Theory Assignment
Automata Theory.

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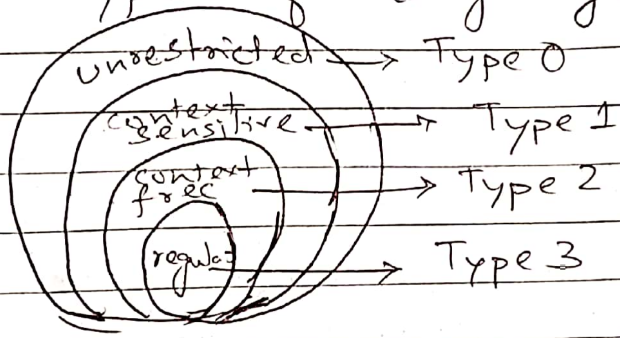
(1) Explain chomsky hierarchy of grammar give the production rules of each type of grammar & give one example of each type. Then mention diff. types of automata which are the acceptors for different types of language.



The Chomksy hierarchy:

Type-0 grammar: unrestricted grammar.
Production rule: $\alpha \to \beta$
$\alpha \in (V \cup T)^* . V . (V \cup T)^*$
$\beta \in (V \cup T)^*$
Example: G: $S ab \to ba$
$A \to S$

Automation: Turing machine.

Type-1 grammar: Context-sensitive grammar

Production rule: $\alpha A \beta \to \alpha \gamma \beta$ or we might say $|\alpha A \beta| <= |\alpha \gamma \beta|$
where $\alpha, \beta \in (V \cup T)^*$, $A \in V$, $\gamma \in (V \cup T)^+$
Example: G: $S \to AB$, $A \to abc$, $B \to b$
Automation: ~~Non-deterministic push down automata~~

Automation: Linear bounded non-deterministic turing machine.

Type-2: Grammar: context free grammar

Production rule: $\alpha \to \beta$
where $\alpha \in V$ and $|\alpha| = 1$, $\beta \in (V \cup T)^*$
Example: $G: S \to AB,\ A \to a,\ B \to b$
Automation: Non-deterministic push down automata

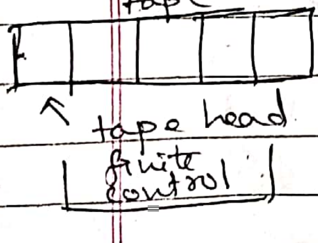
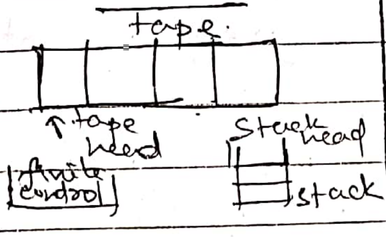
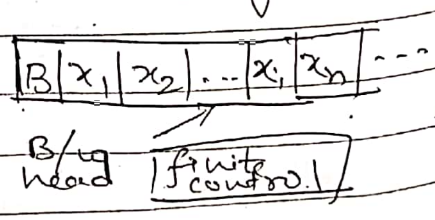
Type 3 Grammar: Regular Grammar

Production rule:
$A \to \alpha \mid aB$ (Right Linear)
$A \to a \mid Ba$ (Left Linear)
where, $A, B \in V$, $|A| = |B| = 1$, $a \in T^*$

Example: $G: S \to Sa,\ S \to a$

Automation: Finite State Automation.

(2.) Differentiate b/w the structures of FSM, PDA & Turing machine mentioning diff. types of each automata.

FSM	PDA	Turing machine
		
FSM is a 5 tuple	PDA is a 7 tuple	It is a 7 tuple.

Date

$M = (Q, \Sigma, \delta, q_0, F)$	$M = (Q, \Sigma, P, q_0, Z_0, F, \delta)$	$M = (Q, \Sigma, P, \delta, q_0, B, F)$
Q = Finite set of states	Q = Finite set of states	Q = Finite set of states
Σ = Finite set of input symbols	Σ = Finite set of i/p alphabets	P = Finite set of symbol
δ = Transition function	F = A set of finite sets	$\Sigma = P - \{B\}$
q_0 = Start state	P = Finite set of stack alphabets	q_0 = Start state
F = final state	q_0 = Initial state	B = Blank symbol
	Z_0 = Starting stack symbol	F = finite set of final states

(3) For the following grammar, find the language produced by them. Give proper explanation.

(a) $G_1: AB \rightarrow AbBC,\ A \rightarrow bCA,\ B \rightarrow b$

It is Type-1, because all the three production follows the type 1 grammar production rule. $\alpha AB \rightarrow \alpha \gamma \beta$ where $\alpha, \beta \in (V \cup T)^*$, $A \in V$, $\gamma \in (V \cup T)^*$ & $|\alpha AB| <= |\alpha \gamma \beta|$, So this grammar will produce context sensitive grammar.

(b) $S \rightarrow AB,\ A \rightarrow a,\ B \rightarrow b$

It is Type-2, since as per type 2, $\alpha \rightarrow \beta$ where $\alpha \in V$ and $|\alpha| = 1$, $\beta \in (V \cup T)^*$. So, this grammar will produce context free grammar.