**CSE 579**

**Programming Assignment 1**

**Template for clingo Work**

Problem 1

| Input  Program | {queen\_function(R, 1..n)}=1:-R=1..n.  :-queen\_function(R1,C),queen\_function(R2,C),R1!=R2.  :-queen\_function(R1,C1),queen\_function(R2,C2),R1!=R2,|R1-R2|=|C1-C2|.  :-queen\_function(R,C),R=3..6,C=3..6. |
| --- | --- |
| Command  Line | clingo -c n=8 pa1\_problem1.txt 0 |
| Output  of clingo | saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=8 pa1\_problem1.txt 0  clingo version 5.4.1  Reading from pa1\_problem1.txt  Solving...  Answer: 1  queen\_function(5,7) queen\_function(1,4) queen\_function(2,6) queen\_function(4,2) queen\_function(3,8) queen\_function(6,1) queen\_function(7,3) queen\_function(8,5)  Answer: 2  queen\_function(2,3) queen\_function(3,1) queen\_function(6,8) queen\_function(4,7) queen\_function(1,5) queen\_function(5,2) queen\_function(7,6) queen\_function(8,4)  Answer: 3  queen\_function(2,4) queen\_function(4,1) queen\_function(5,8) queen\_function(3,7) queen\_function(1,6) queen\_function(6,2) queen\_function(7,5) queen\_function(8,3)  Answer: 4  queen\_function(6,7) queen\_function(1,3) queen\_function(2,5) queen\_function(3,2) queen\_function(4,8) queen\_function(5,1) queen\_function(8,6) queen\_function(7,4)  SATISFIABLE  Models : 4  Calls : 1  Time : 0.066s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.011s |

Problem 2

| Input  Program | {queen\_function(ROW, 1..n)}=1:-ROW=1..n.  :-queen\_function(ROW\_1,COL),queen\_function(ROW\_2,COL),ROW\_1!=ROW\_2.  :-queen\_function(ROW\_1,COL\_1),queen\_function(ROW\_2,COL\_2),ROW\_1!=ROW\_2,|ROW\_1-ROW\_2|=|COL\_1-COL\_2|. |
| --- | --- |
| Command  Line | You should write multiple command lines below.  clingo -c n=3 pa1\_problem2.txt 0  clingo -c n=4 pa1\_problem2.txt 0  clingo -c n=5 pa1\_problem2.txt 0  clingo -c n=6 pa1\_problem2.txt 0  clingo -c n=7 pa1\_problem2.txt 0  clingo -c n=8 pa1\_problem2.txt 0  clingo -c n=9 pa1\_problem2.txt 0  clingo -c n=10 pa1\_problem2.txt 0  clingo -c n=11 pa1\_problem2.txt 0  clingo -c n=12 pa1\_problem2.txt 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 | 0.004s | | 5 | 10 | 0.003s | | 6 | 4 | 0.006s | | 7 | 40 | 0.010s | | 8 | 92 | 0.046s | | 9 | 352 | 0.043s | | 10 | 724 | 0.249s | | 11 | 2680 | 2.553s | | 12 | 14200 | 39.999s | |

Problem 3

| Input  Program | 1 {a(ROW,COL,N): ROW=1..9, COL=1..9, ROW\_1<=ROW, ROW<=ROW\_1+2, COL\_1<=COL, COL<=COL\_1+2} 1  :- N=1..9, ROW\_1 = 3\*(0..2)+1, COL\_1 = 3\*(0..2)+1.  :- a(ROW,COL,N), a(ROW,COL,N1), N!=N1.  :- a(ROW,COL,N), a(ROW,COL\_1,N), COL!=COL\_1.  :- a(ROW,COL,N), a(ROW\_1,COL,N), ROW!=ROW\_1.  pa1\_problem3\_instance contains following content:  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 pa1\_problem3.txt pa1\_problem3\_instance.txt 0 |
| Output  of clingo | saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo pa1\_problem3.txt pa1\_problem3\_instance.txt 0  clingo version 5.4.1  Reading from pa1\_problem3.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 : 0.054s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.052s |

