FORMAL LANGUAGE AND AUTOMATA

REMOVAL OF EPLISON AND UNIT USELESS SYMBOLS

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OBJECTIVE OF THE PROBLEM

- **Removal of Epsilon Productions:**
- **Identify Epsilon Productions:**
  - Look for productions of the form A → ε, where A is a non-terminal symbol.
  - Also, identify nullable non-terminals (non-terminals that can derive ε).
- **Remove Epsilon Productions:**
  - For each production A → ε, remove it.
  - For each production B → αAβ, add new productions without A, considering all possible combinations of A being present or absent in the derivation of α and β.

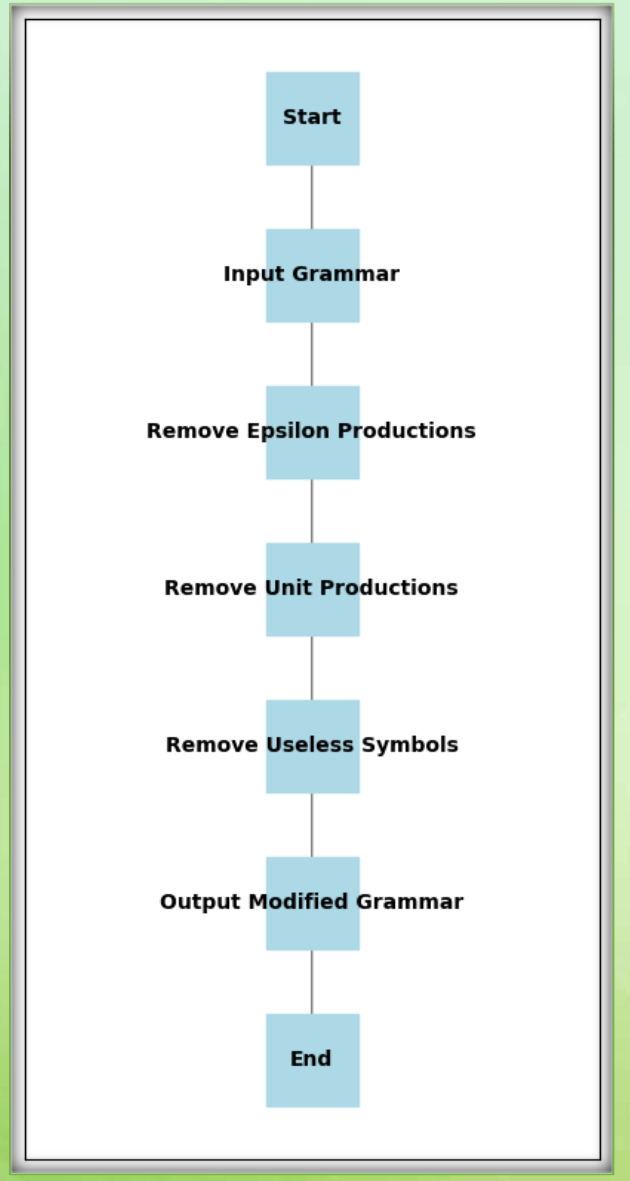
OBJECTIVE OF THE PROBLEM CTND.

- **Removal of Useless Symbols:**
- **Identify Non-Terminals and Terminals:**
  - Non-terminals that derive at least one string are called reachable non-terminals.
  - Terminals are always considered reachable.
- **Find Reachable Non-Terminals:**
  - Start with the start symbol and mark it as reachable.
  - Mark any non-terminal as reachable if it appears on the right-hand side of a production where all symbols are reachable.
- **Remove Unreachable Non-Terminals:**
  - Remove any non-terminals and their productions that are not marked as reachable.
- **Find Useful Terminals:**
  - Terminals that appear on the right-hand side of any production are useful.
- **Remove Useless Productions:**
  - Remove any production that involves non-terminals or terminals that are not useful.

APPLICATIONS

- Compiler Design
- Code Optimization
- Natural Language Processing (NLP)
- Automated Code Generation
- Error Detection and Reporting
- Educational Purposes
- Automated Testing

FLOWCHART:


Start
Input Grammar
Remove Epsilon Productions
Remove Unit Productions
Remove Useless Symbols
Output Modified Grammar
End

OUTPUT:

```
Original grammar:
Terminals: {'b', 'c', 'a'}
Non-terminals: {'A', 'S', 'B', 'C'}
Start symbol: S
Productions:
A -> aA |
S -> AB | C
B -> bB | c
C -> S | cC
Grammar after removing epsilon productions:
Terminals: {'b', 'c', 'a'}
Non-terminals: {'A', 'S', 'B', 'C'}
Start symbol: S
Productions:
A -> aA | a
S -> AB | B | C
B -> bB | c
C -> S | cC
Grammar after removing unit productions:
Terminals: {'b', 'c', 'a'}
Non-terminals: {'A', 'S', 'B', 'C'}
Start symbol: S
Productions:
A -> aA | a
S -> AB | bB | c | cC
B -> bB | c
C -> AB | cC
```