**CSE 579**

**Programming Assignment 1**

**Template for clingo Work**

Problem 1

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| Input  Program | {queen(X,1..8)}=1 :- X=1..8.  :- queen(X1, Y), queen(X2, Y), X1!=X2.  :- queen(X1, Y1), queen(X2, Y2), X1!=X2, |X1-X2| = |Y1-Y2|.  :- queen(X,Y), X=3..6, Y=3..6. |
| Command  Line | clingo p1.txt 0 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p1.txt 0  clingo version 5.3.0  Reading from p1.txt  Solving...  Answer: 1  queen(5,7) queen(1,4) queen(2,6) queen(4,2) queen(3,8) queen(6,1) queen(7,3) queen(8,5)  Answer: 2  queen(2,3) queen(3,1) queen(6,8) queen(4,7) queen(1,5) queen(5,2) queen(7,6) queen(8,4)  Answer: 3  queen(2,4) queen(4,1) queen(5,8) queen(3,7) queen(1,6) queen(6,2) queen(7,5) queen(8,3)  Answer: 4  queen(6,7) queen(1,3) queen(2,5) queen(3,2) queen(4,8) queen(5,1) queen(8,6) queen(7,4)  SATISFIABLE  Models : 4  Calls : 1  Time : 0.005s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.016s |

Problem 2

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| Input  Program | {queen(X,1..n)}=1 :- X=1..n.  :- queen(X1, Y), queen(X2, Y), X1!=X2.  :- queen(X1, Y1), queen(X2, Y2), X1!=X2, |X1-X2| = |Y1-Y2|. |
| Command  Line | You should write multiple command lines below.  clingo p2.txt -c n=3 0  clingo p2.txt -c n=4 0  clingo p2.txt -c n=5 0  clingo p2.txt -c n=6 0  clingo p2.txt -c n=7 0  clingo p2.txt -c n=8 0  clingo p2.txt -c n=9 0  clingo p2.txt -c n=10 0  clingo p2.txt -c n=11 0  clingo p2.txt -c n=12 0 |
| Output  of clingo | Since the output is large, do not copy them into the submission. |
| Answer  to Questions | Draw a table that lists the number of solutions and the times to compute all solutions. Use CPU time that clingo returns.   |  |  |  | | --- | --- | --- | | Value n | Number of solutions | time | | 3 | 0 | 0.003s | | 4 | 2 | 0.003s | | 5 | 10 | 0.028s | | 6 | 4 | 0.007s | | 7 | 40 | 0.075s | | 8 | 92 | 0.204s | | 9 | 352 | 0.734s | | 10 | 724 | 1.554s | | 11 | 2680 | 9.585s | | 12 | 14200 | 73.150s | |

Problem 3

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| Input  Program | {a(X,Y,N): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- N=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,N), a(X,Y,N1), N1!=N.  :- a(X,Y,N), a(X,Y1,N), Y1!=Y.  :- a(X,Y,N), a(X1,Y,N), X1!=X.  %Instance  a(1,1,8).  a(2,3,3).  a(2,4,6).  a(3,2,7).  a(3,5,9).  a(3,7,2).  a(4,2,5).  a(4,6,7).  a(5,5,4).  a(5,6,5).  a(5,7,7).  a(6,4,1).  a(6,8,3).  a(7,3,1).  a(7,8,6).  a(7,9,8).  a(8,3,8).  a(8,4,5).  a(8,8,1).  a(9,2,9).  a(9,7,4). |
| Command  Line | clingo p3.txt prob3\_instance.txt 0 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p3.txt prob3\_instance.txt 0  clingo version 5.3.0  Reading from p3.txt ...  Solving...  Answer: 1  a(1,1,8) a(2,3,3) a(2,4,6) a(3,2,7) a(3,5,9) a(3,7,2) a(4,2,5) a(4,6,7) a(5,5,4) a(5,6,5) a(5,7,7) a(6,4,1) a(6,8,3) a(7,3,1) a(7,8,6) a(7,9,8) a(8,3,8) a(8,4,5) a(8,8,1) a(9,2,9) a(9,7,4) a(4,1,1) a(1,2,1) a(6,1,2) a(7,2,2) a(1,3,2) a(5,1,3) a(8,2,3) a(8,1,4) a(2,2,4) a(4,3,4) a(7,1,5) a(3,3,5) a(3,1,6) a(5,2,6) a(9,3,6) a(9,1,7) a(6,3,7) a(6,2,8) a(2,1,9) a(5,3,9) a(9,5,1) a(3,6,1) a(4,4,2) a(8,5,2) a(2,6,2) a(9,4,3) a(4,5,3) a(1,6,3) a(3,4,4) a(7,6,4) a(1,5,5) a(6,5,6) a(8,6,6) a(1,4,7) a(7,5,7) a(5,4,8) a(2,5,8) a(9,6,8) a(7,4,9) a(6,6,9) a(2,7,1) a(5,9,1) a(5,8,2) a(9,9,2) a(7,7,3) a(3,9,3) a(1,8,4) a(6,9,4) a(6,7,5) a(9,8,5) a(2,9,5) a(1,7,6) a(4,9,6) a(2,8,7) a(8,9,7) a(4,7,8) a(3,8,8) a(8,7,9) a(4,8,9) a(1,9,9)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.021s (Solving: 0.01s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.016s |

