SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

IMPORTANT QUESTIONS

UNIT III
SIMPLE 4 MARK QUESTION WITH ANSWER

1. **What are the different ways of language acceptances by a PDA and define them? (Dec 15)**

   PDA accepts its input either by "acceptance by final state" or "Acceptance by Empty stack"

PDA acceptance by empty stack method	**PDA acceptance by empty final method**
PDA accepts when set of strings that cause the PDA to empty its stack	PDA accepts its input by consuming it and entering an accepting state
For each PDA $P = (Q,\Sigma,\Gamma,\delta, q_0, Z_0, F)$ then $L(P) = \{w \mid (q_0,w,z_0) \quad (q,\in,\alpha)\}$	For each PDA $P = (Q,\Sigma,\Gamma,\delta , q_0 , Z_0 ,F)$ then N(P) $= \{w \mid (q_0,w,z_0) \quad (q,\in, \in)\}$

2. **Does a PDA has a memory? Justify (May 16)**

   The Push down automaton is in essence a nondeterministic fine automaton with ε-transitions permitted and one additional capability: a stack on which it can store a string of "stack symbols". Thus the automaton can remember an infinite amount of information.

3. **Define pumping lemma for CFL (May 15,16)**

   Let L be a CFL+ then there exists a constant n such that if z is any string in L such that |z| is at least n, then we can write z = uvwxy subject to the following consitions:

   - $|vwx| \leq n$. That is, the middle portion is not too long.
   - $vx \neq \in$. Since v and x are the pieces to be pumped, these strings should not be empty
   - For all $i \geq 0$, uv^iwx^iy is in L. These two strings are pumped any number of times

4. **Differentiate PDA acceptance by empty stack method with acceptance by final method (May 15)**

PDA acceptance by empty stack method	**PDA acceptance by empty final method**
PDA accepts when set of strings that cause the PDA to empty its stack	PDA accepts its input by consuming it and entering an accepting state
For each PDA $P = (Q,\Sigma,\Gamma,\delta,q_0,Z_0,F)$ then $L(P) = \{w \mid (q_0,w,z_0) \quad (q,\in,\alpha)\}$	For each PDA $P = (Q,\Sigma,\Gamma,\delta,q_0,Z_0,F)$ then $N(P) = \{w \mid (q_0,w,z_0) \quad (q,\in,\in)\}$

5. **Define Push Down Automata (May 2016, Dec 15)**

The formal notation for PDA involves seven components the specification are : $P = (Q,\Sigma,\Gamma,\delta,q_0,Z_0,F)$ where,

Q = Finite set of states, ,Σ = Finite set of input symbol,Γ = A finite stack alphabets,δ = transition function,q_0 = Start State,Z_0 = Start symbol, F = Accepting state

6. **Compare NFA and PDA**

NFA	**PDA**
The language accepted by NFA is the regular language	The language accepted by PDA is Context free language.
NFA has no memory.	PDA is essentially an NFA with a stack (memory).
It can store only limited amount of information.	It stores unbounded limit of information.
A language/string is accepted only by reaching the final state.	It accepts a language either by empty Stack or by reaching a final state.

7. **Define Deterministic PDA**

A PDA $M = (Q,\Sigma,\Gamma,\delta,q_0,Z_0,F)$ is deterministic if and only if the following condition are meet.

- $\delta(q,a,X)$ has at most one member for any q in Q, a in Σ or a $=\in$ and X in Γ
- If $\delta(q,a,X)$ is nonempty, for some a in Σ, then $\delta(q,\in,X)$ must be empty

Eg: $L = \{0^n 1^n \mid n \geq 1\}$

8. What is the significance of PDA?

Finite Automata is used to model regular expression and cannot be used to represent non regular languages. Thus to model a context free language, a Pushdown Automata is used.

9. Define Instantaneous description (ID) in PDA.

The "turnstile" notation is used for connecting pairs of ID's that represent one or many moves of a PDA. The process of transition is denoted by the turnstile symbol "⊢".

- ID describe the configuration of a PDA at a given instant.ID is a triple such as
- (q, w ,γ) , where q is a state , w is a string of input symbols and is a string of stack symbols.
- Instantaneous Description (ID) is an informal notation of how a PDA "computes" a input string and make a decision that string is accepted or rejected.
- The relevant factors of pushdown configuration notation by a triple (q, w, γ) where;
- q is the current state of the control unit
- w is the unread part of the input string or the remaining input alphabets
- γ is the current contents of the PDA stack.

