**AI-Project-1: CSP (Graph Coloring)**

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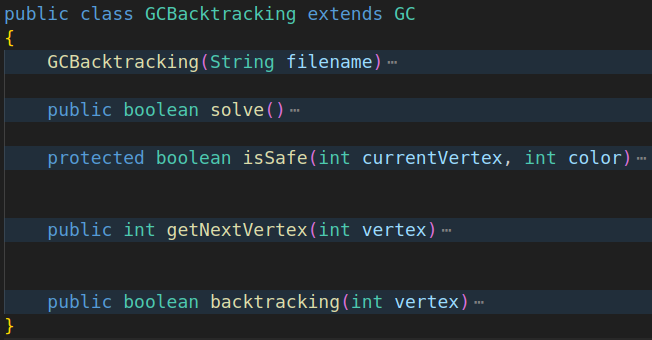
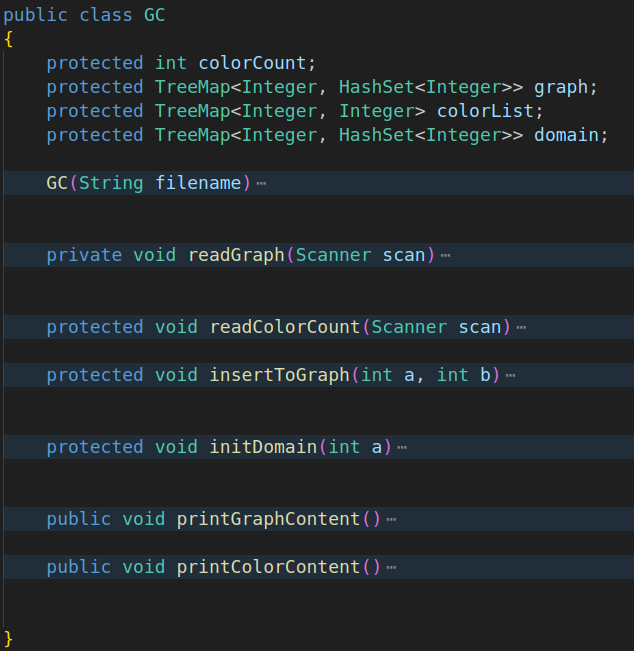
**Student ID:** g34987427

**Introduction:**

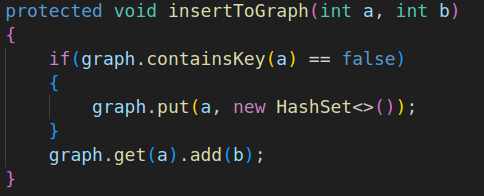
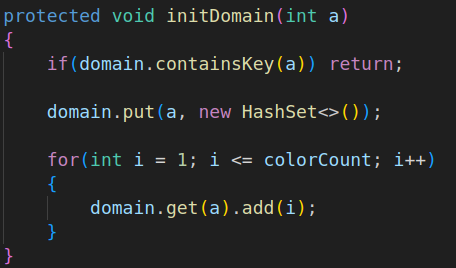
This report outlines the structure and key concepts behind the implementation of a solution for the Graph Coloring problem in the context of Constraint Satisfaction Problems. As with previous projects, the chosen programming language is Java. The solution will utilize a **backtracking** approach with **ordering heuristics**(MRV, LCV, Tie-breaking) and the **AC3 algorithm for constraint propagation**.

**General Structure**:

As it can be observed the there couple of classes that contains different approaches to tackle this problem, however they all are the child classes two base classes structure of which are provided below:

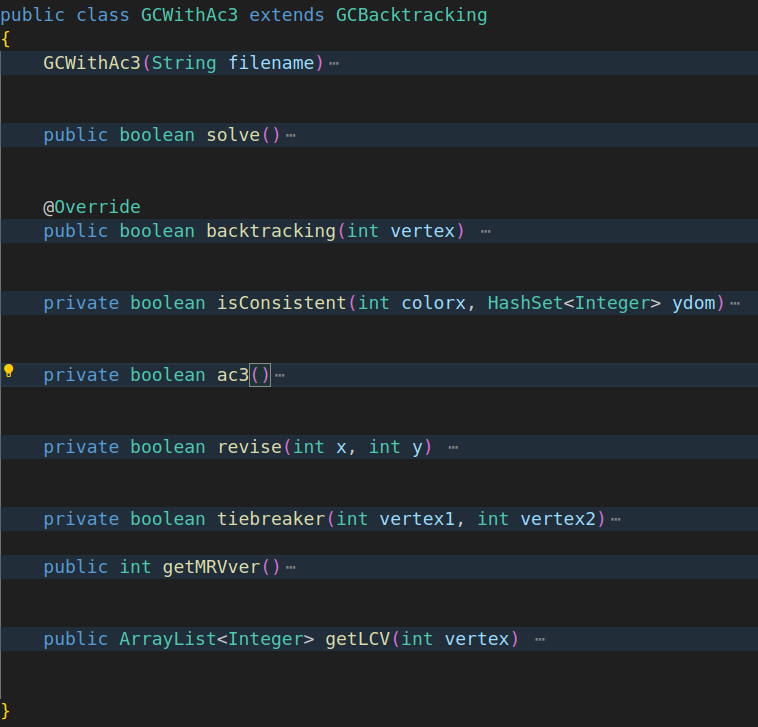


The first class (on the left) is used only to read contents of the files to graph, determine color count and initialize domains.