Problem 4

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| Input  Program | {a(X,Y,N): X=1..16, Y=1..16, X1<=X, X<=X1+3, Y1<=Y, Y<=Y1+3} = 1 :- N=1..16, X1 = 4\*(0..3)+1, Y1 = 4\*(0..3)+1.  :- a(X,Y,N), a(X,Y,N1), N1!=N.  :- a(X,Y,N), a(X,Y1,N), Y1!=Y.  :- a(X,Y,N), a(X1,Y,N), X1!=X.  %Instance  a(1,1,9).  a(1,2,14).  a(1,6,3).  a(1,8,5).  a(1,9,15).  a(1,11,2).  a(1,15,7).  a(1,16,1).  a(2,1,6).  a(2,2,12).  a(2,6,14).  a(2,11,10).  a(2,15,5).  a(2,16,11).  a(3,1,4).  a(3,4,7).  a(3,5,6).  a(3,8,13).  a(3,9,16).  a(3,12,1).  a(3,13,2).  a(3,16,9).  a(4,2,15).  a(4,3,16).  a(4,5,9).  a(4,6,7).  a(4,11,11).  a(4,12,6).  a(4,14,3).  a(4,15,14).  a(5,2,7).  a(5,3,15).  a(5,14,2).  a(5,15,16).  a(6,1,5).  a(6,3,13).  a(6,5,14).  a(6,7,15).  a(6,10,10).  a(6,12,3).  a(6,14,1).  a(6,16,8).  a(7,2,8).  a(7,4,10).  a(7,6,9).  a(7,7,4).  a(7,8,11).  a(7,9,13).  a(7,10,6).  a(7,11,15).  a(7,13,14).  a(7,15,3).  a(8,1,16).  a(8,5,5).  a(8,7,3).  a(8,10,14).  a(8,12,9).  a(8,16,6).  a(9,1,15).  a(9,5,16).  a(9,7,10).  a(9,10,9).  a(9,12,13).  a(9,16,14).  a(10,2,9).  a(10,4,6).  a(10,6,5).  a(10,7,13).  a(10,8,3).  a(10,9,1).  a(10,10,15).  a(10,11,4).  a(10,13,7).  a(10,15,12).  a(11,1,2).  a(11,3,8).  a(11,5,15).  a(11,7,14).  a(11,10,16).  a(11,12,12).  a(11,14,5).  a(11,16,13).  a(12,2,13).  a(12,3,12).  a(12,14,9).  a(12,15,11).  a(13,2,5).  a(13,3,3).  a(13,5,2).  a(13,6,16).  a(13,11,13).  a(13,12,10).  a(13,14,12).  a(13,15,9).  a(14,1,8).  a(14,4,4).  a(14,5,12).  a(14,8,1).  a(14,9,6).  a(14,12,7).  a(14,13,15).  a(14,16,3).  a(15,1,10).  a(15,2,1).  a(15,6,15).  a(15,11,16).  a(15,15,6).  a(15,16,2).  a(16,1,11).  a(16,2,2).  a(16,6,8).  a(16,8,14).  a(16,9,3).  a(16,11,1).  a(16,15,10).  a(16,16,7). |
| Command  Line | clingo p4.txt prob4\_instance.txt 0 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p4.txt prob4\_instance.txt 0  clingo version 5.3.0  Reading from p4.txt ...  Solving...  Answer: 1  a(1,1,9) a(1,2,14) a(1,6,3) a(1,8,5) a(1,9,15) a(1,11,2) a(1,15,7) a(1,16,1) a(2,1,6) a(2,2,12) a(2,6,14) a(2,11,10) a(2,15,5) a(2,16,11) a(3,1,4) a(3,4,7) a(3,5,6) a(3,8,13) a(3,9,16) a(3,12,1) a(3,13,2) a(3,16,9) a(4,2,15) a(4,3,16) a(4,5,9) a(4,6,7) a(4,11,11) a(4,12,6) a(4,14,3) a(4,15,14) a(5,2,7) a(5,3,15) a(5,14,2) a(5,15,16) a(6,1,5) a(6,3,13) a(6,5,14) a(6,7,15) a(6,10,10) a(6,12,3) a(6,14,1) a(6,16