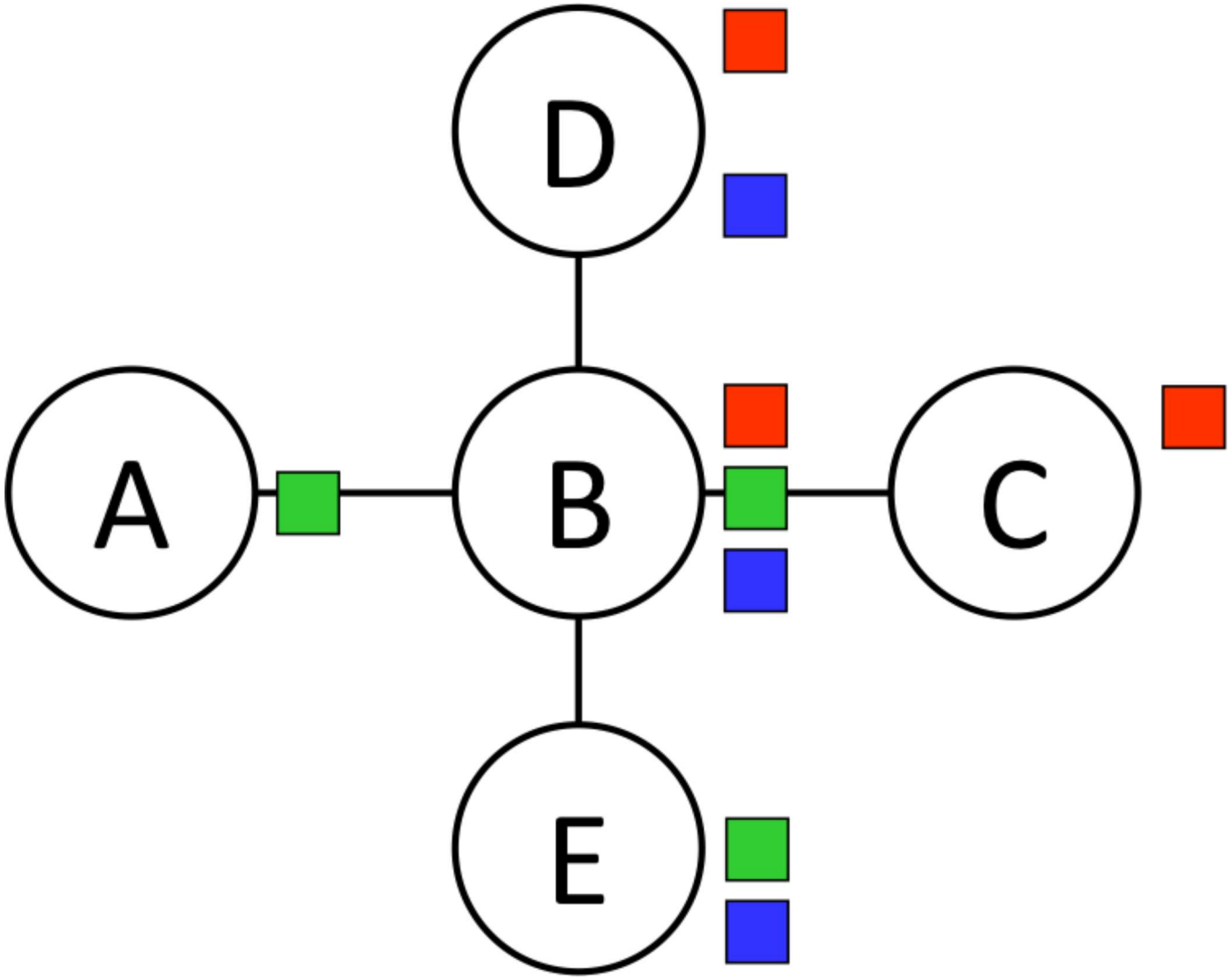
hw2_csps_q5_solving_tree_structured_csps

