Advanced Topics in AI
Improving structure

Instructor: Prof. Dr. techn. Wolfgang Nejdl
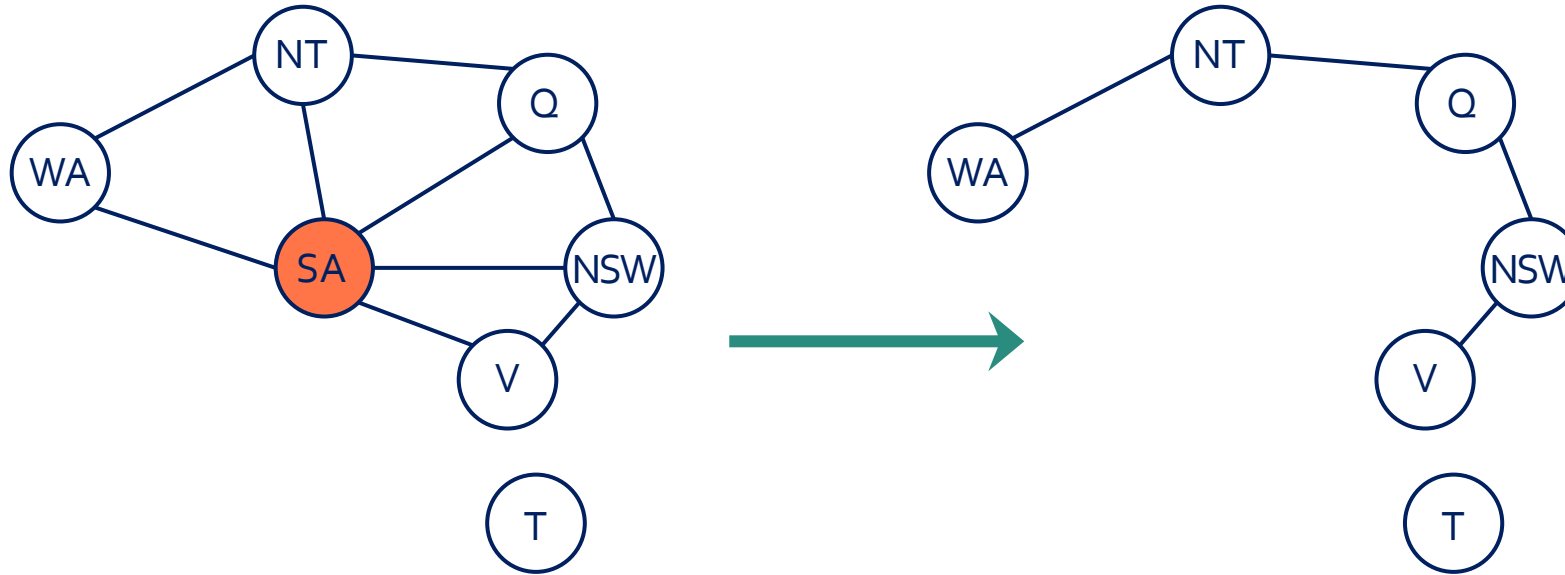
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Nearly Tree-Structured CSPs

- Conditioning: instantiate a variable, prune its neighbors' domains

- Cutset conditioning: instantiate (in all ways) a set of variables such that the remaining constraint graph is a tree

