Gradiance Online Accelerated Learning

Zayd

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Help

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Your score:	100

1. Suppose we execute the Chomsky-normal-form conversion algorithm of Section 7.1.5 (p. 272). Let $A \rightarrow BC0DE$ be one of the productions of the given grammar, which has already been freed of ε-productions and unit productions. Suppose that in our construction, we introduce new variable X_a to derive a terminal *a*, and when we need to split the right side of a production, we use new variables Y_1, Y_2,...

What productions would replace $A \rightarrow BC0DE$? Identify one of these replacing productions from the list below.

a) $Y_2 \rightarrow CY_3$
b) $A \rightarrow BY_1$
c) $Y_3 \rightarrow X_0Y_4$
d) $Y_3 \rightarrow DY_4$

Answer submitted: **b)**

You have answered the question correctly.

2. Let L be the language of all strings of a's and b's such that no prefix (proper or not) has more b's than a's. Let G be the grammar with productions

```
S → aS | aSbS | ε
```

To prove that L = L(G), we need to show two things:

1. If S =>* w, then w is in L.
2. If w is in L, then S =>* w.

We shall consider only the proof of (1) here. The proof is an induction on n, the number of steps in the derivation S =>* w. Here is an outline of the proof, with reasons omitted. You need to supply the reasons.

Basis:
1) If n=1, then w is ε because _______.
2) w is in L because _______.
Induction:
3) Either (a) $S \Rightarrow aS \Rightarrow^{n-1} w$ or (b) $S \Rightarrow aSbS \Rightarrow^{n-1} w$ because _______.
4a) In case (a), w = ax, and $S \Rightarrow^{n-1} x$ because _______.
5a) In case (a), x is in L because _______.
6a) In case (a), w is in L because _______.
4b)

In case (b), w can be written w = aybz, where S =>^{p} y and S =>^{q} z for some p and q less than n because _______.

5b)

In case (b), y is in L because _______.

6b)

In case (b), z is in L because _______.

7b)

In case (b), w is in L because _______.

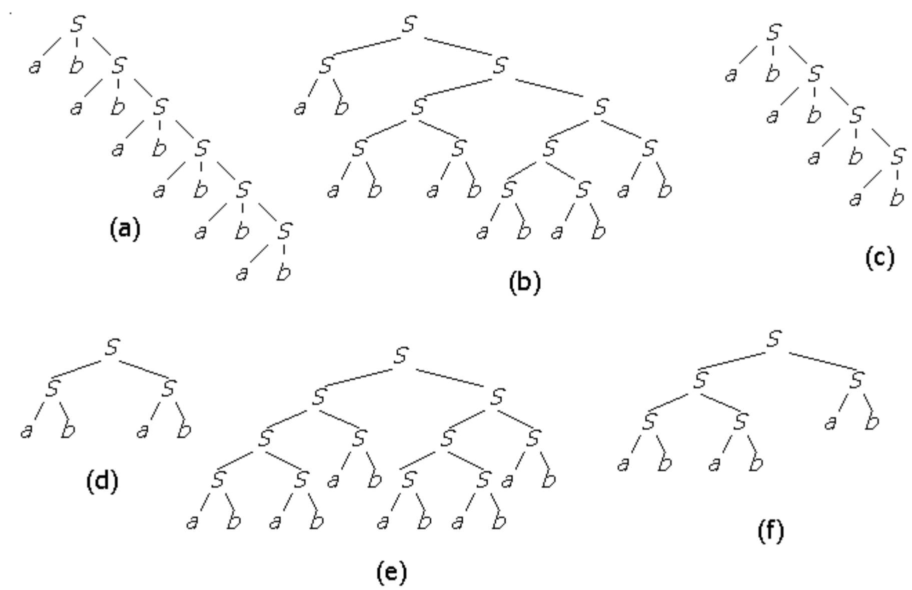
For which of the steps above the appropriate reason is contained in the following argument:
"The following two statements are true
(i) if string x has no prefix with more b's than a's, then neither does string ax,
(ii) if strings y and z are such that no prefix has more b's than a's, then neither does string aybz."

a) 4a
b) 1
c) 6b
d) 6a

Answer submitted: **d)**

You have answered the question correctly.

3. Consider the grammar G: S → abS, S → ab. Which of the following strings is a word of L(G) AND is the yield of one of the parse trees for grammar G in the figure below?