,8) a(7,2,8) a(7,4,10) a(7,6,9) a(7,7,4) a(7,8,11) a(7,9,13) a(7,10,6) a(7,11,15) a(7,13,14) a(7,15,3) a(8,1,16) a(8,5,5) a(8,7,3) a(8,10,14) a(8,12,9) a(8,16,6) a(9,1,15) a(9,5,16) a(9,7,10) a(9,10,9) a(9,12,13) a(9,16,14) a(10,2,9) a(10,4,6) a(10,6,5) a(10,7,13) a(10,8,3) a(10,9,1) a(10,10,15) a(10,11,4) a(10,13,7) a(10,15,12) a(11,1,2) a(11,3,8) a(11,5,15) a(11,7,14) a(11,10,16) a(11,12,12) a(11,14,5) a(11,16,13) a(12,2,13) a(12,3,12) a(12,14,9) a(12,15,11) a(13,2,5) a(13,3,3) a(13,5,2) a(13,6,16) a(13,11,13) a(13,12,10) a(13,14,12) a(13,15,9) a(14,1,8) a(14,4,4) a(14,5,12) a(14,8,1) a(14,9,6) a(14,12,7) a(14,13,15) a(14,16,3) a(15,1,10) a(15,2,1) a(15,6,15) a(15,11,16) a(15,15,6) a(15,16,2) a(16,1,11) a(16,2,2) a(16,6,8) a(16,8,14) a(16,9,3) a(16,11,1) a(16,15,10) a(16,16,7) a(12,1,1) a(2,3,1) a(8,4,1) a(7,3,2) a(4,4,2) a(5,1,3) a(9,2,3) a(2,4,3) a(11,2,4) a(8,3,4) a(3,3,5) a(9,4,5) a(6,2,6) a(16,3,6) a(13,1,7) a(9,3,7) a(1,4,8) a(15,3,9) a(6,4,9) a(3,2,10) a(10,3,10) a(8,2,11) a(1,3,11) a(11,4,11) a(7,1,12) a(16,4,12) a(4,1,13) a(15,4,13) a(10,1,14) a(14,3,14) a(5,4,14) a(13,4,15) a(14,2,16) a(12,4,16) a(7,5,1) a(9,6,1) a(4,7,1) a(8,6,2) a(2,7,2) a(12,8,2) a(15,5,3) a(2,5,4) a(12,6,4) a(15,8,4) a(14,7,5) a(11,6,6) a(5,7,6) a(13,8,6) a(12,5,7) a(15,7,7) a(8,8,7) a(5,5,8) a(12,7,8) a(4,8,8) a(16,7,9) a(11,8,9) a(1,5,10) a(14,6,10) a(5,8,10) a(10,5,11) a(3,6,11) a(13,7,11) a(6,6,12) a(3,7,12) a(9,8,12) a(16,5,13) a(5,6,13) a(2,8,15) a(1,7,16) a(6,8,16) a(5,10,1) a(6,9,2) a(14,10,2) a(10,12,2) a(3,10,3) a(11,11,3) a(5,9,4) a(16,10,4) a(1,12,4) a(4,9,5) a(12,10,5) a(5,11,5) a(15,12,5) a(12,11,6) a(11,9,7) a(2,10,7) a(6,11,7) a(8,9,8) a(13,10,8) a(9,11,8) a(2,12,8) a(2,9,9) a(14,11,9) a(12,9,10) a(9,9,11) a(15,10,11) a(5,12,11) a(15,9,12) a(4,10,12) a(8,11,12) a(1,10,13) a(13,9,14) a(3,11,14) a(12,12,14) a(16,12,15) a(7,12,16) a(13,13,1) a(11,15,1) a(9,15,2) a(12,13,3) a(4,13,4) a(9,14,4) a(6,15,4) a(13,16,4) a(16,13,5) a(7,16,5) a(9,13,6) a(1,14,6) a(7,14,7) a(15,13,8) a(10,14,8) a(3,15,8) a(5,13,9) a(11,13,10) a(8,14,10) a(4,16,10) a(6,13,11) a(14,14,11) a(1,13,12) a(5,16,12) a(8,13,13) a(2,14,13) a(14,15,13) a(15,14,14) a(3,14,15) a(8,15,15) a(12,16,15) a(2,13,16) a(16,14,16) a(10,16,16)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.100s (Solving: 0.01s 1st Model: 0.00s Unsat: 0.01s)  CPU Time : 0.094s |