Question 5: Solving Tree-Structured CSPs

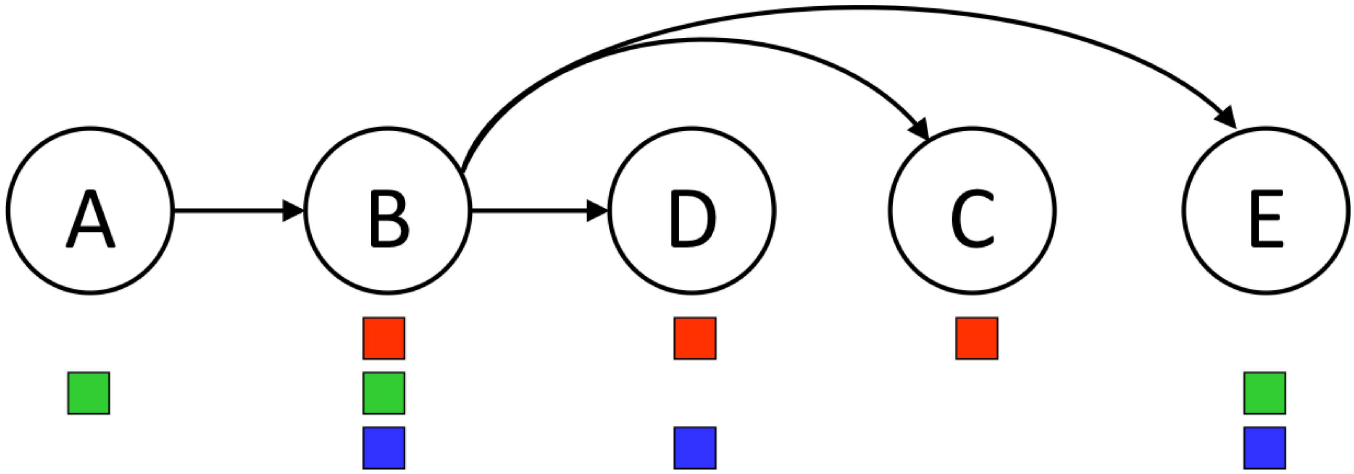
0.0/4.0 points (graded)

Consider the following tree-structured CSP that encodes a coloring problem in which neighboring nodes cannot have the same color. The domains of each node are shown.



The algorithm for solving tree-structured CSPs starts by picking a root variable. We can pick any variable for this. For this exercise, we will pick A. There are several linearizations

consistent with A as the root; we will use the one shown below.



Step 1: Remove Backward

In this step we start with the right-most node (E), enforce arc-consistency for its parent (B), then do the same for the second-to-right-most node (C) and its parent (B), and so on. Execute this process, and then mark the remaining values for each variable below.

- [ ] A: red
- [x] A: green ✔
- [ ] A: blue
- [ ] B: red
- [x] B: green ✔
- [x] B: blue ✔
- [x] C: red ✔
- [ ] C: green
- [ ] C: blue
- [x] D: red ✔

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- [ ] D: green
- [x] D: blue ✔
- [ ] E: red
- [x] E: green ✔
- [x] E: blue ✔

Enforcing B→C removes red from B's domain, because if B is red, C has no possible values. No other arcs change any domains.

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Answers are displayed within the problem

problem

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Step 2: Assign Forward

Now that all domains have been pruned, we can find the solution in a single forward pass (i.e. no need for backtracking). This is done by starting at the left-most node (A), picking any value remaining in its domain, then going to the next variable (B), picking any value in its domain that is consistent with its parent, and continue left to right, always picking a value consistent with its parent's assignment.

If at any given node there are multiple colors left that are consistent with its parent's value, break ties by picking red over green, and then green over blue.

What is the solution found by running the algorithm?

- [ ] A: red

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- [x] A: green ✔
- [ ] A: blue
- [ ] B: red
- [ ] B: green
- [x] B: blue ✔
- [x] C: red ✔
- [ ] C: green
- [ ] C: blue
- [x] D: red ✔
- [ ] D: green
- [ ] D: blue
- [ ] E: red
- [x] E: green ✔
- [ ] E: blue

Green is picked for A, leaving only blue for B. This leaves red for D, red for C, and green for E as the only values that satisfy the constraints.

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