CSE322 - Formal Languages And Automation Theory

150+ MCQ Questions from All Units

For More MCQs

https://github.com/sauravhathi

Q1. A Turing Machine is an accepting device which accepts the languages __________.

(a) recursively enumerable set

(b) recursively set

(c) enumerable set

(d) none of the above

Q2. Let L={w∈(0+1)∗|w has even number of 1's}, i.e. L is the set of all bit strings with even number of 1's. Which one of the regular expression below represents L?

(a) (0∗10∗1)∗

(b) 0∗(10∗10∗)∗

(c) 0∗(10∗1∗)∗0∗

(d) 0∗1(10∗1)∗10∗

Ans: b

Q3. Which of the following problems are decidable?

(a) Does a given program ever produce an output?

(b) If L is a context-free language, then, is L also context-free?

(c) If L is a regular language, then, is L also regular?

(d) If L is a recursive language, then, is L also recursive?

Ans: c,d

Explanation: CFL's are not closed under complementation. Regular and recursive languages are closed under complementation.

Q4. Which of the following are decidable?

(a) Whether the intersection of two regular languages is infinite

(b) Whether a given context-free language is regular

(c) Whether two push-down automata accept the same language

(d) Whether a given grammar is context-free

Ans: a,d

Q5. Which of the following statements is false?

(a) The halting problem for Turing machine is un-decidable

(b) Determining whether ambiguity a context free grammar is un-decidable

(c) Given two arbitrary context free grammars G1 and G2 whether L(G1)=L(G2)

(d) Given two regular grammars G1 and G2, it is un-decidable whether L(G1)=L(G2)

Ans: d

Explanation:

Case (a):

The Halting Problem for TM is un-decidable problem. By un-decidable means no algorithm exist for it.

Case (b):

Ambiguity in a CFG is undecidable. No algorithm can decide if a CFG is ambiguous. By ambiguous means the CFG has two or more derivations for some sentence.

https://github.com/sauravhathi

Case (c):

The equivalance problem of CFG's is undecideable. We have no algorithm to decide if two CFG's generate the same language.

Case (d):

The regular sets are a well behaved class of languages. Practically everything about Regular Language is decidable.

Q6. Which one of the following problems is un-decidable?

(a) Deciding if a given context-free grammar is ambiguous.

(b) Deciding if a given string is generated by a given context-free grammar.

(c) Deciding if the language generated by a given context-free grammar is empty.

(d) Deciding if the language generated by a given context-free grammar is finite.

Ans: a

Q7. Which one of the following is the strongest correct statement about a finite language over some finite alphabet ∑?

(a) It could be un-decidable

(b) It is Turing-machine recognizable

(c) It is a regular language

(d) It is a context-sensitive language

Ans: c

Q8. It is decidable whether:

(a) An arbitrary Turing machine halts after 10 steps.

https://github.com/sauravhathi

(b) A Turing machine prints a specific letter.

(c) A Turing machine computes the product of two numbers.

(D) None of the above.

Ans: a,c

Explanation:

Case (a):

Just run the TM for 10 steps and see it halts or not. So this is decideable.

Case (b):

The printing problem of TMs is Undecidable. This can be reduce to the halting problem when the TM halts let it print something.

Case (c):

Multiplication, Addition can be done by TM so this is decidable.

Q9. Which of the following problems are un-decidable?

(a) Membership problem in context - free languages.

(b) Whether a given context - free language is regular.

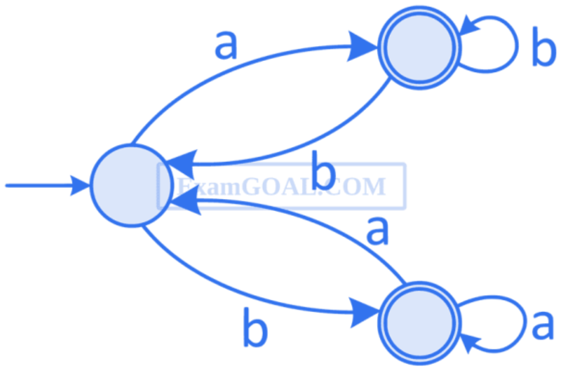
(c) Whether a finite state automation halts on all inputs.

(d) Membership problem for type 0 languages.

Ans: b,d

Q10. Which one of the following regular expressions correctly represents the language of the finite automation given below?

https://github.com/sauravhathi



(a) ab*bab* + ba*aba*

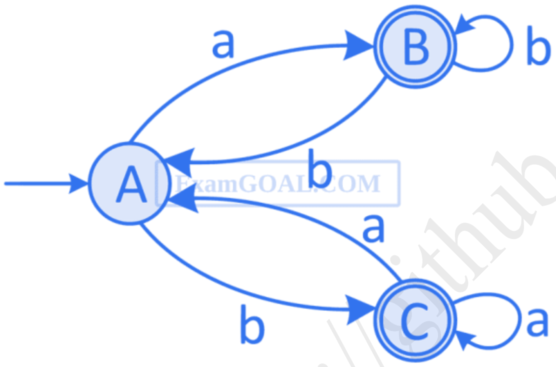
(b) (ab*b)* ab* + (ba*a)*ba*

(c) (ab*b + ba*a)* (a* + b*)

(d) (ba*a + ab*b)* (ab* + ba*)

Ans: d

Explanation:



Resolving the loops on A and solving A completely,

We get, rA = (ba*a + ab*b)*

Now, r = rB + rC = rA(ab* + ba*)

= (ba*a + ab*b)* (ab* + ba*)

Which is choice (d).

Q11. Which one of the following regular expressions represents the set of all binary strings with an odd number of 1's?

(a) 10*(0*10*10*)*

(b) ((0 + 1)*1(0 + 1)*1)*10*

https://github.com/sauravhathi

(c) (0*10*10*)*10*

(d) (0*10*10*)*0*1

Ans: c

Q12. Consider the following statements.

I. If L1 ∪ L2 is regular, then both L1 and L2 must be regular.

II. The class of regular languages is closed under infinite union.

Which of the above statements is/are TRUE?

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

Ans: d

Q13. For Σ = {a, b}, let us consider the regular language L = {x | x = a^2+3k or x = b^10+12k, k ≥ 0}. Which one of the following can be a pumping length (the constant guaranteed by the pumping lemma) for L?

(a) 9

(b) 5

(c) 24

(d) 3

Ans: c

Explanation: According to the Pumping Lemma for Regular Languages, every string w present in the infinite regular language L should be divide into three parts w = xyz, where

https://github.com/sauravhathi

(i) $y \neq \varepsilon$

(ii) $|xy| \leq n$, where n is some positive integer and $|w| \geq n$

(iii) for every $i \geq 0$, the string xy^iz is also in L.

From the question,

when x = b10+12k

then minimum possible string is = b10 or 'bbbbbbbbbb'.

we cannot divide this into three parts x, y, z.

So pumping length should must be more than 10 so that we can divide any string into three parts.

Q14. If L is a regular language over Σ = {a,b}, which one of the following languages is NOT regular?

(a) Suffix (L) = {y ∈ Σ* such that xy ∈ L}

(b) {wwR │w ∈ L}

(c) Prefix (L) = {x ∈ Σ*│∃y ∈ Σ* such that xy ∈ L}

(d) L · LR = {xy │ x ∈ L, yR ∈ L}

Ans: b

Q15. Language L1 is defined by the grammar: S1→aS1b|ε

Language L2 is defined by the grammar: S2→abS2|ε

Consider the following statements:

P: L1 is regular

Q: L2 is regular

Which one of the following is TRUE?

https://github.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

(a) Both P and Q are true

(b) P is true and Q is false

(c) P is false and Q is true

(d) Both P and Q are false

Ans: c

Q16. The number of states in the minimum sized DFA that accepts the language defined by the regular expression

$(0+1)*(0+1)(0+1)*$ is ___________________.

(a) 2

(b) 3

(c) 4

(d) 5

Ans: a

Q17. Which one of the following regular expressions represents the language: the set of all binary strings having two consecutive 0s and two consecutive 1s?

(a) $(0+1)*0011(0+1)*+(0+1)*1100(0+1)*$

(b) $(0+1)*(00(0+1)*11+11(0+1)*00)(0+1)*$

(c) $(0+1)*00(0+1)*+(0+1)*11(0+1)*$

(d) $00(0+1)*11+11(0+1)*00$

Ans: b

https://github.com/sauravhathi

Q18. Let L be the language represented by the regular expression ∑∗0011∑∗ where ∑={0,1}. What is the minimum number of states in a DFA that recognizes L— (complement of L)?

(a) 4

(b) 5

(c) 6

(d) 8

Ans: b

Q19. The length of the shortest string NOT in the language (over ∑={a,b}) of the following regular expression is ____________.

a∗b∗(ba)∗a∗

(a) 1

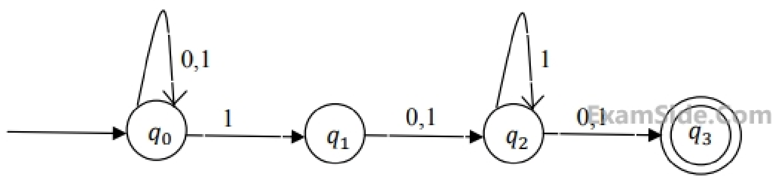
(b) 2

(c) 3

(d) 4

Ans: c

Q20. Consider the finite automation in the following figure.