Problem 5

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| Input  Program | {a(X,Y,N): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- N=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,N), a(X,Y,N1), N1!=N.  :- a(X,Y,N), a(X,Y1,N), Y1!=Y.  :- a(X,Y,N), a(X1,Y,N), X1!=X.  :- a(X,Y,N), a(X1,Y1,N), X\3 == X1\3, Y\3 == Y1\3, 1{X != X1; Y != Y1}.  %Instance  a(1,3,7).  a(1,7,8).  a(2,2,2).  a(2,8,4).  a(3,1,8).  a(3,3,4).  a(3,5,2).  a(3,7,5).  a(3,9,1).  a(4,5,7).  a(5,3,8).  a(5,4,3).  a(5,5,6).  a(5,6,4).  a(5,7,2).  a(6,5,9).  a(7,1,3).  a(7,3,2).  a(7,5,8).  a(7,7,7).  a(7,9,4).  a(8,2,7).  a(8,8,8).  a(9,3,6).  a(9,7,9). |
| Command  Line | clingo p5.txt prob5\_instance.txt 0 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p5.txt prob5\_instance.txt 0  clingo version 5.3.0  Reading from p5.txt ...  Solving...  Answer: 1  a(1,3,7) a(1,7,8) a(2,2,2) a(2,8,4) a(3,1,8) a(3,3,4) a(3,5,2) a(3,7,5) a(3,9,1) a(4,5,7) a(5,3,8) a(5,4,3) a(5,5,6) a(5,6,4) a(5,7,2) a(6,5,9) a(7,1,3) a(7,3,2) a(7,5,8) a(7,7,7) a(7,9,4) a(8,2,7) a(8,8,8) a(9,3,6) a(9,7,9) a(4,3,1) a(4,6,8) a(4,9,6) a(7,6,5) a(4,1,2) a(4,4,5) a(4,7,4) a(7,4,9) a(5,2,9) a(5,8,1) a(8,5,3) a(6,1,6) a(6,4,1) a(6,7,3) a(9,1,4) a(9,4,2) a(6,3,5) a(6,6,2) a(6,9,8) a(9,6,7) a(9,9,3) a(6,2,4) a(6,8,7) a(9,2,8) a(9,5,1) a(9,8,5) a(1,2,5) a(1,5,4) a(1,8,2) a(7,2,1) a(7,8,6) a(2,3,3) a(2,6,1) a(2,9,7) a(8,3,9) a(8,6,6) a(8,9,2) a(2,1,9) a(2,4,8) a(2,7,6) a(8,1,5) a(8,4,4) a(8,7,1) a(2,5,5) a(3,2,6) a(3,8,3) a(1,1,1) a(1,4,6) a(1,6,3) a(1,9,9) a(4,2,3) a(4,8,9) a(3,6,9) a(3,4,7) a(5,1,7) a(5,9,5)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.039s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.047s |