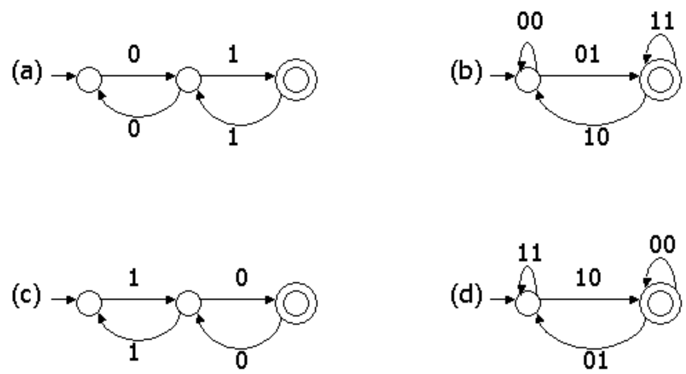


a) ababababab
b) abababababab
c) ababab
d) abab

Answer submitted: **b)**

You have answered the question correctly.

4. Which automata define the same language?



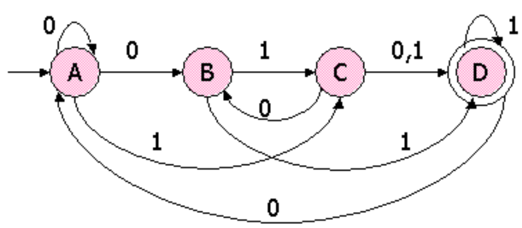
Note: (b) and (d) use transitions on strings. You may assume that there are nonaccepting intermediate states, not shown, that are in the middle of these transitions, or just accept the extension to the conventional finite automaton that allows strings on transitions and, like the conventional FA accepts strings that are the concatenation of labels along any path from the start state to an accepting state.

a) c and d
b) b and d
c) a and c
d) b and c

Answer submitted: **a)**

You have answered the question correctly.

5. Here is a nondeterministic finite automaton:



Some input strings lead to more than one state. Find, in the list below, a string that leads from the start state A to three different states (possibly including A).

a) 110110
b) 0000
c) 01010
d) 101000

Answer submitted: **c)**

You have answered the question correctly.

6. Find, in the list below, a regular expression whose language is the reversal of the language of this regular expression: 1*23*. Recall that the reversal of a language is formed by reversing all its strings, and the reversal of a string $a_1a_2...a_n$ is $a_n...a_2a_1$.

a) 1*3*2
b) 3*21*
c) 3*1*2
d) 23*1*

Answer submitted: **b)**

You have answered the question correctly.

7. The length of the string `abcbc` is:

a) 3

b) 12

c) 5

d) 6

Answer submitted: **c)**

You have answered the question correctly.

8. Here is the transition table of a DFA that we shall call *M*:

	0	**1**
→A	B	G
B	C	H
*C	D	G
*D	A	H
E	F	C
F	G	I
*G	H	C
*H	A	D
I	E	I

Find the minimum-state DFA equivalent to the above. States in the minimum-state DFA are each the merger of some of the states of *M*. Find in the list below a set of states of *M* that forms one state of the minimum-state DFA.

a) {A,F}

b) {A,B}

c) {A}

d) {C,I}

Answer submitted: **c)**

You have answered the question correctly.

9. Consider the grammar G1:

S → ε | aS | aSbS

Which of the following is correct (for a choice to be correct, all propositions must be correct)?

a) a) G1 generates all and only the strings of a's and b's such that every prefix has at least as many a's as b's. b) The following inductive hypothesis will prove it: For n < k, it holds that: Any word in G1 of length n, is such that all its prefixes contain at least as many a's as b's.

b) a) G1 generates all and only the strings of a's and b's such that every prefix has at least as many a's as b's. b) The following inductive hypothesis will prove it: For n less than k, the following two assertions hold: (i) Any word in G1 of length n, is such that all its prefixes contain at least as many a's as b's. (ii) Any word of length n such that every prefix contains at least as many a's as b's is generated by G1.

c) a) G1 generates all and only the strings of a's and b's such that every string has at least as many a's as b's. b) The inductive hypothesis to prove it is: For n < k, it holds: Any word in G1 of length n, is such that all its prefixes contain more a's than b's or as many a's as b's.

d) The string aaba is not generated by the grammar.

Answer submitted: **b)**

You have answered the question correctly.