What is the set of reachable states for the input string 0011?

(a) {q0,q1,q2}

(b) {q0,q1}

https://github.com/sauravhathi

(c) {q0,q1,q2,q3}

(d) {q3}

Ans: a

Q21. If L1={a^n|n≥0} and L2={b^n|n≥0}, consider

I) L1·L2 is a regular language

II) L1·L2={a^nb^n|n≥0}

Which one of the following is CORRECT?

(a) Only (I)

(b) Only (II)

(c) Both (I) and (II)

(d) Neither (I) nor (II)

Ans: a

Q22. Which one of the following is TRUE?

(a) The language L={anbn|n≥0} is regular.

(b) The language L={an|n is prime} is regular.

(c) The language L={w|w has 3k+1 b′ s for some k∈N with ∑={a,b}} is regular.

(d) The language L={ww|w∈∑∗ with ∑={0,1}} is regular.

Ans: c

Q23. Consider the languages L1=ϕ and L2={a}. Which one of the following represents L1L2∗UL1∗?

https://github.com/sauravhathi

(a) {ε}

(b) ϕ

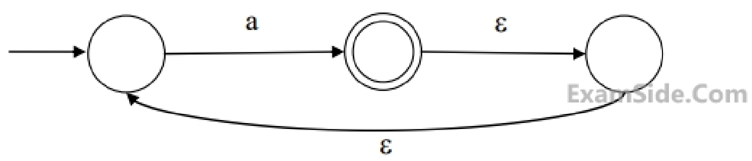
(c) a∗

(d) {ε,a}

Ans: a

Q24. What is the complement of the language accepted by the NFA shown below?

Assume ∑={a} and ε is the empty string.



(a) ϕ

(b) {ε}

(c) a∗

(d) {a,ε}

Ans: b

Q25. Let L1 recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statement is not necessarily true?

(a) L2 − L1 is recursively enumerable.

(b) L1 − L3 recursively enumerable.

(c) L2∩L1 is recursively enumerable.

(d) L2∪L1 is recursively enumerable.

Ans: b

https://github.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

Q26. Which one of the following languages over the alphabet {0,1) is described by the regular expression (0+1)∗0(0+1)∗0(0+1)∗

(a) The set of all strings containing the substring 00

(b) The set of all strings containing at most two 0′s

(c) The set of all strings containing at least two 0′s

(d) The set of all strings that begin and end with either 0 or 1

Ans: c

Q27. Consider the set ∑∗ of all strings over the alphabet ∑={0,1}.∑∗ with the concatenation operator for strings

(a) Does not from a group

(b) Forms a non-commutative group

(c) Does not have a right identity element

(d) Forms a group if the empty string is removed from

Ans: a

Q28. The regular expression 0∗(10∗)∗denotes the same set as

(a) (1∗0)∗1∗

(b) 0+(0+10)∗

(c) (0+1)∗10(0+1)∗

(d) None of the above.

Ans: d

Q29. Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least

https://github.com/sauravhathi

(a) N^2

(b) 2^N

(c) 2N

(d) N!

Ans: b

Q30. Consider the following two statements;

S1:{0^2n|n≥1} is a regular language

S2:{0^m1^n0^m+n|m≥1andn≥1} is a regular language

Which of the following statements is correct?

(a) Only S1 is correct

(b) Only S2 is correct

(c) Both S1 and S2 are correct

(d) None of S1 and S2 is correct

Ans: a

Q31. Let L denote the language generated by the grammar S→0S0|00. Which one of the following is true?

(a) L=0+

(b) L is regular but not 0+

(c) L is context free but not regular

(d) L is not context free

https://github.com/sauravhathi

Ans: c

Q32. Let S and T be languages over ∑={a,b} represented by the regular expressions (a+b∗)∗ and (a+b)∗, respectively. Which of the following is true?

(a) S⊂T

(b) T⊂S

(c) S=T

(d) S∩T=ϕ

Ans: c

Q33. Consider the regular expression (0+1)(0+1).......n times. The minimum state finite automation that recognizes the language represented by this regular expression contains:

(a) n states

(b) n+1 states

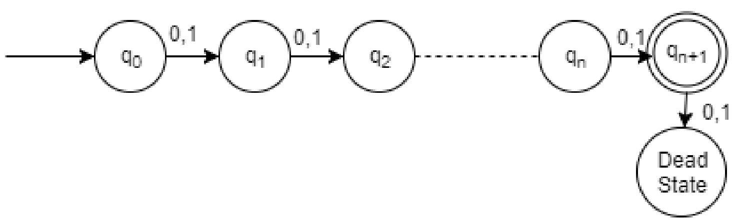
(c) n+2 states

(d) None of the above

Ans: c

Explanation:

(0 + 1)(0 + 1)......................n times = $(0 + 1)^n$



Minimal FA requires n +1 states to accept a string of length n and one state for the dead state.So total n + 2 states are required.

https://github.com/sauravhathi

Q34. How many substrings of different lengths (non-zero) can be formed from a character string of length n ?

(a) n

(b) n2

(c) 2n

(d) n(n+1)/2

Ans: d

Explanation:

Example:

Let w = GAT be a string then |w|= 3

The substrings possible are = { ε,G,A,T,GA,AT,GAT}

So,the substring of length 0 = 1 { the string is = ε }

the substring of length 1 = 3 { the strings are = G,A,T }

the substring of length 2 = 2 { the strings are = GA,AT }

the substring of length 3 = 1 { the strings are = GAT }

So total substrings for string length 3 are = (1 + 2 + 3) + 1

Similarly total substrings for string length n are = (1 + 2 + 3 + ... n times) + 1 = (n(n+1)/2) + 1

Here substrings of length 0 is excluded.

So total substrings are = (n(n+1)/2).

https://github.com/sauravhathi

Q35. Which of the following sets can be recognized by a Deterministic Finite-state Automation?

(a) The numbers 1,2,4,8, ... 2n, ... written in binary.

(b) The numbers 1,2,4,..... 2n, ... written in unary.

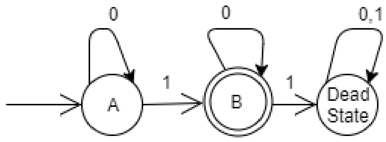
(c) The set of binary strings in which the numbers of zeros is the same as the numbers of ones.

(d) The set {1,101,11011,1110111,...}.

Ans: a

Explanation:

Option A



This is the DFA for { 1,2,4......2^n .....} which is written in binary

1 = 1
2 = 10
4 = 100
} In Binary

Option B

In Unary System

1 = 1
2 =11
4 = 1111

As here no of 1 is not in A.P then we can not create any DFA for that.

NOTE: When all the charecters in a strings is same for all the strings in a language then to create a DFA for that language the size of each string should be in A.P.

Option C

Here we need to count no of zero and then compare it with the no of 1.For that we need a memory to store those 0 and 1.But in DFA such memory is not present so we can't compare.

Option D

In this set { 1 , 101 ,11011,1110111,................} the no of 1's before 0 and after 0 should be the same but in DFA there is no such memory to remember those 1 before 0 so that we can compare with the 1 after 0.

Q36. The string 1101 does not belong to the set represented by

(a) 110∗(0+1)

(b) 1(0+1)∗101

(c) (10)∗(01)∗(00+11)∗

(d) (00+(11)∗0)∗

Ans: c,d

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

Q37. If the regular set A is represented by A=(01+1)∗ and the regular set ′B′ is represented by B=((01)∗1∗), which of the following is true?

(a) A⊂B

(b) B⊂A

(c) A and B are incomparable

(d) A=B

Ans: d

Explanation:

$$\left[(01)^{*}\,1^{*}\right]^{*} = \left((01)^{*} + 1^{*}\right)^{*} = \left[01 + 1\right]^{*}$$

$$By\ u\sin g\ the\ rule\ \ (a^{*}b^{*})^{*} = (a^{*} + b^{*})^{*} = (a + b)^{*}$$

Q38. ∑={a,b}, which one of the following sets is not countable.

(a) Set of all strings over ∑

(b) Set of all languages over ∑

(c) Set of all regular languages over ∑

(d) Set of all languages over ∑ accepted by Turing Machines.

Ans: b

Explanation:

Only option B is correct as set of all languages are uncountable.

Remember: As set of all Turing Machine are countable.So we can say that

(1) Set of all Recursively Enumerable Language are countable.

(2) Set of all Recursively Language are countable.

(3) Set of all Context-Sensitive Language are countable.

(4) Set of all Context Free Language are countable.

https://github.com/sauravhathi

(5) Set of all Regular Language are countable.

Q39. Let L⊆∑∗ where ∑={a,b} which of the following is true?