Problem 6

|  |  |
| --- | --- |
| Input  Program | {a(X,Y,N): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- N=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,N), a(X,Y,N1), N1!=N.  :- a(X,Y,N), a(X,Y1,N), Y1!=Y.  :- a(X,Y,N), a(X1,Y,N), X1!=X.  :- a(X,Y,N), a(X1,Y1,N), |X1-X|+|Y1-Y|==3.  %Instance  a(1,1,3).  a(1,9,4).  a(2,4,6).  a(2,6,9).  a(3,3,6).  a(3,7,9).  a(4,2,8).  a(4,4,3).  a(4,6,2).  a(4,8,6).  a(5,5,7).  a(6,2,1).  a(6,4,8).  a(6,6,5).  a(6,8,7).  a(7,3,7).  a(7,7,8).  a(8,4,7).  a(8,6,8).  a(9,1,9).  a(9,9,7). |
| Command  Line | clingo p6.txt prob6\_instance.txt 0 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p6.txt prob6\_instance.txt 0  clingo version 5.3.0  Reading from p6.txt ...  Solving...  Answer: 1  a(1,1,3) a(1,9,4) a(2,4,6) a(2,6,9) a(3,3,6) a(3,7,9) a(4,2,8) a(4,4,3) a(4,6,2) a(4,8,6) a(5,5,7) a(6,2,1) a(6,4,8) a(6,6,5) a(6,8,7) a(7,3,7) a(7,7,8) a(8,4,7) a(8,6,8) a(9,1,9) a(9,9,7) a(1,3,1) a(3,6,1) a(4,5,1) a(1,5,2) a(2,2,2) a(6,1,2) a(3,5,3) a(5,3,3) a(2,1,4) a(3,4,4) a(6,3,4) a(2,3,5) a(1,4,5) a(5,2,5) a(5,1,6) a(3,2,7) a(4,1,7) a(1,6,7) a(3,1,8) a(2,5,8) a(1,2,9) a(4,3,9) a(5,4,9) a(2,9,1) a(3,9,2) a(5,7,2) a(2,8,3) a(5,6,4) a(4,7,4) a(3,8,5) a(1,7,6) a(6,5,6) a(2,7,7) a(1,8,8) a(5,8,1) a(6,7,3) a(4,9,5) a(5,9,8) a(6,9,9) a(7,1,1) a(8,3,2) a(7,4,2) a(9,2,3) a(7,2,4) a(8,1,5) a(7,5,5) a(8,2,6) a(9,3,8) a(9,4,1) a(8,7,1) a(7,6,3) a(9,5,4) a(9,6,6) a(8,5,9) a(7,8,9) a(9,8,2) a(8,9,3) a(8,8,4) a(9,7,5) a(7,9,6)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.025s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.031s |

