FINAL EXAM

CS372 FORMAL LANGUAGES & THE THEORY OF COMPUTATION

Student ID: .....

Name:.....

PART 1 (Close book -60 minutes)

A. Yes/No questions (10 points total)

Decide for each statement whether it is True or False. Write T to the answer sheet if the statement is necessarily true; write F if it it is not necessarily true.

1. The set of all lanuguages over a finite alphabet Σ is uncountable.
2. Grammar G = < { a, b }, { S,T }, S, P >, with P = { S →S | T, T→ ε } is ambiguous
3. Let Σ = {a, b, c, d} and L = $\{a^i b^j c^k d^l \mid i+k = j+l\}$. L is not regular .
4. x^+ and x^+x^{*+} represent the same language.
5. Power of deterministic automata is equivalent to power of non-deterministic automata.
6. If a regular language is infinite, then every state diagram of DFA that recognizes it contains cycles
7. If a language L is context-free then L is generated by a context free grammar in CNF.
8. The difference between the PCP problem and the MPCP problem is that a solution of the MPCP problem must begin with the first pattern.
9. The language A_{TM} = (M, w) where M accept w is TM decidable.
10. NP ≠ P.

ANSWER SHEET

QUESTION	ANSWER
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

B.Multiple choice questions (30 points total)

Read the questions carefully and check one option

Question 1: If language L={0,1}*, then the reversed language L^R =

A. A.{0,1}* B.{ε}

C.{0}* D.{1}*

Question 2: Number of substrings in of acbab is

A. 11 B. 12 C. 13 D.None of these

Question 3: Two finite state machines are said to be equivalent if they:

A. Have the same number of edges
B. Have the same number of states
C. Recognize the same set of tokens
D. Have the same number of states and edges

Question 4: While applying Pumping lemma over a regular language, we consider a string w that belong to L and fragment it into _____ parts.

A. 2 B. 5 C. 3 D. 6

Question 5: Consider the following languages:

L_1 = {a^(n+m) b^n a^m | n,m ≥ 0}

L_2 = {a^(n+m) b^(n+m) a^(n+m) | n,m ≥ 0}

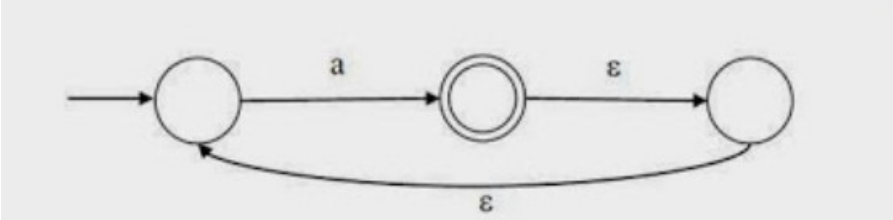
Which of the following is correct?

A. Only L_1 is context-free language
B. Only L_2 is context-free language
C. Both L_1 and L_2 are context free languages
D. Both L_1 and L_2 are not context free languagesx

Question 6: Regular expression x(x+y) denotes the set

A. {xx, xy}
B. {x, y, xx, xy}
C. {x,y}
D. {x,y,xy}

Question 7: Which of the following languages is the complement of language L recognizable by the following NFA (L is a language over Σ ={a}):



A) ε
B) $\{a^n \mid n \geq 0\}$
C) ∅
D) $\{a\} \cup \{\varepsilon\}$

Question 8: Which of the following regular expressions denotes a finite language?

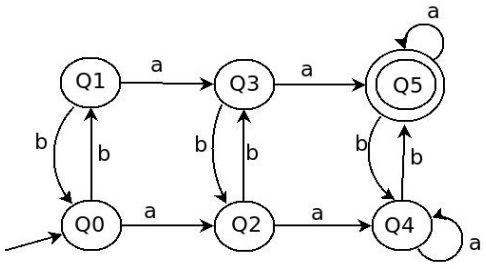
A. (bb + aba + bba)*
B. (aaa + bbb)*
C. ((a + b)(a + b)(a + b))*
D. (aaa + ab + a) + (bbb + bb + a) + ε*

Question 9: Which of the following instances of PCP does not have a match?

A. [a, aa], [bb, b], [a, bb]
B. [a, aaa], [aab, b], [abaa, ab]
C. [b, ba], [aa, b], [bab, aa], [ab, ba]
D. [aa, aab], [bb,ba][abb,b]

Question 10 :

Which of the following strings is accepted by DFA M below?



A. abbaaab
B. aaabba
C. bbaabaa
D. baabbbb

Question 11: Parentheses consist of opening and closing parentheses (,),{,},[,] and an expression has balanced parentheses if:

- Expression between a matching opening and closing parentheses is a balanced parentheses.
- There is no unmatched parentheses that is for every opening bracket, there is a closing bracket and vice versa

Which of the following grammars generates the language of all balanced parenthesis expressions?

