	CS402- Theory of Automata **Solved Subjective** **From Final term Papers**	**Feb 14,2013**
MC100401285	*Moaaz.pk@gmail.com* *Mc100401285@gmail.com*	**PSMD01**

FINALTERM EXAMINATION
Spring 2012
CS402- Theory of Automata

What is the concept of the Union of FA's ?
Answer:- (Page 32)
FA3 be an FA corresponding to r1+ r2, and then the initial state of FA3 must correspond to the initial state of FA1 and the initial state of FA2.

What does mean the LANGUAGE IS CLOSED?
Answer:- (Page 90)
Closed w.r.t. concatenation i.e.the language expressed by RE of type r*.

Stack consistence means that in the PDA?
Answer:- (Page 123)
when a row pops a character it should be there at the top of the STACK

-Where Null string is use the most?
Answer:-
The choice of null string depends on the requirements of the language. In some case we need to have null string to be accepted by the FA.

PUSHDOWN AUTOMATON (PDA)?
Answer:- (Page 119)
PUSHDOWN STACK or PUSHDOWN STORE
PUSHDOWN STACK is a place where the input letters can be placed until these letters are referred again. It can store as many letters as one can in a long column.
Initially the STACK is supposed to be empty i.e. each of its storage location contains a blank.

دنیا میں سب سے مشکل کام اپنی اصلاح اور سب سے آسان کام دوسروں پر نکتہ چینی کرنا ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

Prefixes of a language in another language?

Answer:- (Page 78)

Prefixes of a language in another language

If two languages R and Q are given, then the language the prefixes of Q in R denoted by Pref(Q in R) is the set of strings of letters that, when concatenated to the front of some word in Q to produce some word in R i.e. Pref(Q in R) = the set of all strings p such that there exists words q in Q and w in R such that pq = w. Following are the examples in this regard

Example

Let Q = {aa,abaaabb,bbaaaaa,bbbbbbbbbb} and R = {b,bbbb,bbbaaa,bbbaaaaa}

It can be observed that aa and bbaaaaa occur at the ending parts of some words of R, hence these words help in defining the language pref(Q in R). Thus pref(Q in R) = {b,bbba,bbbaaa}

Conversion form of PDA?

Answer:- (Page 119)

Conversion form of PDA

A PDA is in conversion form if it fulfills the following conditions:

There is only one ACCEPT state.

There are no REJECT states.

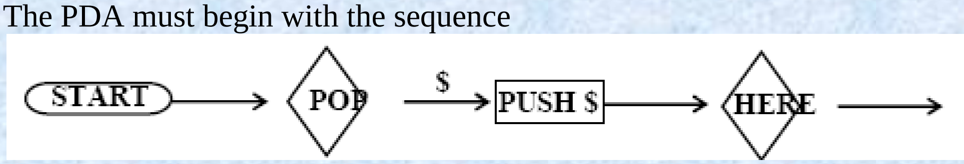
Every READ or HERE is followed immediately by a POP i.e. every edge leading out of any READ or HERE state goes directly into a POP state.

No two POPs exist in a row on the same path without a READ or HERE between them whether or not there are any intervening PUSH states (i.e. the POP states must be separated by READs or HEREs).

All branching, deterministic or nondeterministic occurs at READ or HERE states, none at POP states and every edge has only one label.

Even before we get to START, a “bottom of STACK” symbol $ is placed on the STACK. If this symbol is ever popped in the processing it must be replaced immediately. The STACK is never popped beneath this symbol. Right before entering ACCEPT this symbol is popped out and left.

The PDA must begin with the sequence



The entire input string must be read before the machine can accept the word.

Is automata is a programming subject or theoretical ??? marks 3

Answer:-

In theoretical computer science, automata theory is the study of mathematical objects called abstract machines or automata and the computational problems that can be solved using them. Automata mean "self-acting".

Automata theory is also closely related to formal language theory. An automaton is a finite representation of a formal language that may be an infinite set. Automata are often classified by the class of formal languages they are able to recognize.

