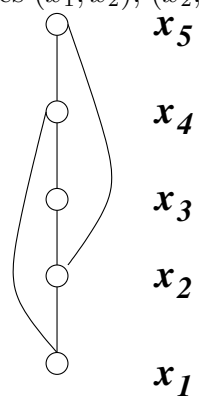
Rina Dechter, Fall-2020

ICS 275, Assignment 5

1. (5 pts) On Monday, November 16th, Prof. Sakalla, who is one of the co-authors of the SAT solver Grasp talks in our AIML seminar. Attend the seminar and summarize his talk in one paragraph.

2. (40 pts. question 1, chapter 6) Let G be a constraint graph of a problem having 5 variables x_1, x_2, x_3, x_4, x_5 with arcs (x_1, x_2), (x_2, x_3), (x_3, x_4), (x_4, x_1), (x_4, x_5), (x_5, x_2).



For a problem having the constraint graph G and using ordering $d_1 = (x_1, x_2, x_3, x_4, x_5)$, confirm, reject, and justify your answer either with an argument or a counter example:

(a) For the graph G and ordering d, graph-based backjumping will always behave exactly as backtracking.

(b) For the graph G and ordering d, Gaschnig's backjumping will always behave like backtracking.

(c) Conflict-directed backjumping and Gaschnig's backjumping are identical on G along d.

(d) Graph-based learning over G and ordering d_1 will never record constraints of size greater than two.

(e) If a leaf dead-end occurs at x_5, what is the induced-ancestor set $I_5(\{x_5\})$? what is the induced ancestors $I_3(\{x_3, x_4\})$? of $I_3(\{x_3, x_4, x_5\})$.

(f) Propose a better ordering for graph-based backjumping. Justify your answer.

(g) If a leaf dead-end occurs at x_5 and another internal dead-end at x_4, what is the conflict-set recorded by graph-based learning?

(h) How would your answer on all previous questions be different if constraint (x_2, x_3) is omitted.

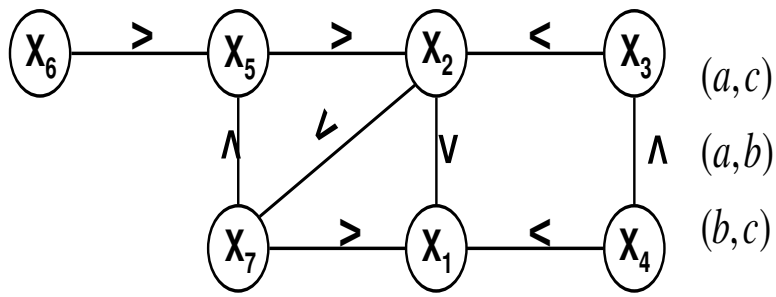


Figure 1: A constraint graph. The domains are a,b,c

3. (10 pts. question 8, chapter 6) Consider the graph in Figure 1. a) Provide a DFS ordering of the graph having the smallest depth you can, and bound the complexity of solving any problem having that graph. b) analyze the complexity of solving this problem with the two algorithms of i) conflict-directed backjumping and ii) graph-based learning.

4. (5 pts. question 13, chapter 6) Prove that when using the same variable ordering, Gaschnig's backjumping always explores every node explored by forward-checking.

5. (10 pt.) Describe in words how CDCL (conflict-directed-clause-learning) works. (see class page pointing to SAT handbook chapters 3 and 4: https://www.enseignement.polytechnique.fr/informatique/INF321/TD/TD910/files/SATHandbook-CDCL.pdf) Simulate its performance on

$$\varphi = \{(A, \neg B, D), (\neg D, F, C), (\neg C), (B, F, E), (C, F, \neg A), (\neg F, \neg A)\}$$