MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY
COURSE: COMPUTER ARTIFICIAL SESSIONAL COURSE CODE: CSE 404
TASK:4 [Constraint Programming: Kakuro puzzle solving]

Problem Statement: Solve kakuro puzzles by Constraint Programming (CP) techniques.

Marks Distribution:

Submission	CP model	Two problems [from book_1]	One problem [from book_2]	Report	UI(Bonus)	Total
10	30	20	20	20	20	100 + 20

Submission:
1. Put all necessary file in a single Folder. Name it: cse404<SecA/B>_task4_
<your roll no>
2. Put the folder in a zip file. Name it the same as that of folder.
3. Email the zip file in this email: submission.cse.mist@gmail.com .
4. The subject of the email must be same as the name of your folder.
5. Deadline: 20 May, 2018 11:59PM.

Detailed instruction for writing Constraint Programs:
You have to solve any two problems from the kakuro_book_1 and any one problem from the kakuro_book_2. each book has a total of eight problems.

To help you, a sample CP code is given (kakuro_cp_choco_solver_formulation_1_sample_problem and kakuro_cp_choco_solver_formulation_2_sample_problem) which solves a kakuro problem
[problem_1 from kakuro_sample_problem_book]

Two formulations are provided. The first formulation available in kakuro_cp_choco_solver_formulation_1_sample_problem is a direct formulation of the problem where for each clue (either horizontal sum or vertical sum), two global constraints (sum and alldiff) are used.

For the second formulation, a further reduction of the domains for the cell variables are made by additional constraints. Let us consider, three variables x1, x2 and x3 with two constraints: alldiff ([x1, x2, x3]) and sum ([x1, x2, x3], “=”, 24). Also, assume all three integer variables have domains with lower bound 1 and upper bound 9. Because the sum of x2 + x3 can be at most 17 (by picking up the highest value possible for both variables), we see that x1 is greater than 6. In other words, x1 has a lower bound of 7. In fact, all the variables has a lower bound of 7.

Similarly, let us consider, three variables x1, x2 and x3 with two constraints: alldiff ([x1, x2, x3]) and sum ([x1, x2, x3], “=”, 8). Also, assume all three integer variables have domains with lower bound 1 and upper bound 9. Because the sum of x2 + x3 has to be at least 3 (by picking up the lowest value

possible for both variables), we see that x1 can not be greater than 5. In other words, x1 has an upper bound of 5 and x1 is less than 6. In fact, all three variables are less than 6.

You have to implement two formulations for each of the three problems (two from book_1 and one from book_2). From the output, you have to note down some of the statistics for the report showing a performance comparison of the two CP formulations.

Detailed instruction for writing the Report:
You have to provide a table showing the problem characteristics.

	Book no, problem no	No of total clues	No of horizontal sums	No of vertical sums	Max no of cells for horizontal sums	Max no of cells for vertical sums
Sample_problem	Sample_book, prob 1	12	6	6	4	4
Problem_1	Book_1, prob					
Problem_2	Book_1, prob					
Problem_3	Book_2, prob					

Also, you have to provide tables showing some solution statistics.

		For the first formulation					
	Book no, problem no	No of variables	No of constraints	No of nodes	No of backtrack	No of fail	Resolution time
Sample_problem	Sample_book, prob 1	76	92	2	0	0	0.042s
Problem_1	Book_1, prob						
Problem_2	Book_1, prob						
Problem_3	Book_2, prob						

		For the second formulation					
	Book no, problem no	No of variables	No of constraints	No of nodes	No of backtrack	No of fail	Resolution time
Sample_problem	Sample_book, prob 1	76	120	2	0	0	0.039s
Problem_1	Book_1, prob						

Problem_2	Book_1, prob						
Problem_3	Book_2, prob						

Instruction for using CP solver:

Writing choco solver code using an online IDE available in the following URL is suggested: https://chocoide.herokuapp.com/

The advantage is you will not need to install choco solver in your own machine. It also has some example CP codes available from the drop-down list which you may study.

If you are comfortable with Java, learning choco solver is easier by studying the tutorial and the user help documentation (choco-solver.pdf for choco 4.0.5 and choco-tuto.pdf). I have also included user_guide-3.3.1.pdf (chapter -18 has a detailed desription of Constraints over integer variables).

http://www.choco-solver.org/ has user-guides, tutorials, and Javadoc sections which contain detailed descriptions.

A user manual for Gecode (MPG.pdf for Gecode 6.0.0) is provided, assuming many students are comfortable with C++. It is quite detailed and has many examples. For example, chapter-21 discusses kakuro puzzle solving.

Finally, learning to write CP using a constraint language is a good thing but it is going to take some time. As you are going to do only one assignment using CP, I suggest using the choco solver online IDE and studying the sample CP code for kakuro solving.