Problem 7

|  |  |
| --- | --- |
| Input  Program | {a(X,Y,N): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- N=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,N), a(X,Y,N1), N1!=N.  :- a(X,Y,N), a(X,Y1,N), Y1!=Y.  :- a(X,Y,N), a(X1,Y,N), X1!=X.  :- a(X,Y,N), a(X1,Y1,N1), gt(X,Y,X1,Y1), N <= N1.  %Instance  gt(1,2,1,1).  gt(1,3,1,2).  gt(1,3,2,3).  gt(1,4,1,5).  gt(1,6,1,5).  gt(1,6,2,6).  gt(1,7,2,7).  gt(1,8,1,7).  gt(1,8,2,8).  gt(1,9,1,8).  gt(1,9,2,9).  gt(2,1,1,1).  gt(2,2,1,2).  gt(2,2,2,1).  gt(2,2,2,3).  gt(2,2,3,2).  gt(2,3,3,3).  gt(2,4,1,4).  gt(2,4,3,4).  gt(2,5,1,5).  gt(2,5,2,4).  gt(2,5,2,6).  gt(2,5,3,5).  gt(2,6,3,6).  gt(2,8,2,7).  gt(2,9,2,8).  gt(2,9,3,9).  gt(3,1,2,1).  gt(3,1,3,2).  gt(3,3,3,2).  gt(3,4,3,5).  gt(3,5,3,6).  gt(3,7,2,7).  gt(3,7,3,8).  gt(3,8,2,8).  gt(3,9,3,8).  gt(4,1,4,2).  gt(4,1,5,1).  gt(4,3,4,2).  gt(4,3,5,3).  gt(4,5,4,4).  gt(4,6,4,5).  gt(4,6,5,6).  gt(4,7,4,8).  gt(4,9,4,8).  gt(5,2,4,2).  gt(5,2,5,1).  gt(5,2,5,3).  gt(5,2,6,2).  gt(5,4,4,4).  gt(5,4,5,5).  gt(5,4,6,4).  gt(5,5,4,5).  gt(5,5,6,5).  gt(5,6,5,5).  gt(5,7,4,7).  gt(5,7,5,8).  gt(5,8,4,8).  gt(5,8,5,9).  gt(5,9,4,9).  gt(6,1,5,1).  gt(6,2,6,1).  gt(6,2,6,3).  gt(6,3,5,3).  gt(6,5,6,4).  gt(6,6,5,6).  gt(6,6,6,5).  gt(6,7,5,7).  gt(6,8,5,8).  gt(6,8,6,7).  gt(6,8,6,9).  gt(7,1,7,2).  gt(7,1,8,1).  gt(7,3,7,2).  gt(7,3,8,2).  gt(7,4,7,5).  gt(7,4,8,4).  gt(7,6,7,5).  gt(7,6,8,6).  gt(7,7,8,7).  gt(7,8,7,7).  gt(7,8,7,9).  gt(8,1,8,2).  gt(8,1,9,1).  gt(8,2,7,2).  gt(8,2,8,3).  gt(8,5,7,5).  gt(8,5,8,4).  gt(8,5,8,6).  gt(8,6,9,6).  gt(8,7,9,7).  gt(8,8,7,8).  gt(8,8,8,6).  gt(8,8,9,6).  gt(8,9,7,9).  gt(8,9,8,8).  gt(8,9,9,9).  gt(9,2,8,2).  gt(9,2,9,1).  gt(9,2,9,3).  gt(9,3,8,3).  gt(9,4,8,4).  gt(9,5,8,5).  gt(9,5,9,4).  gt(9,5,9,6).  gt(9,8,9,7).  gt(9,9,9,8). |