Problem 4

| Input  Program | 1 {a(ROW,COL,N): ROW=1..16, COL=1..16, ROW1<=ROW, ROW<=ROW1+3, COL1<=COL, COL<=COL1+3} 1 :- N=1..16, ROW1 = 4\*(0..3)+1, COL1 = 4\*(0..3)+1.  :- a(ROW,COL,N), a(ROW,COL,N1), N!=N1.  :- a(ROW,COL,N), a(ROW,COL1,N), COL!=COL1.  :- a(ROW,COL,N), a(ROW1,COL,N), ROW!=ROW1.  pa1\_problem4\_instance contains following content: 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 pa1\_problem4.txt pa1\_problem4\_instance.txt 0 |
| Output  of clingo | saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo pa1\_problem4.txt pa1\_problem4\_instance.txt 0  clingo version 5.4.1  Reading from pa1\_problem4.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 : 0.184s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.183s |

Problem 5

| Input  Program | 1 {a(ROW,COL,N): ROW=1..9, COL=1..9, ROW1<=ROW, ROW<=ROW1+2, COL1<=COL, COL<=COL1+2} 1 :- N=1..9, ROW1 = 3\*(0..2)+1, COL1 = 3\*(0..2)+1.  :- a(ROW,COL,N), a(ROW,COL,N1), N!=N1.  :- a(ROW,COL,N), a(ROW,COL1,N), COL!=COL1.  :- a(ROW,COL,N), a(ROW1,COL,N), ROW!=ROW1.  :- a(ROW,COL,N), a(ROW1,COL1,N), ROW\3 == ROW1\3, COL\3 == COL1\3, 1{ROW != ROW1; COL != COL1}.  pa1\_problem5\_instance contains following content:  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 pa1\_problem5.txt pa1\_problem5\_instance.txt 0 |
| Output  of clingo | saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo pa1\_problem5.txt pa1\_problem5\_instance.txt 0  clingo version 5.4.1  Reading from pa1\_problem5.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 : 0.127s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.124s |

Problem 6

| Input  Program | 1 {a(ROW,COL,N): ROW=1..9, COL=1..9, ROW1<=ROW, ROW<=ROW1+2, COL1<=COL, COL<=COL1+2} 1 :- N=1..9, ROW1 = 3\*(0..2)+1, COL1 = 3\*(0..2)+1.  :- a(ROW,COL,N), a(ROW,COL,N1), N!=N1.  :- a(ROW,COL,N), a(ROW,COL1,N), COL!=COL1.  :- a(ROW,COL,N), a(ROW1,COL,N), ROW!=ROW1.  :- a(ROW,COL,N), a(ROW1,COL1,N), |ROW1-ROW|+|COL1-COL|==3.  pa1\_problem6\_instance contains following content:  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 pa1\_problem6.txt pa1\_problem6\_instance.txt 0 |
| Output  of clingo | saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo pa1\_problem6.txt pa1\_problem6\_instance.txt 0  clingo version 5.4.1  Reading from pa1\_problem6.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 : 0.054s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.054s |

Problem 7

| Input  Program | 1 {a(ROW,COL,N): ROW=1..9, COL=1..9, ROW1<=ROW, ROW<=ROW1+2, COL1<=COL, COL<=COL1+2} 1 :- N=1..9, ROW1 = 3\*(0..2)+1, COL1 = 3\*(0..2)+1.  :- a(ROW,COL,N), a(ROW,COL,N1), N!=N1.  :- a(ROW,COL,N), a(ROW,COL1,N), COL!=COL1.  :- a(ROW,COL,N), a(ROW1,COL,N), ROW!=ROW1.  :- a(ROW,COL,N), a(ROW1,COL1,N1), gt(ROW,COL,ROW1,COL1), N <= N1.  pa1\_problem7\_instance contains following content:  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 pa1\_problem7.txt pa1\_problem7\_instance.txt 0 |
| Output  of clingo | saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo pa1\_problem7.txt pa1\_problem7\_instance.txt 0  clingo version 5.4.1  Reading from pa1\_problem7.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 : 0.279s (Solving: 0.24s 1st Model: 0.08s Unsat: 0.16s)  CPU Time : 0.274s |