بری صحبت سے تنہائی بہتر ہے اور تنہائی سے نیک صحبت بہتر ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

Parsing Techniques (5 number)

Answer:- (Page 136)

Recall the CFG for arithmetic expression

S→S+S|S*S|number

It was observed that the word 3+4*5 created ambiguity by considering its value either 23 or 35. To remove this ambiguity, the CFG was modified to S→(S+S)|(S*S)|number

There arises a question that whether a new CFG can be defined without having parentheses with operator hierarchy (i.e. * before +)? The answer is yes. Following is the required PLUS'TIMES grammar S→E, E→T+E|T, T→F*T|F, F→(E)|i

Where i stands for any identifier i.e. number or of storage location name (variable). Following is the derivation of i+i*i

S ⇒E

⇒T+E

⇒F+E

⇒i+E

⇒i+T

⇒i+F*T

⇒i+i*T

⇒i+i*F

⇒i+i*i

-What are live and dead productions. (5 number)

Answer:- (Page 127)

Live production: A production of the form nonterminal → string of two nonterminals is called a live production.

Dead production: A production of the form nonterminal → terminal is called a dead production.

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1: How can we define languages elaborate any five ways.

Answer:- (Page 4)

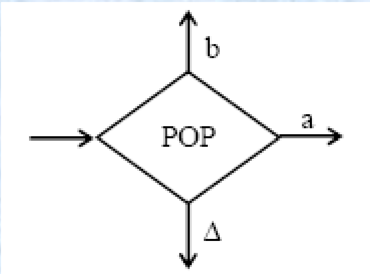
Defining Languages

The languages can be defined in different ways , such as Descriptive definition, Recursive definition, using Regular Expressions (RE) and using Finite Automaton (FA) etc.

اللہ کا خوف سب سے بڑی دانائی ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

2: Describe the POP operation and draw symbol for POP state in context of Push down stack.
Answer:- (Page 107)
POP :
POP is an operation that takes out a letter from the top of the STACK. The rest of the letters are moved one location up. POP state is expressed as



3: Write two difference and two similarities between DFA and NFA.
Answer:- Click here for detail
Difference
1-In FA Finite number of states, having one initial and some (maybe none) final states. While in NFA Finite many states with one initial and some final state. 2-In FA for each state and for each input letter there is a transition showing how to move from one state to another while in NFA there may be more than one transition for certain letters and there may not be any transition for certain letters. 3-In FA □ is valid while in NFA □ is not valid.

Common
Every Language that can be recognized by a DFA can also be recognized by a NFA. The reverse is True.
Both DFA and NFA can only have one start state. But they can have multiple Final states.
Finite set of input letters

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Concept of unit production in CFG? [3 marks]
Answer:- (Page 100)
The productions of the form nonterminal → one nonterminal, is called the unit production.
Unit production is removed in CFG

دنیا کی سب سے بڑی فتح نفس پر قابو رکھنا ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

While converting mealy to Moore num of states remain same or not? justify [5]

Answer:- (Page 61)

Theorem

Statement

For every Mealy machine there is a Moore machine that is equivalent to it (ignoring the extra character printed the Moore machine).

- **Proof**
- Let M be a Mealy machine. At each state there are two possibilities for incoming transitions
- The incoming transitions have the same output character.
- The incoming transitions have different output characters.
- If all the transitions have same output characters, then shift that character to the corresponding state.
-
- If all the transitions have different output characters, then the state will be converted to as many states as the number of different output characters for these transitions, which shows that if this happens at state q then q will be converted to qi^1 and qi2 i.e. if at qi there are the transitions with two output characters then qi1 for one character and q2 for other character.
-
- Shift the output characters of the transitions to the corresponding new states qi and qi. Moreover, these new states q1 and q2 should behave like q as well. Continuing the process, the machine thus obtained, will be a Moore machine equivalent to Mealy machine M.
-

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Consider the language L which is EVEN-EVEN, defined over Σ = {a,b}. In how many classes does L may partition Σ*. Explain briefly.(MArks 3)

Answer:- (Page 77)

Consider the language L which is EVEN'EVEN, defined over Σ = {a,b}. It can be observed that L partitions Σ* into the following four classes

C1= set of all strings with even number of a’s and odd number of b’s.
C2= set of all strings with odd number of a’s and odd number of b’s.
C3= set of all strings with odd number of a’s and even number of b’s.
C4= set of all strings with even number of a’s and even number of b’s.

