

Note: Same rules apply as on previous assignments.

Problem 1 Write the following methods for the graph coloring constraining satisfaction problem:

(a). getDegrees(g) (5 points)

- **Input:** *g*, an undirected, unweighted graph
- **Returns:** *degrees*, a list of the degrees of the vertices in *g*, so *degrees[i]* = the degree of vertex *i*

(b). getNextVariable(g, domains, degrees) (15 points)

- **Inputs:**
 - *g* = an undirected, unweighted graph
 - *domains* = list of remaining colors for each vertex
 - *degrees* = list of degrees of each vertex
- **Returns:** The variable index with the Minimum Remaining Values (not including those with only 1 remaining value), with ties broken by highest degree. If there are ties beyond that, the smallest indexed vertex is picked. If no variable has more than 1 remaining value, returns -1.

(c). AC3(g, domains, v) (30 points)

- **Inputs:**
 - *g* = the graph
 - *domains* = list of remaining colors for each vertex
 - *v* = the vertex whose domain has just been changed
- **Returns:** The list of pruned domains resulting from the AC3 pruning algorithm, but if any domains becomes empty, AC3 returns an empty list.

(d). backtrack(g, domains, degrees) (30 points)

- **Inputs:**
 - *g* = an undirected, unweighted graph
 - *domains* = list of remaining colors for each vertex
 - *degrees* = list of degrees of each vertex
 - **Returns:** A list of domains, each with a single color that from the original domains that is a valid coloring of the graph, or the empty list if no such *m*-coloring exists.
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Problem 2 (10 pts) In the Excel file "*A5_P23, CSP Tracing*", trace through the three coloring backtracking coloring algorithm for the graph given in the "**Problem 2**" tab. For inference, use the AC3 algorithm. For choosing the next variable, use the minimum remaining values; if there are ties, break them by highest degree; if there are still ties, break them by smallest vertex index.

The first 4 tabs show two examples—for each, one is blank and the other is the solution.

Problem 3 (10 pts) Same as above for the "**Problem 3**" tab.