Problem 8

| Input  Program | {bishop\_function(ROW,COL)} :- ROW=1..n, COL=1..n.  :- bishop\_function(ROW1,COL1), bishop\_function(ROW2,COL2), ROW1!=ROW2, |ROW1-ROW2|=|COL1-COL2|.  #maximize{1,ROW,COL: bishop\_function(ROW,COL)}. |
| --- | --- |
| Command  Line | You should write multiple command lines below.  clingo -c n=3 pa1\_problem8.txt 0  clingo -c n=4 pa1\_problem8.txt 0  clingo -c n=5 pa1\_problem8.txt 0  clingo -c n=6 pa1\_problem8.txt 0  clingo -c n=7 pa1\_problem8.txt 0  clingo -c n=8 pa1\_problem8.txt 0 |
| Output  of clingo | **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=3 pa1\_problem8.txt 0**  Reading from pa1\_problem8.txt  Solving...  Answer: 1  Optimization: 0  Answer: 2  bishop\_function(1,1)  Optimization: -1  Answer: 3  bishop\_function(1,1) bishop\_function(1,3)  Optimization: -2  Answer: 4  bishop\_function(1,1) bishop\_function(1,3) bishop\_function(2,1)  Optimization: -3  Answer: 5  bishop\_function(1,1) bishop\_function(1,3) bishop\_function(2,1) bishop\_function(2,3)  Optimization: -4  OPTIMUM FOUND  Models : 5  Optimum : yes  Optimization : -4  Calls : 1  Time : 0.047s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.004s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=4 pa1\_problem8.txt 0**  clingo version 5.4.1  Reading from pa1\_problem8.txt  Solving...  Answer: 1  Optimization: 0  Answer: 2  bishop\_function(4,3)  Optimization: -1  Answer: 3  bishop\_function(4,2) bishop\_function(4,3)  Optimization: -2  Answer: 4  bishop\_function(1,4) bishop\_function(4,2) bishop\_function(4,3)  Optimization: -3  Answer: 5  bishop\_function(1,4) bishop\_function(4,2) bishop\_function(4,3) bishop\_function(4,4)  Optimization: -4  Answer: 6  bishop\_function(1,3) bishop\_function(1,4) bishop\_function(4,2) bishop\_function(4,3) bishop\_function(4,4)  Optimization: -5  Answer: 7  bishop\_function(1,1) bishop\_function(1,2) bishop\_function(1,3) bishop\_function(1,4) bishop\_function(4,2) bishop\_function(4,3)  Optimization: -6  OPTIMUM FOUND  Models : 7  Optimum : yes  Optimization : -6  Calls : 1  Time : 0.005s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.005s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=5 pa1\_problem8.txt 0**  clingo version 5.4.1  Reading from pa1\_problem8.txt  Solving...  Answer: 1  Optimization: 0  Answer: 2  bishop\_function(5,1)  Optimization: -1  Answer: 3  bishop\_function(1,2) bishop\_function(5,1)  Optimization: -2  Answer: 4  bishop\_function(1,2) bishop\_function(5,1) bishop\_function(5,2)  Optimization: -3  Answer: 5  bishop\_function(1,2) bishop\_function(1,5) bishop\_function(5,2) bishop\_function(5,4)  Optimization: -4  Answer: 6  bishop\_function(1,2) bishop\_function(1,5) bishop\_function(5,2) bishop\_function(5,4) bishop\_function(5,5)  Optimization: -5  Answer: 7  bishop\_function(1,2) bishop\_function(5,1) bishop\_function(5,2) bishop\_function(5,3) bishop\_function(5,4) bishop\_function(5,5)  Optimization: -6  Answer: 8  bishop\_function(1,1) bishop\_function(1,2) bishop\_function(1,3) bishop\_function(1,5) bishop\_function(5,2) bishop\_function(5,3) bishop\_function(5,4)  Optimization: -7  Answer: 9  bishop\_function(1,1) bishop\_function(1,2) bishop\_function(1,5) bishop\_function(2,5) bishop\_function(3,1) bishop\_function(3,5) bishop\_function(4,1) bishop\_function(5,4)  Optimization: -8  OPTIMUM FOUND  Models : 9  Optimum : yes  Optimization : -8  Calls : 1  Time : 0.013s (Solving: 0.01s 1st Model: 0.00s Unsat: 0.01s)  CPU Time : 0.012s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=6 pa1\_problem8.txt 0**  clingo version 5.4.1  Reading from pa1\_problem8.txt  Solving...  