Q.3: What does mean the LANGUAGE IS CLOSED?(MArks 3)

Answer:- Rep

ایماندار کو غصہ دیر سے آتا ہے اور جلدی دور ہو جاتا ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

Q7: If two FA have no final state how the intersection of those FA will have final state? (marks 2)
Answer:- (Page 83)
If Both the FAs have no final state, so these FAs accept nothing. This implies that their union will not also accept any string. Hence FA corresponding to the language $(L1\cap L2c) \cup (L1c\cap L2)$ accepts nothing. Thus both the languages are equivalent.

Q:8 give RE for EVEN - EVEN language. (Marks 2)
Answer:- (Page 16)
Consider the EVEN) EVEN language, defined over $\Sigma = \{a, b\}$. As discussed earlier that EVEN)EVEN language can be expressed by the regular expression (aa+bb+(ab+ba)(aa+bb)*(ab+ba))* b

use of push and pop states
Answer:- (Page 107)
A PUSH operator adds a new letter at the top of STACK,
POP is an operation that takes out a letter from the top of the STACK. The rest of the letters are moved one location up.

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Write point of kleen's theorem? 2marks
Answer:- (Page 25)
Kleene’s Theorem
If a language can be expressed by
FA or
TG or
RE
Then it can also be expressed by other two as well.
It may be noted that the theorem is proved, proving the following three parts

Kleene’s Theorem Part I
If a language can be accepted by an FA then it can be accepted by a TG as well.
Kleene’s Theorem Part II
If a language can be accepted by a TG then it can be expressed by an RE as well.
Kleene’s Theorem Part III
If a language can be expressed by a RE then it can be accepted by an FA as well.

زندگی میں کامیابی کا یہی راز ہے کہ پریشانیوں سے پریشان مت بنو

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

What is meant by decidable problem? 2marks

Answer:- (Page 80)

- Decidable problem
- A problem that has decision procedure is called decidable problem e.g. the following problems
- The two regular expressions define the same language.
- The two FAs are equivalent.

Define strings. With example. 3marks

Answer:- (Page 3)

Concatenation of finite number of letters from the alphabet is called a string.

Write regular expression contain even words defined over sigma={a, b} 3marks

Answer:- (Page 9)

((a+b)(a+b))*

Find Pref (Q in R) for:

Q = {10, 11, 00, 010}

R = {01001, 10010, 0110, 10101, 01100, 001010} 3 marks

Answer:-

- Pref (Q in R) ={10,01,011,001}

Explain Semi word and word with example?

Answer:- (Page 97)

Semiword

A semiword is a string of terminals (may be none) concatenated with exactly one nonterminal on the right i.e. a semiword, in general, is of the following form

(terminal)(terminal)··· (terminal)(nonterminal)

S→aaaaS

word

A word is a string of terminals. Λ is also a word.

S→aaaa

a) Write RE defined over Σ ={a, b} strings not ending on aa, ab. 5marks

Answer:-

(a+b)*(ba+bb)

b) Write RE defined over Σ = {a, b} strings must end on aa,ab

Answer:-

(a+b)*(aa+ab)

جھوٹ انسان اور ایمان دونوں کا دشمن ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

What does mean the LANGUAGE IS CLOSED? 3marks
Answer:- Rep

Explain CFG and even-even language. 5marks
Answer:- (Page 87-90)
CFG
CFG is a collection of the followings
An alphabet Σ of letters called terminals from which the strings are formed, that will be the words of the language.
A set of symbols called non-terminals, one of which is S, stands for "start here".
A finite set of productions of the form
Non-terminal → finite string of terminals and /or non-terminals.
Following grammar generates EVEN-EVEN language.
Σ = {a,b}
productions:
S → SS
S → XS
S → Λ
S → YSY
X → aa
X → bb
Y → ab
Y → ba

OR

Consider the following CFG
S → aaS|bbS|abX|baX|Λ
X → aaX|bbX|abS|baS,
The corresponding language is EVEN-EVEN.

Differentiate b/w FA, TG and GTG?
Answer:-
FA
A Finite automaton (FA), is a collection of the followings
Finite number of states, having one initial and some (maybe none) final states.
Finite set of input letters (Σ) from which input strings are formed.
Finite set of transitions i.e. for each state and for each input letter there is a transition showing how to move from one state to another.