10. A Turing machine *M* with start state q_0 and accepting state q_f has the following transition function:

δ(q,a)	**0**	**1**	**B**
q_0	$(q_0,1,R)$	$(q_1,1,R)$	(q_f,B,R)
q_1	$(q_2,0,L)$	$(q_2,1,L)$	(q_2,B,L)
q_2	-	$(q_0,0,R)$	-
q_f	-	-	-

Deduce what *M* does on any input of 0's and 1's. Hint: consider what happens when *M* is started in state q_0 at the left end of a sequence of any number of 0's (including zero of them) and a 1. Demonstrate your understanding by identifying the true transition of *M* from the list below.

a) $q_0$0011 |-* 1101Bq_f

b) $q_0$0101 |-* 0100Bq_f

c) $q_0$0101 |-* 1110Bq_f

d) $q_0$1100 |-* 0011Bq_f

Answer submitted: **d)**

You have answered the question correctly.

11. A *unit pair* (X,Y) for a context-free grammar is a pair where:

1. X and Y are variables (nonterminals) of the grammar.
2. There is a derivation X =>* Y that uses only unit productions (productions with a body that consists of exactly one occurrence of some variable, and nothing else).

For the following grammar:

```
S → A | B | 2
A → C0 | D
B → C1 | E
C → D | E | 3
D → E0 | S
E → D1 | S
```

Identify all the unit pairs. Then, select from the list below the pair that is NOT a unit pair.

a) (A,A)

b) (E,D)

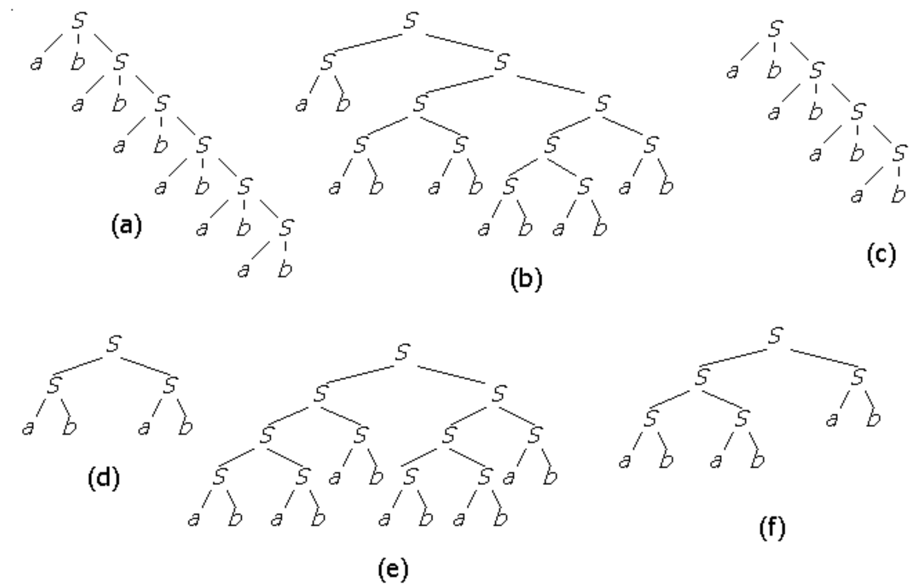
c) (C,D)

d) (E,C)

Answer submitted: **d)**

You have answered the question correctly.

12. Which of the following is a parse tree for the grammar S → abS, S → ab?



a) (a)

b) (f)

c) (e)

d) (b)

Answer submitted: **a)**

You have answered the question correctly.

13. Consider the following languages and grammars. G_1: $S \rightarrow aA|aS$, $A \rightarrow ab$
G_2: $S \rightarrow abS|aA$, $A \rightarrow a$
G_3: $S \rightarrow Sa|AB$, $A \rightarrow aA|a$, $B \rightarrow b$
G_4: $S \rightarrow aS|b$
L_1: $\{a^ib|\ i=1,2,...\}$
L_2: $\{(ab)^iaa|\ i=0,1,...\}$
L_3: $\{a^ib|\ i=2,3,...\}$
L_4: $\{a^iba^j|\ i=1,2,...,\ j=0,1,...\}$
L_5: $\{a^ib|\ i=0,1,...\}$

Match each grammar with the language it defines. Then, identify a correct match from the list below.

a) G_1 defines L_4.

b) G_1 defines L_5.

c) G_2 defines L_2.

d) G_4 defines L_2.

Answer submitted: **c)**

You have answered the question correctly.

14. Here is an instance of the Modified Post's Correspondence Problem:

	List A	List B
1	01	010
2	11	110
3	0	01

If we apply the reduction of MPCP to PCP described in Section 9.4.2 (p. 404), which of the following would be a pair in the resulting PCP instance.

a) ($, $*)

b) (*0*1, 0*1*0*)

c) (1*1, *1*1*0)

d) (*0*1*, *0*1*0)

Answer submitted: **d)**

You have answered the question correctly.

15. Here are the transitions of a determininstic pushdown automaton. The start state is q_0, and *f* is the accepting state.