- Cutset size c gives runtime: $O(\, (d^c)\, (n - c)\, d^2\,)$
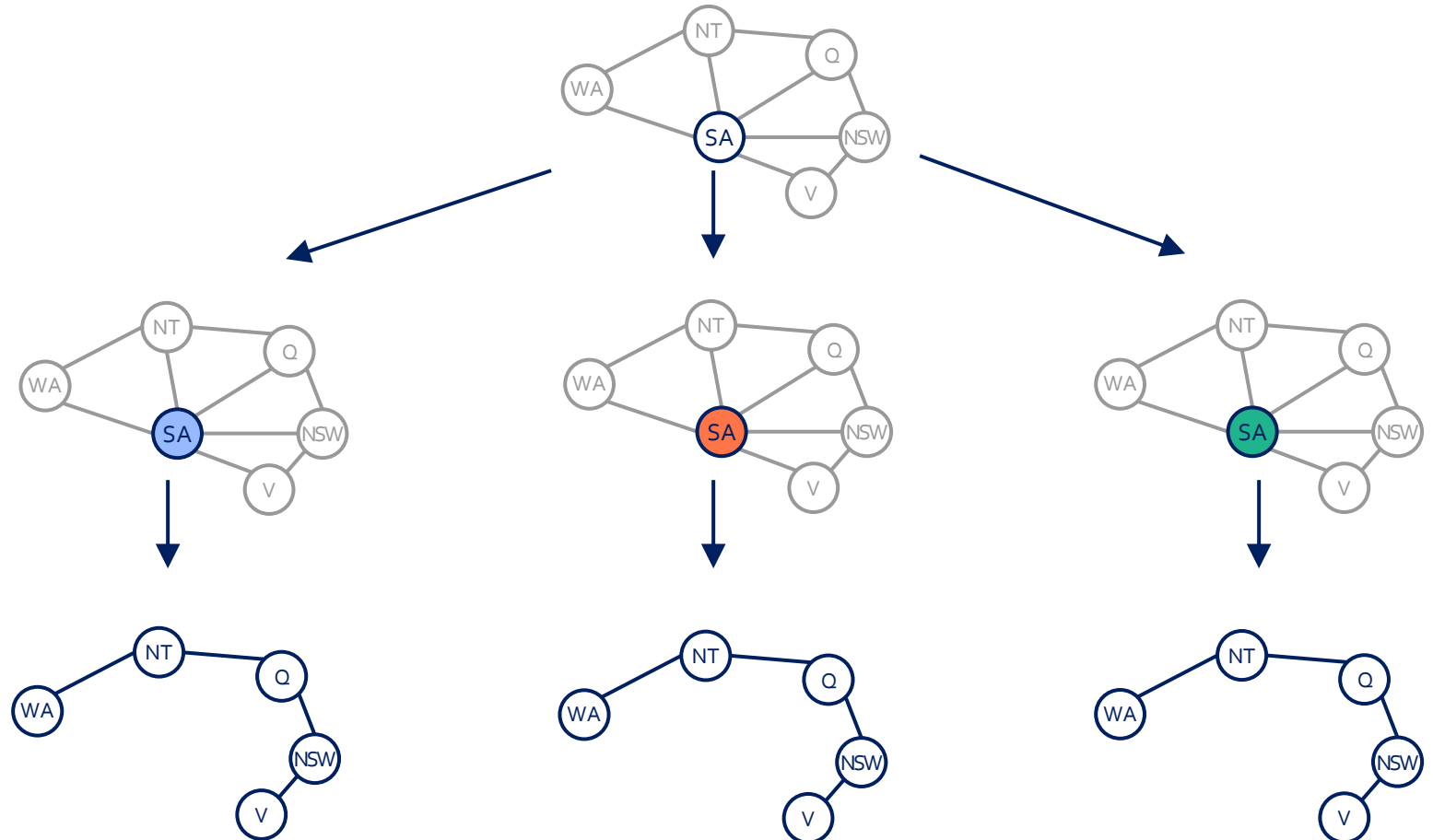 - very fast for small c

Cutset Conditioning

Choose a cutset

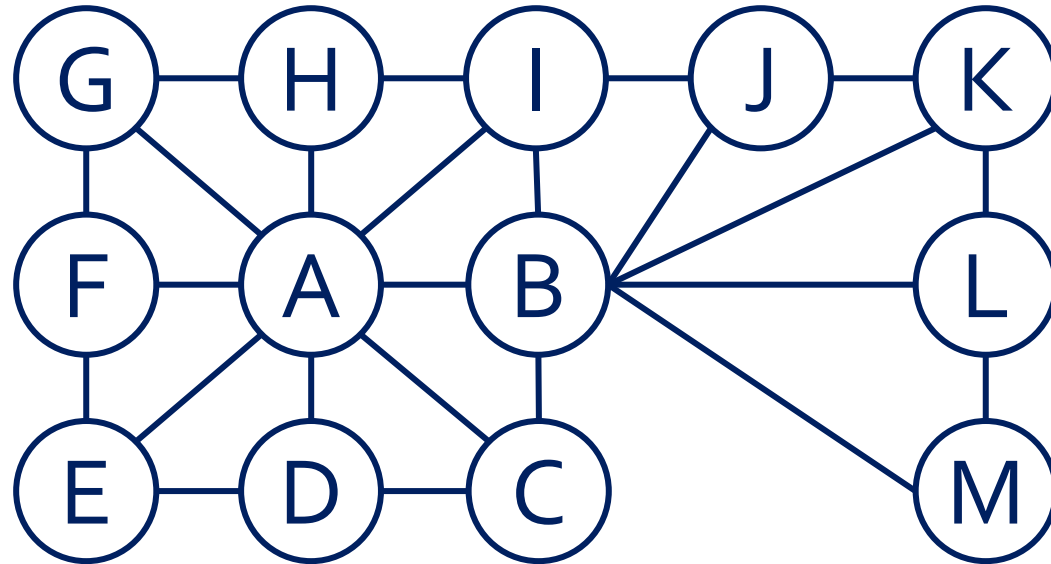Instantiate the cutset
(all possible ways)

