csc 304 revised question 1

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Solution

1. Computability also known as recursion theory is the area of mathemat dealing with concept of effective procedure - a procedure that can be carried out by following specific rules while complexity theory is the study of complexity and of complex systems, it focuses on classifying computational problems according to their inherent difficulty, and relating these classes to each other

Question 2

2. Complexity theory is used in business as a way to encourage innovative thinking and real time responses to change by allowing businesses with to self organise. In order to effectively put complexity theory to work, however, organization leaders need to give up rigid control of these system.

Computability Theory ÷ It is also known as recursion theory, it is a branch of mathematical logic of computer science and of the theory of computation that originated in the 1930's with the study of computable functions and Turing degrees

Question 3

3. Set ÷ A set is a collection of well defined and distinct objects, considered as an object on its own

E.G ÷ Sets of all the computers in the world, sets of all apples on a tree.

Power set ÷ The power set of any set S is the set of all subsets of S, including the empty set and S itself, variously denoted

~~Similarly~~ S

as. P(s)

E.g ÷ Find the power set of $R = [a, b, c, d]$

$2^4 = 16$

Power $= [\emptyset, a, b, c, d, ab, ac, ad, bc, bd, cd, abcd, abc, acd, abd$ and $bcd]$.

Member of a Set ÷ These are members, known as elements of a set and it is any one of the distinct object that make up that set. It is denoted by $\in$

E.g Suppose we have the set A composed of the following elements

$A = \{3, 5, 7, 1\}$

The value 5 is an Element of A

$\therefore 5 \in A$

Subset ÷ A subset is when the set A is contained inside the set B, the set A is a subset of another set B if all elements of the set A are elements of the set B

The subset relationship is denoted as $A \subseteq B$

E.g ÷ the set $\{1, 2, 3, 4, 5\}$

A subset of this is $\{1, 2, 3\}$, Another subset is $\{3, 4\}$ or even another as $\{1\}$ e.t.c. But $\{1, 6\}$ is not a subset

Proper Subset ÷ A proper subset definition of A set A is a subset of A that is not equal to A. In other words, if B is a proper subset of A, then all elements of B are in A but A contains at least one element that is not B. For example, if $A = [1, 3, 5]$ and the $B = [1, 5]$ is a proper subset of A

Infinite Set ÷ A set is said to be an infinite set whose element cannot be listed if it has no restriction (i.e uncountable) by the natural number 1, 2, 3, 4 . . . . n

For any natural number n is called infinite set. A set which is not finite is called an infinite set

Finite Set ÷ A finite set is a set that has a finite number of elements. Informally, a finite set is a set which one could in principle count and finish counting. For example ÷ 1 is a finite set element given five

Unordered Pair ÷ An unordered pair a pair set is a set of the form $\{a, b\}$ i.e a set having two element a and b with no particular relation between them. In contrast, an order pair (a, b) has a as its first element and b as its second element

Union of A set ÷ The union (denoted by $\cup$) of a collection of sets is the set of all elements in the collection. It is one of the fundamental operations through which sets can be combined and related to each other.

$A \cup B = \{x : x \in A$ or $x \in B$

$A = \{1, 2, 3, 4\}$

$B = \{3, 4, 6, 8\}$

$A \cup B = \{1, 2, 3, 4, 6, 8\}$

Intersection of A set ÷ The intersection of two set A and B, denoted by $A \cap B$ is the set containing all elements of A that also belongs to B (or equivalently all elements of B that belongs to A)

For example ÷ If $A = \{2,4,6,8,10\}$, $B = \{1,3,8,4,6\}$
$A \cap B = \{2,4,6,8\}$

Complement of A set ÷ The complement of a set A refers to the elements not in A, when all sets under consideration are considered to be subsets of a given set U, the absolute complement of A is the set of elements in U but not in A. It denoted by A^c, A'.
For example ÷
$U = \{1,2,3,4,5,6,7,8,9,10\}$
$A = \{1,2,3\}$
$A^c = \{4,5,6,7,8,9,10\}$

Difference of A set ÷ The difference between two sets, written $A - B$ is the set of all elements of A that are not in elements of B. The difference operation, along with union, intersection is an important and fundamental set theory operation.
Example $U = \{a,b,c,d,e,f,g,h\}$
$A = \{a,b,c,e,h\}$
$B = \{b,c,f,h\}$
$A - B = \{a,e\}$