(a) L={x|x has an equal number of a′s and b′s} is regular

(b) L={a^nb^n|n≥1} is regular

(c) L={x|x has more a′s than b′s} is regular

(d) L={a^mb^n|m≥1,n≥1} is regular

Ans: d

Q40. Which two of the following four regular expressions are equivalent?

(i) (00)∗(ε+0)

(ii) (00)∗

(iii) 0∗

(iv) 0(00)∗

(a) (i) and (ii)

(b) (ii) and (iii)

(c) (i) and (iii)

(d) (iii) and (vi)

Ans: c

Explanation:

0*= { ε ,0,00,000,............}

(00)*(ε+0)= (00)* + (00)*0 = even + odd = 0*

So,0* = (00)*(ε+0)

Q41. State True or False with one line explanation:

https://github.com/sauravhathi

A FSM (Finite State Machine) can be designed to add two integers of any arbitrary length (arbitrary number of digits).

(a) TRUE

(b) FALSE

Ans: b

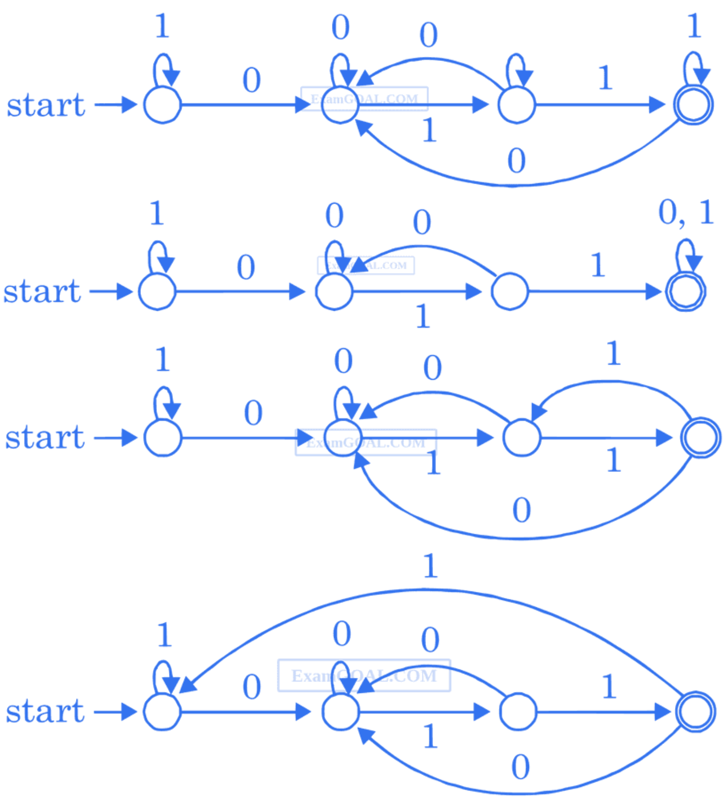
Explanation: As FSM has a finite memory then it can not store carry bit to add arbitary length strings.

.com/sauravhathi

Q42. Consider the following language.

L = { w ∈ {0, 1}* | w ends with the substring 011}

Which one of the following deterministic finite automata accepts L?



(a) figure 1

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University. We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

(b) figure 2

(c) figure 3

(d) figure 4

Ans: d

Q43. Consider the following language.

L = {x ∈ {a, b}* | number of a’s in x is divisible by 2 but not divisible by 3}

The minimum number of states in a DFA that accepts L is ______.

(a) 2

(b) 3

(c) 6

(d) 9

Ans: 6

Q44. Let N be an NFA with n states. Let k be the number of states of a minimal DFA which is equivalent to N. Which one of the following is necessarily true?

Which one of the following is necessarily true?

(a) k≥2n

(b) k≥n

(c) k≤n2

(d) k≤2n

Ans: d

https://github.com/sauravhathi

Q45. The number of states in the minimal deterministic finite automaton corresponding to the regular expression (0+1)∗(10) is ________________.

(a) 1

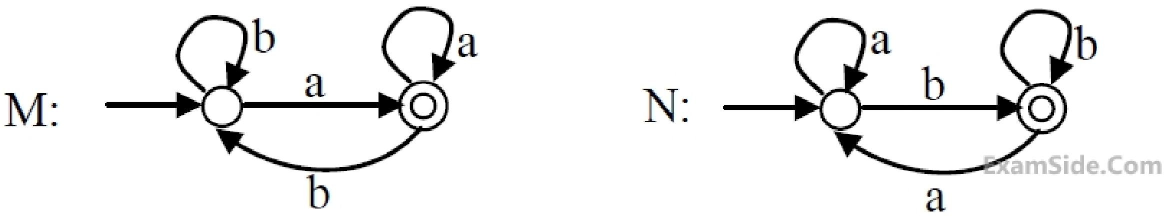
(b) 2

(c) 3

(d) 4

Ans: c

Q46. Consider the DFAs M and N given above. The number of states in a minimal DFA that accepts the language L(M) ∩ L(N) is___________.



(a) 2

(b) 1

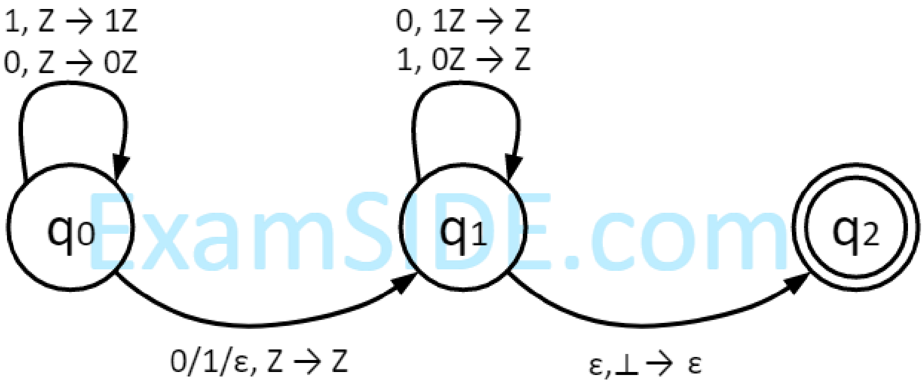
(c) 3

(d) 4

Ans: b

Q47. Consider the NPDA ⟨Q={q0,q1,q2}, Σ={0,1}, Γ={0,1,⊥}, δ,q0,⊥, F={q2}⟩ , where (as per usual convention) Q is the set of states, Σ is the input alphabet, Γ is the stack alphabet, δ is the state transition function q0 is the initial state, ⊥ is the initial stack symbol, and F is the set of accepting states. The state transition is as follows:

https://github.com/gauravhathi



Which one of the following sequences must follow the string 101100 so that the overall string is accepted by the automaton?

(a) 10110

(b) 10010

(c) 01010

(d) 01001

Ans: b

Q48. Let L1={w∈{0,1}∗|w has at least as many occurrences of (110)′s as (011)′s}. Let L2={w∈{0,1}∗|w has at least as many occurrences of (000)′s as (111)′s}. Which one of the following is TRUE?

(a) L1 is regular but not L2

(b) L2 is regular but not L1

(c) Both L1 and L2 are regular

(d) Neither L1 nor L2 are regular

Ans: a

Q49. Let L1={w∈{0,1}∗|w has at least as many occurrences of (110)′s as (011)′s}. Let L2={w∈{0,1}∗|w has at least as many occurrences of (000)′s as (111)′s}. Which one of the following is TRUE?

https://github.com/sauravhathi

(a) L1 is regular but not L2

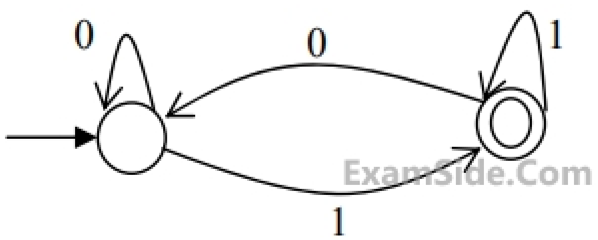
(b) L2 is regular but not L1

(c) Both L1 and L2 are regular

(d) Neither L1 nor L2 are regular

Ans: a

Q50. Which of the regular expression given below represent the following DFA?



(i) 0*1(1+00*1)*

(ii) 0*1*1+11*0*1

(iii) (0+1)∗*1

(a) I and II only

(b) I and III only

(c) II and III only

(d) I, II and III

Ans: b

Q51. Consider the following languages

L1={0p1q0r|p,q,r≥0}

L2={0p1q0r|p,q,r≥0,p≠r}

Which one of the following statements is FALSE?

(a) L2 is context-free

(b) L1∩L2 is context-free

(c) Complement of L2 is recursive

(d) Complement of L1 is context-free but not regular

Ans: d

Q52. Let L={w∈(0+1)∗|w has even number of 1′s}, i.e L is the set of all bit strings with even number of 1′s. which one of rhe regular expression below represents L.

(a) (0∗10∗1)∗

(b) 0∗(10∗10∗)∗

(c) 0∗(10∗1)∗0∗

(d) 0∗1(10∗1)∗10∗

Ans: b

Q53. The above DFA accepts the set of all strings over {0,1} that

(a) Begin either with 0 or 1

(b) End with 0

(c) End with 00.