Answer: 1  Optimization: 0  Answer: 2  bishop\_function(1,6)  Optimization: -1  Answer: 3  bishop\_function(1,6) bishop\_function(6,6)  Optimization: -2  Answer: 4  bishop\_function(1,6) bishop\_function(6,3) bishop\_function(6,6)  Optimization: -3  Answer: 5  bishop\_function(1,6) bishop\_function(2,1) bishop\_function(6,3) bishop\_function(6,6)  Optimization: -4  Answer: 6  bishop\_function(1,6) bishop\_function(2,1) bishop\_function(5,1) bishop\_function(6,3) bishop\_function(6,6)  Optimization: -5  Answer: 7  bishop\_function(1,6) bishop\_function(2,1) bishop\_function(5,1) bishop\_function(6,3) bishop\_function(6,4) bishop\_function(6,6)  Optimization: -6  Answer: 8  bishop\_function(2,1) bishop\_function(5,6) bishop\_function(6,1) bishop\_function(6,2) bishop\_function(6,3) bishop\_function(6,4) bishop\_function(6,6)  Optimization: -7  Answer: 9  bishop\_function(1,6) bishop\_function(2,1) bishop\_function(2,6) bishop\_function(5,1) bishop\_function(5,6) bishop\_function(6,3) bishop\_function(6,4) bishop\_function(6,6)  Optimization: -8  Answer: 10  bishop\_function(1,6) bishop\_function(2,1) bishop\_function(2,6) bishop\_function(3,1) bishop\_function(4,6) bishop\_function(5,1) bishop\_function(5,6) bishop\_function(6,3) bishop\_function(6,6)  Optimization: -9  Answer: 11  bishop\_function(1,3) bishop\_function(1,4) bishop\_function(2,1) bishop\_function(2,6) bishop\_function(5,1) bishop\_function(5,6) bishop\_function(6,1) bishop\_function(6,3) bishop\_function(6,4) bishop\_function(6,6)  Optimization: -10  OPTIMUM FOUND  Models : 11  Optimum : yes  Optimization : -10  Calls : 1  Time : 0.066s (Solving: 0.06s 1st Model: 0.00s Unsat: 0.06s)  CPU Time : 0.066s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=7 pa1\_problem8.txt 0**  clingo version 5.4.1  Reading from pa1\_problem8.txt  Solving...  Answer: 1  Optimization: 0  Answer: 2  bishop\_function(3,1)  Optimization: -1  Answer: 3  bishop\_function(3,1) bishop\_function(5,7)  Optimization: -2  Answer: 4  bishop\_function(1,7) bishop\_function(3,1) bishop\_function(5,7)  Optimization: -3  Answer: 5  bishop\_function(1,7) bishop\_function(3,1) bishop\_function(4,7) bishop\_function(5,7)  Optimization: -4  Answer: 6  bishop\_function(1,7) bishop\_function(3,1) bishop\_function(4,7) bishop\_function(5,7) bishop\_function(7,3)  Optimization: -5  Answer: 7  bishop\_function(1,7) bishop\_function(3,1) bishop\_function(5,7) bishop\_function(6,1) bishop\_function(7,3) bishop\_function(7,4)  Optimization: -6  Answer: 8  bishop\_function(1,7) bishop\_function(3,1) bishop\_function(5,7) bishop\_function(6,1) bishop\_function(7,3) bishop\_function(7,4) bishop\_function(7,7)  Optimization: -7  Answer: 9  bishop\_function(1,7) bishop\_function(2,1) bishop\_function(3,1) bishop\_function(5,7) bishop\_function(6,1) bishop\_function(7,3) bishop\_function(7,4) bishop\_function(7,7)  Optimization: -8  Answer: 10  bishop\_function(1,7) bishop\_function(2,1) bishop\_function(3,1) bishop\_function(5,7) bishop\_function(6,1) bishop\_function(6,7) bishop\_function(7,3) bishop\_function(7,4) bishop\_function(7,7)  Optimization: -9  Answer: 11  bishop\_function(1,7) bishop\_function(2,1) bishop\_function(2,7) bishop\_function(3,1) bishop\_function(5,1) bishop\_function(5,7) bishop\_function(6,1) bishop\_function(6,7) bishop\_function(7,4) bishop\_function(7,7)  Optimization: -10  Answer: 12  bishop\_function(1,3) bishop\_function(1,5) bishop\_function(2,1) bishop\_function(2,7) bishop\_function(4,7) bishop\_function(6,1) bishop\_function(6,7) bishop\_function(7,1) bishop\_function(7,3) bishop\_function(7,5) bishop\_function(7,7)  Optimization: -11  Answer: 13  bishop\_function(1,4) bishop\_function(1,5) bishop\_function(1,7) bishop\_function(2,1) bishop\_function(2,7) bishop\_function(3,1) bishop\_function(5,7) bishop\_function(6,1) bishop\_function(6,7) bishop\_function(7,3) bishop\_function(7,4) bishop\_function(7,7)  Optimization: -12  OPTIMUM FOUND  Models : 13  Optimum : yes  Optimization : -12  Calls : 1  Time : 0.579s (Solving: 0.57s 1st Model: 0.00s Unsat: 0.57s)  CPU Time : 0.578s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c n=8 pa1\_problem8.txt 0**  clingo version 5.4.1  Reading from pa1\_problem8.txt  Solving...  