Constraint Satisfaction

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Russell and Norvig, 3rd Edition, Chapter 6

These slides are new and can contain mistakes and typos. Please report them to Sven (skoenig@usc.edu).

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Examples • Eight-queens problem В С D Е F G Н Ŵ 1 Ŵ 2 Ŵ 3 Ŵ 4 Ŵ 5 Ŵ 6 Ŵ 7 Ŵ 8

Examples

- Different formulations are possible for the N-queens problem.
 - Formulation 1
 - Variables: Location of each queen
 - Domains: Set of all squares
 - Constraints: Any two queens cannot attack each other or be in the same square.
 - Number of states: (N²)^N

• Formulation 2

- Variables: Occupied status for each square
- Domains: Boolean
- Constraints: Any two queens cannot attack each other. Exactly N variables have value true.
- Number of states: 2^(N²)
- and many others









Backtracking Search

- Skip an assignment if, after the assignment, at least one constraint between assigned variables is not satisfied.
- Backtrack once all assignments have been tried unsuccessfully.























Backjumping

- When backtracking, do not backtrack to the preceding variable but to the latest one that, when assigned a different value, has a chance to avoid the empty domain of the current variable.
- Backtracking with backjumping never needs more steps than backtracking (without backjumping) but can result in fewer steps.







Forward Checking

- Before assigning a value to a variable, remove all values from the domains of the unassigned variables that are inconsistent with the assigned value. Skip the assignment if at least one unassigned variable has an empty domain afterward.
- Backtrack once all assignments have been tried unsuccessfully.
- Backtracking with forward checking never needs more steps than backtracking with backjumping but can result in fewer steps.













































Maintaining Path Consistency

- Before assigning a value to a variable, remove all values from the domains of the unassigned variables that are inconsistent with the assigned value. Then, repeatedly remove a consistent pair of values from the cross product of the domains of two variables if there exists another variable that has no value in its domain that is consistent with the pair of values.
- Skip the assignment if at least one unassigned variable has an empty domain afterward.
- Backtrack once all assignments have been tried unsuccessfully.
- Backtracking with maintaining path consistency never needs more steps than backtracking with maintaining arc consistency but can result in fewer steps.

























- Want to play around with constraint satisfaction algorithms?
- Go here: http://aispace.org/constraint/