Symmetric difference of a set ÷ The symmetric difference of set A with respect to set B is the set of elements which are in either of the sets A and B but not in their intersection. This is denoted as $A \Delta B$ or $A \ominus B$
For example ÷ If $A = \{1,2,3,4,5,6,7,8\}$ and $B = \{1,3,5,6,7,8,9\}$

then $A - B = \{2,4\}$, $B - A = \{9\}$
$\therefore A \Delta B = \{2,4,9\}$

Question 4

$U = \{1,2,3,4,5,6,7,8,9\}$
$A = \{2,3,4,5,6,9\}$
$B = \{0,2,4,8 \ldots 20\}$
$C = \{1,3,5 \ldots\}$
$D = \{1,2,3,4,5,6,7,8,9\}$

i) $B \cap C = \{\cancel{2,4}\}$
ii) $A \cap D = \{3,5,6,9,4\}$
iii) $A \cap C = \{3,5,9\}$
iv) $A \cup B = \{0,2,3,4,5,6,8,9 \ldots 20\}$ / $\{0,2,3,4,5,6,8,9,10,11,12,13,14,15,16,17,18,19,20\}$
v) $B \cup D = \{0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20\}$
$A \cap C \mid B^c = \{1,3,5,7,9\}$ ~~11, 13, 15, 17, 19~~
$B^c \mid D^c = \{\ \}$
$C^c \mid C^c = \{2,4,6,8\}$
$A - B = \{3,5,6,9\}$
$D - C = \{2,4,6,8\}$
$C - B = \{1,3,5,7,9,11,13,15,17,19\}$
$A \oplus C = A - C \cup C - A$
$A - C = \{3,5,9\}$
$C - A = \{0,8,10,12,14,16,18,20\}$
$A \oplus C = \{0,3,5,8,9,10,12,14,16,18,20\}$

The concept of initial segment is often (and usually more clearly) reffered to by its mundane description: the set of preceding elements

<u>Contatination Of String</u> :- String concatenation is the operation of joining character strings end to end. In some but not all formalisations of concatenation theory

<u>Language</u> :- A language L over an alphabet Σ is a collection of strings (word) or Σ. Recall that Σ^* denotes the set of all words of strings on Σ. T are empty words.

Question 6

A = {a, c, e, i, o, n

V = concatenation

U = catetioncona

i) Length of word = V, (Cv) = 13

ii) Concatenate V and U :- V·U = {concatenationcatetioncona}

iii) Reverse String U ÷ U^R = {anocnoitetac}

iv) M = Cacontatione

∴ the substring of m is $\Sigma^0 \cup \Sigma^1\ \Sigma^2 \cup \Sigma^3 \cup \Sigma^4 \cup \Sigma^5 \cup \Sigma^6 \cup \Sigma^7 \cup \Sigma^8 \cup \Sigma^9 \Sigma^{?}$
$\Sigma^{4} \cup \Sigma^{n}$

$\Sigma^0 = \{\varepsilon, \lambda\}$

$\Sigma^1 = \{a, c, o, n, t, i, e\}$

Question 7

S = ~~abr~~ abracaba

i) the sub string of S

$S = \Sigma^0 \cup \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \cup \Sigma^4 \cup \Sigma^5 \cup \Sigma^6 \cup \Sigma^7 \cup \Sigma^8$

$\Sigma^0 = \{\varepsilon; T\}$

$\Sigma^1 = \{a, b, r, c\}$

$\Sigma^2 = \{ab, br, ra, ac, ca, ab, ba\}$

$\Sigma^3 = \{abr, bra, rac, aca, cab, aba\}$

$\Sigma^4 = \{abra, brac, raca, caba, acab\}$

$\Sigma^5 = \{abrac, bracab, racaba\}$

$\Sigma^6 = \{abraca, bracab, racaba\}$

$\Sigma^7 = \{abracab, bracaba\}$

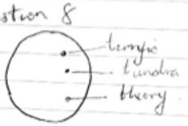
$\Sigma^8 = \{abracaba\}$

S = {ε, a, b, r, c, ab, br, ra, ac, ca, ab, ba, abr, bra, rac, aca, cab, aba, abra, brac, raca, caba, acab, abrac, braca, racab, acaba, abraca, bracab, racaba, abracab, bracaba, abracaba}

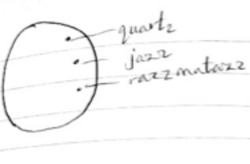
ii Initial segment S ÷ {a, ab, ac, ab, abr, aca, aba, abra, acab, abrac, acaba, abracm, abracab, abracaba}

Question 8

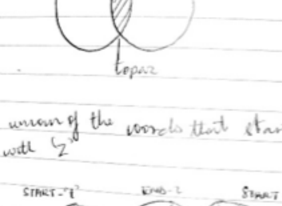
i) START - t



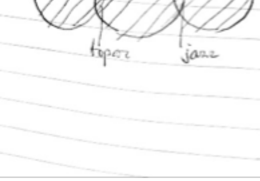
ii END - z



iii) The intersection between words that start with "t" & the that that ends with "z"



iv) The union of the words that start with "T", "J" and ends with "z"



