中 山 大 学 软 件 学 院 **2008** 级 软 件 工 程 专 业 (2011 春季学期)

《编译原理》 期末试题试卷(A)参考答案

(考 试 形 式： 闭 卷   考 试 时 间 ： 2 小 时)

警 示 《中山大学授予学士学位工作细则》第六条

考 试 作 弊 不 授 予 学 士 学 位

方向：_____   姓名：_____   学号：_____

注意：答案一定要写在答卷中，写在本试题卷中不给分。本试卷要和答卷一起交回。

1. **(8 points) Give a regular expression for each of the following languages over the alphabet {a, b}:**
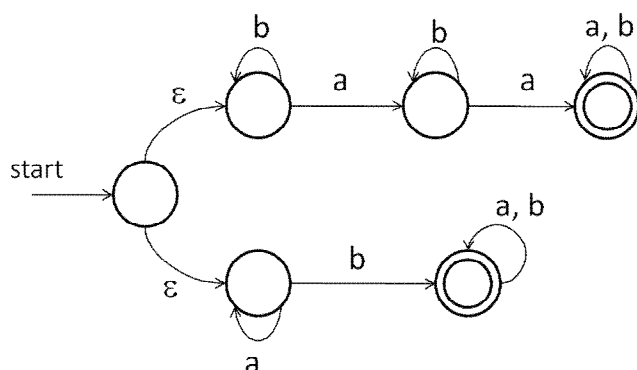   (1) **(4 points) All nonempty strings that start and end with the same symbol.**
   (2) **(4 points) All strings that contain no repeated b's (including the empty string).**

【参考答案】
   (1) **a(a|b)*a | b(a|b)*b | a | b**
   (2) **a*(ba+)*b?**

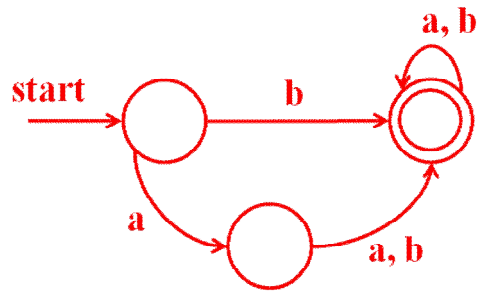2. **(12 points) Consider the following NFA:**

   (1) **(4 points) What language does the NFA accept? Please describe it in natural language.**
   (2) **(8 points) Convert the NFA to an equivalent DFA. You may construct the DFA directly.**

【参考答案】
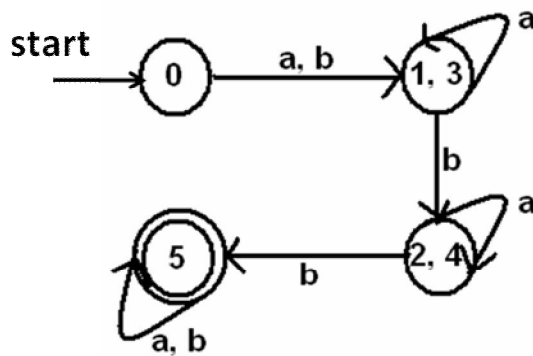   (1) **所有至少包含 2 个 a 或 1 个 b 的由 a, b 组成的字符串.**
   (2)

start   b

a

a, b

3. **(7 points) Minimize the DFA represented by the following transition table, where state 0 is the start state and state 5 is the only accepting state.**

	a	b
0	1	3
1	1	2
2	2	5
3	3	4
4	4	5
5	5	5

【参考答案】

start

0   a, b   1, 3   a

b

5   b   2, 4   a

a, b

4. **(10 points) Give a context-free grammar (CFG) for each of the following languages over the alphabet {a, b}:**
   (1) **(5 points) $L = \{a^i b^j \mid i \geq 0$ and $2*i \leq j \leq 3*i\}$.**
   (2) **(5 points) $L = \{w \mid w$ contains an odd number of symbols, and the symbol in the middle of w is a\}$.**

【参考答案】
   (1) S → aSbb | aSbbb | ε
   (2) S → aSa | aSb | bSa | bSb | a

5. **(8 points) Consider the following grammar over the alphabet {a, b, c}:**
   S → Xa
   X → bX
   X → Y

