma and explain how to use it to prove that a language is not regular. **5**

b) Use the Pumping Lemma to prove the language $L = \{a^n b^n \mid n > 0\}$ is not regular. **6**

c) Show the language $L = \{a^n b^n \mid n > 0\}$ is context free by designing a context–free grammar that generates L. **6**

4 Consider the following ambiguous grammar and answer the questions.

$E \rightarrow a \mid E + E \mid E^*E$

a) What does an ambiguous grammar mean? **3**

b) Give two leftmost derivations of a + a *a. Write down also the associated derivation trees. **4**

屏幕剪辑的捕获时间: 2022/10/17 16:11

5 Consider the following context free grammar

$$S \rightarrow aAS \mid a \mid BS \mid \varepsilon$$
$$A \rightarrow SbA \mid ba$$

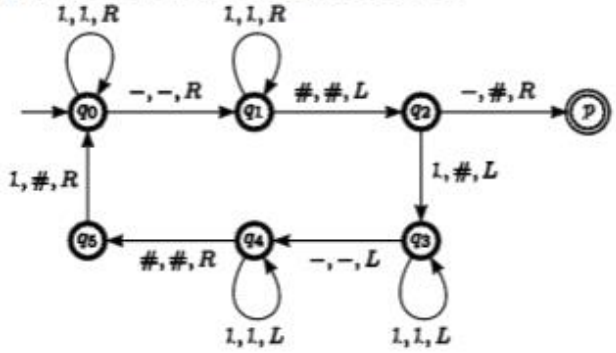
a) Eliminate ε-productions. **4**

b) Eliminate any unit productions in the resulting grammar of a). **4**

c) Eliminate any useless symbols in the resulting grammar of b). **4**

d) Put the resulting grammar in c) into Chomsky normal form. **4**

6 Consider the transition diagram of a Turing machine with doubly infinite tape as below, together with the explanations. The input of this machine is encoded as a unary string x-y, where x and y are sequences of "1".



In the diagram, state q0 is the initial state and state p is the accepting state. The three-component tuple labelling the transitions stands for the symbol being scanned, the symbol to be written and the direction of the head move. For example, at state q0, if the machine is scanning symbol "1", it will not change the content of the cell being scanned and the head will move one cell to the right. At state q2, if the symbol being scanned is "-" it will be changed to "#" and the head will move one cell to the right. The current state then will change to state p.

For each of the following initial inputs on the tape given below what will be the output?

a) #11111-11# **5**

b) #11-111# **5**

7 a) What are recursive and recursively enumerable languages? Which one of the two sets stands for decidable problems? 5

b) What is a reduction? Briefly explain how this technique can be used to prove that certain problems are undecidable. 5

The end