| Command  Line | clingo p7.txt prob7\_instance.txt 0 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p7.txt prob7\_instance.txt 0  clingo version 5.3.0  Reading from p7.txt ...  Solving...  Answer: 1  gt(1,2,1,1) gt(1,3,1,2) gt(1,3,2,3) gt(1,4,1,5) gt(1,6,1,5) gt(1,6,2,6) gt(1,7,2,7) gt(1,8,1,7) gt(1,8,2,8) gt(1,9,1,8) gt(1,9,2,9) gt(2,1,1,1) gt(2,2,1,2) gt(2,2,2,1) gt(2,2,2,3) gt(2,2,3,2) gt(2,3,3,3) gt(2,4,1,4) gt(2,4,3,4) gt(2,5,1,5) gt(2,5,2,4) gt(2,5,2,6) gt(2,5,3,5) gt(2,6,3,6) gt(2,8,2,7) gt(2,9,2,8) gt(2,9,3,9) gt(3,1,2,1) gt(3,1,3,2) gt(3,3,3,2) gt(3,4,3,5) gt(3,5,3,6) gt(3,7,2,7) gt(3,7,3,8) gt(3,8,2,8) gt(3,9,3,8) gt(4,1,4,2) gt(4,1,5,1) gt(4,3,4,2) gt(4,3,5,3) gt(4,5,4,4) gt(4,6,4,5) gt(4,6,5,6) gt(4,7,4,8) gt(4,9,4,8) gt(5,2,4,2) gt(5,2,5,1) gt(5,2,5,3) gt(5,2,6,2) gt(5,4,4,4) gt(5,4,5,5) gt(5,4,6,4) gt(5,5,4,5) gt(5,5,6,5) gt(5,6,5,5) gt(5,7,4,7) gt(5,7,5,8) gt(5,8,4,8) gt(5,8,5,9) gt(5,9,4,9) gt(6,1,5,1) gt(6,2,6,1) gt(6,2,6,3) gt(6,3,5,3) gt(6,5,6,4) gt(6,6,5,6) gt(6,6,6,5) gt(6,7,5,7) gt(6,8,5,8) gt(6,8,6,7) gt(6,8,6,9) gt(7,1,7,2) gt(7,1,8,1) gt(7,3,7,2) gt(7,3,8,2) gt(7,4,7,5) gt(7,4,8,4) gt(7,6,7,5) gt(7,6,8,6) gt(7,7,8,7) gt(7,8,7,7) gt(7,8,7,9) gt(8,1,8,2) gt(8,1,9,1) gt(8,2,7,2) gt(8,2,8,3) gt(8,5,7,5) gt(8,5,8,4) gt(8,5,8,6) gt(8,6,9,6) gt(8,7,9,7) gt(8,8,7,8) gt(8,8,8,6) gt(8,8,9,6) gt(8,9,7,9) gt(8,9,8,8) gt(8,9,9,9) gt(9,2,8,2) gt(9,2,9,1) gt(9,2,9,3) gt(9,3,8,3) gt(9,4,8,4) gt(9,5,8,5) gt(9,5,9,4) gt(9,5,9,6) gt(9,8,9,7) gt(9,9,9,8) a(1,1,2) a(1,2,3) a(1,3,9) a(2,3,6) a(1,5,1) a(1,4,5) a(1,6,4) a(2,6,3) a(2,7,1) a(1,7,6) a(1,8,7) a(2,8,2) a(1,9,8) a(2,9,5) a(2,1,4) a(2,2,7) a(3,2,1) a(3,3,5) a(2,4,8) a(3,4,7) a(2,5,9) a(3,5,6) a(3,6,2) a(3,9,4) a(3,1,8) a(3,7,9) a(3,8,3) a(4,2,6) a(4,1,9) a(5,1,1) a(4,3,7) a(5,3,2) a(4,4,3) a(4,5,4) a(4,6,8) a(5,6,6) a(4,8,1) a(4,7,5) a(4,9,2) a(5,2,8) a(6,2,5) a(5,4,9) a(5,5,5) a(6,4,1) a(6,5,2) a(5,7,7) a(5,8,4) a(5,9,3) a(6,1,3) a(6,3,4) a(6,6,7) a(6,7,8) a(6,8,9) a(6,9,6) a(7,2,2) a(7,1,7) a(8,1,6) a(7,3,8) a(8,2,4) a(7,5,3) a(7,4,6) a(8,4,2) a(7,6,9) a(8,6,5) a(8,7,3) a(7,7,4) a(7,8,5) a(7,9,1) a(9,1,5) a(8,3,1) a(8,5,7) a(9,6,1) a(9,7,2) a(8,8,8) a(8,9,9) a(9,9,7) a(9,2,9) a(9,3,3) a(9,4,4) a(9,5,8) a(9,8,6)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.188s (Solving: 0.16s 1st Model: 0.05s Unsat: 0.11s)  CPU Time : 0.172s |

