B Tech II 4th Sem End Sem Exam CS 208 Automata and Formal Languages (AFL) May 2021

5 May 2021 (2:00 pm to 3:00 pm)
There are 60 number of questions. The duration for the quiz is one hour.

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* Required

*

The number of terms in expression of $(x+y+z)^n$ is

$^1/_2\,(n)(n+2)$

a)

$^1/_2\,(n+1)(n+2)$

b)

$^1/_2\,(n+1)(n+3)$

c)

d) None of the above

Write correct option from (a, b, c, d) *

Which of the following grammars is ambiguous?
(a) S → a | abSb | aAb, A → bS | aAAb
(b) S → aB | ab, A → aAB | a, B → ABb | b
(c) S → S + S | S * S |a | b
(d) all of these

d

If we have an algorithm to determine whether a given element belongs to a set X or not, then this set is called *

- (•) Recursive
- ( ) Recursively Enumerable
- ( ) Complete
- ( ) Context-sensitive

*

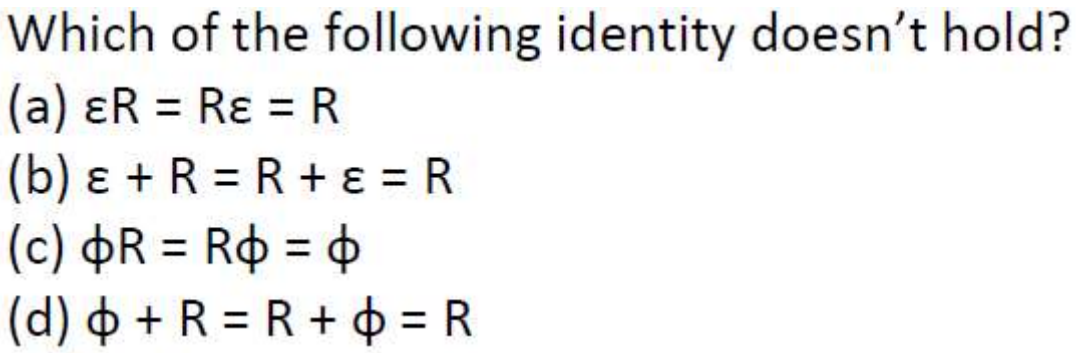
Which of the following is FALSE with respect to possible outcomes of executing a Turing Machine over a given input?

- ( ) a) It may halt and accept the input
- (•) b) It may halt by changing the input
- ( ) c) It may halt and reject the input
- ( ) d) It may never halt

Find the false statement *

- (●) L is recursively enumerable then so is complement of L
- ( ) L is recursive then so is complement of L
- ( ) L is recursive then complement of L is recursively enumerable
- ( ) If L and complement of L are recursively enumerable then both are recursive

Write correct option from (a, b, c, d) *



b

CFG is not closed under *

- ( ) union
- ( ) Kleene star
- (●) complement
- ( ) product

Comparing TM and computers we find *

- ○ Computers have more computational power
- ○ TM has move computational power
- ◉ Both are equivalent
- ○ They cannot be compared

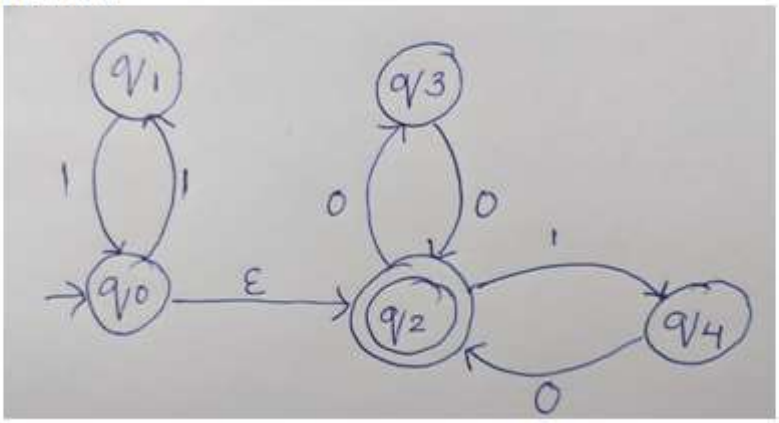
Write correct option from (a, b, c, d) *

The language generated by the grammar $S \rightarrow 0S1 \mid 0A1$, $A \rightarrow 1A \mid 1$ is
(a) $\{ 0^m1^n : m > n > 1\}$
(b) $\{ 0^m1^n : m > n > 1\}$
(c) $\{ 0^m1^n : n > m \geq 1\}$
(d) $\{ 0^m1^n : n > m > 1\}$

c

*

What is the difference in number of state when the given epsilon NFA is Converted to NFA?



