

This is a mult-section quiz. You may not communicate to anyone about it until I notify you that you can.

SI340 Quiz 8 Name _____ **Alpha** _____

Convert the following CFG into Chomsky Normal form by first eliminating λ -production, unit productions and useless variables (in that order).

$$\begin{aligned} S &\rightarrow aSa \mid bSb \mid D \\ D &\rightarrow aRb \mid bRa \\ R &\rightarrow aRa \mid bRb \mid \lambda \end{aligned}$$

Eliminating λ -production – Nullables = {R} so productions change to

$$\begin{aligned} S &\rightarrow aSa \mid bSb \mid D \\ D &\rightarrow aRb \mid bRa \mid ab \mid ba \\ R &\rightarrow aRa \mid bRb \mid aa \mid bb \end{aligned}$$

Eliminating unit productions

$$\begin{aligned} \text{S-derivable} &= \{D\} \\ \text{D-derivable} &= \{\} \\ \text{R-derivable} &= \{\} \text{ so productions change to} \\ S &\rightarrow aSa \mid bSb \mid aRb \mid bRa \mid ab \mid ba \\ D &\rightarrow aRb \mid bRa \mid ab \mid ba \\ R &\rightarrow aRa \mid bRb \mid aa \mid bb \end{aligned}$$

Eliminating Useless Variables:

$$\begin{aligned} \text{Live} &= \{S, D, R\} \text{ so there are no dead variables and the productions do not change.} \\ \text{Reachable} &= \{S, R\} \text{ so Unreachable} = \{D\} \text{ so productions are} \\ S &\rightarrow aSa \mid bSb \mid aRb \mid bRa \mid ab \mid ba \\ R &\rightarrow aRa \mid bRb \mid aa \mid bb \end{aligned}$$

Change to Chomsky Normal Form: At this point the variables you use may be different from mine.

$$\begin{aligned} X &\rightarrow a \\ Y &\rightarrow b \\ Z &\rightarrow XS \\ W &\rightarrow YS \\ V &\rightarrow XR \\ U &\rightarrow YR \\ S &\rightarrow XSX \mid YSY \mid XRY \mid YRX \mid XY \mid YX \text{ which in CNF is } ZX \mid WY \mid VY \mid UX \mid XY \mid YX \\ R &\rightarrow XRX \mid YRY \mid XX \mid YY \text{ which in CNF is } VX \mid UY \mid XX \mid YY \end{aligned}$$