Problem 8

|  |  |
| --- | --- |
| Input  Program | {a(X,Y)} :- X=1..n, Y=1..n.  :- a(X,Y), a(X1,Y1), X!=X1, |X-X1|=|Y-Y1|.  #maximize{1,X,Y: a(X,Y)}. |
| Command  Line | You should write multiple command lines below.  clingo p8.txt -c n=3 0  clingo p8.txt -c n=4 0  clingo p8.txt -c n=5 0  clingo p8.txt -c n=6 0  clingo p8.txt -c n=7 0  clingo p8.txt -c n=8 0 |
| Output  of clingo | Answer: 5  a(1,1) a(1,3) a(2,1) a(2,3)  Optimization: -4  OPTIMUM FOUND  Models : 5  Optimum : yes  Optimization : -4  Calls : 1  Time : 0.004s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.000s  Answer: 7  a(1,1) a(1,2) a(1,3) a(1,4) a(4,2) a(4,3)  Optimization: -6  OPTIMUM FOUND  Models : 7  Optimum : yes  Optimization : -6  Calls : 1  Time : 0.013s (Solving: 0.01s 1st Model: 0.01s Unsat: 0.00s)  CPU Time : 0.000s  Answer: 9  a(1,1) a(1,2) a(1,5) a(2,5) a(3,1) a(3,5) a(4,1) a(5,4)  Optimization: -8  OPTIMUM FOUND  Models : 9  Optimum : yes  Optimization : -8  Calls : 1  Time : 0.042s (Solving: 0.04s 1st Model: 0.00s Unsat: 0.01s)  CPU Time : 0.016s  Answer: 11  a(1,3) a(1,4) a(2,1) a(2,6) a(5,1) a(5,6) a(6,1) a(6,3) a(6,4) a(6,6)  Optimization: -10  OPTIMUM FOUND  Models : 11  Optimum : yes  Optimization : -10  Calls : 1  Time : 0.037s (Solving: 0.03s 1st Model: 0.00s Unsat: 0.02s)  CPU Time : 0.031s  Answer: 13  a(1,4) a(1,5) a(1,7) a(2,1) a(2,7) a(3,1) a(5,7) a(6,1) a(6,7) a(7,3) a(7,4) a(7,7)  Optimization: -12  OPTIMUM FOUND  Models : 13  Optimum : yes  Optimization : -12  Calls : 1  Time : 0.533s (Solving: 0.53s 1st Model: 0.00s Unsat: 0.50s)  CPU Time : 0.500s  Answer: 15  a(1,1) a(1,2) a(1,6) a(2,8) a(3,1) a(4,1) a(4,8) a(5,1) a(5,8) a(6,8) a(7,1) a(8,1) a(8,3) a(8,7)  Optimization: -14  OPTIMUM FOUND  Models : 15  Optimum : yes  Optimization : -14  Calls : 1  Time : 18.451s (Solving: 18.45s 1st Model: 0.00s Unsat: 18.13s)  CPU Time : 17.938s |
| Answer  to Questions | Draw a table that lists the maximum value of bishops when the chessboard is n by n, where n is 3, 4, 5, 6, 7, 8. Infer the general function f(n) that returns the maximum value of bishops.   |  |  | | --- | --- | | Value n | f(n) | | 3 | 4 | | 4 | 6 | | 5 | 8 | | 6 | 10 | | 7 | 12 | | 8 | 14 |   f(n) = (n-1) \* 2 |

Problem 9

|  |  |
| --- | --- |
| Input  Program | {in(X,1..k)} = 1 :- X=1..n.  :- in(X,S), in(Y,S), in(X+Y,S), X!=Y. |
| Command  Line | You should write multiple command lines below.  clingo p9.txt -c k=1 -c n=2  clingo p9.txt -c k=2 -c n=8  clingo p9.txt -c k=3 -c n=23  clingo p9.txt -c k=4 -c n=66 |
| Output  of clingo | D:\Softwares\clingo-5.3.0-win64>clingo p9.txt -c k=1 -c n=2  clingo version 5.3.0  Reading from p9.txt  Solving...  Answer: 1  in(1,1) in(2,1)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.002s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.000s  D:\Softwares\clingo-5.3.0-win64>clingo p9.txt -c k=2 -c n=8  clingo version 5.3.0  Reading from p9.txt  Solving...  Answer: 1  in(1,1) in(2,1) in(3,2) in(4,1) in(5,2) in(6,2) in(7,2) in(8,1)  SATISFIABLE  Models : 1+  Calls : 1  Time : 0.002s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.016s  D:\Softwares\clingo-5.3.0-win64>clingo p9.txt -c k=3 -c n=23  clingo version 5.3.0  Reading from p9.txt  Solving...  Answer: 1  in(1,2) in(2,2) in(3,3) in(4,2) in(5,3) in(6,3) in(7,3) in(8,2) in(9,1) in(10,1) in(11,2) in(12,1) in(13,1) in(14,1) in(15,1) in(16,2) in(17,1) in(18,1) in(19,3) in(20,1) in(21,3) in(22,2) in(23,3)  SATISFIABLE  Models : 1+  Calls : 1  Time : 0.014s (Solving: 0.01s 1st Model: 0.01s Unsat: 0.00s)  CPU Time : 0.016s |
| Answer  to Questions | Fill in the values accordingly.   |  |  | | --- | --- | | Exact value of A(1) | 2 | | Exact value of A(2) | 8 | | Exact value of A(3) | 23 | | Largest lower bound for A(4)  Note: it would take longer time when you increase the value of n. Thus, you may stop increasing the value of n when your program does not terminate within 10 minutes and submit the last trial of n. | Did not terminate within 10 minutes of execution. | |