- a) 0
- b) 1
- c) 2
- d) 3

If there exists a language L, for which there exists a TM, T that accepts every word in L and either rejects or loops for every word that is not in L, is said to be *

- Recursive
- Recursive enumerable
- NP-hard
- None of these

*

Let P (n) be the statement that $1^2 + 2^2 + \cdots + n^2 = n(n+1)(2n+1)/6$ for n > 0.
What is the statement P (1)?

$1^2 + 2^2 + \cdots + n^2 = n(n+1)(2n+1)/6$

a)

b) n=1

c) It doesn't exist

$1^2 = 1(1+1)(2+1)/6$

d)

*

Which of the following is an extension to the basic model of Turing machine

- a) Multitude Turing machine
- b) Multi-head Turing machine
- c) Offline Turing machine
- d) All of the above

*

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

- a) N^2
- b) 2^N
- c) 2N
- d) N!

*

Which of the following is true for the language $\{a^p | p \text{ is a prime}\}$

- 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

Find the incorrect statement *

- set of real numbers is not enumerable
- if a set S is infinite countable then its power set is not countable
- if L is not recursively enumerable then its complement cannot be recursive
- family of recursive is a equivalent to family of recursively enumerable

*

The number of states in the minimal deterministic finite automaton corresponding to the regular expression (0 + 1)*(10) is _____

- a) 2
- b) 3
- c) 4
- d) 5

Write correct option from (a, b, c, d) *

The grammar that generates $L = \{a^n b^n c^i \mid n=1, i=0\}$ is
(a) $S \rightarrow A \mid Sc, A \rightarrow ab \mid aAb$
(b) $S \rightarrow aAb \mid Sc, A \rightarrow ab \mid aAb$
(c) both set of production rules
(d) none of these

d

*

Which of the following transition IDs given below denotes stack is popped?

- (a) $\delta(q,a,Y)=\{(p,\varepsilon)\}$
- b) $\delta(q,a,Y)=\{(p,Y)\}$
- c)$\delta(q,a,Y)=\{(q,Y)\}$
- d) None of the mentioned

Write correct option from (a, b, c, d) *

The grammar that generates $L = \{wcw^t \mid w \in \{a, b\}^* \}$ is
(a) $S \rightarrow aSa \mid bSb \mid aca \mid bcb$
(b) $S \rightarrow aSa \mid bSb \mid c$
(c) both set of production rules
(d) none of these

c

Write correct option from (a, b, c, d) *

Which of the following is not regular
(a) string of zero whose length is perfect square
(b) set of palindromes over 0 and 1
(c) string of zero whose length is prime
(d) all of these

d

If we have a procedure to determine whether a given element belongs to a set X or not, then this set is called *

- (●) Recursive
- ( ) Recursively Enumerable
- ( ) Complete
- ( ) Context-sensitive

Write correct option from (a, b, c, d) *

Context free grammar which generates $\{a^l b^m c^n \mid l+m = n\}$ has its production rules given by
(a) $S \rightarrow bSc \mid aSc \mid ac \mid a \mid bS_1, S_1 \rightarrow S_1c \mid c$
(b) $S \rightarrow aSc \mid ac \mid bc \mid bS_1c, S_1 \rightarrow bS_1c \mid bc$
(c) $S \rightarrow cSb, cS \rightarrow Sc, bS \rightarrow Sb, S \rightarrow aS_1c, S_1 \rightarrow aS_1c, S_1 \rightarrow ac$
(d) $S \rightarrow aS, S \rightarrow aS1, S_1 \rightarrow bS_1, S_1 \rightarrow bS_2, S_2 \rightarrow bS_3, S_3 \rightarrow cS_3 \mid c$

b

Which of the following statement is correct? *

- ○ If the emptiness problem is decidable for Type 3 grammars, then it is also decidable for Type 0 grammars
- ◉ If the emptiness problem is decidable for Type 0 grammars, then it is also decidable for Type 3 grammars
- ○ If the emptiness problem is undecidable for Type 0 grammars, then it is also undecidable for Type 3 grammars
- ○ None of these