A. S → (S) | () | [S] | [] |{S}|{}
B. S → (S | S) | [S | S] |{S | S}| (|) | [|] |{ | }

C. $S \rightarrow SS \mid (S) \mid \{S\} \mid [S] \mid \varepsilon$

D. None of these

Question12: Given a context free grammar with set of variables{S,A,B}, set of terminal symbols {a,b}, and set of production rules: {S → AB, A → AB | a, B → BA | b}. Which of the following derivations does not derive string abab?

A. S ⇒ AB ⇒ Ab ⇒ ABb ⇒ ABAb ⇒ AbAb ⇒ Abab ⇒ abab

B. S ⇒ AB ⇒ ABB ⇒ ABAB ⇒ aBaB ⇒ abab

C. S ⇒ AB ⇒ ABA ⇒ ABAB ⇒ ABAb ⇒ AbAb ⇒ Abab ⇒ abab

D. S ⇒ AB ⇒ aB ⇒ aBA ⇒ abA ⇒ abAB ⇒ abaB ⇒ abab

Question 13: The problem that is decidable is

A. Emptiness problem for TM's

B. Membership problem for CFG's

C. Equivalence problem for TMs

D. Acceptance problem for TM's

Question 14: The worst-case efficiency of solving the searching problem (with an unsorted list L[n] and key k) is? Here p represents a polynomial function.

A. O(p(n))

B. O(p(n log n))

C. $O(p(n^2))$

D. O(p(m log n))

Question 15: The language described by the regular expression 0*00(0+1)* over the alphabet {0 1} is the set of

A. all strings beginning with at least two 0's

B. all strings ending with at least two 0's

C. All strings that begin and end with either 0's or 1's

D. All strings containing the substring 00

Question 16: If $L_1 = \{a^n \mid n \geq 0\}$, $L_2 = \{a^n b^m \mid n \geq 0, m \geq 1\}$ then $L_1 \cup L_2$ is:

A. $\{a^n b^m \mid n \geq 0, m \geq 1\}$ B. $\{a^n b^m \mid n \geq 0, m \geq 0\}$

C. $\{a^n b^m \mid n \geq 1, m \geq 0\}$ D, $\{a^n b^m \mid n \geq 1, m \geq 1\}$

Question 17: Which of the following statements is false?

A. A context sensitive language is also a regular language

B. A context free language is also a context sensitive language

C. A context free language is also recursive enumerable language

D. A regular languageis also a context free language

Question 18: Which of the following problems is NP complete?

A. Emptiness of a regular languag

B. Halting Problem

C. Satisfiability

D. Modified Post's Correspondence Problem

Question 19: We have decision problems P_1 and P_2 as described below:

P_1: Does a given Turing machine accept a given string?

P_2: Does a given context-free grammar generate an infinite number of strings?

The statement that holds true for P_1 and P_2 is

A. Only P_2 is decidable

B. Only P_1 is decidable

C. Neither P_1 nor P_2 are decidable

D. Both P_1 and P_2 are decidable

Question 20: _____ is the class of decision problems that can be solved by non-deterministic polynomial algorithms?

A. NP

B. Non P

C. NP Hard

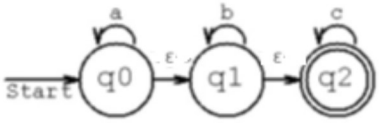
D. Complete

ANSWER SHEET

QUESTION	ANSWER	QUESTION	ANSWER
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

PART I1 (Open book – 60 minutes)

1/(15 points) Give a DFA that accepts the language accepted by the following NFA:

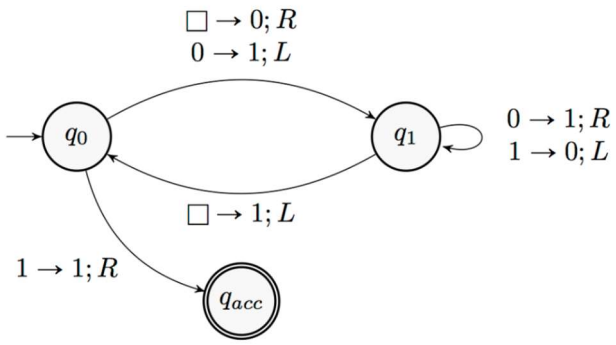


2/(5 points)Prove that the following instance of PCP does not have a match: [0, 111], [10111, 101], [10, 01], [01, 11]

3/(15 points) Convert the following grammar to equivalent grammar in Chomsky normal form:

S → aXbX, X → aY | bY | c, Y → aXa | c

5/ (10 points) Given the encoding of the following Turing machine, here □ represents blank symbol.



5/ (15 points) Consider the following Push down automaton M. Give the sequence of configurations that M accepts input strings abcc