(d) Contain the substring 00.

Ans: c

Q54. L=L1∩L2 where L1 and L2 are languages defined as follows.

https://github.com/sauravhathi

L1={ambmcanbn|m,n≥0}

L2={aibick|i,j,k≥0} Then L is

(a) Not recursive

(b) Regular

(c) Context free but not regular

(d) Recursively enumerable but not context free

Ans: d

Q55. Which of the following are regular sets?

I. $\{a^n b^{2m} \mid n \geq 0, m \geq 0\}$

II. $\{a^n b^m \mid n = 2m\}$

III. $\{a^n b^m \mid n \neq m\}$

IV. $\{xcy \mid x, y \in \{a,b\}^*\}$

(a) I & IV only

(b) I & III only

(c) I only

(d) IV only

Ans: c

Q56. Which of the following languages is regular?

(a) {ww^R|w∈{0,1}+}

(b) {ww^Rx|x,w∈{0,1}+}

https://github.com/sauravhathi

(c) {wxw^R|x,w∈{0,1}+}

(d) {xww^R|x,w∈{0,1}+}

Ans: c

Q57. Given that language L1 is regular and that the language L1∩L2 is regular is the language L2 is always regular?

(a) Yes

(b) No

Ans: a

Q58. Consider the following languages:

L1={ww|w∈{a,b}∗}

L2={a^nb^nc^m|m,n≥0}

L3={a^mb^nc^n|m,n≥0}

Which of the following statements is/are FALSE?

(a) L1 is not context-free but L2 and L2 are deterministic context-free.

(b) Neither L1 nor L2 is context-free.

(c) L2, L3 and L2 ∩ L3 all are context-free.

(d) Neither L1 nor its complement is context-free.

Ans: b,c,d

Explanation:

L1={ww|w∈{a,b}∗}

L2={anbncm|m,n≥0}

https://github.com/sauravhathi

L3={ambncn|m,n≥0}

L1 is not context free because it has string matching in straight order, which PDA cannot do.

L2 and L3 are clearly DCFL's, since they have only one comparison and DPDA can accept both.

(a) is therefore true.

(b) is false since L2 is DCFL and every DCFL is a CFL.

(c) is false because L2 ∩ L3 = {anbncn | n ≥ 0} is not a CFL.

(d) is false because complement of "ww" has CFG and is CFL.

Q59. Consider the following languages:

L1 = {a^nwa^n | w ∈ {a, b}*}

L2 = {wxw^R | w, x ∈ {a, b}*, | w | , | x | > 0}

Note that wR is the reversal of the string w. Which of the following is/are TRUE?

(a) L1 and L2 are regular.

(b) L1 and L2 are context-free

(c) L1 is regular and L2 is context-free.

(d) L1 and L2 are context-free but not regular.

Ans: a,b,c

Explanation:

L1 = {a^nwa^n | w ∈ {a, b}*}

L2 = {wxw^R | w, x ∈ {a, b}*, | w | , | x | > 0}

L1 is regular because by putting n = 0, we create a subset {w | w∈ {a, b}*} which contains all possible strings. So if subset of L1 is (a + b)*, then L1 = (a b)*.

https://github.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University. We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

L2 is regular because by putting w as "a" and "b" we get a regular expression a(a + b)+a + b(a + b)+b, which covers all other string which can be obtained by putting w as "a", "ab", "ba", "bb", etc.

So, L2 = a(a + b)+a + b(a + b)+b, which is regular.

So, L1 and L2 both are regular.

Now every regular is also context-free.

So, option (a), (b), (c) are all true and option (d) is false.

Q60. Consider the language

L = { a^n|n≥0 } ∪ { a^nb^n|n≥0 }

and the following statements.

I. L is deterministic context-free.

II. L is context-free but not deterministic context-free.

III. L is not LL(k) for any k.

Which of the above statements is/are TRUE?

(a) I only

(b) II only

(c) I and III only

(d) III only

Ans: c

Q61. Which of the following languages is generated by the given grammar?

S→aS|bS|ε

(a) {a^nb^m|n,m≥0}

https://github.com/sauravhathi

(b) $\{w \in \{a,b\}^* | w \text{ has equal number of } a's \text{ and } b's\}$

(c) $\{a^n | n \ge 0\} \cup \{b^n | n \ge 0\} \cup \{a^n b^n | n \ge 0\}$

(d) $\{a,b\}^*$

Ans: d

Q62. The lexical analysis for a modern computer language such as java needs the power of which one of the following machine model in a necessary and sufficient sense?

(a) Finite state automata

(b) Deterministic pushdown automata

(c) Non -deterministic pushdown automata

(d) Turing machine

Ans: a

Q63. $S \rightarrow aSa | bSb | a | b$

The language generated by the above grammar over the alphabet {a,b} is the set of

(a) All palindromes

(b) All odd length palindromes

(c) Strings that begin and with same symbol

(d) All even length palindromes

Ans: c

Q64. Which one of the following is FALSE?

(a) There is a unique minimal DFA for every regular language

(b) Every NFA can be converted to an equivalent PDA

https://github.com/sauravhathi

(c) Complement of every context free language is recursive

(d) Every non deterministic PDA can be converted to an equivalent deterministic PDA

Ans: b

Q65. Let L1={0^n+m1^n0^m|n,m≥0},

L2={0^n+m1^n+m0^m|n,m≥0}, and

L3={0^n+m1^n+m0^n+m|n,m≥0}, Which of these languages are NOT context free?

(a) L1 only

(b) L3 only

(c) L1 and L2

(d) L2 and L3

Ans: d

Q66. Which of the following grammar rules violate the requirements of an operator grammar? P, Q,R are non-terminals and r,s,t are terminals.

1)P→QR 2)P→QsR

3)P→c 4)P→QtRr

(a) (1) only

(b) (1) and (3) only

(c) (2) and (3) only

(d) (3) and (4) only

Ans: b

https://github.com/sauravhathi

Q67. The language accepted by a pushdown Automation in which the stack is limited to 10 items is best described as

(a) Context free

(b) Regular

(c) Deterministic Context Free

(d) Recursive

Ans: c

Q68. Which of the following statement is true?

(a) If a language is context free it can always be accepted by deterministic pushdown automation

(b) The union of two context free language is context free

(c) The intersection of two context free languages is context free

(d) The complement of a context free language is context free

Ans: b

Q69. Context free languages are closed under:

(a) Union, intersection

(b) Union, Kleene closure

(c) Intersection, complement

(d) Complement, Kleene Closure

Ans: b

Q70. Let LD be the set of all languages accepted by a PDA by final state and LE the set of all languages accepted by empty stack. Which of the following is true?

https://github.com/sauravhathi

(a) LD=LE

(b) LD⊃LE

(c) LD⊂LE

(d) None of the above

Ans: a

Q71. Consider the grammar with the following productions.

S→aαb|bαc|aB

S→αS|b

S→αbb|ab

Sα→bdb|b

the above grammar is

(a) Context free grammar

(b) Regular grammar

(c) Context sensitive grammar

(d) LR(k)

Ans: d

Q72. State whether the following statement is TRUE / FALSE. The problem is to whether a Turing Machine M accepts input w is un-decidable.

(a) TRUE

(b) FALSE

https://github.com/sauravhathi

Ans: b

Q73. State whether the following statement is TRUE / FALSE.

The intersection of two CFL′s is also CFL.

(a) TRUE

(b) FALSE

Ans: b

Q74. State whether the following statement is TRUE / FALSE.

A is recursive if both a and its complement are accepted by Turing Machine M accepts.

(a) TRUE

(b) FALSE

Ans: b

Q75. State whether the following statement is TRUE / FALSE.

Regularity is preserved under the operation of string reversal.

(a) TRUE

(b) FALSE

Ans: b

Q76. State whether the following statement is TRUE / FALSE.

A minimal DFA that is equivalent to an NFDA with n modes has always 2n states

(a) TRUE

https://github.com/sauravhathi

(b) FALSE

Ans: b

Q77. State whether the following statement is TRUE / FALSE.

All subjects of regular sets are regular.

(a) TRUE

(b) FALSE

Ans: b

Q78. Let ⟨M⟩ denote an encoding of an automation M. Suppose that $\sum = \{0, 1\}$. Which of the following languages is/are NOT recursive?

(a) L = { ⟨M⟩ | M is a PDA such that L(M) = $\sum^*$}

(b) L = { ⟨M⟩ | M is a DFA such that L(M) = Φ}

(c) L = { ⟨M⟩ | M is a PDA such that L(M) = Φ}

(d) L = { ⟨M⟩ | M is a DFA such that L(M) = $\sum^*$}

Ans: a

Suppose that L1 is a regular and L2 is a context-free language, Which one of the following languages is NOT necessarily context-free?

(a) L1 · L2

(b) L1 ∪ L2

(c) L1 ∩ L2

(d) L1 - L2

https://github.com/sauravhathi

Ans: d

Q79. Consider the following languages.