The number of symbols necessary to simulate any TM with m symbols and n states is *

- ○ m + n
- ○ mn
- ◉ mn + m
- ○ mn + n

Write correct option from (a, b, c, d) *

Pick the correct statement. The logic of pumping lemma is a good example of
(a) the pigeon hole principle
(b) the divide and conquer technique
(c) recursion
(d) iteration

a

Finite state machine can be considered to be a TM *

- ○ a finite tape length, with rewinding and unidirectional movement
- ◉ a finite tape length, without rewinding capability and unidirectional tape movement
- ○ a finite tape length, without rewinding and bi-directional movement
- ○ a finite tape length, rewinding capability and bi-directional tape movement

*

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

a*(ba)*b*a*

- ○ a) 2
- ○ b) 3
- ◉ c) 4
- ○ d) 5

*

A language L is called Turing-decidable (or just decidable), if there exists a Turing Machine M such that on input x, M accepts if x ∈ L and M rejects otherwise. L is called undecidable if it is not decidable. Which of the following option is false?

- ○ a) The class of decidable languages is closed under union
- ◉ b) The class of decidable languages is closed under complement.
- ○ c) The class of decidable languages is closed under intersection
- ○ d) None of these

*

Consider the following CFG, G:
S → AaS | ε
A → SbB
B → bCC
C → cD | Ec
D → abAA
E → bc
F → bBC
The number of useless symbols in the grammar is,

- a) 0
- b) 1
- c) 2
- d) 5

Set of all Turing machines is *

- Uncountable
- Countable but infinite
- Finite
- Void

*

Consider the following two statements:

S1: $\{ 0^{2^n} \mid n >= 1\}$ is a regular language

S2: $\{ 0^m\ 0^n\ 0^{(m+n)} \mid m >= 1$ and $n >= 2\}$ is a regular language. Which of the following is true?

- (●) 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

Write correct option from (a, b, c, d) *

The language generated by the grammar $S \rightarrow 0S1 \mid 0A1$, $A \rightarrow 1A0 \mid 10$ is

(a) $\{ 0^n1^m0^m1^n : m, n > 1\}$

(b) $\{ 0^n1^m0^m1^n : m, n \geq 1\}$

(c) $\{ 0^m1^n : n, m \geq 1\}$

(d) $\{ 1^m0^n : n, m \geq 1\}$

b

*

What is the equivalent grammar to that given below containing no unit productions?
A → BC | B
B → C | bd
C → cC | d

A → BC | bd | cC |d
B → bd
C → cC | d

a)

A → BC | bd
B → bd
C → cC | d

b)

A → BC | bd | cC |d
B → bd | cC | d
C → cC | d

c)

d) None of these

*

Language of finite state machine is

- a) Type 0
- b) Type 1
- c) Type 2
- d) Type 3 (selected)

*

Which of the following statement/s states that Input string is accepted in Pushdown Automata (PDA):

S1: When the final state is reached in PDA.
S2: When the stack has any input symbol in it.
S3: When the stack is empty.

- a) S1 only
- b) S2 and S3 only
- c) S2 and S1 only
- d) S1 and S3 only (selected)

Write correct option from (a, b, c, d) *

Let G be the grammar S → aA, A → Abb | b, sentential forms of G are
(a) aAb^{2n}, ab^{2n+1} where, n ≥ 0
(b) aAb^{2n}, ab^{2n+1} where, n ≥ 1
(c) aAb^{2n}, ab^{2n} where, n ≥ 0
(d) none of these

a

Decidability in Decidable and Undecidable problems refers to *

- ○ Unsolvability
- ○ Existence of algorithm which generates the set of solutions
- ◉ Existence of algorithm which takes an instance of the problem and determines whether the answer to that instance is yes or no
- ○ Those problems whose answers are only either in yes or no

Write correct option from (a, b, c, d) *

Which of the following grammars can generate w = aabbb
(a) S → AB, A → aA | a, B → bB | b
(b) S → AB, A → BB | a, B → AB | b
(c) both set of production rules
(d) none

c

*

Which of the following is true?

