Xi'an Jiaotong-Liverpool University

西交利物浦大學

MODULE CODE	EXAMINER	DEPARTMENT	TEL
INT201	Wenjin Lu	INTELLIGENT SCIENCE	1505

1st SEMESTER 2021-2022 EXAMINATION (RESIT, OPEN BOOK)

BACHELOR DEGREE – Year 3

DECISION, COMPUTATION AND LANGUAGE

TIME ALLOWED: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1、 **Total marks available are 100 marks. Marks for this examination account for 100% of the total credit for INT201.**

2、 **The paper consists of 7 questions. Answer all the questions.**

3、 **The number at the right column indicates the mark for each question.**

4、 **Answers should be written in the answer script provided.**

5、 **This is an OPEN BOOK examination. You can reference textbooks but discuss with other students in any way is not allowed.**

6、 **The time of the exam is strictly limited to 2 hours.**

7、 **For students who take the exam online, at the end of the examination, be absolutely sure to submit your answer via Learning Mall. The time for submission of your answer via Learning Mall is strictly limited to 15 minutes. Once the time is over, the submission link will be closed.**

8、 **All answers must be in English.**

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. True, subset ∈ L **3**

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

c) Turning machine can accept regular languages, context free languages, recursive languages. True (more powerful) **3**

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

e) The regular expressions $cab(ab)^*$ and $c(aba)^*b$ denotes the same language. False (cab, cb) **3**

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

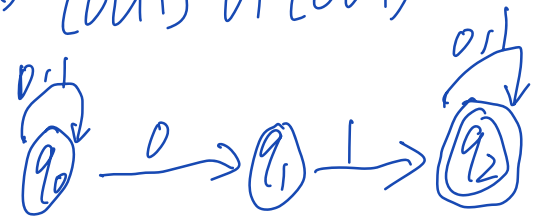
$$E \rightarrow a \mid E + E \mid E^*E$$

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

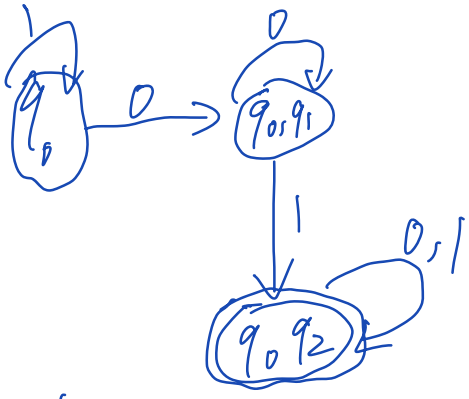
b) Give two leftmost derivations of a + a *a. Write down also the associated derivation trees. **4**

2. (a) $(0\cup1)^*01(0\cup1)^*$

(b)



(c)



(d) Yes.

3.(a) Pumping Lemma is for a regular Language if the length of string larges than the State that means there must have some part of string is looped in some State, So we can deride the String in to three parts xy^iz where i means loop times. and the y means the loop part. and the $|xy|\leq p$ means that Loop only can loop in states if it have loop part $|y|\geq 1$ $i\geq 0$

(b) Assume L is regular Language

There exists a constant "p" for L

Choose $S=a^pb^p$ $|S|=2p\geq p$, let divide S into xyz

where $|xy|\leq p$ $|y|\geq 1$ and xy^iz $i\geq 0$

let $x=a^m$ $y=b^n$ where $m+n=p$

if $i=2$ $S=xy^2z=a^{p+n}b^p$ cause $|a^n|\geq 1$ so $S>2p$

$|a^{p+n}|\neq|b^p|$ So L is not regular Language.

(c) $M=(V,\Sigma,R,S)$

$V=\{S\},\Sigma=\{a,b\}$.

R:

$S\to aSb|\varepsilon$

4. 没学过

5. (a) $S\to aAS|aA|a|BS|B$

$A\to SbA|bA|ba$

(b) $S\to aAS|aA|a|BS$

$A\to SbA|bA|ba$

(c) $S\to aAS|aA|a$

$A\to SbA|bA|ba$

S_3: $S_0\to aN|aA|a$

$S\to aN|aA|a$

$A\to SM|bA|ba$

$N\to AS$

$M\to bA$

S_4: $S_0\to RN|RA|a$

$S\to RN|RA|a$

$A\to SM|XA|XR$

$N\to AS$

$M\to XA$

$R\to a$

$X\to b$

(4) S_1: $S_0\to S$

$S\to aAS|aA|a$

$A\to SbA|bA|ba$

S_2: $S_0\to aAS|aA|a$

$S\to aAS|aA|a$.

$A\to SbA|bA|ba$

5 Consider the following context free grammar

$$\begin{aligned} S &\rightarrow aAS \mid a \mid BS \mid \varepsilon \\ A &\rightarrow SbA \mid ba \end{aligned}$$

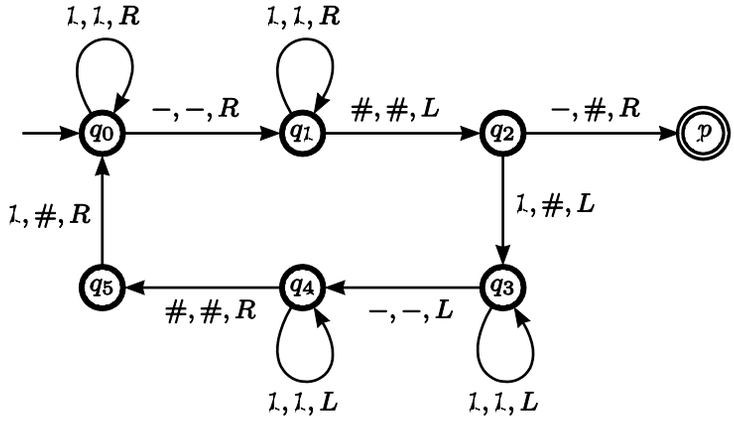
a) Eliminate ε-productions. **4**

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**

6. (a) ###111####

(b) Reject.

7. (b) Reduction. is a method to let a problem reduction to a hasdes problem., that means if we can solve the hasdes problem, we also can solve the original problem

We can reduction a undecidable problem into the problem which we want to anaysis. if undecidable can reduction to. that means the original problem is also undecidable

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