CS 173, Fall 2014
Examlet 9, Part B

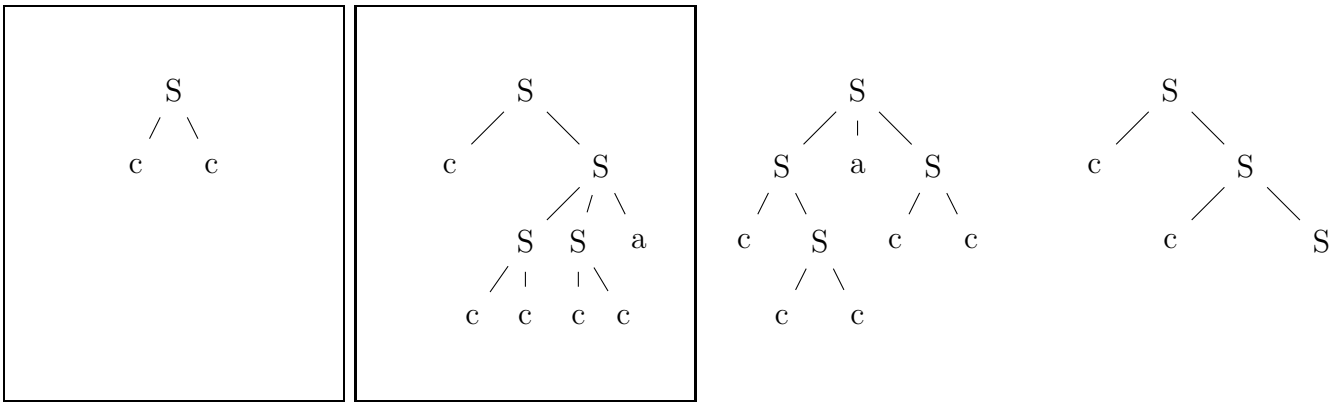
NETID:

FIRST: **LAST:**

Discussion: **Thursday** **2** **3** **4** **5** **Friday** **9** **10** **11** **12** **1** **2**

1. (8 points) Here is a grammar, with start variable S and terminals a and c. Circle the trees that match the grammar.

$$S \rightarrow S\ S\ a \mid c\ S \mid c\ c$$



2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n+1} 2^k =$ $2^{n+1}+1$ ☐ $2^{n+2}-1$ ☐ $2^{n+2}-2$ ☑ 2^n-2 ☐

The root node of a tree is an internal node always ☐ sometimes ☑ never ☐

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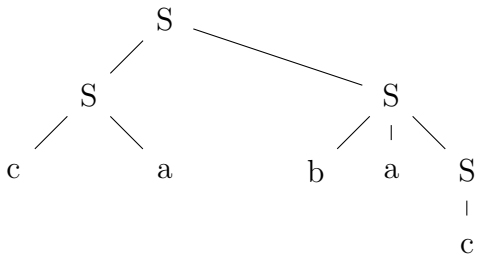
1. (8 points) Consider the following grammar G

   $S \to b\ a\ S \ \mid\ S\ S \ \mid\ c \ \mid\ c\ a$

   S is the only start symbol. The terminal symbol are a, b, and c.

   Here are two sequences of leaf labels. For each sequence, either draw a tree from grammar G whose leaves have this sequence of labels, or else explain briefly why G cannot generate this sequence of leaf labels.

   $c\ a\ b\ a\ c$



   $c\ a\ c\ b\ c$

   In grammar G, every b is followed immediately by an a. This string can't be generated by G because it has a b with a c right after it.

2. (4 points) Check the (single) box that best characterizes each item.

   $\sum_{k=0}^{n-1} 2^k$ $2^n - 2$ ☐ $2^n - 1$ ☑ $2^{n-1} - 1$ ☐ $2^{n+1} - 1$ ☐

   A full m-ary tree with i internal nodes has $mi + 1$ nodes total. always ☑ sometimes ☐ never ☐

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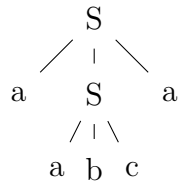
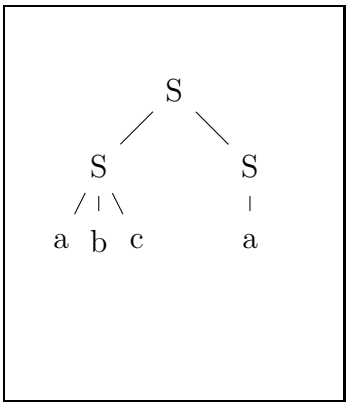
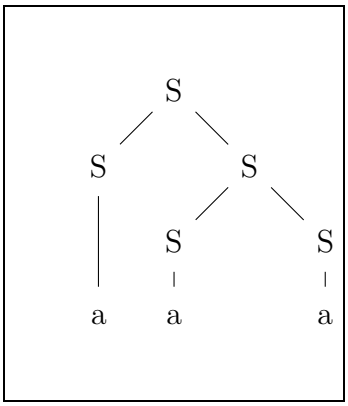
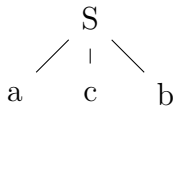
1. (8 points) Here is a grammar with start symbol S and terminals symbols a,b, and c. Circle the trees that match the grammar.

$$S \rightarrow S\ S \mid a\ b\ c \mid a$$









2. (4 points) Check the (single) box that best characterizes each item.

The number of nodes in a binary tree of height h

$\geq 2^h$	☐	$= 2^{h+1} - 1$	☐
$\leq 2^{h+1} - 1$	☑	$\geq 2^{h+1} - 1$	☐

The level of the root node in a tree of height h.

0	☑	1	☐		
$h-1$	☐	h	☐	$h+1$	☐

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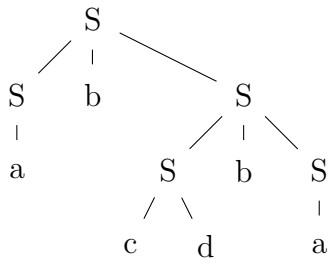
1. (8 points) Consider the following grammar G

   $S \to S\ b\ S \mid a \mid c\ d$

   S is the only start symbol. The terminal symbols are a, b, c, and d.

   Here are two sequences of leaf labels. For each sequence, either draw a tree from grammar G whose leaves have this sequence of labels, or else explain briefly why G cannot generate this sequence of leaf labels.

   $a\ b\ c\ d\ b\ a$



   $a\ a\ a\ c\ d$

   In grammar G, making strings with more than two leaves requires using the first rule (SbS) which produces a b. This string can't be generated by G because it is more than two characters long with no b in it.

2. (4 points) Check the (single) box that best characterizes each item.

   Total number of leaves in a 3-ary tree of height h

   3^h ☐ $\leq 3^h$ ☑

   $\frac{1}{2}(3^{h+1}-1)$ ☐ $3^{h+1}-1$ ☐

   The mathematical symbol for an empty (zero-length) string

   $\emptyset$ ☐ e ☐ ϵ ☑ NULL ☐