L1 = {wxyx | w, x, y ∈ (0 + 1)+}

L2 = {xy | x, y ∈ (a + b)*, |x| = |y|, x ≠ y}

Which one of the following is TRUE?

(a) L1 is regular and L2 is context-free.

(b) L1 is context-free but not regular and L2 is context-free.

(c) Neither L1 nor L2 is context-free.

(d) L1 is context-free but L2 is not context-free.

Ans: a

Q80. Consider the following languages:

I. {a^mb^nc^pd^q|m+p=n+q, where m,n,p,q≥0}

II. {a^mb^nc^pd^q|m=n and p=q, where m,n,p,q≥0}

III. {a^mb^nc^pd^q|m=n=p and p≠q, where m,n,p,q≥0}

IV. {a^mb^nc^pd^q|mn=p+q, where m,n,p,q≥0}

Which of the languages above are context-free?

(a) I and IV only

(b) I and II only

(c) II and III only

(d) II and IV only

https://github.com/sauravhathi

Ans: b

Q81. Consider the following context-free grammars:

G1:S→aS|B,B→b|bBG2:S→aA|bB,A→aA|B|ε,B→bB|ε

Which one of the following pairs of languages is generated by G1 and G2, respectively?

(a) {a^mb^n|m>0 or n>0} and {a^mb^n|m>0 and n>0}

(b) {a^mb^n|m>0 and n>0} and {a^mb^n|m>0 or n≥0}

(c) {a^mb^n|m≥0 or n>0} and {a^mb^n|m>0 and n>0}

(d) {a^mb^n|m≥0 and n>0} and {a^mb^n|m>0 or n>0}

Ans: d

Q82. Which of the following languages are context-free?

L1={a^mb^na^nb^m|m,n≥1}

L2={a^mb^na^mb^n|m,n≥1}

L3={a^mb^n|m=2n+1}

(a) L1 and L2 only

(b) L1 and L3 only

(c) L2 and L3 only

(d) L3 only

Ans: b

Q83. Consider the following languages over the alphabet ∑={0,1,c}:

L1={0^n1^n|n≥0}L2={wcw^r|w∈{0,1}∗}L3={ww^r|w∈{0,1}∗}

https://github.com/sauravhathi

Here, w^r is the reverse of the string w. Which of these languages are deterministic Context- free languages?

(a) None of the languages

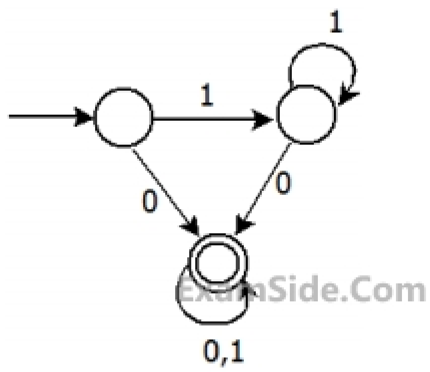
(b) (B) Only L1

(c) Only L1 and L2

(d) All the three languages.

Ans: c

Q84. Consider the DFA A given below.



Which of the following are FALSE?

1. Complement of L(A) is context - free.

2. L(A) =(11∗0+0)(0+1)∗0∗1∗)

3. For the language accepted by A,A is the minimal DFA.

4. A accepts all strings over {0,1} of length at least 2.

(a) 1 and 3 only

(b) 2 and 4 only

(c) 2 and 3 only

(d) 3 and 4 only

Ans: d

https://github.com/sauravhathi

Q85. Consider the languages

L1={0^i1^j|i≠j}

L2={0^i1^j|i=j}

L3={0^i1^j|i=2j+1}

L4={0^i1^j|i≠2j}

(a) only L2 is context free

(b) only L2 and L3 are context free

(c) only L1 and L2 are context free

(d) all are context free

Ans: d

Q86. Match the following List-I with List - II

List-I

E) Checking that identifiers are declared before their

F) Number of formal parameters in the declaration of a function agrees with the number of actual parameters in a use of that function

G) Arithmetic expression with matched pairs of parentheses

H) Palindromes

List-II

P) L={a^nb^mc^nd^m|n≥1,m≥1}

Q) X→XbX|XcX|dXf|g

R) L={www|w∈(a|b)∗}

S) X→bXB|cXc|ε

https://github.com/sauravhathi

(a) E−P,F−R,G−Q,H−S

(b) E−R,F−P,G−S,H−Q

(c) E−R,F−P,G−Q,H−S

(d) E−P,F−R,G−S,H−Q

Ans: c

Q87. Which of the following statements are true?

1. Every left-recursive grammar can be converted to a right-recursive grammar and vice-versa

2. All ε-productions can be removed from any context-free grammar by suitable transformations

3. The language generated by a context-free grammar all of whose productions are of the form X→w or X→wY (where, w is a string of terminals and Y is a non terminal), is always regular

4. The derivation trees of strings generated by a context-free grammar in Chomsky Normal Form are always binary trees

(a) 1,2,3 and 4

(b) 2,3 and 4 only

(c) 1,3 and 4 only

(d) 1,2 and 4 only

Ans: c

Q88. Which of the following statement is false?

(a) Every NFA can be converted to an equivalent DFA

(b) Every non-deterministic Turing machine can be converted to an equivalent deterministic Turing machine.

(c) Every regular language is also a context- free language

https://github.com/sauravhathi

(d) Every subset of a recursively enumerable set is recursive

Ans: d

Q89. Consider the CFG with {S,A,B} as the non-terminal alphabet, {a,b} as the terminal alphabet, S as the start symbol and the following set of production rules:

$$S \rightarrow aB \qquad S \rightarrow bA$$
$$B \rightarrow b \qquad A \rightarrow a$$
$$B \rightarrow bS \qquad A \rightarrow aS$$
$$B \rightarrow aBB \qquad A \rightarrow bAA$$

ExamSide.Com

Which of the following strings is generated by the grammar?

(a) aaaabb

(b) aabbbb

(c) aabbab

(d) abbbba

Ans: c

Q90. The language L={0^i21^i|i≥0} over the alphabet {0,1,2} is

(a) Not recursive.

(b) is recursive and is a deterministic CFL.

(c) is a regular language.

(d) is not a deterministic CFL but a CFL.

Ans: b

https://github.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

Q91. Consider the CFG with {S,A,B} as the non-terminal alphabet, {a,b} as the terminal alphabet, S as the start symbol and the following set of production rules:

$$S \rightarrow aB \qquad S \rightarrow bA$$
$$B \rightarrow b \qquad A \rightarrow a$$
$$B \rightarrow bS \qquad A \rightarrow aS$$
$$B \rightarrow aBB \qquad A \rightarrow bAA$$

ExamSide.Com

For the correct string of (earlier question) how many derivation trees are there?

(a) 1

(b) 2

(c) 3

(d) 4

Ans: b

https://github.com/sauravhathi

Q92. Consider the following statements about the context-free grammar

G={S→SS,S→ab,S→ba,S→ε}

1. G is ambiguous
2. G produces all strings with equal number of a′s and b′s
3. G can be accepted by a deterministic PDA.

Which combination below expresses all the true statements about G?

(a) 1 only

(b) 1 and 3 only

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

(c) 2 and 3 only

(d) 1,2 and 3

Ans: d

Q93. Consider the language :

$L1=\{ww^R|w\in\{0,1\}*\}$

$L2=\{w\neq w^R|w\in\{0,1\}*\}$ where $\neq$ is a special symbol

$L3=\{ww|w\in\{0,1\}*\}$

Which one of the following is TRUE?

(a) L1 = is a deterministic CFL

(b) L2 = is a deterministic CFL

(c) L3 is a CFL, but not a deterministic CFL

(d) L3 IS A DETERMINISTIC CFL

Ans: b

Q94. Consider the language :

$L1=\{a^nb^nc^m|n,m>0\}$ and $L2=\{a^nb^mc^m|n,m>0\}$

Which of the following statement is FALSE?

(a) $L1\cap L2$ is a context-free language

(b) $L1\cap L2$ is a context-free language

(c) L1 and L2 are context-free language

(D) $L1\cap L2$ is a context sensitive language

https://github.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

Ans: d

Q95. Let M=(K,∑,F,Δ,s,F) be a pushdown automation. Where

K={s,f},F={f},∑={a,b},F={a} and Δ={((s,a,∈),(s,a)),((s,b,∈),(s,a)),
((s,a,∈),(f,∈),((f,a,a),(f,∈)),((f,b,a),(f,∈))}.

Which one of the following strings is not a number of L(M)?

(a) aaa

(b) aabab

(c) baaba

(d) bab

Ans: c

Q96. The language {a^mb^nc^m+n|m,n≥} is

(a) Regular

(b) Context-free but not regular

(c) Context sensitive but not context free

(d) Type-0 but not context sensitive

Ans: b

Q97.Consider the following grammar G:

S→bS|aA|bA→bA|aBB→bB|aS|a

https://github.com/sauravhathi

Let Na(w) and Nb(w) denote the number of a′s and b′s in a string w respectively. The language

L(G)⊆{a,b}+ generated by G is

(a) {w|Na(w)>3Nb(w)}

(b) {w|Nb(w)>3Na(w)}

(c) {w|Na(w)=3k,k∈{0,1,2,...}}

(d) {w|Nb(w)=3k,k∈{0,1,2,...}}

Ans: c

Q98. Consider the following decision problems:

P1 Does a given finite state machine accept a given string

P2 Does a given context free grammar generate an infinite number of stings.