(A) The language $L = \{a^n b^n \mid n \geq 0\}$ is regular.

(B) The language $L = \{a^n \mid n \text{ is prime}\}$ is regular.

(C) The language $L = \{w \mid w \text{ has } 3k+1\ b\text{'s for some } k \in \mathbb{N} \text{ with } \Sigma = \{a, b\}\}$ is regular.

(D) The language $L = \{ww \mid w \in \Sigma^* \text{ with } \Sigma = \{0,1\}\}$ is regular.

- a) A
- b) B
- c) C
- d) D
- e) None of these

*

Let Σ be a finite non-empty alphabet and let 2∑* be the power set of Σ*. Which one of the following is TRUE?

- a) Both 2∑* and Σ* are countable
- b) 2∑* is countable and Σ* is uncountable
- c) 2∑* is uncountable and Σ* is countable
- d) Both 2∑* and Σ* are uncountable

Which of the following is accepted by an NPDA and not DPDA? *

- ○ all strings in which a given symbol is present atleast twice
- ◉ even palindromes (i.e. palindromes made up if even no of symbols)
- ○ string ending with a particular alphabet
- ○ none of these

The problem of determining that a Turing Machine would halt after giving Yes / No output is *

- ◉ Unsolvable
- ○ Solvable
- ○ Decidable
- ○ None of these

Write correct option from (a, b, c, d) *

What language is generated by the following grammar G = < S, ∧, {A, B}, {a, b}, P, S > where P is
S → aB | bA, A → a | aS | bAA, B → b | bS | aBB
(a) all words consisting of equal numbers of a's and b's
(b) all words consisting of one a more than the number of b's
(c) all words consisting of one b more than the number of a's
(d) none of these

c

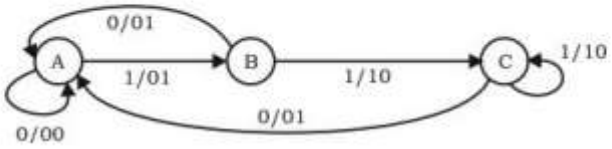
Write correct option from (a, b, c, d) *

The regular expression (1+00*1)+(1+00*1)(0+0+10*1)*(0+10*1) is equivalent to
(a) 0*1(0+10*1)*
(b) (1+00*1)(0+10*1)*
(c) (1+00*1)(0*(10*1)*)*
(d) all of these

d

*

The Finite state machine described by the following state diagram with A as starting state, where an arc label is x / y and x stands for 1-bit input and y stands for 2- bit output



- (●) a) Outputs the sum of the present and the previous bits of the input.
- ( ) b) Outputs 01 whenever the input sequence contains 11.
- ( ) c) Outputs 00 whenever the input sequence contains 10.
- ( ) d) None of these

*

Which of the following regular expressions describes the language over {0, 1} consisting of strings that contain exactly three 0's?

- a) (0 + 1) * 000(0 + 1) *
- b) 1 * 01 * 01 * 01*
- c) 1 * 0001 *
- d) (0 + 1) * 0(0 + 1) * 0 (0 + 1) * 0 (0 + 1) *

Write correct option from (a, b, c, d) *

Any string of terminal that can be generated by the following CFG
S → XY, X → aX | bX | a, Y → Ya | Yb | a
(a) has at least one b
(b) should end in a
(c) has no consecutive a or b
(d) has at least two a

b

Pushdown automata can recognize *

- all regular languages, some nonregular languages, all context-free languages
- all regular languages, all nonregular languages, all context-free languages
- all regular languages, some nonregular languages, all context-free languages and some non-context-free languages
- all regular languages, some nonregular languages, all context-free languages and all non-context-free languages

*

A formal language is recursive if :

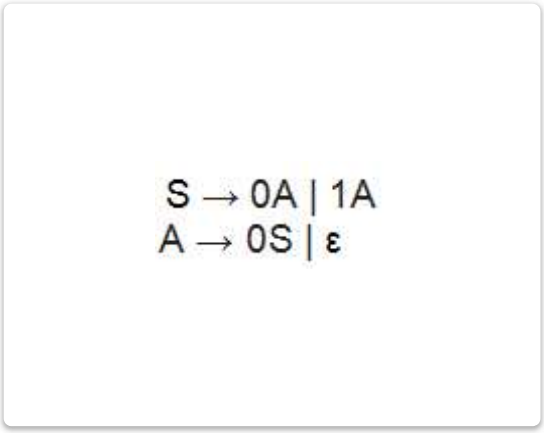
- a) A total turing machine exists
- b) A turing machine that halts for every input
- c) Turing machine rejects if the input does not belong to the language
- d) All of the mentioned

