CSC-257
Theory Of Computation
(BSc CSIT, TU)

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3. Eliminating Unit Production

- A unit production is a production of the form A → B, where A and B are both variables(Non terminals)
- Here, if A→ B, we say B is A-derivable and B → C, we say C is B-derivable
- Thus if both of two A → B and B → C, then A→* C, hence C is also A-derivable
- Here pairs (A, B), (B, C) and (A, C) are called the unit pairs.
- To eliminate the unit productions, first find all of the unit pairs
- (A, A) is a unit pair for any variable A as A →* A
- If we have A → B then (A, B) is unit pair
- If (A, B) is unit pair i.e. A → B, and if we have B → C then (A, C) is also a unit pair

3. Eliminating Unit Production

- Suppose a grammar G = (V, T, P, S)
- To eliminate unit productions from G, we have to find another grammar G′ = (V, T, P′, S) with no unit productions. For this, we may workout as below:
  - Initialize P′ = P
  - For each A ∈ V, find a set of A-derivable variables
  - For every pair (A, B) such that B is A-derivable and for every non-unit production B → α, we add production A → α in P′ if it is not in P′ already
  - Delete all unit productions from P′

3. Eliminating Unit Production

- Example 1: Remove the unit production for grammar G defined by productions

  P = {

  $S \rightarrow S+T \mid T$

  $T \rightarrow T*F \mid F$

  $F \rightarrow (S) \mid a$

  }

- Solution : Initialize

  P' = {

  $S \rightarrow S+T \mid T$

  $T \rightarrow T*F \mid F$

  $F \rightarrow (S) \mid a$

  }

3. Eliminating Unit Production

- Now, find unit pairs as :

  Here, S → T So, (S, T) is unit pair

  T → F So, (T, F) is unit pair

  Also, S → T and T → F So, (S, F) is unit pair

- Now, add each non-unit productions of the form B → α in P' for each pair (A, B) as :

  P' = {

  S → S+T | | T*F | (S) | a | T

  T → T*F | (S) | a | F

  F → (S) | a

  }

3. Eliminating Unit Production

- Now delete unit productions of the form A → B from P′ and final production will be as :

P′ = {

S → S+T | | T*F | (S) | a

T → T*F | (S) | a

F → (S) | a

}

3. Eliminating Unit Production

- Exercise 1 : Remove unit productions from the following

  P = {

  $S \rightarrow XY$, $X \rightarrow a$, $Y \rightarrow Z \mid b$,

  $Z \rightarrow M$, $M \rightarrow N$, $N \rightarrow a$

  }

- Exercise 2 : Remove unit productions from the following

  P = {

  $S \rightarrow 0A \mid 1B \mid C$

  $A \rightarrow 0S \mid 00$

  $B \rightarrow 1 \mid A$

  $C \rightarrow 01$

  }