CSPB 3202 - Truong - Artificial Intelligence

Started on	Thursday, 30 May 2024, 6:11 PM
State	Finished
Completed on	Thursday, 30 May 2024, 6:12 PM
Time taken	37 secs
Marks	63.00/63.00
Grade	**10.00** out of 10.00 (**100**%)

Question **1**

Correct

Mark 5.00 out of 5.00

When enforcing arc consistency in a CSP, the set of values which remain when the algorithm terminates does not depend on the order in which arcs are processed from the queue.

Select one:

- (selected) a. True ✔
- b. False

Question **2**

Correct

Mark 5.00 out of 5.00

In a general CSP with n variables, each taking d possible values, what is the maximum number of times a backtracking search algorithm might have to backtrack (i.e. the number of the times it generates an assignment, partial or complete, that violates the constraints) before finding a solution or concluding that none exists? (choose one)

Select one:

- a. 0
- b. $O(1)$
- c. $O(nd^2)$
- d. $O(n^2d^3)$
- e. $O(d^n)$ ✔
- f. ∞

Question **3**

Correct

Mark 5.00 out of 5.00

What is the maximum number of times a backtracking search algorithm might have to backtrack in a general CSP, if it is running arc consistency and applying the MRV and LCV heuristics? (choose one)

Select one:

- a. $O(d^n)$ ✔
- b. $O(n^2d^3)$
- c. 0
- d. $O(1)$
- e. $O(nd^2)$
- f. ∞

Question **4**

Correct

Mark 5.00 out of 5.00

What is the maximum number of times a backtracking search algorithm might have to backtrack in a tree-structured CSP, if it is running arc consistency and using an optimal variable ordering? (choose one)

Select one:

- a. $O(d^n)$
- b. ∞
- c. $O(nd^2)$
- d. $O(1)$
- e. 0 ✔
- f. $O(n^2 d^3)$

Question **5**

Correct

Mark 10.00 out of 10.00

Select all of the following statements about CSPs that are true.

- [x] Even when using arc consistency, backtracking might be needed to solve a CSP. ✔
- [x] Even when using forward checking, backtracking might be needed to solve a CSP. ✔
- [ ] None of the above.

Select all of the following statements about CSPs that are true.

- [ ] When using backtracking search with the same rules to select unassigned variables and to order value assignments (in our case, usually Minimum Remaining Values and Least-Constraining Value, with alphabetical tiebreaking), arc consistency will always give the same solution as forward checking, if the CSP has a solution.
- [x] For a CSP with binary constraints that has no solution, some initial values may still pass arc consistency before any variable is assigned. ✔
- [ ] None of the above.

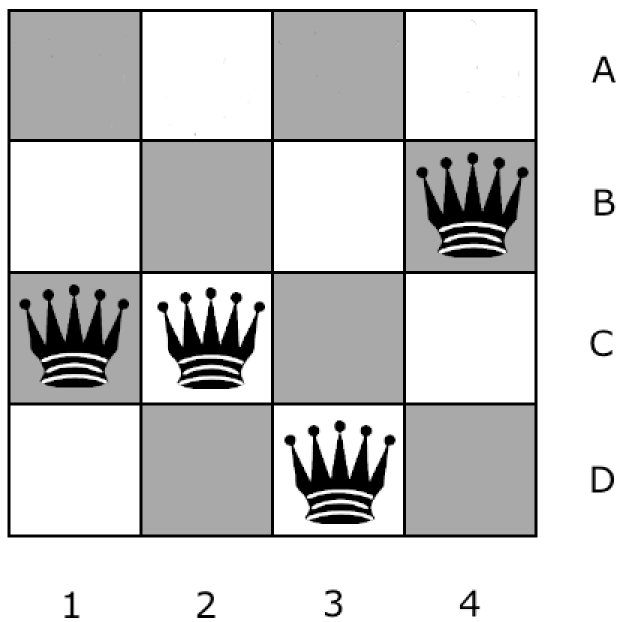
Question **6**

Correct

Mark 15.00 out of 15.00

The min-conflicts algorithm attempts to solve CSPs iteratively. It starts by assigning some value to each of the variables, ignoring the constraints when doing so. Then, while at least one constraint is violated, it repeats the following: (1) randomly choose a variable that is currenly violating a constraint, (2) assign to it the value in its domain such that after the assignment the total number of constraints violated is minimized (among all possible selections of values in its domain).