Answer: 1  Optimization: 0  Answer: 2  bishop\_function(8,7)  Optimization: -1  Answer: 3  bishop\_function(1,3) bishop\_function(8,7)  Optimization: -2  Answer: 4  bishop\_function(1,3) bishop\_function(8,2) bishop\_function(8,7)  Optimization: -3  Answer: 5  bishop\_function(1,3) bishop\_function(5,8) bishop\_function(8,2) bishop\_function(8,7)  Optimization: -4  Answer: 6  bishop\_function(1,3) bishop\_function(5,1) bishop\_function(5,8) bishop\_function(8,2) bishop\_function(8,7)  Optimization: -5  Answer: 7  bishop\_function(3,1) bishop\_function(5,1) bishop\_function(5,8) bishop\_function(7,1) bishop\_function(7,8) bishop\_function(8,3)  Optimization: -6  Answer: 8  bishop\_function(1,3) bishop\_function(1,4) bishop\_function(1,8) bishop\_function(5,1) bishop\_function(7,8) bishop\_function(8,2) bishop\_function(8,3)  Optimization: -7  Answer: 9  bishop\_function(1,3) bishop\_function(1,6) bishop\_function(1,8) bishop\_function(5,1) bishop\_function(5,8) bishop\_function(7,1) bishop\_function(7,8) bishop\_function(8,3)  Optimization: -8  Answer: 10  bishop\_function(1,4) bishop\_function(1,6) bishop\_function(1,8) bishop\_function(3,1) bishop\_function(4,8) bishop\_function(5,1) bishop\_function(7,8) bishop\_function(8,2) bishop\_function(8,3)  Optimization: -9  Answer: 11  bishop\_function(1,3) bishop\_function(1,6) bishop\_function(1,8) bishop\_function(2,8) bishop\_function(4,8) bishop\_function(5,1) bishop\_function(5,8) bishop\_function(7,1) bishop\_function(8,3) bishop\_function(8,7)  Optimization: -10  Answer: 12  bishop\_function(1,2) bishop\_function(3,7) bishop\_function(3,8) bishop\_function(4,2) bishop\_function(5,8) bishop\_function(6,1) bishop\_function(6,2) bishop\_function(6,3) bishop\_function(6,6) bishop\_function(6,8) bishop\_function(8,7)  Optimization: -11  Answer: 13  bishop\_function(1,2) bishop\_function(1,4) bishop\_function(1,5) bishop\_function(1,6) bishop\_function(1,7) bishop\_function(1,8) bishop\_function(2,2) bishop\_function(6,8) bishop\_function(7,5) bishop\_function(7,6) bishop\_function(8,2) bishop\_function(8,3)  Optimization: -12  Answer: 14  bishop\_function(1,2) bishop\_function(1,4) bishop\_function(1,5) bishop\_function(1,6) bishop\_function(1,7) bishop\_function(1,8) bishop\_function(2,2) bishop\_function(6,8) bishop\_function(7,5) bishop\_function(8,2) bishop\_function(8,3) bishop\_function(8,5) bishop\_function(8,7)  Optimization: -13  Answer: 15  bishop\_function(1,1) bishop\_function(1,2) bishop\_function(1,6) bishop\_function(2,8) bishop\_function(3,1) bishop\_function(4,1) bishop\_function(4,8) bishop\_function(5,1) bishop\_function(5,8) bishop\_function(6,8) bishop\_function(7,1) bishop\_function(8,1) bishop\_function(8,3) bishop\_function(8,7)  Optimization: -14  OPTIMUM FOUND  Models : 15  Optimum : yes  Optimization : -14  Calls : 1  Time : 17.236s (Solving: 17.22s 1st Model: 0.00s Unsat: 16.89s)  CPU Time : 17.218s |
| 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 for all n>=2 and f(1)=1  OR  f(n) = 2n -2 + delta\_{n,1} Where delta\_{n,1} is kronecker delta which equals 1 when n = 1 and 0 otherwise. |