Y → Zc

Z → bZ

Z → ε

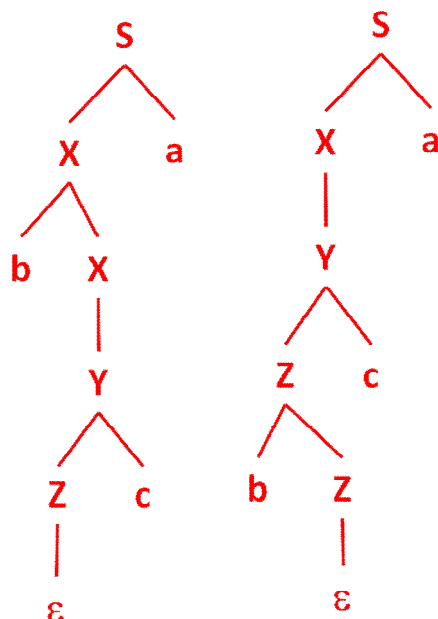**(1)** **(5 points) Demonstrate that this grammar is ambiguous.**

(2) **(3 points) Please remove exactly one production from this grammar to obtain an unambiguous grammar generating the same language.**

【参考答案】

(1)

(2) 删除 X → bX 或 Z → bZ 均可.

6. **(12 points) Compute FIRST and FOLLOW for each nonterminal in the following grammar:**

   S → A

   A → BA'

   A' → iBA' | ε

   B → CB'

   B' → +CB' | ε

   C →)A* | (

【参考答案】

FIRST(S) = FIRST(A) = FIRST(B) = FIRST(C) = { (,) }

FIRST(A') = { i, ε }

FIRST(B') = { +, ε }

FOLLOW(S) = { $ }

FOLLOW(A) = FOLLOW(A') = { $, * }

FOLLOW(B) = FOLLOW(B') = { $, *, i }

FOLLOW(C) = { $, *, +, i }
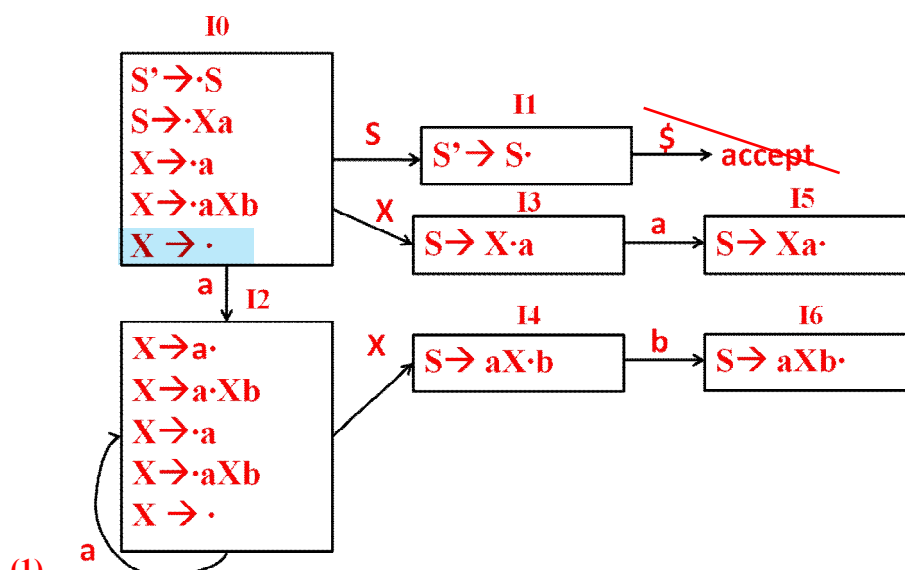
7. **(13 points) Consider the following grammar:**

   S → Xa

   X → a | aXb | ε

   (1) (9 points) Construct a DFA for viable prefixes of this grammar using LR(0) items.

   (2) (4 points) Identify a shift-reduce conflict and a reduce-reduce conflict under SLR(1) parsing.

【参考答案】

I0
S' → ·S
S → ·Xa
X → ·a
X → ·aXb
X → ·

I1 (on S): S' → S· —$ → accept

I3 (on X): S → X·a —a→ **I5**: S → Xa·

I2 (on a from I0):
X → a·
X → a·Xb
X → ·a
X → ·aXb
X → ·
(on a, loops to itself)

I4 (on X from I2): S → aX·b —b→ **I6**: S → aXb·

(1)

(2) 由于 a ∈ FOLLOW(X) = {a, b}，因而在状态 I0（或 I2），遇到输入符号 a 时既可移进也可归约；由于 a ∈ FOLLOW(X) = {a, b}，因而在状态 I2，遇到输入符号 a 时既可用产生式 X→a 归约，也可用产生式 X→ε 归约.

8. **(10 points) The following grammar generates binary fractions.**

   F → 0.B

   B → 0B

      | 1B

      | 0

      | 1

   Design a syntax-directed definition (SDD) for the above grammar such that the nonterminal *F* has an attribute *F.val* which keeps the decimal value of the binary fraction generated by *F*. Please use as few attributes as possible and do NOT modify the grammar.