In this question, you are asked to execute the min-conflicts algorithm on a simple problem: the 4-queens problem in the figure shown below. Each queen is dedicated to its own column (i.e. we have variables Q_1, Q_2, Q_3 and Q_4 and the domain for each one of them is A, B, C, D). In the configuration shown below, we have $Q_1 = C, Q_2 = C, Q_3 = D, Q_4 = B$. Two queens are in conflict if they share the same row, diagonal, or column (though in this setting, they can never share the same column).



You will execute min-conflicts for this problem three times, starting with the state shown in the figure above. When selecting a variable to reassign, min-conflicts chooses a conflicted variable at random. For this problem, assume that your random number generator always chooses the leftmost conflicted queen. When moving a queen, move it to the square in its column that leads to the fewest conflicts with other queens. If there are ties, choose the topmost square among them.

We recommend you work out the solutions to the following questions on a sheet of scratch paper, and then enter your results below.

Starting with the queens in the configuration shown in the above figure, which queen will be moved, and where will it be moved to?

Queen

- [x] 1 ✔
- [ ] 2
- [ ] 3
- [ ] 4

Position

- [x] A ✔
- [ ] B
- [ ] C
- [ ] D

Continuing off of Part 1, which queen will be moved, and where will it be moved to?

Queen

- [ ] 1
- [x] 2 ✔
- [ ] 3
- [ ] 4

Position

- [x] A ✔
- [ ] B
- [ ] C
- [ ] D

Continuing off of Part 2, which queen will be moved, and where will it be moved to?

Queen

- [x] 1 ✔
- [ ] 2
- [ ] 3
- [ ] 4

Position

- [ ] A
- [ ] B
- [x] C ✔
- [ ] D

Question 7

Correct

Mark 6.00 out of 6.00

Assume you are given a CSP and you enforce arc consistency. Which of the following are true?

Select one or more:

- [ ] a. If the CSP has no solution, it is guaranteed that enforcement of arc consistency resulted in at least one domain being empty.
- [ ] b. If the CSP has a solution, then after enforcing arc consistency, you can directly read off the solution from resulting domains.
- [x] c. In general, to determine whether the CSP has a solution, enforcing arc consistency alone is not sufficient; backtracking may be required. ✔
- [ ] d. None of the above.

Question **8**

Correct

Mark 12.00 out of 12.00

We are given a CSP with only binary constraints. Assume we run backtracking search with arc consistency as follows. Initially, when presented with the CSP, one round of arc consistency is enforced. This first round of arc consistency will typically result in variables having pruned domains. Then we start a backtracking search using the pruned domains. In this backtracking search we use filtering through enforcing arc consistency after every assignment in the search.

Which of the following are true about this algorithm?

- [ ] If after a run of arc consistency during the backtracking search we end up with the filtered domains of **all** of the not yet assigned variables being empty, this means the CSP has no solution.
- [ ] If after a run of arc consistency during the backtracking search we end up with the filtered domain of **one** of the not yet assigned variables being empty, this means the CSP has no solution.
- [x] None of the above. ✔

Which of the following are true about this algorithm?

- [x] If after a run of arc consistency during the backtracking search we end up with the filtered domains of **all** of the not yet assigned variables being empty, this means the search should backtrack because this particular branch in the search tree has no solution. ✔
- [x] f after a run of arc consistency during the backtracking search we end up with the filtered domain of **one** of the not yet assigned variables being empty, this means the search should backtrack because this particular branch in the search tree has no solution. ✔
- [ ] None of the above.

Which of the following are true about this algorithm?

- [x] If after a run of arc consistency during the backtracking search we end up with the filtered domains of all of the not yet assigned variables each having exactly one value left, this means we have found a solution. ✔
- [ ] If after a run of arc consistency during the backtracking search we end up with the filtered domains of all of the not yet assigned variables each having more than one value left, this means we have found a whole space of solutions and we can just pick any combination of values still left in the domains and that will be a solution.
- [x] If after a run of arc consistency during the backtracking search we end up with the filtered domains of all of the not yet assigned variables each having more than one value left, this means we can't know yet whether there is a solution somewhere further down this branch of the tree, and search has to continue down this branch to determine this. ✔