Which of the following statements is true?

(a) Both P1 and P2 are decidable

(b) Neither P1 and P2 are decidable

(c) Only P1 is decidable

(d) Only P2 is decidable

Ans: a

Q99. If L1 is a context free language and L2 is a regular which of the following is/are false?

(a) L1−L2 is not context free

(b) L1∩L2 is context free

https://github.com/sauravhathi

(c) ~L1 is context free

(d) ~L2 is regular

Ans: a,c

Q100. Which of the following statements is false?

(a) Every finite subset of a non-regular set is regular

(b) Every subset of a regular set is regular

(c) Every finite subset of a regular set is regular

(d) The intersection of two regular sets is regular

Ans: b

Q101. Let L be the set of all binary strings whose last two symbols are the same. The number of states in the minimum state deterministic finite-state automation accepting L is

(a) 2

(b) 4

(c) 5

(d) 8

Ans: c

Q102. Which of the following languages over {a,b,c} is accepted by Deterministic push down automata?

(a) {w⊂w^R|w∈{a,b}∗}

(b) {ww^R|w∈{a,b,c}∗}

(c) {a^nb^nc^n|n≥0}

https://github.com/sauravhathi

(d) {w|w is palindrome over {a,b,c}}

Ans: a

Q103. If L1 and L2 are context free languages and R a regular set, one of the languages below is not necessarily a context free language. Which one?

(a) L1L2

(b) L1∩L2

(c) L1∩R

(d) L1∪L2

Ans: b

Q104. Which of the following features cannot be captured by context-free grammars?

(a) Syntax of if-then-else statements

(b) Syntax of recursive procedures

(c) Whether a variable has been declared before its use

(d) Variable names of arbitrary length

Ans: c

Q105. Context-free languages are

(a) closed under union

(b) closed under complementation

(c) closed under intersection

(d) closed under Kleene closure.

https://github.com/sauravhathi

Ans: a,d

Q106. Context free languages and regular languages are both closed under the operation(s) of :

(a) Union

(b) Intersection

(c) Concatenation

(d) Complementation

Ans: a,c

Q107. FORTRAN is:

(a) Regular language.

(b) Context free language.

(c) Context sensitive language.

(d) None-of the above.

Ans: c

108. A context-free grammar is ambiguous if:

(a) The grammar contains useless non-terminals.

(b) It produces more than one parse tree for some sentence.

(c) Some production has two non-terminals side by side on the right-hand side.

(d) None of the above.

Ans: b

https://github.com/sauravhathi

Q109. Which of the following is/are undecidable?

(a) Given two Turing machines M1 and M2, decide if L(M1) = L(M2).

(b) Given a Turing machine M, decide if L(M) is regular.

(c) Given a Turing machine M, decide if M accepts all strings.

(d) Given a Turing machine M, decide if M takes more than 1073 steps on every string.

Ans: a,b,c

Explanation:

A, B, C choices are all non-trivial properties of RE language (language of TM's) and hence all UNDECIDABLE.

Choice (d) is DECIDABLE. Why?

A Turing Machine see only at most the first 1073 symbols of input in its first 1073 steps. Hence whether it stops on first 1073 steps depends only on the first 1073 symbols of input.

Since the number of strings of length 1073 is finite, it gives a way to decide this. Run the input machine M on all inputs of length 1073 and check whether any of them stops within 1073 steps. If so, reject, otherwise accept.

Q110. Which of the following statements is/are TRUE?

(a) Every subset of a recursively enumerable language is recursive.

(b) If a language L and its complement L— are both recursively enumerable, then L must be recursive.

(c) Complement of a context-free language must be recursive.

(d) If L1 and L2 are regular, then L1 ∩ L2 must be deterministic context-free.

Ans: b,c,d

Explanation:

https://github.com/sauravhathi

(a) No language is closed under subset operation. So subset of an RE language may or may not be REC. So option (a) is false.

(b) If L and L— are both RE ⇒ L is REC is a theorem and is true.

(c) (CFL)C = (CSL)C = CSL

Every CSL is recursive.

So, complement of CFL is recursive is true.

(d) L1 → regular, L2 → regular

⇒ L1 ∩ L2 = Regular ∩ Regular = Regular

Now every regular language is a DCFL.

So, option (d) is true.

Q111. Consider the following types of languages: L1: Regular, L2: Context-free, L3: Recursive, L4: Recursively enumerable. Which of the following is/are TRUE?

I. L3'—∪L4 is recursively enumerable

II. L2'—∪L3 is recursive

III. L1∗∩L2 is context-free

IV. L1∪L2'— is context-free

(a) I only

(b) I and III only

(c) I and IV only

https://github.com/sauravhathi

(d) I, II and III only

Ans: d

Q112. Consider the following statements.

I. The complement of every Turing decidable language is Turing decidable

II. There exists some language which is in NP but is not Turing decidable

III. If L is a language in NP, L is Turing decidable

Which of the above statements is/are true?

(a) Only II

(b) Only III

(c) Only I and II

(d) Only I and III

Ans: d

Q113. For any two languages L1 and L2 such that L1 is context-free and L2 is recursively enumerable but not recursive, which of the following is/are necessarily true?

I. L'—1 (complement of L1) is recursive

II. L'—2 (complement of L2) is recursive

III. L'—1 is context-free

IV. L'—1∪L2 is recursively enumerable

(a) I only

(b) III only

(c) III and IV only

https://github.com/sauravhathi

(d) I and IV only

Ans: d

Q114. Let A≤mB denotes that language A is mapping reducible (also known as many-to-one reducible) to language B. Which one of the following is FALSE?

(a) If A≤mB and B is recursive then A is recursive.

(b) If A≤mB and A is undecidable then B is un-decidable.

(c) If A≤mB and B is recursively enumerable then A is recursively enumerable.

(d) If A≤mB and B is not recursively enumerable then A is not recursively enumerable.

Ans: d

Q115. Which of the following statements is/are FALSE?

1. For every non-deterministic Turing machine, there exists an equivalent deterministic Turing machine

2. Turing recognizable languages are closed under union and complementation

3. Turing decidable languages are closed under intersection and complementation

4. Turing recognizable languages are closed under union and intersection

(a) 1 and 4 only

(B) 1 and 3 only

(c) 2 only

(d) 3 only

Ans: c

Q116. Which of the following is true for the language {a^p|P prime }?

https://github.com/sauravhathi

(a) It is not accepted by a Turing machine

(b) It is regular but not context-free

(c) It is context-free but not regular

(d) It is neither regular nor context-free, but accepted by a Turing machine

Ans: d

Q117. If the strings of a language L can be effectively enumerated in lexicographic (i.e., alphabetic(c) order, which of the following statements is true?

(a) L is necessarily finite

(b) L is regular but not necessarily finite

(C) L is context free but not necessarily regular

(d) L is recursive but not necessarily context free

Ans: d

Q118. Regarding the power of recognition of languages, which of the following statement is false?

(a) The non-deterministic finite-state automata are equivalent to deterministic finite-state automata.

(b) Non-deterministic Push-down automata are equivalent to deterministic Push-down automata.

(c) Non-deterministic Turing machines are equivalent to deterministic Turing machines.

(d) Multi-tape Turing machines are equivalent to Single-tape Turing machines.

Ans: b

Q119. Which of the following statements is / are true / false?

https://github.com/sauravhathi

Regular languages are closed under infinite union.

(a) TRUE

(b) FALSE

Ans: b

Q120. Which of the following statements is / are true / false?

Union of two recursive languages is recursive

(a) TRUE

(b) FALSE

Ans: b

Q121. Which of the following statements is / are true / false?

The language {0^n|n is prime} is not regular

(a) TRUE

(b) FALSE

Ans: b

Q122. For a Turing machine M, {M} denotes an encoding of M. Consider the following two languages.

L1 = {(M) | M takes more than 2021 steps on all inputs}

L2 = {(M) | M takes more than 2021 steps on some input}

Which one of the following options is correct?

https://github.com/sauravhathi

(a) Both L1 and L2 are undecidable.

(b) L1 is undecidable and L2 is decidable.

(c) L1 is decidable and L2 is undecidable.

(d) Both L1 and L2 are decidable.

Ans: d

Q123. Consider the following problems. L(G) denotes the language generated by a grammar G. L(M) denotes the language accepted by a machine M.

I. For an unrestricted grammar G and a string W, whether w∈L(G)

II. Given a Turing machine M, whether L(M) is regular

III. Given two grammars G1 and G2, whether L(G1)=L(G2)

IV. Given an NFA N, whether there is a deterministic PDA P such that N,and P accept the same language.

Which one of the following statements is correct?

