University of the People

CS4408 Artificial Inteligence

Unit 4 Written Assignment 4

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**Programming Assignment: Coloring programe**

1. **Implementation Details:**
   * Uses a class-based structure for better organization
   * Implements CSP with backtracking algorithm
   * Handles file input/output as specified
   * Includes error checking for vertex count (2-20)
   * Uses the 7 colors in the specified order
2. **Key Features:**
   * Reads graph structure from text file
   * Validates input constraints
   * Implements backtracking with forward checking
   * Provides proper output formatting
   * Includes comprehensive test cases
3. **Test Cases:**
   * Test Case 1: The example from the assignment (5 regions)
   * Test Case 2: A simple 3-vertex graph
   * Test Case 3: A more complex 7-vertex graph

To run the program:

1. Run it using Python 3: python CSPsolution.py
2. The program will automatically create and run the test cases

The program will create separate test files for each case and show both input and output.

The graph is stored in two main data structures:

* A dictionary (self.graph) maps each vertex to its list of adjacent vertices.
* A list (self.vertices) preserves the order of vertices as they appear in the file.

This structure accurately represents the map and is well suited for the constraint satisfaction approach.

The core of the assignment is the backtracking algorithm used to solve the map coloring problem. The implementation includes:

* **Safety Check:** The is\_safe method verifies that assigning a particular color to a vertex does not conflict with any adjacent vertices.
* **Recursive Backtracking:** The solve\_map\_coloring method uses recursion to assign colors to vertices one by one. If a vertex cannot be assigned any color without a conflict, the algorithm backtracks to try a different assignment.
* **Color Order:** Colors are attempted in the specified order: red, green, blue, yellow, violet, gray, and orange.

In our implementation, if the algorithm can't assign colors to all vertices without conflicts using the 7 available colors, it returns a failure, and the program prints "Not possible with 7 colors." This behavior is also demonstrated in our test case with a complete graph (K8) where 8 colors would be needed, ensuring the program meets the assignment requirement for such scenarios.