Fall Semester, 2002 **B.Y. Choueiry**

CSCE 421/821: Foundations of Constraint Processing

Homework 3

Assigned: Tuesday, October 15, 2002.

Due: Tuesday, November 5, 2002, *by 9:30 a.m.* Use `handin`.

Total value: 100 points.

Advice: You may discuss the implementation aspects of this homework with a colleague, the TA or instructor. However, the code must be written individually. *Always* acknowledge sources of information (URL, book, class notes, colleagues, etc.) Please inform instructor quickly about typos or other errors.

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1. Tree graph **(Total 15 points)**

Consider a constraint graph structured as a tree, any tree. Apply the procedure for finding the width of this graph (will be discussed in class).

(a) **(5 points)** What is the width of this graph?

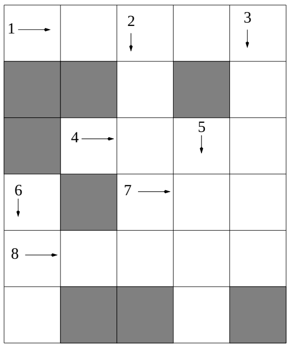
(b) State **(5 points)** and demonstrate **(5 points)** a theorem about the width of a tree-structured graph.

2. Crossword Puzzle **(Total 35 points)**

Consider the list of words:

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

for the crossword puzzle:



The numbers 1, 2, …, 8 in the crossword puzzle correspond to the words that will start at those locations. The arrows correspond to the direction of the alignment of the letters in the words.

(a) **(20 points)** Model this puzzle as a binary CSP. State what are the variables, their respective domains, and the binary constraints between variables.
Hint: model every variable as a vector (i.e., one dimension array) and express the constraints as an equality between the respective positions of two arrays.

(b) **(5 points)** Draw the constraint graph.

(c) **(10 points)** Make this CSP arc-consistent.

3. Backtrack search **(Total 50 points)**

Using the data structures you implemented in Homework 2, implement a chronological backtrack (BT) search procedure and another one with forward-checking (FC) for finding the first solution to the following CSPs:

(a) 6-Queen Problem,

(b) Zebra problem,

(c) Crossword puzzle.

Do not run arc-consistency prior to search. Use the static variable ordering heuristic of your choice, preferably one of those you implemented in Homework 2 (i.e., least domain, least degree, and least ratio of domain to degree). Along with your documented code, report the results in a table as the one shown below. **20 points** will be assigned for code correctness, clarity, and *documentation*.

Your chosen static ordering heuristic						
	BT			FC		
	#CC	#NV	CPU time	#CC	#NV	CPU time
6-Queen **(10 points)**						
Zebra-problem **(10 points)**						
Crossword puzzle **(10 points)**						