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

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2. Eliminating Є - Productions

- A grammar is said to have Є-productions if there is a production of the form A → Є.

- Here our strategy is to begin by discovering which variables are "nullable".

- A variable 'A' is "nullable" if A →* Є

2. Eliminating Є - Productions

- Algorithm (Steps to remove Є-production from the grammar) :
  - If there is a production of the form A $\rightarrow$ Є, then A is nullable.
  - If there is production of the form B $\rightarrow$ X_1X_2 ………. and each X_i's are nullable then B is also nullable.
  - Find all the nullable variables
  - Now to make grammar Є-production free, add the original production as well as all the combinations of the production that can be formed by replacing the nullable variables in the production by Є
  - Do not include B $\rightarrow$ Є if there is such production.

2. Eliminating Є - Productions

- Example :

- Consider a grammar :

    S → ABC

    A → BB | Є

    B → CC | a

    C → AA | b

- Here :

    A → Є   A is nullable

    B → CC →* Є   B is nullable

    C → AA →* Є   C is nullable

    S → ABC →* Є   S is nullable

2. Eliminating Є - Productions

- Now after removal of Є-productions, new CFG is :

  S → ABC | AB | BC | AC | A | B | C

  A → BB | B

  B → CC | C | a

  C → AA | A | b

2. Eliminating Є - Productions

- Example

- Consider a CFG

S → AB

A → aAA | Є

B → bBB | Є

- Here :

A → Є   A is nullable

B → Є   B is nullable

S → AB →* Є   S is nullable

2. Eliminating Є - Productions

- Now after removal of Є-productions, new CFG is :

    S → AB | A | B

    A → aAA | aA | a

    B → bBB | bB | b

2. Eliminating Є - Productions

- Exercises

- Remove Є-productions from following grammar

  S → ABCd

  A → BC

  B → bB | Є

  C → cC | Є

- Remove Є-productions from following grammar

  S → aMb

  M → BC

  B → bB | Є

  C → cC | Є