State-Symbol	a	b	ε
q_0-Z_0	(q_1,AAZ_0)	(q_2,BZ_0)	(f,ε)
q_1-A	(q_1,AAA)	(q_1,ε)	-
q_1-Z_0	-	-	(q_0,Z_0)
q_2-B	(q_3,ε)	(q_2,BB)	-
q_2-Z_0	-	-	(q_0,Z_0)
q_3-B	-	-	(q_2,ε)
q_3-Z_0	-	-	(q_1,AZ_0)

Describe informally what this PDA does. Then, identify below the one input string that the PDA accepts.

a) bababba

b) abbbabb

c) abbbab

d) babbaba

Answer submitted: **c)**

You have answered the question correctly.

16. The grammar G:

S → SS | a | b

is ambiguous. That means at least some of the strings in its language have more than one leftmost derivation. However, it may be that some strings in the language have only one derivation. Identify from the list below a string that has exactly TWO leftmost derivations in G.

a) ba

b) bbb

c) a

d) abab

Answer submitted: **b)**

You have answered the question correctly.

17. Which of the following pairs of grammars define the same language?

a) G_1: S → AB|a, A → b
G_2: S → a|b

b) G_1: S → AB|a, A → b
G_2: S → a

c) G_1: S → AB, A → aAA|ε , B → baBB|ε
G_2: S → CB|B|ε , C → aCC|aC|a, B → baBB|baB|ba

d) G_1: S → SaBaS|aca, B → ScS|ε
G_2: S → SaAaS|ε, A → cS

Answer submitted: **b)**

You have answered the question correctly.

18. Here are seven regular expressions:

1. (0*+10*)*
2. (0+10)*
3. (0*+10)*
4. (0*+1*)*
5. (0+1)*
6. (0+1*0)*
7. (0+1*)*

Determine the language of each of these expressions. Then, find in the list below a pair of equivalent expressions.

a) (0+1*0)* and (0+1*)*
b) (0+10)* and (0*+1*)*
c) (0+1)* and (0+10)*
d) (0+10)* and (0*+10)*

Answer submitted: **d)**

You have answered the question correctly.

19. Consider the languages.
(a) $\{0^{2n}1^n \mid n > 0\}$
(b) $\{0^{5n}1^n \mid n > 0\}$
(c) {w | w a string of 0's and 1's such that when interpreted in reverse as a binary integer it is a multiple of 5}
(d) $\{0^n1^n|n>0\}$
(e) {w | w a string of 0's and 1's such that its length is a perfect square}
(f) {w | w string of 0's and 1's such that when interpreted as a binary integer it is not a multiple of 5}
(g) {w | w a string of 0's and 1's such that its length is not a perfect cube}
(h) {w | w a string of 0's and 1's such that the number of 0's is not equal to twice the number of 1's}

Which is a regular language?

a) (h)
b) (e)
c) (b)
d) (f)

Answer submitted: **d)**

You have answered the question correctly.

20. Consider the grammar G with start symbol S:

S → bS | aA | b
A → bA | aB
B → bB | aS | a

Which of the following is a word in L(G)?

a) ababbbbbbb
b) ababbbbbbbbbbb
c) ababba
d) ababbbb

Answer submitted: **c)**

You have answered the question correctly.

21. Let L be the language of all strings of a's and b's such that no prefix (proper or not) has more b's than a's. Let G be the grammar with productions

```
S → aS | aSbS | ε
```

To prove that L = L(G), we need to show two things:

1. If S =>* w, then w is in L.
2. If w is in L, then S =>* w.

We shall consider only the proof of (1) here. The proof is an induction on n, the number of steps in the derivation S =>* w. Here is an outline of the proof, with reasons omitted. You need to supply the reasons.

	Basis:
1)	If n=1, then w is ε because _______.
2)	w is in L because _______.
	Induction:
3)	Either (a) S => aS $=>^{n-1}$ w or (b) S => aSbS $=>^{n-1}$ w because _______.
4a)	In case (a), w = ax, and S $=>^{n-1}$ x because _______.
5a)	In case (a), x is in L because _______.
6a)	In case (a), w is in L because _______.
4b)	In case (b), w can be written w = aybz, where S $=>^{p}$ y and S $=>^{q}$ z for some p and q less than n because _______.
5b)	In case (b), y is in L because _______.
6b)	In case (b), z is in L because _______.
7b)	In case (b), w is in L because _______.

Some of the steps above have one of the following reasons:

I) "The following two statements are true:
(i) if string x has no prefix with more b's than a's, then neither does string ax,
(ii) if strings y and z are such that no prefix has more b's than a's, then neither does string aybz."