(a) Only I and II are undecidable

(b) Only III is undecidable

(c) Only II and IV are undecidable

(d) Only I, II and III are undecidable

Ans: d

Q124. The set of all recursively enumerable languages is

(a) closed under complementation.

(b) closed under intersection.

https://github.com/sauravhathi

(c) a subset of the set of all recursive languages

(d) an uncountable set.

Ans: b

Q125. Consider the following languages.

L1={⟨M⟩|M takes at least 2016 steps on some input },

L2={⟨M⟩|M takes at least 2016 steps on all inputs } and

L3={⟨M⟩|M accepts ε},

where for each Turing machine M,⟨M⟩ denotes a specific encoding of M. Which one of the following is TRUE?

(a) L1 is recursive and L2,L3 are not recursive

(b) L2 is recursive and L1,L3 are not recursive

(c) L1,L2 are recursive and L3 is not recursive

(d) L1,L2,L3 are recursive

Ans: c

Q126. Let X be a recursive language and Y be a recursively enumerable but not recursive language. Let W and Z be two languages such that Y'— reduces to W, and Z reduces to X'— (reduction means the standard many-one reduction). Which one of the following statements is TRUE?

(a) W can be recursively enumerable and Z is recursive.

(B) W can be recursive and Z is recursively enumerable.

(c) W is not recursively enumerable and Z is recursive.

(d) W is not recursively enumerable and Z is not recursive.

https://github.com/sauravhathi

Ans: c

Q127. Let L be a language and L'— be its complement. Which one of the following is NOT a viable possibility?

(a) Neither L nor L'— is recursively enumerable (r.e).

(b) One of L and L'— is r.e. but not recursive; the other is not r.e.

(c) Both L and L'— are r.e. but not recursive.

(d) Both L and L'— are recursive.

Ans: c

Q128. Let <M> be the encoding of a Turing machine as a string over ∑={0,1}.

Let L={<M>|M is a Turing machine that accepts a string of length 2014}. Then, L is

(a) decidable and recursively enumerable

(b) un-decidable but recursively enumerable

(c) un-decidable and not recursively enumerable

(d) decidable but not recursively enumerable

Ans: b

Q129. If L and L'— are recursively enumerable then L is

(a) Regular

(b) Context-free

(c) Context-sensitive

(d) Recursive.

Ans: d

https://github.com/sauravhathi

Q130. Let L1 be a regular language, L2 be a deterministic context-free language and L3 a recursively enumerable, but not recursive, language. Which one of the following statement is false?

(a) $L1 \cap L2$ is deterministic CFL

(b) $L3 \cap L1$ is recursive

(c) $L1 \cup L2$ is context-free

(d) $L1 \cap L2 \cap L3$ is recursively enumerable

Ans: b

Q131. For $s \in (0+1)*$, let d(s) denote the decimal value of s(e.g.d(101)=5)

Let $L=\{s \in (0+1)* | d(s) \bmod 5=2 \text{ and } d(s) \bmod 7 \neq 4\}$

Which of the following statement is true?

(a) L is recursively enumerable, but not recursive

(b) L is recursive, but not context-free

(c) L is context-free, but not regular

(d) L is regular

Ans: d

Q132. Let L1 be a recursive language, and Let L2 be a recursively enumerable but not a recursive language. Which one of the following is TRUE?

(a) L1'— is recursive and L2'— is recursively enumerable

(b) L1'— is recursive and L2'— is not recursively enumerable

(c) L1'— and L2— are recursively enumerable

(d) L1'— is recursively enumerable and L2'— is recursive

https://github.com/sauravhathi

Ans: b

Q133. The C language is:

(a) A context free language

(b) A context sensitive language

(c) A regular language

(d) Parsable fully only by a Turing machine

Ans: a

Q134. Which of the following is true?

(a) The complement of a recursively language is recursive.

(b) The complement of a recursively enumerable language is recursively enumerable.

(c) The complement of a recursively language is either recursive or recursively enumerable.

(d) The complement of a context-free language is context-free.

Ans: c

Q135. Which one of the following is not decidable?

(a) Given a Turing machine M, a stings s and an integer k, M accepts s within k steps

(b) Equivalence of two given Turing machines

(c) Language accepted by a given finite state machine is not empty

(d) Language generated by a context free grammar is non empty

Ans: b

https://github.com/sauravhathi

Q136. hich of the following conversions is not possible (algorithmically)?

(a) Regular grammar to context free grammar

(b) Non-deterministic FSA to deterministic FSA

(c) Non-deterministic PDA to deterministic PDA

(d) Non-deterministic Turing machine to deterministic Turing machine

Ans: c

Q137. In which of the cases stated below is the following statement true?

"For every non-deterministic machine M1 there exists an equivalent deterministic machine M2 recognizing the same language".

(a) M1 is nondeterministic finite automation

(b) M1 is a nondeterministic PDA

(c) M1 is a non-deterministic Turing machine

(d) For no machine M1 use the above statement true

Ans: a,c

Q138. Recursive languages are:

(a) A proper superset of context free languages.

(b) Always recognizable by pushdown automata.

(c) Also called Type (0) languages.

(d) Recognizable by Turing machines.

Ans: d

Q139. There are ________ tuples in finite state machine.

https://github.com/sauravhathi

(a) 4

(b) 5

(c) 6

(d) unlimited

Ans: b

Explanation: States, input symbols, initial state, accepting state and transition function.

Q140. Finite State transition function maps.

(a) Σ * Q -> Σ

(b) Q * Q -> Σ

(c) Σ * Σ -> Q

(d) Q * Σ -> Q

Ans: d

Explanation: Inputs are state and input string output is states.

Q141. Number of states require to accept string ends with 10.

(a) 3

(b) 2

(c) 1

(d) can't be represented.

Ans: a

Explanation: This is minimal finite automata.

Q142. Finite State Extended transition function is .

https://github.com/sauravhathi

a) Q * Σ* -> Q

b) Q * Σ -> Q

c) Q* * Σ* -> Σ

d) Q * Σ -> Σ

Ans: a

Explanation: This takes single state and string of input to produce a state.

https://github.com/sauravhathi

Q143. Language of finite automata is.

a) Type 0

b) Type 1

c) Type 2

d) Type 3

Ans: d

Explanation: According to Chomsky classification.

Q144. Finite automata requires minimum _______ number of stacks.

a) 1

b) 0

c) 2

d) None of the mentioned

Ans: b

Explanation: Finite automata doesn't require any stack operation.

Q145. Regular expressions are closed under

a) Union

b) Intersection

c) Kleen star

d) All of the mentioned

Ans: d

NOTES

PDA Tuple

PDA = { Q,Σ,qo,F,Zo,Γ,δ }

Q -> Finite set of states
Σ -> Input Alphabets
qo -> Initial State
F -> set of Final States
Zo -> Bottom/Initial Stack Symbol
Γ -> Stack Alphabet
δ -> Transition Function

https://
.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University. We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

Finite Automata Tuple

Finite Automata is a collection of 5- tuples

$$M=(Q , \Sigma , \delta , q_0 , F)$$

where

- Q - Finite set of states
- Σ - Finite set of Input symbols
- δ - Transition Function
  - i.e., $Q \times \Sigma \rightarrow Q$
- q_0 - Initial State
- F - Final State

Grammars

A *grammar* is a 4-tuple G = (V, T, P, S) where

1) V is a set of *nonterminal symbols* (also called *variables* or *syntactic categories*)
2) T is a finite set of *terminal symbols*, disjoint from V
3) P is a finite subset of $(V \cup T)^* V (V \cup T)^* \times (V \cup T)^*$
4) S is a distinguished symbol in V called the *start symbol* (or *sentence*)

Context Free Grammar (CFG)

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

Definition. A context-free grammar (CFG) is a 4-tuple (V, Σ, R, S), where:

- Σ is an alphabet (characters Σ are called **terminals**)
- V is a set (elements in NT are called **variables**)
- R is a subset of NT $\times$ ($\Sigma \cup$ NT)*

If $(\alpha,\beta) \in R$, we write $\alpha \rightarrow \beta$

$\alpha \rightarrow \beta$ is called a **rule**

- S, the **start variable**, is one of the variables in NT
- $V \cap \Sigma = \varnothing$

Context Free languages (CFL)

Definition. Given a context-free grammar G = (V, Σ, R, S), the **language generated** or derived from G is the set:

$$L(G) = \{w \in \Sigma^*: S \Rightarrow^* w\}$$

Definition. A language L is context-free if there is a context-free grammar G = (Σ, NT, R, S), such that L is generated from G

Deterministic Finite Automata (DFA)

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

- A deterministic finite automaton (DFA) is a five-tuple A = (Q, Σ, δ, q_0, F) where
  1. Q is a finite set of *states*
  2. Σ is a finite set of *input symbols*
  3. δ is a function δ: Q × Σ → Q called *transition function*
  4. $q_0 \in Q$ is called the *start state*
  5. $F \subseteq Q$ is called the set of *accepting states*

Linear Bound Automata (LBA)

