CS 173, Fall 2015
Examlet 9, Part B

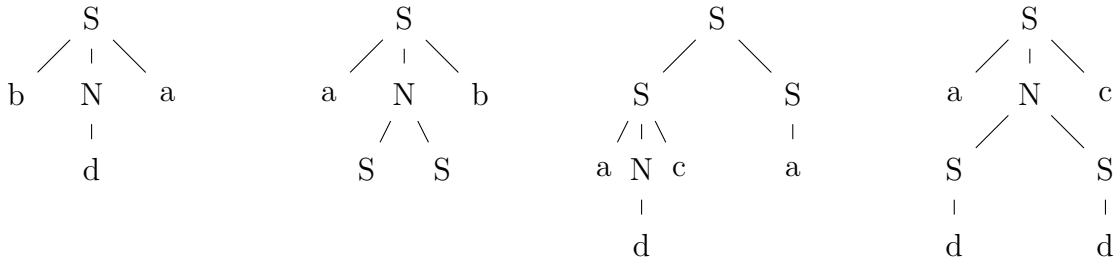
NETID:

FIRST:	LAST:

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

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

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



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

The level of the root node in a tree of height h.	0	☐	1	☐	$h-1$	☐	h	☐	$h+1$	☐
$\sum_{k=0}^{n+1} 2^k$	$2^{n+1}+1$	☐	$2^{n+2}-1$	☐	$2^{n+2}-2$	☐	$2^{n+1}-1$	☐		

CS 173, Fall 2015
Examlet 9, Part B

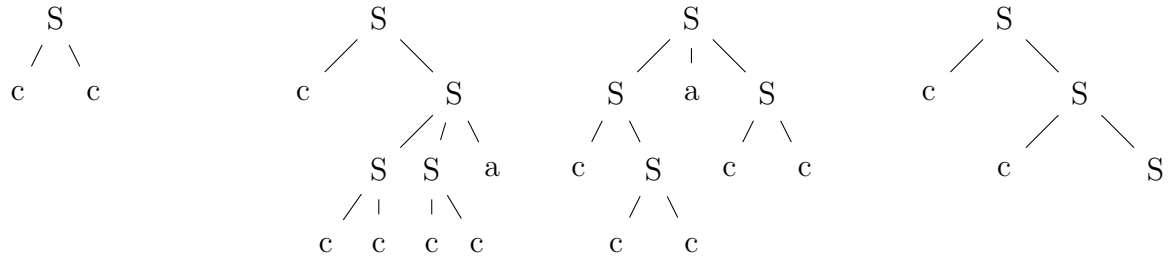
NETID:

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.

The number of nodes in a full complete binary tree of height h

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

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

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

CS 173, Fall 2015
Examlet 9, Part B

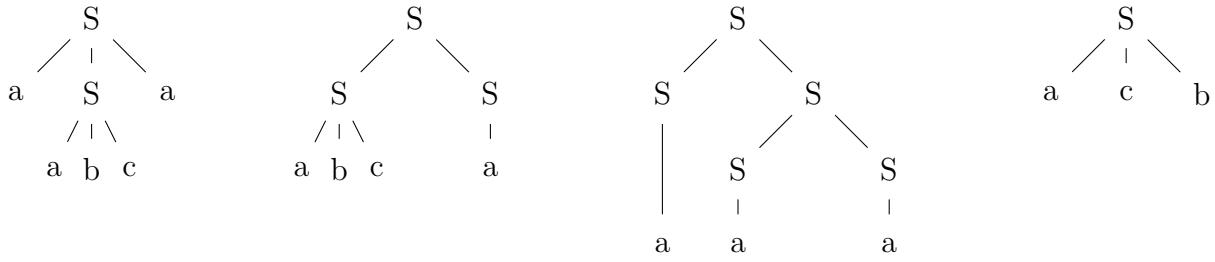
NETID:

FIRST: **LAST:**

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

1. (8 points) Here is a grammar with start 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.

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

The number of nodes in a binary tree of height h

$\geq 2^h$ ☐ $= 2^{h+1} - 1$ ☐

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

CS 173, Fall 2015
Examlet 9, Part B

NETID:

FIRST: **LAST:**

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

1. (8 points) Consider the following grammar G

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

   S is the only start symbol. The terminal symbols 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.

   $b\ a\ b\ c\ a\ b\ a$ $\qquad\qquad$ $b\ b\ a\ c\ b\ a\ b$

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

   A binary tree of height h has at least $2^h - 1$ vertices (nodes). true ☐ false ☐

   A tree with n nodes has
   n edges ☐ $n-1$ edges ☐ $\leq n$ edges ☐
   $n/2$ edges ☐ $\log n$ edges ☐

CS 173, Fall 2015
Examlet 9, Part B

NETID:

FIRST: **LAST:**

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

1. (8 points) Consider the following grammar G

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

   S is the only start symbol. The terminal symbols 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.

   $b\ a\ b\ c\ b\ b\ b$ $\qquad\qquad$ $b\ b\ c\ a\ b\ a\ b$

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

   Number of nodes at level k in a full complete binary tree.

2^k	☐	$2^k - 1$	☐
$2^{k+1} - 1$	☐	2^{k-1}	☐

   The chromatic number of a full 3-ary tree

1	☐	2	☐	≤ 2	☐
3	☐	≤ 3	☐	can't tell	☐

CS 173, Fall 2015
Examlet 9, Part B

NETID:

FIRST: **LAST:**

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

1. (8 points) Consider the following grammar G

   $S \rightarrow\ a\ S\ \mid\ a\ N$

   $N \rightarrow\ N\ N\ \mid\ b\ c\ \mid\ c\ c$

   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.

   $a\ b\ c\ c\ c\ a$ $\qquad\qquad$ $a\ c\ c\ b\ c$

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

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

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