L2.2 – Simplification of CFG (Removal of Unit Productions)

Simplification of Context Free Grammar

Removal of Unit Productions

Any Production Rule of the form $A \rightarrow B$ where $A, B \in$ Non Terminals is called Unit Production

Procedure for Removal

Step 1: To remove $A \rightarrow B$, add production $A \rightarrow x$ to the grammar rule whenever $B \rightarrow x$ occurs in the grammar. [$x \in$ Terminal, x can be Null]

Step 2: Delete $A \rightarrow B$ from the grammar.

Step 3: Repeat from Step 1 until all Unit Productions are removed.

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Example: Remove Unit Productions from the Grammar whose production rule is given by

P: $S \rightarrow XY,\ X \rightarrow a,\ Y \rightarrow Z|b,\ Z \rightarrow M,\ M \rightarrow N,\ N \rightarrow a$

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$Y \rightarrow Z, \quad Z \rightarrow M, \quad M \rightarrow N$

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P: $S \rightarrow XY$, $X \rightarrow a$, $Y \rightarrow Z|b$, $Z \rightarrow M$, $M \rightarrow N$, $N \rightarrow a$

$Y \rightarrow Z$, $Z \rightarrow M$, $M \rightarrow N$

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$Y \rightarrow Z$, $Z \rightarrow M$, $M \rightarrow N$

1) Since $N \rightarrow a$, we add $M \rightarrow a$

P: $S \rightarrow XY$, $X \rightarrow a$, $Y \rightarrow Z|b$, $Z \rightarrow M$, $M \rightarrow a$, $N \rightarrow a$

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Step 2: Delete A→B from the grammar.

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Y→Z, Z→M, M→N

1) Since N→a, we add M→a

P: S→XY, X→a, Y→Z|b, Z→M, M→a, N→a

2) Since M→a, we add Z→a

Step 2: Delete A→B from the grammar.

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Y→Z, Z→M, M→N

1) Since N→a, we add M→a

P: S→XY, X→a, Y→Z|b, Z→M, M→a, N→a

2) Since M→a, we add Z→a

P: S→XY, X→a, Y→Z|b, Z→a, M→a, N→a

3) Since Z→a, we add Y→a

$Y \to Z$, $Z \to M$, $M \to N$

1) Since $N \to a$, we add $M \to a$

P: $S \to XY$, $X \to a$, $Y \to Z|b$, $Z \to M$, $M \to a$, $N \to a$

2) Since $M \to a$, we add $Z \to a$

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3) Since $Z \to a$, we add $Y \to a$

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3) Since $Z \to a$, we add $Y \to a$

P: $S \to XY$, $X \to a$, $Y \to a|b$, $Z \to a$, $M \to a$, $N \to a$

Remove the Unreachable symbols

$Y \to Z$, $Z \to M$, $M \to N$

1) Since $N \to a$, we add $M \to a$

P: $S \to XY$, $X \to a$, $Y \to Z|b$, $Z \to M$, $M \to a$, $N \to a$

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Remove the Unreachable symbols

P: $S \to XY$, $X \to a$, $Y \to a|b$

Questions????