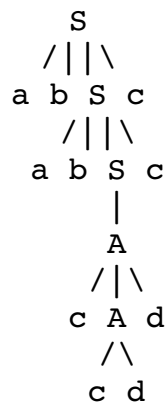


Languages and Machines

Chap3: 1(abc), 2(abc), 4(ab), 12, 15, 21, 25

1.*(a)* $S \rightarrow abSc$ $S \rightarrow ababScc$ $S \rightarrow ababAcc$ $S \rightarrow ababcAdcc$ $S \rightarrow ababccddcc$ *(b)**(c)* $\{ab\}^n c^m d^m \{c\}^n$ $n \geq 0$ $m > 0$ **2.***(a)* $S \rightarrow ASB$ $S \rightarrow aAbSB$ $S \rightarrow aaAbbSB$ $S \rightarrow aabbSB$ $S \rightarrow aabbB$ $S \rightarrow aabbba$ *(b)* $S \rightarrow ASB$ $S \rightarrow aAbSB$ $S \rightarrow abSB$ $S \rightarrow abASBB$ $S \rightarrow abaAbSBB$ $S \rightarrow abaaAbbSBB$ $S \rightarrow abaabbSBB$ $S \rightarrow abaabbBB$

$S \rightarrow abaabbbaB$

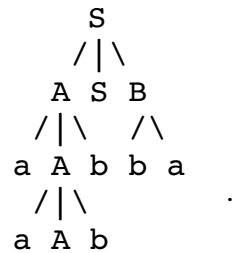
$S \rightarrow abaabbbabBa$

$S \rightarrow abaabbbabbBaa$

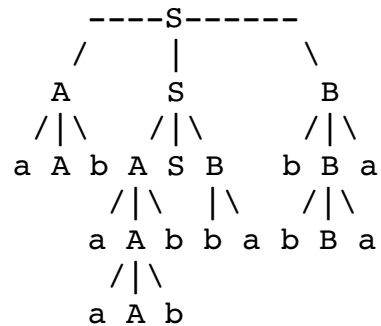
$S \rightarrow abaabbbabbbaa$

(c)

Tree for part a:



Tree for part b:



(d)

$\{a^n b^n\}^m \{b^r a^r\}^m$

where,

$m, n \geq 0$

$r > 0$

4.

(a)

$S \rightarrow AB$

$S \rightarrow aAB$

$S \rightarrow aaB$

$S \rightarrow aaAB$

$S \rightarrow aaaB$

$S \rightarrow aaab$

(b)

$S \rightarrow AB$

$S \rightarrow AAB$

$S \rightarrow AAb$

$S \rightarrow Aab$

$S \rightarrow aAab$

$S \rightarrow aaab$

12. $S \rightarrow aSb \mid .\backslash$ **15.** $S \rightarrow ABC$ $A \rightarrow aA \mid .\backslash$ $B \rightarrow bB \mid .\backslash$ $C \rightarrow cC \mid .\backslash$ **21.** $S \rightarrow bS \mid A$ $A \rightarrow aA \mid B$ $B \rightarrow bbS \mid .\backslash$ **25.** $A \rightarrow aB \mid bD \mid .\backslash$ $B \rightarrow aA \mid bC$ $C \rightarrow aD \mid bB \mid .\backslash$ $D \rightarrow bA \mid aC \mid .\backslash$