【参考答案】

产生式	语义规则
F → 0.B	F.val = B.val
B → 0B$_1$	B.val = B$_1$.val * 0.5
B → 1B$_1$	B.val = 0.5 + B$_1$.val * 0.5

B → 0	B.val = 0
B → 1	B.val = 0.5

9. **(8 points) Consider the following fragment of three-address instructions:**

(1)		b := 1
(2)		b := 2
(3)		if w <= x goto B
(4)		e := b
(5)		jump B
(6)	A:	jump D
(7)	B:	c := 3
(8)		b := 4
(9)		c := 6
(10)	D:	if y <= z goto E
(11)		jump End
(12)	E:	g := g + 1
(13)		h: = 8
(14)		jump A
(15)	End:	h := 9

Please partition these three-address instructions into basic blocks, and draw the control flow graph. You may draw the resulting graph directly, but you must mark each node by number n~m indicating that the corresponding basic block consists of instructions n through m, inclusive.

【参考答案】
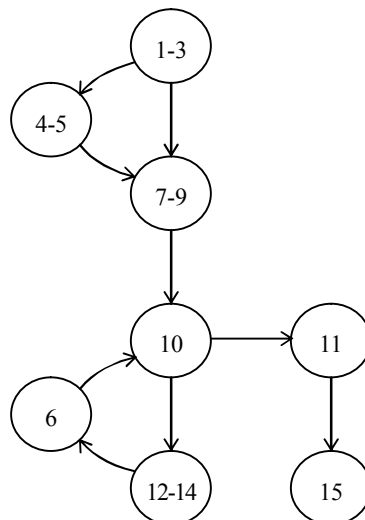
10. **(12 points) Consider the following basic blocks:**

(1) T0 := 3.14	(7) B := A
(2) T1 := 2*T0	(8) T5 := 2*T0
(3) T2 := R+r	(9) T6 := R+r

(4) T3 := R－r   **(10)** T7 := T3－T5

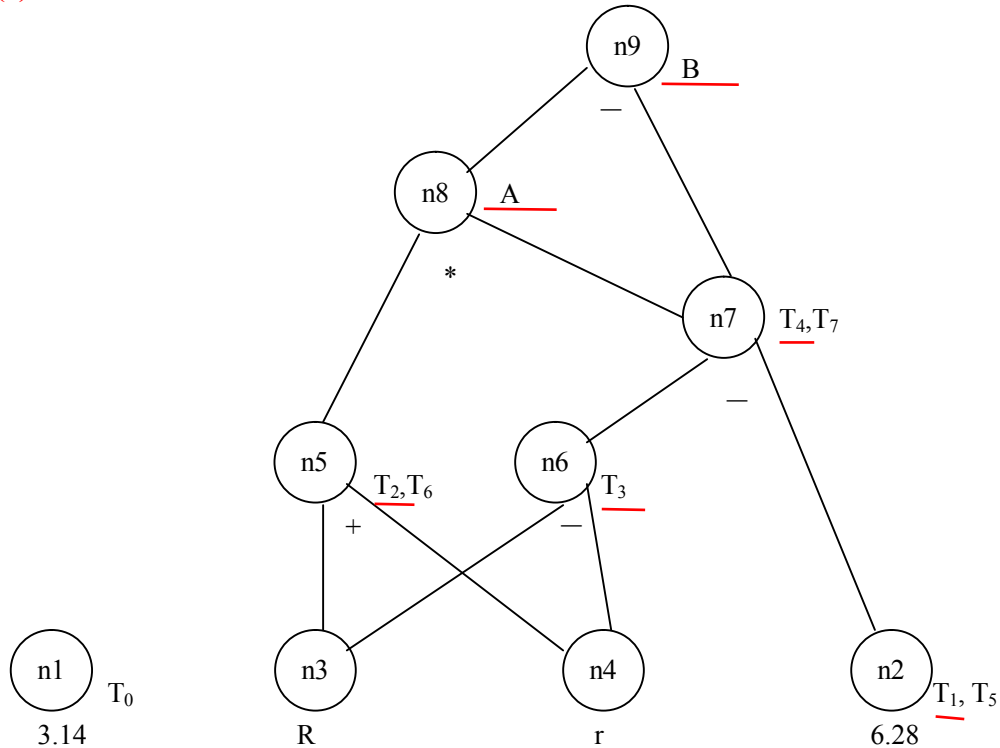**(5)** T4 := T3－T1   **(11)** B := A－T7

(6) A := T2*T4

(1)   (7 points) Construct a DAG for this basic block.

(2)   (5 points) Assuming that only A and B are live on exit from this basic block, simplify the three-address code.

【参考答案】

(1)

(2)

S1 := R+r

S2 := R－r

S3 := S2－6.28

A := S1*S3

B := A－S3

注意本题中的临时变量 S1~S3 可以替换为其它名称.