Problem 9

| Input  Program |  |
| --- | --- |
| Command  Line | You should write multiple command lines below.  clingo -c k=1 -c n=2 pa1\_problem9.txt 0  clingo -c k=2 -c n=8 pa1\_problem9.txt 0  clingo -c k=3 -c n=23 pa1\_problem9.txt 0  clingo -c k=4 -c n=67 pa1\_problem9.txt 0 |
| Output  of clingo | **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=1 -c n=2 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  Answer: 1  add\_function(1,1) add\_function(2,1)  SATISFIABLE  Models : 1  Calls : 1  Time : 0.001s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.001s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=1 -c n=3 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  UNSATISFIABLE  Models : 0  Calls : 1  Time : 0.001s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.001s  **—--------------------------------------------------------------------------------**  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=2 -c n=8 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  Answer: 1  add\_function(1,1) add\_function(2,1) add\_function(3,2) add\_function(4,1) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,1)  Answer: 2  add\_function(3,1) add\_function(1,2) add\_function(2,2) add\_function(4,2) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,2)  SATISFIABLE  Models : 2  Calls : 1  Time : 0.005s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.005s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=2 -c n=9 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  UNSATISFIABLE  Models : 0  Calls : 1  Time : 0.005s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 0.005s  **—--------------------------------------------------------------------------------**  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=3 -c n=23 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  Answer: 1  add\_function(1,2) add\_function(2,2) add\_function(3,3) add\_function(4,2) add\_function(5,3) add\_function(6,3) add\_function(7,3) add\_function(8,2) add\_function(9,1) add\_function(10,1) add\_function(11,2) add\_function(12,1) add\_function(13,1) add\_function(14,1) add\_function(15,1) add\_function(16,2) add\_function(17,1) add\_function(18,1) add\_function(19,3) add\_function(20,1) add\_function(21,3) add\_function(22,2) add\_function(23,3)  Answer: 2  add\_function(1,2) add\_function(2,2) add\_function(3,3) add\_function(4,2) add\_function(5,3) add\_function(6,3) add\_function(7,3) add\_function(8,2) add\_function(9,1) add\_function(10,1) add\_function(11,2) add\_function(12,1) add\_function(13,1) add\_function(14,1) add\_function(15,1) add\_function(16,1) add\_function(17,1) add\_function(18,1) add\_function(19,3) add\_function(20,1) add\_function(21,3) add\_function(22,2) add\_function(23,3)  Answer: 3  add\_function(1,2) add\_function(2,2) add\_function(3,3) add\_function(4,2) add\_function(5,3) add\_function(6,3) add\_function(7,3) add\_function(8,2) add\_function(9,1) add\_function(10,1) add\_function(11,2) add\_function(12,1) add\_function(13,1) add\_function(14,1) add\_function(15,1) add\_function(16,1) add\_function(17,2) add\_function(18,1) add\_function(19,3) add\_function(20,1) add\_function(21,3) add\_function(22,2) add\_function(23,3)  Answer: 4  