Bi-Objective Evolutionary Bayesian Network Structure Learning via Skeleton Constraint

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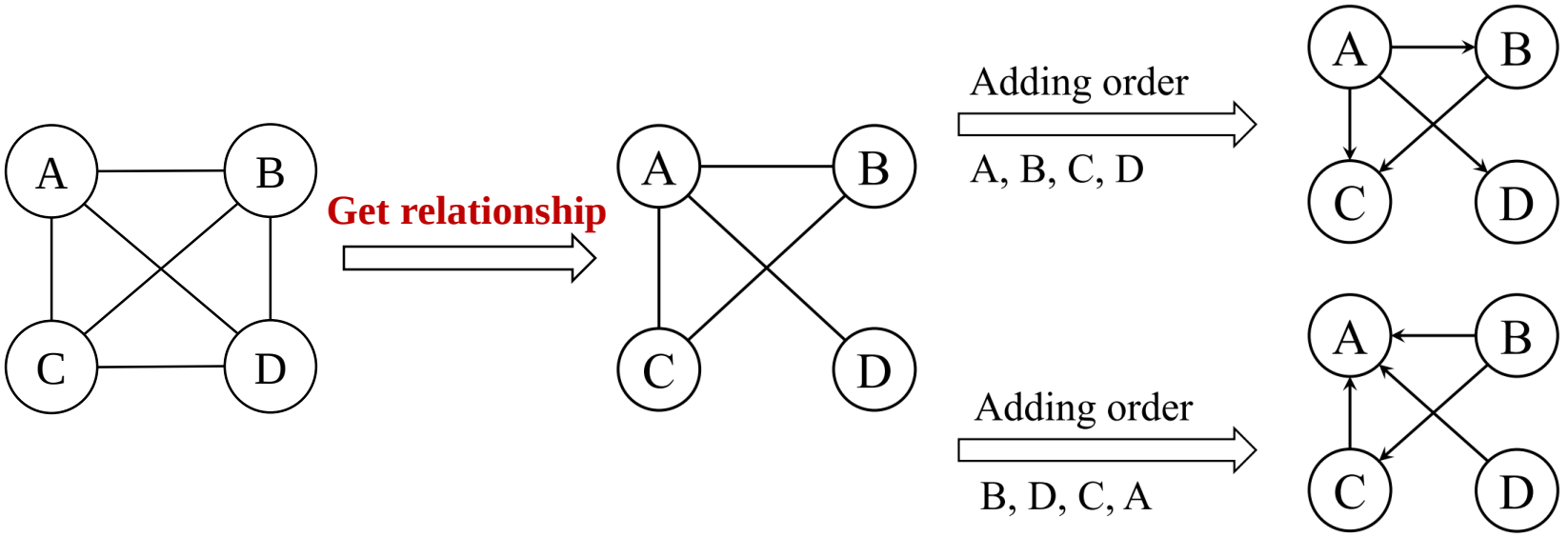
Problems & Ideas

- Problems of existing bi-objective Bayesian structure learning methods:
  - Existing bi-objective structure learning methods fail to obtain good structures on **medium-scale Bayesian networks**.

- Ideas: The **relationship information** between variables can be used to constrain the search space.



The example of the individuals generated by initialization strategy based on the skeleton which obtained by conditional independence test. Left: The complete skeleton. Middle: the fixed skeleton. Right: Two individuals generated in the initial population.

Main Contributions

- Contributions:
  - A bi-objective evolutionary Bayesian network structure learning algorithm via skeleton constraint (BBS) for medium-scale networks;
  - Several strategies are designed based on the skeleton for expanding the scale of Bayesian network structure learning;
  - On the educational problem of discovering the influencing factors of students' academic performance, BBS provides high quality solutions and is featured with the flexibility of solution selection.

Networks	BOS	BBS
cancer	0.7 ± 0.7	$\mathbf{0.0 \pm 0.0}$
earthquake	0.3 ± 0.4	$\mathbf{0.0 \pm 0.0}$
survey	1.1 ± 0.3	$\mathbf{1.0 \pm 0.0}$
asia	1.5 ± 1.4	$\mathbf{0.3 \pm 0.6}$
sachs	6.4 ± 2.4	$\mathbf{1.9 \pm 0.8}$
child	15.3 ± 3.6	$\mathbf{3.9 \pm 1.0}$

SHD* yielded by each bi-objective Bayesian network structure learning methods. The smaller the SHD* is , the higher the quality of solutions are.