Ma2201/CS2022
Quiz 0111

Foundations of C.S.

Spring, 2022

PRINT NAME: _____
$\mathcal{SIGN}$: _____

1. (6 pts) Define a regular grammar for the language of all strings on $\{a, b, c\}$ which contain the substring *abc*.

Make your variables and roles are specified so that your design is clear.

♣ *I will give two solutions. One essentially "non-deterministic", and one "deterministic" in approach.*

The first S recurses through the initial string before the abc. For A, B, C, the initial strings of the required abc have been derived, and C derives any letters beyond the required abc:

$$\begin{array}{rcl} G: S & \rightarrow & aS \mid bS \mid cS \mid aX \\ X & \rightarrow & bY \\ Y & \rightarrow & cD \mid c \\ D & \rightarrow & aD \mid bD \mid cD \mid a \mid b \mid c \end{array}$$

The second solution has two types of states, S, S_a, and S_{ab} indicating progress toward building an abc, and D, for building on prefixes already containing an abc.

$$\begin{array}{rcl} G: S & \rightarrow & bS \mid cS \mid aS_a \\ S_a & \rightarrow & aS_a \mid bS_ab \mid cS \\ S_{ab} & \rightarrow & aS_a \mid bS \mid cD \mid c \\ D & \rightarrow & aD \mid bD \mid cD \mid a \mid b \mid c \end{array}$$

♣

2. (4 pts) Use CHAIN to convert to an equivalent grammar with no chain rules.

$$\begin{array}{rcl} G: S & \rightarrow & aA \mid bB \mid C \\ A & \rightarrow & ab \mid aAcC \\ B & \rightarrow & bc \mid A \mid a^2Ac^2C \\ C & \rightarrow & ca \mid B \mid a^3Ac^3C \end{array}$$

♣ $CHAIN(S) = \{S, A, B, C\}$, $CHAIN(A) = \{A\}$, $CHAIN(B) = \{A, B\}$. $CHAIN(C) = \{A, B, C\}$.

$$\begin{array}{rcl} G: S & \rightarrow & aA \mid bB \mid ab \mid aAcC \mid bc \mid a^2Ac^2C \mid ca \mid a^3Ac^3C \\ A & \rightarrow & ab \mid aAcC \\ B & \rightarrow & bc \mid a^2Ac^2C \mid ab \mid aAcC \\ C & \rightarrow & ca \mid a^3Ac^3C \mid bc \mid a^2Ac^2C \mid ab \mid aAcC \end{array}$$

♣