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Class = BS-CS / F20

Subject = Theory of Automata

Assignment = 04

Q1: Discuss the benefits of converting CFG into CNF with the help of suitable example.

Ans Converting a context-free grammar (CFG) into Chomsky Normal form (CNF) offers the following benefits:

1. **Simplicity and Clarity:** CNF simplifies the grammar, making it easier to understand and less ambiguous.
2. **Efficient parsing:** CNF enables efficient parsing algorithms, reducing computational complexity.
3. **Elimination of ϵ -production:** CNF removes empty string derivation, simplifying parsing and avoiding issues.
4. **Removal of unit productions:** CNF eliminates unit productions, improving parsing efficiency.
5. **Improved analysis and transformation:** CNF facilitates analysis, optimization, and manipulation of the grammar.

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Example :

CFG Form :

$$S \rightarrow bA \mid aB$$

$$A \rightarrow a \mid aS \mid bAA$$

$$B \rightarrow b \mid bS \mid aBB$$

CNF Form :

$$S \rightarrow YA \mid XB$$

$$A \rightarrow a \mid XS \mid YR_1$$

$$B \rightarrow b \mid YS \mid XR_2$$

$$X \rightarrow a$$

$$Y \rightarrow b$$

$$R_1 \rightarrow AA$$

$$R_2 \rightarrow BB$$

Q2: Construct a memory based computational machine from the following CNF and validate it.

$$S \rightarrow AB$$

$$X \rightarrow a$$

$$Y \rightarrow b$$

$$R_1 \rightarrow BB$$

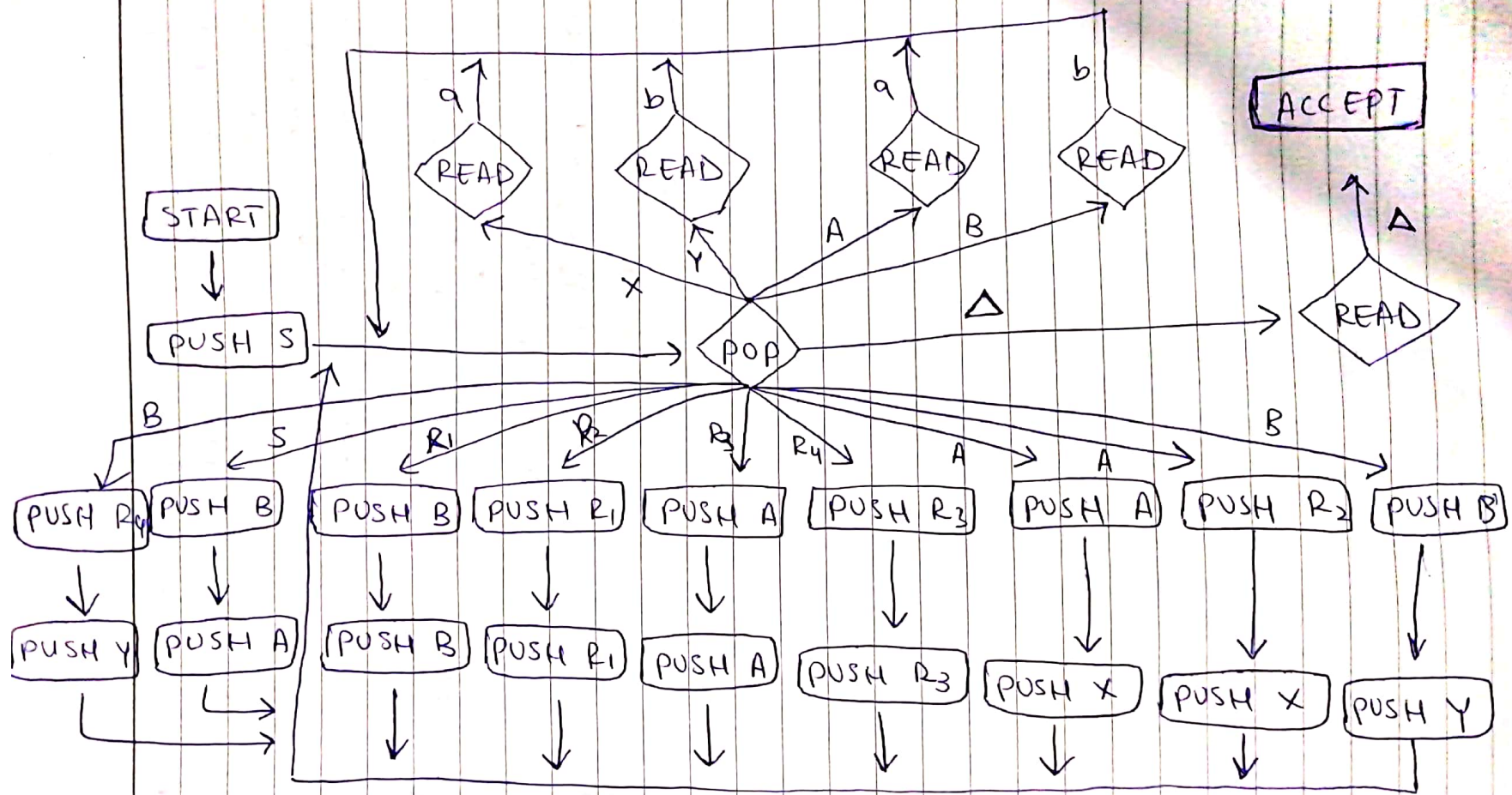
$$R_2 \rightarrow R_1 R_1$$

$$R_3 \rightarrow AA$$

$$R_4 \rightarrow R_3 R_3$$

$$A \rightarrow XA \mid XR_2 \mid a$$

$$B \rightarrow YB \mid YR_4 \mid b$$



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Ans
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Q3 Discuss the practical applications of CNF in solving real time problems.

Ans CNF has practical application ⁱⁿ many ~~has~~ app fields and can help solve real time problems. Here are some of its application.

1. CNF is widely used in Natural language processing tasks such as syntactic, parsing, machine translation, etc.
 2. CNF plays a vital role in compiler design.
 3. It provides a structured representation of grammar ~~from data~~ making it easier to optimize its properties.
 4. Can be used in machine learning tasks to induce grammar from data.
 5. It has applications in bioinformatics for analyzing DNA and RNA sequences.
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