عقل مند کہتا ہے میں کچھ نہیں جانتا جبکہ بے وقوف کہتا ہے کہ میں سب کچھ جانتا ہوں

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

TG

A Transition graph (TG), is a collection of the followings

Finite number of states, at least one of which is start state and some (maybe none) final states.

Finite set of input letters (Σ) from which input strings are formed.

Finite set of transitions that show how to go from one state to another based on reading specified substrings of input letters, possibly even the null string (Λ).

GTG

A generalized transition graph (GTG) is a collection of three things

Finite number of states, at least one of which is start state and some (maybe none) final states.

Finite set of input letters (Σ) from which input strings are formed.

Directed edges connecting some pair of states labeled with regular expression.

It may be noted that in GTG, the labels of transition edges are corresponding regular expressions

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1. Can we accept the string going from final to initial state?

Answer:- (Page 81)

NO…

To examine whether a certain FA accepts any words, it is required to seek the paths from initial to final state.

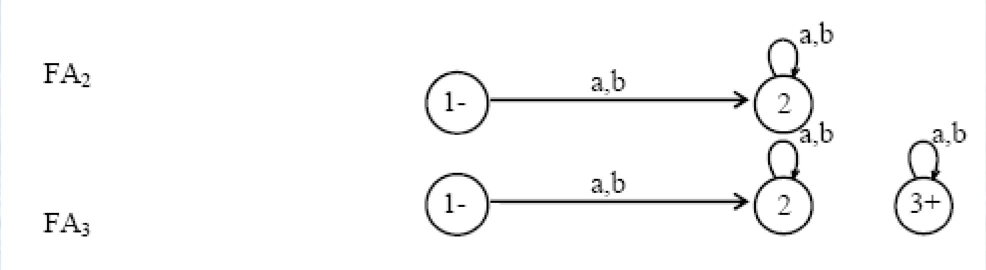
2. State uses of PDA in computing?

Answer:-

It provides theoretical basis for how computing machine can perform computation. It is uses for constructing compiler parser design.

3. if there is no initial state in FA then that FA does not accept any language Discuss two situations when an FA does not accept any string not even the null string?

Answer:- (Page 15)



In FA2, there is no final state and in FA3, there is a final state but FA3 is disconnected as the states 2 and 3 are disconnected.

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

4. Describe pop operation?and draw symbol for pop state in contex of push down stack?
Answer:- Rep

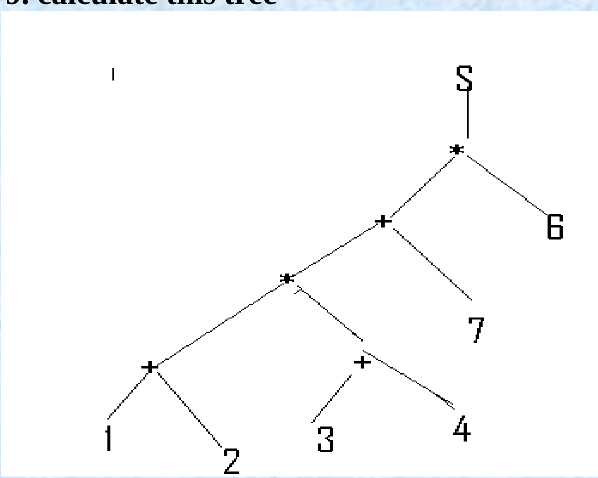
5. Describe unit production in detail?
Answer:- Rep

6. Push and pop operation?
Answer:- Rep

7. Prove kleens theorem part two?
Answer:- (Page 25)
Kleene’s Theorem Part II
If a language can be accepted by a TG then it can be expressed by an RE as well.

8. Difference between push down stack and push down store?
Answer:- (Page 107)
There is no difference between PUSHDOWN STACK or PUSHDOWN STORE
PUSHDOWN STACK is a place where the input letters can be placed until these letters are referred again. It can store as many letters as one can in a long column.
Initially the STACK is supposed to be empty i.e. each of its storage location contains a blank.