10. Give an example of a language accepted by a PDA but not by DPDA.

The language L = $\{ww^R, \mid w \text{ is in } (0+1)^*\}$ is a example of PDA which cannot be deterministic

11. construct PDA that accepts the language generated by the grammar S->aSbb|aab

The PDA P = {{q}, {a,b}, {S,a,b} , δ , q, S} Where δ defined by:

i) δ(q,∈,S) = {(q,aSbb), (q,aab) }

ii) δ(q,a,a) = {(q, ∈) }

iii) δ(q,b,b) = {(q, ∈) }

12. construct PDA that accepts the language generated by the grammar S->0BB, B->0S|1S|0

The PDA P = {{q}, {0,1}, {S,B,0,1} , δ , q, S} Where δ defined by:

i) δ(q,∈,S) = {(q,0BB) }

ii) δ(q,∈,B) = {(q,0S), (q,1S), (q,0) }

iii) δ(q,0,0) = {(q, ∈) }

iv) δ(q,1,1) = {(q, ∈) }

13. What is the specification of PDA P_F which accept the language by final state which is also accepted by Empty stack PDA P_N

The specification of P_F is as follow:
$P_F = \{Q\cup\{p_0,p_f\}, \Sigma, \Gamma\cup\{X_0\}, \delta_F, p_0, X_0, \{p_f\}\}$ where
p_0 is the new state which push Z_0 then enter the start state of
P_N q_0 p_f is the new accepting state of P_F

14. What is the specification of PDA P_N which accept the language by empty stack which is also accepted by final state PDA P_F

The specification of P_N is as follow:
$P_N = \{Q\cup\{p_0,p_f\}, \Sigma, \Gamma\cup\{X_0\}, \delta_N, p_0, X_0, \{p\}\}$ where
p_0 is the new state which push Z_0 then enter the start state of P_F q_0

For each accepting state of P_F add a transition on $\in$ to p, which pop it stack contents

15. What is the advantage of Pumping lemma over CFL

Pumping lemma over context free language used to check whether the given language are regular or CFL are not.

16. Construct a PDA for the given grammar S→ aAA, A→aS| bS |a (May '15)

PART B/C

Problematic question

1. **Construct a PDA to accept the following language L on ∑={a,b} by empty stack . L ={ww^R | W Є ∑$^+$} (Dec '15 May '16 10 mark)**
2. **Construct a PDA to accept the language L = {a^n b^n c^n | n ≥ 1} by empty stack and by final state (June '14 10 marks)**
3. **Give formal PDA that accepts {wcw^R | w in (0+1)*} by empty stack (Dec '13 8 marks)**
4. **Design a PDA to accept {0^n1^n | n > 1} Draw the transition diagram for the PDA. Show by instantaneous description that the PDA accepts the string '0011' (Dec '15 10 mark)**
5. **Construct PDA to recognize the Grammar G with following production and trace for a String of acceptance and rejection (May '16 10 mark)**

   S → aSA / ε

   A → bB

   /cc B

   →bd / ε
6. **Convert PDA to CFG. PDA is given by (Dec '15 10 mark) P = ({p,q}, {0,1}, {X,Z}, δ , q, Z) where δ is given by**

   δ(p,1,Z) = {(p,XZ)}

   δ(p,ε,Z) = {(p,ε)}

   δ(p,1,X) =

   {(p,XX)}

   δ(q,1,X) = {(q,

   ε)} δ(p,0,X) =

   {(q,X)} δ(q,0,Z)

   = {(p,Z)}

7. **Let M = ($\{q_0,q_1\}$, {0,1}, $\{x,z_0\}$, δ , q_0, z_0,ϕ) where δ is given by**

   $\delta(q_0,0,z_0) = \{(q_0,xz_0)\}$

   $\delta(q_0,0,x) = \{(q_0,xx)\}$

   $\delta(q_0,\in,x) = \{(q_1, \in)\}$

   $\delta(q_0,1,x) = \{(q_1, \in)\}$

   $\delta(q_1,\in, z_0) = \{(q_1, \in)\}$

8. **What is an instantaneous description of a PDA ? How will you represent it ? Also give the three important principle of ID and their transaction (May '16 6 mark)**

9. **Explain acceptance by final state and acceptance by empty stack of a pushdown automata**

   (May '16 8 mark)

10. **State pumping Lemma for CFL. Use pumping lemma to show that the language L =$\{a^ib^jc^k$ |**

    i < j< k} is not a CFL (May '16 8 mark)

11. **Discuss on Deterministic PDA.Differentiate between deterministic pushdown automata and non deterministic pushdown automata (May '16 , Dec '15 6 mark)**

12. **State the pumping lemma for CFLs. What is its main application ? Give two example (Dec**

    '11 8 marks)

13. **If L is context free language prove that there exists a PDA M, such that L = N(M) (Dec '14**

    8 marks)

14. **Prove that if L is N(M_1) (the language accepted by empty stack) for some PDA M_1, then L is**

    N(M_2) (the language accepted by final state) for some PDA M_2 (Dec '14 8 marks)

15. **State pumping Lemma for CFL. Use pumping lemma to show that the language L**

    =$\{a^nb^nc^n$ | $n \geq 1\}$ is not a CFL (Dec '15 6 mark)

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