Title: Search orders in CSPs

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Book: Foundations of Constraint Satisfaction

Chapter: 6

Theory and Practice of Constraint Satisfaction

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www.cse.unl.edu/~choueiry/CSE990-05/

Motivation for ordering heuristics

- In lookahead:
  - failure could be detected earlier under some orderings than others
  - larger portions of the solution space can be pruned off under some orderings than others

- In BT, less of undoing-labels needs to be done under some orderings than others

- When searching for one solution, value ordering may speed up search as branches that have a better chance to reach a solution are explored first

Heuristics

Value ordering:

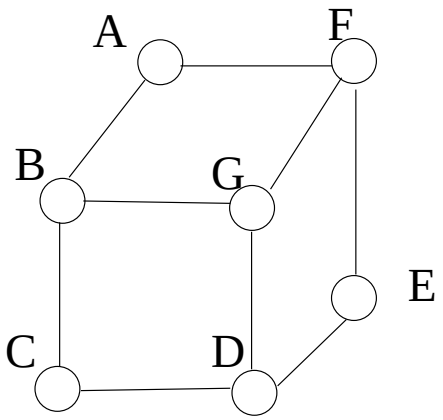
Min-conflict heuristic
orders values according to the conflicts in which they are involved with the future variables.

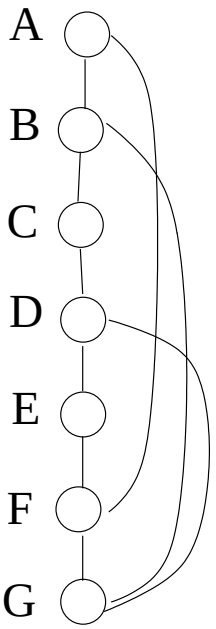
Variable ordering

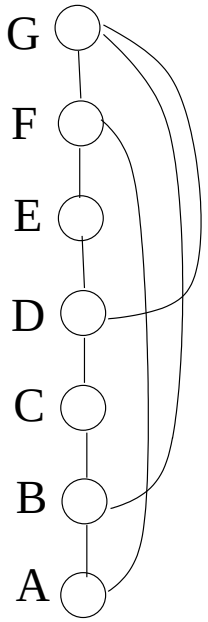
- Minimal width ordering (MWO)
- Minimal bandwidth ordering (MBO)
- Fail first principal (FFP)
- Maximal cardinality ordering (MCO)

$\rightarrow$ static, dynamic?

Minimal width ordering







Reduces the chance of backtracking: variables that have more unassigned values depending on them are labeled first. Variables at the front of the ordering are in general more constrained..

Finding minimum width ordering: $\mathcal{O}(n^2)$.

Minimal bandwidth ordering

Localizes/confines backtracking:
the smaller the bandwidth is, the sooner one could backtrack to relevant decisions

Finding minimum bandwidth ordering:

$\rightarrow$ NP-hard.

Is there an ordering of a *given* bandwidth k?

$\rightarrow \mathcal{O}(n^{k+1})$ (polynomial)

Fail First Principal

Aims at recognizing dead-ends as soon as possible so that search effort can be saved.

Several FFP measures

$\rightarrow$ *e.g.* domain size (smallest domain first)

Simple, cheap and effective

Suitable for both static and dynamic ordering

Maximum Cardinality Ordering

An approximation of min. width ordering, $\mathcal{O}(n)$

Choose a node arbitrarily. Among the remaining nodes, choose the one that is connected to the maximum number of already chosen nodes, break ties arbitrarily, repeat...
Reverse the final order.