add\_function(3,2) add\_function(1,3) add\_function(2,3) add\_function(4,3) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,3) add\_function(9,1) add\_function(10,1) add\_function(11,3) add\_function(12,1) add\_function(13,1) add\_function(14,1) add\_function(15,1) add\_function(16,1) add\_function(17,1) add\_function(18,1) add\_function(19,2) add\_function(20,1) add\_function(21,2) add\_function(22,3) add\_function(23,2)  Answer: 5  add\_function(3,2) add\_function(1,3) add\_function(2,3) add\_function(4,3) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,3) add\_function(9,1) add\_function(10,1) add\_function(11,3) add\_function(12,1) add\_function(13,1) add\_function(14,1) add\_function(15,1) add\_function(16,1) add\_function(17,3) add\_function(18,1) add\_function(19,2) add\_function(20,1) add\_function(21,2) add\_function(22,3) add\_function(23,2)  Answer: 6  add\_function(3,2) add\_function(1,3) add\_function(2,3) add\_function(4,3) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,3) add\_function(9,1) add\_function(10,1) add\_function(11,3) add\_function(12,1) add\_function(13,1) add\_function(14,1) add\_function(15,1) add\_function(16,3) add\_function(17,1) add\_function(18,1) add\_function(19,2) add\_function(20,1) add\_function(21,2) add\_function(22,3) add\_function(23,2)  Answer: 7  add\_function(1,1) add\_function(2,1) add\_function(3,3) add\_function(4,1) add\_function(5,3) add\_function(6,3) add\_function(7,3) add\_function(8,1) add\_function(9,2) add\_function(10,2) add\_function(11,1) add\_function(12,2) add\_function(13,2) add\_function(14,2) add\_function(15,2) add\_function(16,1) add\_function(17,2) add\_function(18,2) add\_function(19,3) add\_function(20,2) add\_function(21,3) add\_function(22,1) add\_function(23,3)  Answer: 8  add\_function(1,1) add\_function(2,1) add\_function(3,3) add\_function(4,1) add\_function(5,3) add\_function(6,3) add\_function(7,3) add\_function(8,1) add\_function(9,2) add\_function(10,2) add\_function(11,1) add\_function(12,2) add\_function(13,2) add\_function(14,2) add\_function(15,2) add\_function(16,2) add\_function(17,1) add\_function(18,2) add\_function(19,3) add\_function(20,2) add\_function(21,3) add\_function(22,1) add\_function(23,3)  Answer: 9  add\_function(1,1) add\_function(2,1) add\_function(3,3) add\_function(4,1) add\_function(5,3) add\_function(6,3) add\_function(7,3) add\_function(8,1) add\_function(9,2) add\_function(10,2) add\_function(11,1) add\_function(12,2) add\_function(13,2) add\_function(14,2) add\_function(15,2) add\_function(16,2) add\_function(17,2) add\_function(18,2) add\_function(19,3) add\_function(20,2) add\_function(21,3) add\_function(22,1) add\_function(23,3)  Answer: 10  add\_function(1,1) add\_function(2,1) add\_function(3,2) add\_function(4,1) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,1) add\_function(9,3) add\_function(10,3) add\_function(11,1) add\_function(12,3) add\_function(13,3) add\_function(14,3) add\_function(15,3) add\_function(16,1) add\_function(17,3) add\_function(18,3) add\_function(19,2) add\_function(20,3) add\_function(21,2) add\_function(22,1) add\_function(23,2)  Answer: 11  add\_function(1,1) add\_function(2,1) add\_function(3,2) add\_function(4,1) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,1) add\_function(9,3) add\_function(10,3) add\_function(11,1) add\_function(12,3) add\_function(13,3) add\_function(14,3) add\_function(15,3) add\_function(16,3) add\_function(17,1) add\_function(18,3) add\_function(19,2) add\_function(20,3) add\_function(21,2) add\_function(22,1) add\_function(23,2)  