9. calculate this tree



Answer:- (Page 95)
It can be written as *+*+1 2+3 4 7 6)
The above arithmetic expression in (o'o'o) form can be calculated as
++1 2+3 4 7 6 = *+*3+3 4 7 6
= *+*3 7 7 6 = *+21 7 6 = *28 6 = 168

خود کو تمھیں سے بڑھ کر کوئی اچھا مشورہ نہیں دے سکتا

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

10. Five conditions of PDA conversion?

Answer:- (Page 119)

A PDA is in conversion form if it fulfills the following conditions:
There is only one ACCEPT state.
There are no REJECT states.
Every READ or HERE is followed immediately by a POP i.e. every edge leading out of any READ or HERE state goes directly into a POP state.
No two POPs exist in a row on the same path without a READ or HERE between them whether or not there are any intervening PUSH states (i.e. the POP states must be separated by READs or HEREs).
All branching, deterministic or nondeterministic occurs at READ or HERE states, none at POP states and every edge has only one label.

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Q1: what is POP stake and draw it diagram.

Answer:- Rep

Q6 : Consider the following CFG
S aXb|bXa
XaX|bX|
What does it mean?

Answer:- (Page 91)

The above CFG generates the language of strings, defined over ={a,b}, beginning and ending in different letters.

Q7: Explain Distinguishable strings and Indistinguishable strings?

Answer:- (Page 53)

Distinguishable strings and Indistinguishable strings

Two strings x and y, belonging to Σ^*, are said to be **distinguishable** w.r.t a language $L \subseteq \Sigma^*$ if there exists a string z belonging to Σ^* s.t. $xz \in L$ but $yz \notin L$ or $xz \notin L$ but $yz \in L$.
Two strings x and y, belonging to Σ^*, are said to be **indistinguishable** with respect to a language $L \subseteq \Sigma^*$ if for every string z belonging to Σ^*, either both xz or yz $\in L$ or both don't belong to L.

جو شخص ناکامیوں سے ڈر کر بھاگتا ہے کامیابی اُس سے ڈر کر بھاگتی ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

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1. What is Row Language?
Answer:- (Page 123)
Row language whose alphabet is Σ = {Row1, Row2, ⋯, Row7} i.e. the alphabet consists of the letters which are the names of the rows in the summary table.

2. What does FA stands for?
Answer:- (Page 11)
Finite Automaton

3. What are live and dead productions.
Answer:- (Page 123)
Live production: A production of the form nonterminal → string of two nonterminals is called a live production.
Dead production: A production of the form nonterminal → terminal is called a dead production.

4. What do you mean by wanted and unwanted branches?
Answer:- (Page 137)
wanted branches (the branches that lead to the required word)
unwanted branches (the branches that don't lead to the required word)

5.Given the CFG, had to write the language (EQUAL)
Answer:- (Page)
Σ = {a,b}
productions:
S → aB
S → bA
A → a
A → aS
A → bAA
B → b
B → bS
B → aBB
This grammar generates the language EQUAL(The language of strings, with number of a’ s equal to number of b’ s).

جو لوگوں کے سامنے فخر کرتا ہے وہ لوگوں کی نظروں سے گر جاتا ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

6. Construct corresponding CFG for the given language
(1) All words of even length but not multiple of 3.

Answer(page 90)
Example
$\sum = \{a,b\}$
productions:
$S \rightarrow SS$
$S \rightarrow XS$
$S \rightarrow \Lambda$
$S \rightarrow YSY$
$X \rightarrow aa$
$X \rightarrow bb$
$Y \rightarrow ab$
$Y \rightarrow ba$
This grammar generates EVEN'EVEN language.

(2) Palindrome (both even and odd palindrome). (5 mark)
Answer(page 91)
Example
The CFG for odd length of Palindrom is given as:

$S \rightarrow aSa \mid bSb \mid a \mid b$
The CFG for even length of Palindrom is given as:
$S \rightarrow aSa \mid bSb \mid aa \mid bb \mid \wedge$

7.Who invented Turing m/c
Answer:- (Page 140)
Alan Mathison Turing developed the machines called Turing machines.