*

Find a CFG for |{ w | w is odd and its middle symbol is 0 }

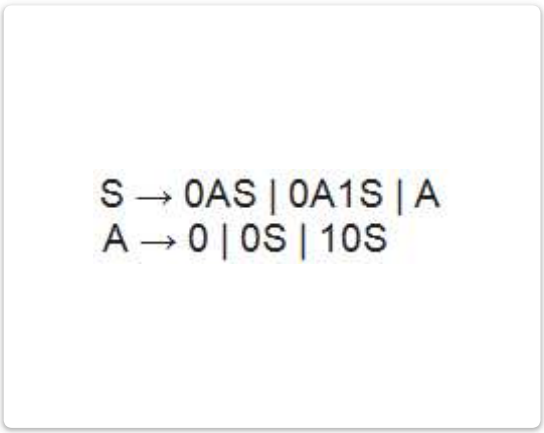
a) S → 0 | 1 | 0S0 | 0S1

b)



c) S → 0 | 0S0 | 0S1 | 1S0 | 1S1

d)



Write correct option from (a, b, c, d) *

Which of the following is true
(a) S → aSbS | bSaS | λ is unambiguous
(b) S → aB | ab, A → aAB | a, B → ABb | b is unambiguous
(c) S → AB | aaB, A → a |Aa, B → b is unambiguous
(d) S → aB, B → Bb | b is unambiguous

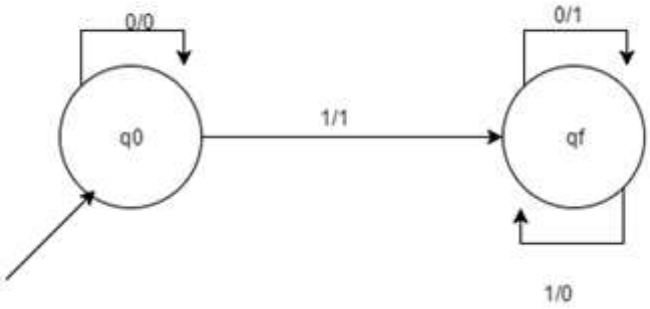
d

The class of TMs is equivalent to the class of *

- (●) Type 0 Grammars
- ( ) Type 1 Grammars
- ( ) Type 2 Grammars
- ( ) Type 3 Grammars

*

The following mealy machine outputs which of the following?



- a) 9's Complement
- b) 2's Complement
- c) 1's Complement
- d) 10's Complement

Select the false statement *

- The Turing Machine halting problem is undecidable
- The Turing Machine halting problem is decidable
- The blank-tape halting problem is undecidable
- None of these

*

Can we use PDA to recognize the following language: $L = \{a^i c^j | i = j \text{ and } i,j \geq 1\}$?

- a) True
- b) False

*

How many strings of length less than 3 contains the language described by the regular expression (a+b)*b(x+xy)*?

- a) 7
- b) 4
- c) 12
- d) 5

Write correct option (a, b, c, d) *

Which of the following languages is context free?

(a) $L = \{a^m b^m c^n : m \leq n \leq 2^m\}$

(b) $L = \{a^m b^n : n = m^2\}$

(c) $L = \{a^n \wedge 2 : 1 \leq n\}$

(d) None of these

d

TM is more powerful than Finite state machine because *

- tape movement is confined to one direction
- it has no finite state control
- it has the capability to remember arbitrary long input symbols
- none of there

Write correct option from (a, b, c, d) *

Which of the following languages cannot be produced by a regular grammar?
(i) $\{a^n b^n : n > 0\}$ (ii) $\{a^m b^k : k > n \geq 0\}$ (iii) $\{ww^R : w \in \{a, b\}^*\}$
(a) (i)
(b) (i) and (ii)
(c) (ii) and (iii)
(d) all of these

d

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