Total points: 10
Section 5.1 #9 b) #12 b) #22
Section 5.2 #20 (please show the grammar in example 5.5 is ambiguous.)

Section 5.1

9b. Find context-free grammars for the following languages (with $n \geq 0$, $m \geq 0$).

$L = \{a^n b^m : n = m - 1\}$.

Answer

$S \rightarrow aSb \mid b$

12b. Find context-free grammars for the following languages (with $n \geq 0$, $m \geq 0$, $k \geq 0$).

$L = \{a^n b^m c^k : n = m \text{ or } m \neq k\}$.

Answer

$S \rightarrow S1 \mid S2$

$S1 \rightarrow S1c \mid A$

$A \rightarrow aAb \mid \lambda$

$S2 \rightarrow aS2 \mid B$

$B \rightarrow CD \mid DE$

$C \rightarrow bC \mid b$

$D \rightarrow bDc \mid \lambda$

$E \rightarrow cE \mid c$

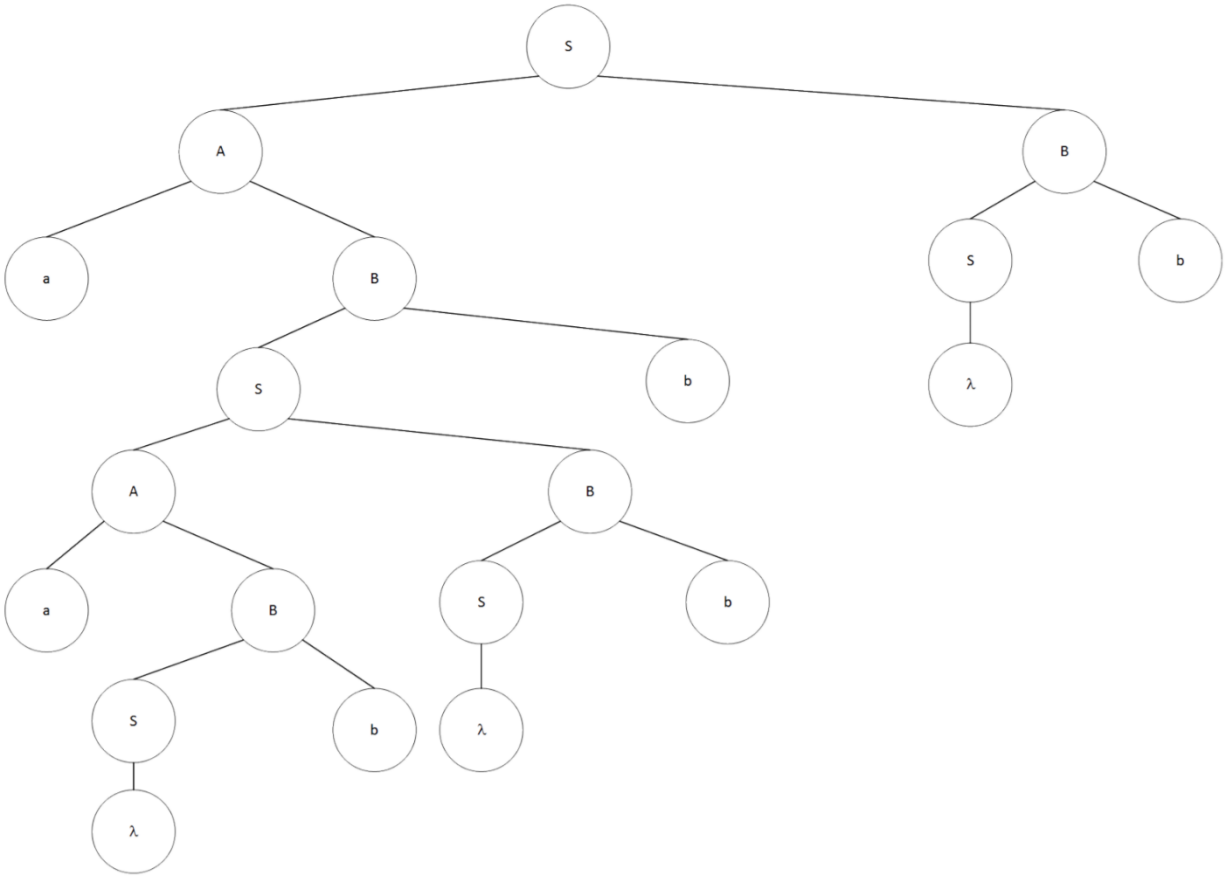
22. (4pts) Show a derivation tree for the string aabbbb with grammar

$S \rightarrow AB \mid \lambda$,

$A \rightarrow aB$,

$B \rightarrow Sb$.

Answer


S
A
B
a
B
S
b
S
b
λ
A
B
a
B
S
b
S
b
λ
λ

Section 5.2

20. (4pts) Show that the following grammar is ambiguous.

S → aAB
A → bBb
B → A | λ

Answer

Derivation 1

S ⇒ aAB ⇒ abBbB ⇒ abAbB ⇒ abbBbbB ⇒ abbAbb ⇒ abbbBbbbB ⇒ abbbbbb

Derivation 2

S ⇒ aAB ⇒ abBbB ⇒ abbB ⇒ abbbAb ⇒ abbbbBbb ⇒ abbbbbb

There exists 2 left-most derivations for the string abbbbbb, so the grammar is ambiguous.

Grading: students can also draw two different parse trees to show the grammar is ambiguous.