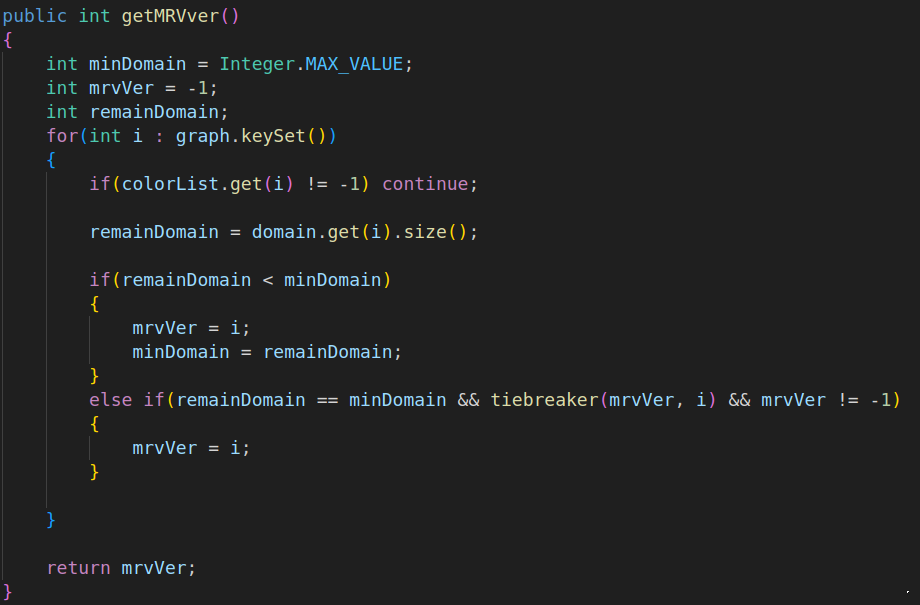
The second class uses simple bactracking algorithm to solve the graph coloring. The other classes will extend and override backtracking by adding ordering, filtering and constraint propagation techniques.

The main class the report will focus on is the AC3 with ordering approach which is contained in its own separate class:

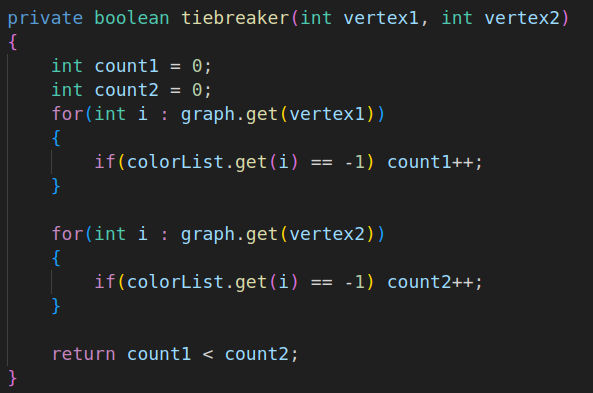


**Heuristics(Ordering):**

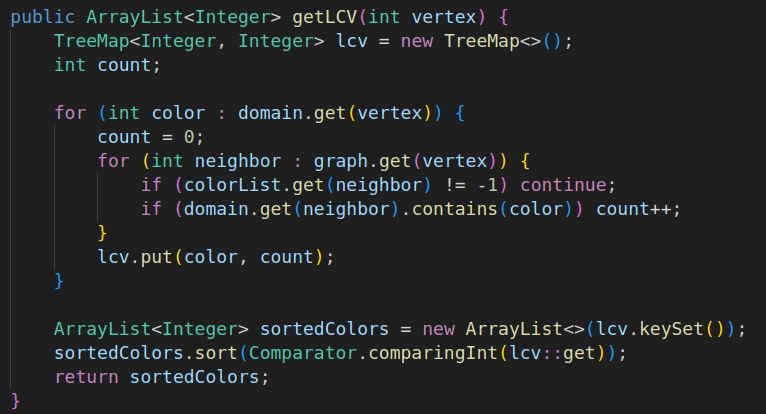
**MRV:** the first algorithm used to enhance the backtracking is MRV which will loop through the all the domains of the vertexes that are not yet assigned and find the vertex that has the least amount colors in their domain:



**Tie-breaker:** n the early stages of backtracking, it is common for multiple vertixes to have the same number of values in their domain. To maximize efficiency, it is recommended to select the vertex with the highest number of unassigned neighbors(in other words vertex that is involved with more constraints).



**LCV:** Now as the vertex is selected it is important to decide which color to choose from its domain. LCV offers to select the color that will effect domains of neighboring vertexes less. LCV will return the list of colors sorted from least constraining to most constraining.



Now as the ordering algorithms were discussed it is time to move to constraint propagation