# CS138 Section Week 7

May 13, 2016

**Grammar Simplification.** Consider the context-free grammar below

$$
\begin{aligned}
&S \to AB\,,\\
&A \to aA \mid AC \mid \lambda\,,\\
&B \to aB \mid bb\,,\\
&C \to aC \mid C\,.
\end{aligned}
$$

a. Remove $\lambda$-productions.

b. Remove unit productions.

c. Remove useless productions.

d. Finally, turn the grammar into CNF (Chomsky Normal Form).

e. What goes wrong if you do step b before step a?

**CYK Parsing.** Using the grammar you obtained above, parse the string $w = aabb$ using the CYK algorithm given in class, and fill in the table below. Recall $V_{ij} := \{X \in V \mid X \Rightarrow^* w_{ij}\}$, where $w_{ij}$ is the substring starting at position $i$ and end at position $j$. Is the grammar ambiguous? If so, provide two parse trees for $w$.

| | | | |
|---|---|---|---|
| $V_{11} =$ | $V_{12} =$ | $V_{13} =$ | $V_{14} =$ |
| | $V_{22} =$ | $V_{23} =$ | $V_{24} =$ |
| | | $V_{33} =$ | $V_{34} =$ |
| | | | $V_{44} =$ |

**Truthful Language.** Consider the set of terminal alphabet, $\Sigma = \{T, F, \neg, \Rightarrow\}$. Devise a context-free grammar for the language of "true" statements, $L$. For example, $((\neg F) \Rightarrow T) \in L$ and $(T \Rightarrow (\neg T)) \notin L$. Same as in the homework, you should use one pair of parenthesis per operation to make the grammer unambiguous.