8.Equivalent /non-equivalent langages
Answer:- (Page 80)

Determining whether the two languages are equivalent or not ?
If L_1 and L_2 are two regular languages, then they can be expressed by FAs. As shown earlier, L_1^c , L_2^c , $L_1 \cup L_2$, $L_1 \cap L_2$ are regular languages and the methods have already been developed to build their corresponding FAs. It can be observed that $(L_1 \cap L_2^c) \cup (L_1^c \cap L_2)$ is regular language that accepts the words which are in L_1 but not in L_2 or else in L_2 but not in L_1 . The corresponding FA cannot accept any word which is in both L_1 and L_2 i.e. if L_1 and L_2 are equivalent, then this FA accepts not even null string. Following are the methods that determine whether a given FA accepts any words

عقل مند اپنے عیب خود دیکھتا ہے اور بیوقوفوں کے عیب دنیا دیکھتی ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

9. What are formal languages?
Answer:- (Page 3)
Formal Languages are Syntactic languages.

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What is Transition?
Answer:- (Page 11)
Transition showing how to move from one state to another.

Alternative form of this production
$\Sigma = \{a,b\}$
productions:
$S \rightarrow aS|\ bS\ |a|b|\ \Lambda$
Answer:- (Page 88)
This grammar also defines the language expressed by (a+b)*.

What is input Tap?
Answer:- (Page 105)
The part of an FA, where the input string is placed before it is run, is called the input TAPE.
The input TAPE is supposed to accommodate all possible strings. The input TAPE is partitioned with cells, so that each letter of the input string can be placed in each cell.

What is live production?
Answer:- Rep

Differentiate between Distinguishable and Indistinguishable strings.
Answer:- Rep

What is wanted and unwanted branches
Answer:- Rep

What is unit of production?
Answer:- Rep

بد صورت چہرہ بد صورت دماغ سے بہتر ہے

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

Define two rules ………………(Row Language.).

Answer:- (Page 125)

Following are the three rules of defining all possible productions of CFG of the row language
The trip starting from START state and ending in ACCEPT state with the NET style
Net(START, ACCEPT, $) gives the production of the form S → Net(START, ACCEPT, $)

(L1UL2^C) intersection (L1^{C}U L2) the language or accept any thing or not…

Answer:- (Page 80)

(L1 ∩ L2c) ∪ (L1c ∩ L2) is regular language that accepts the words which are in L1 but not in L2 or else in L2 but not in L1 .

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ambiguous grammer,

Answer:- (Page 95)

The CFG is said to be ambiguous if there exists atleast one word of it's language that can be generated by the different production trees.

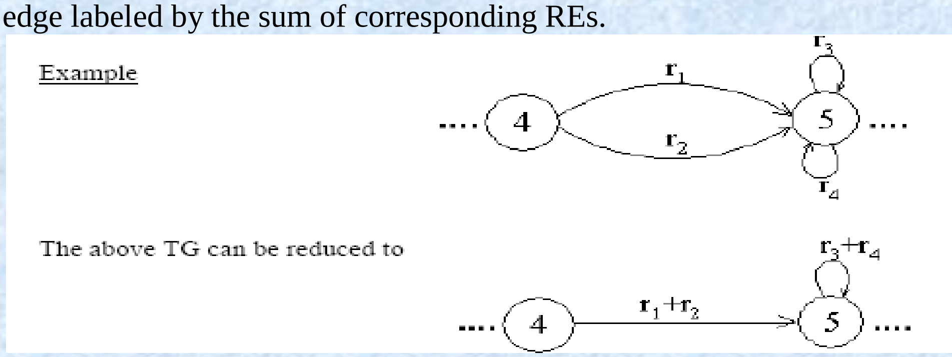
Difference between semi-word and word with example?

Answer:- Rep

If there are more than one edges between two states then we can replace them by one edge in a TG. Explain it with examples?

Answer:- (Page 27)

If a state has two (more than one) incoming transition edges labeled by the corresponding REs, from the same state (including the possibility of loops at a state), then replace all these transition edges with a single transition edge labeled by the sum of corresponding REs.



عقل مند آدمی اس وقت تک نہیں بولتا جب تک خاموشی نہیں ہو جاتی

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

How can you say that two FAs are equivalent?
Answer:- (Page 15)
It is to be noted that two FAs are said to be equivalent, if they accept the same language

What is a production?
Answer: - (Page 87)
Productions: The grammatical rules are often called productions.