➢A linear bounded automaton can be defined as an 8-tuple

(Q, T, ∑, q_0, ML, MR, δ, F) where

Q is a finite set of states

T is the tape alphabet

∑ is the input alphabet

q_0 is the initial state

ML is the left end marker

MR is the right end marker where **MR ≠ ML**

δ is a transition function which maps each pair (state, tape symbol) to (state, tape symbol, Constant 'c') where c can be 0 or +1 or -1

F is the set of final states

Turing Machine (TM)

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University.
We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

- Formally, a Turing machine is a 7-tuple

  M = (Q, ∑, Γ, δ, q_0,B, F)

  where:

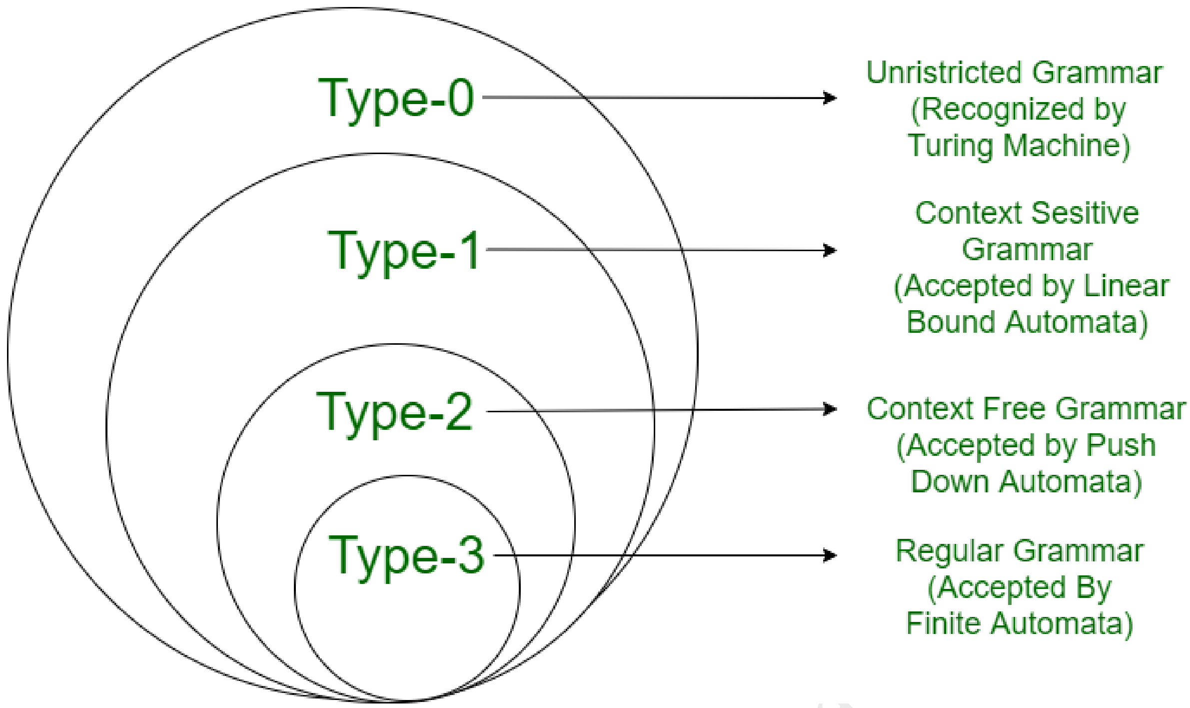
  1. Q : The finite set of states of the finite control.
  2. ∑ : The finite set of input symbols.
  3. Γ : The finite set of tape symbols; ∑ ⊂ Γ.
  4. δ : The *transition function*.
  5. q_0 ϵ Q is the *start state*.
  6. B ϵ Γ is the *blank* symbol; B ∉ ∑.
  7. F⊆ Q is the set of *final* or *accepting* states.

Table 2.1 Summary for Chomsky hierarchy

Grammar	Languages	Production rules
Type-0	Recursively enumerable	$\alpha \to \beta$ (no restrictions)
Type-1	Context-sensitive	$\alpha A \beta \to \alpha\gamma\beta$
Type-2	Context-free	$A \longrightarrow \gamma$
Type-3	Regular	$A \longrightarrow a$ and $A \longrightarrow aB$

Type	Grammar	Production rules
Type 0	unrestricted	$\alpha \to \beta$
Type 1	context-sensitive	$\alpha A\beta \to \alpha\gamma\beta$
Type 2	**context-free**	$A \to \gamma$
Type 3	regular	$A \to aB$ or $A \to Ba$

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University. We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.



Last Minute Notes – Theory of Computation

Finite Automata: It is used to recognize patterns of specific type input. It is the most restricted type of automata which can accept only regular languages (languages which can be expressed by regular expression using OR (+), Concatenation (.), Kleene Closure(*) like a*b*, (a+b) etc.)

Deterministic FA and Non-Deterministic FA: In deterministic FA, there is only one move from every state on every input symbol but in Non-Deterministic FA, there can be zero or more than one move from one state for an input symbol.

Note:

- Language accepted by NDFA and DFA are same.
- Power of NDFA and DFA is same.
- No. of states in NDFA is less than or equal to no. of states in equivalent DFA.
- For NFA with n-states, in worst case, the maximum states possible in DFA is 2^n
- Every NFA can be converted to corresponding DFA.

https://github.com/saura

Identities of Regular Expression :

$\Phi + R = R + \Phi = R$
$\Phi * R = R * \Phi = \Phi$
$\varepsilon * R = R * \varepsilon = R$
$\varepsilon^* = \varepsilon$
$\Phi^* = \varepsilon$
$\varepsilon + RR^* = R^*R + \varepsilon = R^*$

$(a+b)^* = (a^* + b^*)^* = (a^* b^*)^* = (a^* + b)^* = (a + b^*)^* = a^*(ba^*)^* = b^*(ab^*)^*$

Moore Machine: Moore machines are finite state machines with output value and its output depends only on present state.
Mealy Machine: Mealy machines are also finite state machines with output value and its output depends on present state and current input symbol.

Push Down Automata: Pushdown Automata has extra memory called stack which gives more power than Finite automata. It is used to recognize context free languages.

Deterministic and Non-Deterministic PDA: In deterministic PDA, there is only one move from every state on every input symbol but in Non-Deterministic PDA, there can be more than one move from one state for an input symbol.

Note:

- Power of NPDA is more than DPDA.
- It is not possible to convert every NPDA to corresponding DPDA.
- Language accepted by DPDA is subset of language accepted by NPDA.
- The languages accepted by DPDA are called DCFL (Deterministic Context Free Languages) which are subset of NCFL (Non Deterministic CFL) accepted by NPDA.

Linear Bound Automata: Linear Bound Automata has finite amount of memory called tape which can be used to recognize Context Sensitive Languages.

□ LBA is more powerful than Push down automata.

FA < PDA < LBA < TM

Turing Machine: Turing machine has infinite size tape and it is used to accept Recursive Enumerable Languages.

https://github.com/sauravhathi

This is a collection of study materials, projects, and roadmaps for Computer Science Engineering students at Lovely Professional University. We are a community of students who are passionate about learning and teaching. We are here to help you learn and grow.

- Turing Machine can move in both directions. Also, it doesn't accept ε .
- If the string inserted in not in language, machine will halt in non-final state.

Deterministic and Non-Deterministic Turing Machines: In deterministic turing machine, there is only one move from every state on every input symbol but in Non-Deterministic turing machine, there can be more than one move from one state for an input symbol.

Note:

- Language accepted by NTM, multi-tape TM and DTM are same.
- Power of NTM, Multi-Tape TM and DTM is same.
- Every NTM can be converted to corresponding DTM.

github.com/sauravhathi

Decidable and Undecidable Problems:

A language is **Decidable or Recursive** if a Turing machine can be constructed which accepts the strings which are part of language and rejects others. e.g.; A number is prime or not is a decidable problem.

A language is **Semi–Decidable or Recursive Enumerable** if a turing machine can be constructed which accepts the strings which are part of language and it may loop forever for strings which are not part of language.

A problem is **undecidable** if we can't construct an algorithms and Turing machine which can give yes or no answer. e.g.; Whether a CFG is ambiguous or not is undecidable.

Decidability Table

Problem	RL	DCFL	CFL	CSL	RL	REL
Membership Problem	D	D	D	D	D	UD
Emptiness Problem	D	D	D	UD	UD	UD
Completeness Problem	D	UD	UD	UD	UD	UD
Equality Problem	D	D	UD	UD	UD	UD
Subset Problem	D	UD	UD	UD	UD	UD
$L1 \cap L2 = \phi$	D	UD	UD	UD	UD	UD
Finiteness	D	D	D	UD	UD	UD
Complement is of same type	D	D	UD	D	D	UD
Intersection is of same type	D	UD	UD	UD	UD	UD
Is L regular	D	D	UD	UD	UD	UD

Countability :

- Set of all strings over any finite alphabet are countable.
- Every subset of countable set is either finite or countable.

- Set of all Turing Machines are countable.
- The set of all languages that are not recursive enumerable is Uncountable.

https://github.com/sauravhathi

https://github.com/sauravhathi