Question 9

i) Sets of Strings containing 11 in it
$\{011, 111, 1011, 110, \dots\}$

ii) Sets of all strings starting with 0 and ending with 1
$\{01, 001, 0101, \dots\}$

iii) Set of all strings with length 2
$\{00, 01, 10, \dots\}$

iv) Sets of all strings ending with 10
$\{010, 1110, 00110, \dots\}$

Question 10

i) Possible alphabets for $L = \{en, naub, ugh\}$.
Solution
$\{ \Sigma, e, g, b, n, o, u \}$

ii) possible alphabet for $L = \{bear, rear, 2200\}$

Solution
$\{ \Sigma, b, e, a, r, 2, 0 \}$

iii) Possible alphabet of all binary strings
$= \{ \Sigma, 0, 1 \}$.

Question 11

$A = \{0, P\}$

i. set of all strings ending with p
$(0+p)^* p$
(ii) Set of all strings with equal number of 0's p's
$(0+p)^*$
(iii) Set of all strings starting with p and ending with 0
$p(0+p)^* 0$
(iv) Set of strings with length 4
$(0+p)(0+p)(0+p)(0+p)$

Question 12

1. $\{b^n a \mid n > 0\}$
Set of all string beginning with one or more b's followed by an a.
ii) $\{a^n a b^m \mid n \geq 0, m > 0\}$
Set of all strings beginning with zero or more a's followed by one a followed by one or more b's
iii) $\{b^n b^m a^m \mid n \geq 0, m \geq 0\}$
Set of all strings beginning with zero or more b's followed by zero or more b's followed by zero or more a's
iv) {ab, abb, aab, aba, bbbab, ... }
$\{b^p a^m b^n \mid p \geq 0, m > 0, n \geq 0\}$
Set of all strings beginning with zero or more b's followed by one or more a's followed by zero or more b's

Question 13

$A = \{a, b\}$

i) $\{b, ba, bab, bab, bbb, \dots\}$

$\{b^n a^m b^p \mid n > 0, m \geq 0, p \geq 0\}$

Set of all strings beginning with one or more b's followed by zero or more b's

ii) $\{bab, babb, bbab, bbabb, babbb, bbbab, \dots\}$

$b^m a b^n \mid m > 0, n > 0$

Set of all strings starting with one or more b's followed by one a followed by one or more b's

iii) $\{b, bb, bbb, bbbb \dots\}$

$\{b^n b^m \mid n \geq 0, m \geq 0\}$

iv) $\{ab, aabb, aaabbb \dots\}$

$a^m b^m \mid m \geq 0, n \geq 0\}$

Question 14

L, L_1, L_2 are languages over Σ

Union ÷ $L \cup L_2 = \{u \in \Sigma^* \mid u \in L_1 \text{ or } u \in L_2\}$

Intersection ÷ $L_1 \cap L_2 = \{u \in \Sigma^* \mid u \in L_1 \text{ and } u \in L_2\}$

difference ÷ $L_1 - L_2 = \{u \in \Sigma^* \mid u \in L' \text{ and } u \notin L_2\}$

Complement = $\bar{L} = \Sigma^* - L$

Positive closure ÷ $L^+ = \bigcup_{i=0}^{\infty} L^i = L^1 \cup L^2 \cup \dots$

Question 14 (contd)

Star operation = $L^* = \bigcup_{i=0}^{\infty} L^i = L^0 \cup L^1 \cup L^2 \cup, \dots \cup L^i$

Multiplication = $L_1 L_2 = \{uv \mid u \in L_1, v \in L_2\}$

Power ÷ $L^0 = \{\varepsilon\}$ or $\{\lambda\}$, $L^n = L^{n-1} L^1$ if $n \geq 1$

$B \oplus C = B - C \cup C - B$

$B - C = \{0, 2, 4, 8 \ldots 20\}$

$C - B = \{1, 3, 5 \ldots\}$

$B \oplus C = \{0, 1, 2, 3, 4, 5, 8 \ldots 20\}$

$C \oplus D =$

xv) $D \oplus B = D - B \cup B - D$

Question 5

Alphabet :- In formal language theory, a string is defined as a finite sequence of members of an underlying base set of this set is called the alphabet of a string or collection of strings. It is denoted as Σ

Word :- It is a branch of computer science and mathematics that deals with logic of computation with simple machines

Length of a word :- Usually, the defined bit length of a word is equivalent to the width of the computer's data bus so that a word can be moved in a single operation from storage to a processor register. For any computer architecture with an eight-bit byte, the world will be some multiple of eight bits

Substring :- A substring is a contiguous sequence of characters within a string. For instance, "the best of" is a substring of "it was the best of times".

Initial segment :- The initial segment (of S) determined by a is defined as:

$S_a := \{b \in S : b \leq a \wedge b \neq a\}$

which is also rendered as:

$S_a := \{b \in S : b < a$