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If L1,L2 and L3 be any three finite languages over Sigma = {a,b}, then how will be
$(L1 \cap L2) \cup (L2 \cap L3) \neq \emptyset$
Answer: -
$(L1 \cap L2) \cup (L2 \cap L3) \neq \emptyset$ is not always true. It depends on all the languages. If L1 has some common words with L2 or L2 has some common words with L3, then this will not be equal to empty. However if L1 does not have common words with L2 or L2 does not have common words with L3 then this statement will be wrong.

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two different method for converting the NFA to FA 5marks
Answer: - (Page 43)
Method 1: Since an NFA can be considered to be a TG as well, so a RE corresponding to the given NFA can be determined (using Kleene' s theorem). Again using the methods discussed in the proof of Kleene's theorem, an FA can be built corresponding to that RE. Hence for a given NFA, an FA can be built equivalent to the NFA

Method 2: Since in an NFA, there may be more than one transition for a certain letter and there may not be any transition for certain letter, so starting from the initial state corresponding to the initial state of given NFA, the transition diagram of the corresponding FA, can be built introducing an empty state for a letter having no transition at certain state and a state corresponding to the combination of states, for a letter having more than one transitions

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Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies
(IEMS) Samundari

Explain the decidability and examples. 5marks

Answer: - (Page 80)

Decidability

Effectively solvable problem

A problem is said to be effectively solvable if there exists an algorithm that provides the solution in finite number of steps e.g. finding solution for quadratic equation is effectively solvable problem, because the quadratic formula provides an algorithm that determines the solution in a finite number of arithmetic operations, (four multiplications, two subtractions, one square root and one division).

similarity and dif b/w DFA and NFA 3 marks

Answer: - Rep

RE for Even-even 2 marks

Answer: - (Page 10)

(aa+bb+(ab+ba)(aa+bb)*(ab+ba))*

FINALTERM EXAMINATION
Fall 2010
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Question No: 27 (Marks: 2)

Differentiate between Regular and Non regular languages?

Answer: - (Page 10 & 71)

The language generated by any regular expression is called a regular language.
The language that cannot be expressed by any regular expression is called a Nonregular language.

Question No: 28 (Marks: 2)

What is meant by a "Transition" in FA?

Answer: - Rep

Question No: 29 (Marks: 2)

What are the halt states of PDAs?

Answer: - (Page 105)

ACCEPT and REJECT states are called the halt states.
Reject state is like dead non final state.
Accept state is like final state.

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Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari

Question No: 30 (Marks: 2)
Identify the null productions and nullable productions from the following CFG:
S -> ABAB
A -> a | /\
B-> b | /\
Answer: - (Page 102)
Here S → ABAB is nullable production and A → Λ, B → Λ are null productions.

Question No: 31 (Marks: 3)
Describe the POP operation and draw symbol for POP state in context of Push down stack.
Answer: - Rep

Question No: 32 (Marks: 3)
What does the the following tape of turing machine show?

FROM Where	TO Where	READ What	POP What	PUSH What	ROW Number
$READ_9$	$READ_3$	b	b	abb	11

Answer: - (Page 124)
Row11 is not Net style sentence because the trip from READ9 to READ3 does not pop one letter form the STACK, while it adds two letters to the STACK. However Row11 can be concatenated with some other Net style sentences e.g. Row11Net(READ3, READ7, a)Net(READ7, READ1, b)Net(READ1, READ8, b) Which gives the nonterminal.
Net(READ9, READ8, b), now the whole process can be written as
Net(READ9, READ8, b) → Row11Net(READ3, READ7,a) Net(READ7, READ1, b)Net(READ1, READ8, b)
Which will be a production in the CFG of the corresponding row language.

Question No: 33 (Marks: 3)
Find Pref (Q in R) for:
Q = {10, 11, 00, 010}
R = {01001, 10010, 0110, 10101, 01100, 001010}
Answer: - Rep

Question No: 35 (Marks: 5)
Consider the language L which is EVEN-EVEN, defined over **Σ** = {a,b}. In how many classes does L may partition **Σ***. Explain briefly.
Answer: - Rep
Question No: 36 (Marks: 5)
What are the conditions (any five) that must be met to know that PDA is in conversion form?
Answer: - Rep

Muhammad Moaaz Siddiq – MCS(4th)
Moaaz.pk@gmail.com
Campus:- Institute of E-Learning & Moderen Studies (IEMS) Samundari