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Artificial Intelligence

K-SAT Problem

Aim:

The aim of this experiment is to develop a program that can generate random k-SAT problem.

Theory:

The program should generate k-SAT problems by randomly assigning truth values to a set of variables within clauses. Each clause has a fixed length, k, and consists of k literals which are either the variable or its negation. The program should ensure that each problem generated conforms to constraints of k-SAT where each clause is composed of exactly k literals.

K-SAT is a fundamental problem, particularly in computational complexity theory and the study of algorithms. It is a special case of the Boolean satisfiability problem, where each clause in the boolean formula is limited to at most k literals. The problem involves determining if there exists an assignment to the boolean variables that satisfies the formula.

Algorithm:

1. Generate K-SAT Problem
   - input parameters k (no. of literals per clause), m (number of clause), n (no. of variables).
   - Process:
     1. initialize an empty formula
     2. For each clause up to m:
        - randomly select k distinct variables
        - For each variable, randomly decide if it should be negated
        - add constructed clause to formula
   - Output: A K-SAT problem represented as a list of clauses

2. Solving a K-SAT Problem:
Given the nature of the problem as NP-Complete for $K > 2$, the solution approach will involve heuristics or approximation for larger instances.

Architecture:
- use lists to store clauses & variables
- use boolean arrays or dictionaries to manage variable assignments