**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 problem1.txt 0 |
| Output  of clingo | 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 |

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 problem2.txt -c n=3 0  clingo problem2.txt -c n=4 0  clingo problem2.txt -c n=5 0  clingo problem2.txt -c n=6 0  clingo problem2.txt -c n=7 0  clingo problem2.txt -c n=8 0  clingo problem2.txt -c n=9 0  clingo problem2.txt -c n=10 0  clingo problem2.txt -c n=11 0  clingo problem2.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 | 0.001s | | 4 | 2 | 0.001s | | 5 | 10 | 0.002s | | 6 | 4 | 0.002s | | 7 | 40 | 0.004s | | 8 | 92 | 0.007s | | 9 | 352 | 0.024s | | 10 | 724 | 0.106s | | 11 | 2680 | 0.760s | | 12 | 14200 | 8.189s | |

Problem 3

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| Input  Program | {a(X,Y,Z): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- Z=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,Z), a(X,Y,Z1), Z1!=Z.  :- a(X,Y,Z), a(X,Y1,Z), Y1!=Y.  :- a(X,Y,Z), a(X1,Y,Z), 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 problem3.txt 0 |
| Output  of clingo | 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 |

Problem 4

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| Input  Program | {a(X,Y,Z): X=1..16, Y=1..16, X1<=X, X<=X1+3, Y1<=Y, Y<=Y1+3} = 1 :- Z=1..16, X1 = 4\*(0..3)+1, Y1 = 4\*(0..3)+1.  :- a(X,Y,Z), a(X,Y,Z1), Z1!=Z.  :- a(X,Y,Z), a(X,Y1,Z), Y1!=Y.  :- a(X,Y,Z), a(X1,Y,Z), 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 problem4.txt 0 |
| Output  of clingo | 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 |

Problem 5

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| Input  Program | {a(X,Y,Z): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- Z=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,Z), a(X,Y,Z1), Z1!=Z.  :- a(X,Y,Z), a(X,Y1,Z), Y1!=Y.  :- a(X,Y,Z), a(X1,Y,Z), X1!=X.  :- a(X,Y,Z), a(X1,Y1,Z), 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 problem5.txt 0 |
| Output  of clingo | 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 |

Problem 6

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| Input  Program | {a(X,Y,Z): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- Z=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,Z), a(X,Y,Z1), Z1!=Z.  :- a(X,Y,Z), a(X,Y1,Z), Y1!=Y.  :- a(X,Y,Z), a(X1,Y,Z), X1!=X.  :- a(X,Y,Z), a(X1,Y1,Z), |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 problem6.txt 0 |
| Output  of clingo | 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 |

Problem 7

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| Input  Program | {a(X,Y,Z): X=1..9, Y=1..9, X1<=X, X<=X1+2, Y1<=Y, Y<=Y1+2} = 1 :- Z=1..9, X1 = 3\*(0..2)+1, Y1 = 3\*(0..2)+1.  :- a(X,Y,Z), a(X,Y,Z1), Z1!=Z.  :- a(X,Y,Z), a(X,Y1,Z), Y1!=Y.  :- a(X,Y,Z), a(X1,Y,Z), X1!=X.  :- a(X,Y,Z), a(X1,Y1,Z1), gt(X,Y,X1,Y1), Z <= Z1.  %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 problem7.txt 0 |
| Output  of clingo | 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 |

Problem 8

|  |  |
| --- | --- |
| Input  Program | {bishop(X,Y)} :- X=1..n, Y=1..n.  :- bishop(X1,Y1), bishop(X2,Y2), X1!=X2, |X1-X2|=|Y1-Y2|.  #maximize{1,X,Y: bishop(X,Y)}. |
| Command  Line | You should write multiple command lines below.  clingo problem8.txt -c n=3 0  clingo problem8.txt -c n=4 0  clingo problem8.txt -c n=5 0  clingo problem8.txt -c n=6 0  clingo problem8.txt -c n=7 0  clingo problem8.txt -c n=8 0 |
| Output  of clingo | Answer: 5  bishop(1,1) bishop(1,3) bishop(2,1) bishop(2,3)  Optimization: -4  OPTIMUM FOUND  Models : 5  Optimum : yes  Optimization : -4  Answer: 7  bishop(1,1) bishop(1,2) bishop(1,3) bishop(1,4) bishop(4,2) bishop(4,3)  Optimization: -6  OPTIMUM FOUND  Models : 7  Optimum : yes  Optimization : -6  Answer: 9  bishop(1,1) bishop(1,2) bishop(1,5) bishop(2,5) bishop(3,1) bishop(3,5) bishop(4,1) bishop(5,4)  Optimization: -8  OPTIMUM FOUND  Models : 9  Optimum : yes  Optimization : -8  Answer: 11  bishop(1,3) bishop(1,4) bishop(2,1) bishop(2,6) bishop(5,1) bishop(5,6) bishop(6,1) bishop(6,3) bishop(6,4) bishop(6,6)  Optimization: -10  OPTIMUM FOUND  Models : 11  Optimum : yes  Optimization : -10  Answer: 13  bishop(1,4) bishop(1,5) bishop(1,7) bishop(2,1) bishop(2,7) bishop(3,1) bishop(5,7) bishop(6,1) bishop(6,7) bishop(7,3) bishop(7,4) bishop(7,7)  Optimization: -12  OPTIMUM FOUND  Models : 13  Optimum : yes  Optimization : -12  Answer: 15  bishop(1,1) bishop(1,2) bishop(1,6) bishop(2,8) bishop(3,1) bishop(4,1) bishop(4,8) bishop(5,1) bishop(5,8) bishop(6,8) bishop(7,1) bishop(8,1) bishop(8,3) bishop(8,7)  Optimization: -14  OPTIMUM FOUND  Models : 15  Optimum : yes  Optimization : -14 |
| 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) = 2n-2 |

Problem 9

|  |  |
| --- | --- |
| Input  Program | {in(A,1..t)} = 1 :- A=1..n.  :- in(A,K), in(B,K), in(A+B,K), A!=B. |
| Command  Line | You should write multiple command lines below.  clingo problem9.txt -c t=1 -c n=2  clingo problem9.txt -c t=2 -c n=8  clingo problem9.txt -c t=3 -c n=23  clingo problem9.txt -c t=4 -c n=66 |
| Output  of clingo | Solving...  Answer: 1  in(1,1) in(2,1)  SATISFIABLE  Models : 1  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+  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+  Solving...  Answer: 1  in(3,3) in(1,4) in(2,4) in(4,4) in(5,3) in(6,3) in(7,3) in(8,4) in(9,1) in(10,1) in(11,4) in(12,1) in(13,1) in(14,1) in(15,1) in(16,1) in(17,1) in(18,1) in(19,3) in(20,1) in(21,3) in(22,4) in(23,3) in(24,2) in(25,4) in(26,2) in(27,2) in(28,2) in(29,2) in(30,2) in(31,4) in(32,2) in(33,2) in(34,2) in(35,2) in(36,2) in(37,2) in(38,2) in(39,2) in(40,2) in(41,2) in(42,2) in(43,2) in(44,2) in(45,2) in(46,2) in(47,2) in(48,2) in(49,2) in(50,4) in(51,3) in(52,3) in(53,3) in(54,1) in(55,1) in(56,1) in(57,1) in(58,1) in(59,4) in(60,1) in(61,1) in(62,1) in(63,3) in(64,3) in(65,3) in(66,4)  SATISFIABLE  Models : 1+ |
| 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. | 66 | |