II) "All n-step derivations of w produce either ε (for n=1) or use one of the productions with at least one nonterminal in the body (for n > 1). In case the production S → aS is used, then w=ax with x being produced by a (n-1)-step derivation. In case the production S → aSbS is used then w=aybz with y and z being produced by derivations with number of steps less than n."

III) "by the inductive hypothesis"

Choose as correct a (STEP, REASON) pair. (I.e., a correct pair means that step STEP is true because of reason REASON.)

a) (2,III)

b) (6b,I)

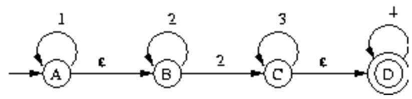
c) (7b,I)

d) (4a,III)

Answer submitted: **c)**

You have answered the question correctly.

22. Here is a nondeterministic finite automaton with epsilon-transitions:



Suppose we use the extended subset construction from Section 2.5.5 (p. 77) to convert this epsilon-NFA to a deterministic finite automaton with a dead state, with all transitions defined, and with no state that is inaccessible from the start state. Which of the following would be a transition of the DFA?

Note: we use S-x->T to say that the DFA has a transition on input x from state S to state T.

a) {A,B,C}-3->{C,D}

b) {D}-3->{}

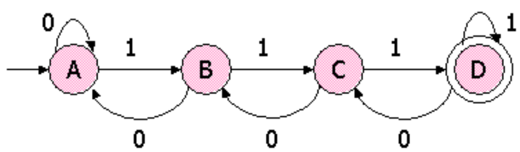
c) {B,C,D}-3->{C}

d) {C,D}-ε->{D}

Answer submitted: **b)**

You have answered the question correctly.

23. Converting a DFA such as the following:



to a regular expression requires us to develop regular expressions for limited sets of paths --- those that take the automaton from one particular state to another particular state, without passing through some set of states. For the automaton above, determine the languages for the following limitations:

1. L_{AA} = the set of path labels that go from A to A without passing through C or D.
2. L_{AB} = the set of path labels that go from A to B without passing through C or D.
3. L_{BA} = the set of path labels that go from B to A without passing through C or D.
4. L_{BB} = the set of path labels that go from B to B without passing through C or D.

Then, identify a correct regular expression from the list below. Note: there are several different regular expressions possible for each of these languages. However, each of the correct answers can be thought of as built from more limited components. For example, the regular expression **1** is the set of path labels that go from A to B without passing through any of the four states.

a) L_{AA} = (0*10)*

b) L_{BA} = 0(00*10)*

c) L_{AB} = 0*1(01+10)*

d) L_{AA} = (0+10)*

Answer submitted: **d)**

You have answered the question correctly.

24. G_1 is a context-free grammar with start symbol S_1, and no other nonterminals whose name begins with "S." Similarly, G_2 is a context-free grammar with start symbol S_2, and no other nonterminals whose name begins with "S." S_1 and S_2 appear on the right side of no productions. Also, no nonterminal appears in both G_1 and G_2.

We wish to combine the symbols and productions of G_1 and G_2 to form a new grammar G, whose language is the concatenation of the languages of G_1 and G_2. The start symbol of G will be S. All productions and symbols of G_1 and G_2 will be symbols and productions of G. Which of the following sets of productions, added to those of G, is guaranteed to make L(G) be $L(G_1)L(G_2)$?

a) $S \rightarrow S_1S_3$, $S_3 \rightarrow S_1S_2$

b) $S \rightarrow S_1.S_2$

c) $S \rightarrow S_1S_2 \mid \varepsilon$

d) $S \rightarrow S_1S_3$, $S_3 \rightarrow S_4S_2$, $S_4 \rightarrow \varepsilon$

Answer submitted: **d)**

You have answered the question correctly.

25. Let *h* be the homomorphism defined by h(a) = 01, h(b) = 10, h(c) = 0, and h(d) = 1. If we take any string *w* in (0+1)*, $h^{-1}(w)$ contains some number of strings, N(w). For example, $h^{-1}(1100)$ = {ddcc, dbc}, i.e., N(1100) = 2. We can calculate the number of strings in $h^{-1}(w)$ by a recursion on the length of *w*. For example, if w = 00x for some string x, then N(w) = N(0x), since the first 0 in w can only be produced from *c*, not from *a*.

Complete the reasoning necessary to compute N(w) for any string *w* in (0+1)*. Then, choose the correct value of N(01100110).

a) 34

b) 8

c) 128

d) 16

Answer submitted: **d)**

You have answered the question correctly.