

FORMAL LANGUAGES & AUTOMATA
QUIZ-2

State the type of each grammar given below with respect to Chomsky hierarchy and explain the reason why that grammar belongs to the type you stated. Write the regular expression for each of these grammars (Give the general form of productions for the grammars (e.g., $a^n b^n c^n$) for which it is not possible to write a regular expression).

Grammar	Type and reason	Regular expression (or general form)
$\langle S \rangle ::= \langle A \rangle \langle B \rangle$ $\langle A \rangle ::= a \langle A \rangle b \mid ab$ $\langle B \rangle ::= b \langle B \rangle a \mid \Lambda$	Type 0: If there is an empty string on the right-hand side, it is definitely Type 0. The only exception is the language involving an empty string in the production rule for S (i.e., $\langle S \rangle ::= \dots \mid \Lambda$) which is allowed by all the grammars except Type 1.	This grammar does not have a regular expression as it is not Type 3. General structure is in the following form: $a^i + b^{i+j} + a^j, i > 0, j \geq 0.$
$S \rightarrow aS \mid bS \mid aba$	Type 3: A single nonterminal on the left-hand side and a right-hand side consisting of a number of terminals followed by a single nonterminal.	$L(G) = (a \vee b)^* aba$
$S \rightarrow aAbc \mid abc$ $A \rightarrow aAbC \mid abC$ $Cb \rightarrow bC$ $Cc \rightarrow cc$	Type 1: Multiple symbols on the left-hand side and the length of the left-hand side can not exceed the length of the right-hand side.	This grammar does not have a regular expression as it is not Type 3. General structure is in the following form: $a^n b^n c^n, n > 0.$
$\langle S \rangle ::= a \langle S \rangle a \mid b \langle S \rangle b \mid c$ $a \langle S \rangle a ::= ac$	Type 0: Multiple symbols on the left-hand side and the length of the left-hand side exceeds the length of the right-hand side.	This grammar does not have a regular expression as it is not Type 3. General structure is in the following form: $x(c \vee ac)x^R, x = (a \vee b)^*.$

Duration: 25 mins