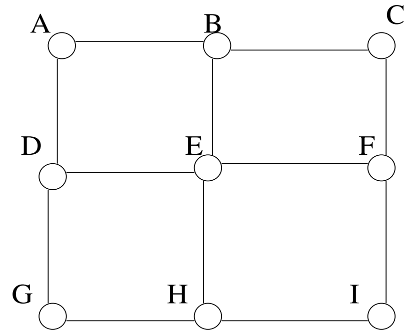


Figure 1: Grid with nine nodes

Rina Dechter, Fall-2020

ICS 275, Assignment 3

Read chapters 4 in book and answer the following questions:

1. (10 pts. question 3 chapter 4) Let (G^*, d) be an ordered induced graph of an arbitrary graph. Prove that G^* is chordal.

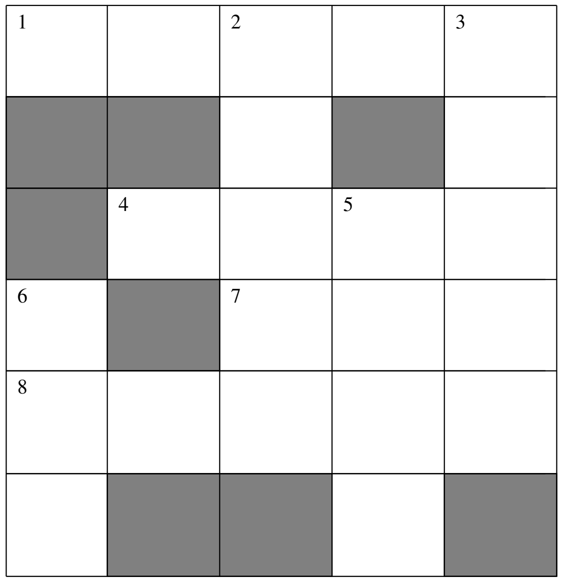
2. (15 pts. question 7 chapter 4) Consider the graph in Figure 1.

   (a) What is the induced-width of the graph? Provide an ordering having minimum induced-width.

   (b) Assume that the graph expresses a binary constraint network with some constraints (e.g., inequalities). Provide a complexity bound using the induced-width parameter when applying algorithm Directional Path-consistency (DPC) along the optimal induced-width ordering of this problem.

   (c) Can algorithm DPC always decide consistency of every constraint problem having the grid constraint graph? Either prove or give a counter example.

3. (20 pts. question 12 chapter 4) Consider the crossword puzzle:



Word List

aft	laser
ale	lee
eel	line
heel	sails
hike	sheet
hoses	steer
keel	tie
knot	

(a) Model the problem as a binary csp, that is, where the words are the variables (the problem has 8 variables). Draw its constraint graph.

(b) Generate a min-induced-width and max-cardinality ordering of the constraint graph. Generate the induced graph along these orderings. What is the w* of this problem?

(c) What level of directional-i-consistency is guaranteed to generate a backtrack-free representation for the ordered graphs that you picked, regardless of the actual constraints relations?

(d) Using the min-induced-width ordering, show the constraints which will be recorded for this specific problem by 1) directional arc-consistency, 2) directional path-consistency 3) adaptive-consistency. (Show the constraint scopes generated for all buckets and the actual relations generated when processing the first 3 buckets).

4. (10 pts. extra credit, question 13 chapter 4) Consider the crypt-arithmetic problem TA+DB = GBA. and use the formulation of the problem with carries.

(a) Draw the primal constraint graph of the problem

(b) Find an ordering of the variables using the min-induced-width algorithm in Chapter 2. What is the width of the ordering you generated. Compute the induce graph and the induced-width of the ordering generated.

(c) Hand-simulate algorithm adaptive-consistency on the ordering you created First describe the schemes of the initial partitioning into buckets, then show how new relations are created. Describe only the schemes (scopes of functions) of the relations.

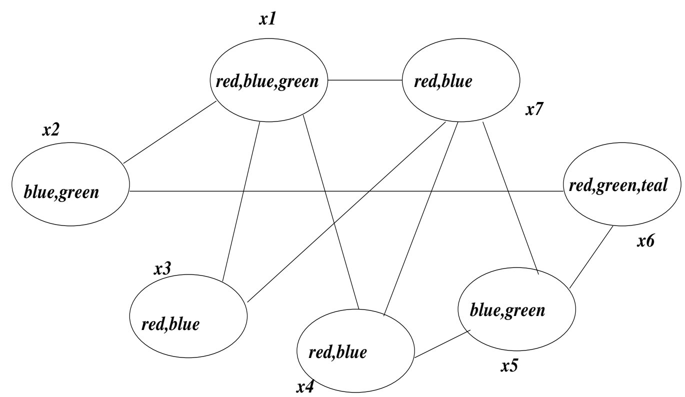


Figure 2: A graph coloring problem.

(d) Bound the complexity of the algorithm on the ordering of your choice.

5. (Optional, question 11 Chapter 4) Consider the modified coloring problem in Figure 2. The constraints are inequalities constraints, and the domains are indicated inside the nodes in the graph. Let $d = x_1, x_7, x_4, x_5, x_6, x_3, x_2$ (assume search starts from x_1 and directional consistency starts from x_2).

   (a) Generate a directional strong path-consistent network for this problem, using ordering d.

   (b) Generate a backtrack-free problem using adaptive-consistency.

   (c) Find a solution to the problem.

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