Compute residual CSP
for each assignment

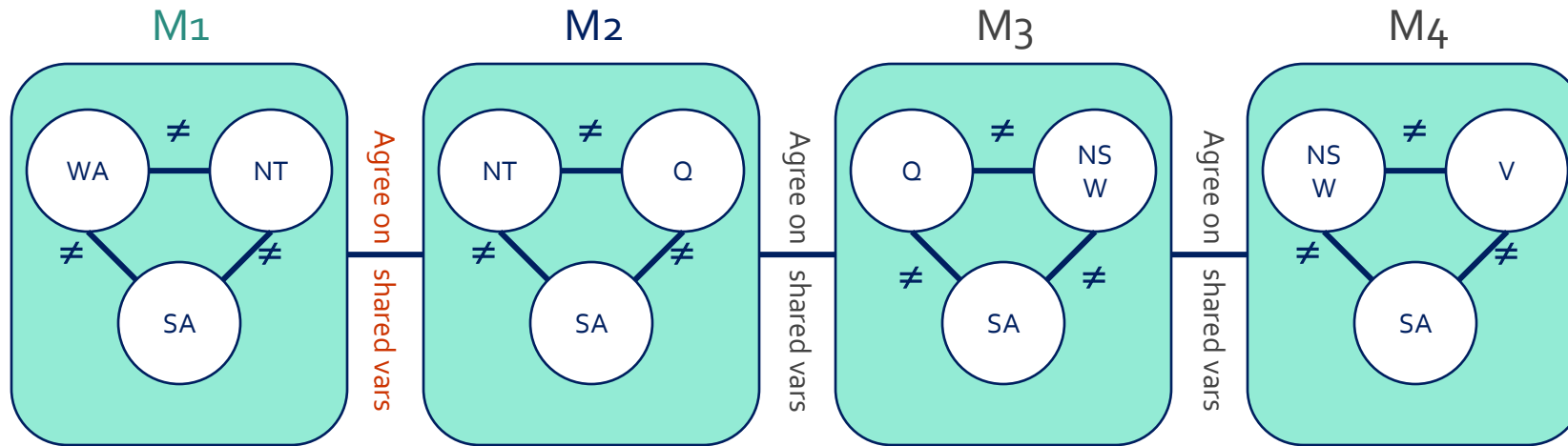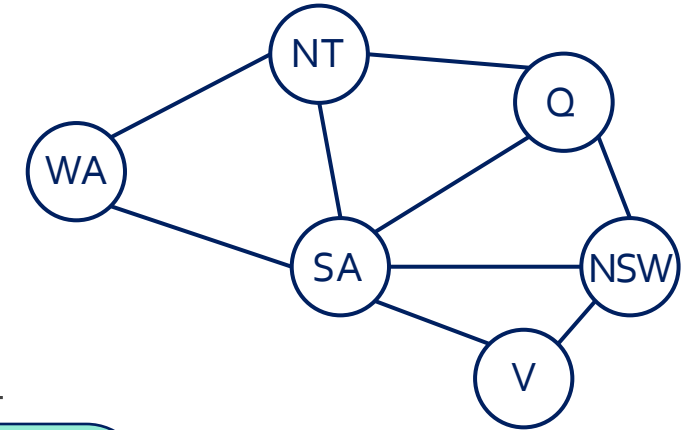Solve the residual
CSPs (tree structured)

Cutset Quiz

Find the smallest cutset for the graph below.

Tree Decomposition

- Idea: create a tree-structured graph of mega-variables
- Each mega-variable encodes part of the original CSP
- Subproblems overlap to ensure consistent solutions

M1

{(WA=r,SA=g,NT=b),
 (WA=b,SA=r,NT=g),
 ...}

M2

{(NT=r,SA=g,Q=b),
 (NT=b,SA=g,Q=r),
 ...}

M3

Agree: (M1,M2) ∈
    {((WA=g,SA=g,NT=g), (NT=g,SA=g,Q=g)), ...}

M4

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Next: Iterative Improvement

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[These slides were created by Dan Klein and Pieter Abbeel for CS188 Intro to AI at UC Berkeley. All materials are available at http://ai.berkeley.edu.]