Answer: 12  add\_function(1,1) add\_function(2,1) add\_function(3,2) add\_function(4,1) add\_function(5,2) add\_function(6,2) add\_function(7,2) add\_function(8,1) add\_function(9,3) add\_function(10,3) add\_function(11,1) add\_function(12,3) add\_function(13,3) add\_function(14,3) add\_function(15,3) add\_function(16,3) add\_function(17,3) add\_function(18,3) add\_function(19,2) add\_function(20,3) add\_function(21,2) add\_function(22,1) add\_function(23,2)  Answer: 13  add\_function(3,1) add\_function(1,2) add\_function(2,2) add\_function(4,2) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,2) add\_function(9,3) add\_function(10,3) add\_function(11,2) add\_function(12,3) add\_function(13,3) add\_function(14,3) add\_function(15,3) add\_function(16,3) add\_function(17,3) add\_function(18,3) add\_function(19,1) add\_function(20,3) add\_function(21,1) add\_function(22,2) add\_function(23,1)  Answer: 14  add\_function(3,1) add\_function(1,2) add\_function(2,2) add\_function(4,2) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,2) add\_function(9,3) add\_function(10,3) add\_function(11,2) add\_function(12,3) add\_function(13,3) add\_function(14,3) add\_function(15,3) add\_function(16,2) add\_function(17,3) add\_function(18,3) add\_function(19,1) add\_function(20,3) add\_function(21,1) add\_function(22,2) add\_function(23,1)  Answer: 15  add\_function(3,1) add\_function(1,2) add\_function(2,2) add\_function(4,2) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,2) add\_function(9,3) add\_function(10,3) add\_function(11,2) add\_function(12,3) add\_function(13,3) add\_function(14,3) add\_function(15,3) add\_function(16,3) add\_function(17,2) add\_function(18,3) add\_function(19,1) add\_function(20,3) add\_function(21,1) add\_function(22,2) add\_function(23,1)  Answer: 16  add\_function(3,1) add\_function(1,3) add\_function(2,3) add\_function(4,3) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,3) add\_function(9,2) add\_function(10,2) add\_function(11,3) add\_function(12,2) add\_function(13,2) add\_function(14,2) add\_function(15,2) add\_function(16,3) add\_function(17,2) add\_function(18,2) add\_function(19,1) add\_function(20,2) add\_function(21,1) add\_function(22,3) add\_function(23,1)  Answer: 17  add\_function(3,1) add\_function(1,3) add\_function(2,3) add\_function(4,3) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,3) add\_function(9,2) add\_function(10,2) add\_function(11,3) add\_function(12,2) add\_function(13,2) add\_function(14,2) add\_function(15,2) add\_function(16,2) add\_function(17,2) add\_function(18,2) add\_function(19,1) add\_function(20,2) add\_function(21,1) add\_function(22,3) add\_function(23,1)  Answer: 18  add\_function(3,1) add\_function(1,3) add\_function(2,3) add\_function(4,3) add\_function(5,1) add\_function(6,1) add\_function(7,1) add\_function(8,3) add\_function(9,2) add\_function(10,2) add\_function(11,3) add\_function(12,2) add\_function(13,2) add\_function(14,2) add\_function(15,2) add\_function(16,2) add\_function(17,3) add\_function(18,2) add\_function(19,1) add\_function(20,2) add\_function(21,1) add\_function(22,3) add\_function(23,1)  SATISFIABLE  Models : 18  Calls : 1  Time : 0.041s (Solving: 0.03s 1st Model: 0.01s Unsat: 0.00s)  CPU Time : 0.041s  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=3 -c n=24 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  UNSATISFIABLE  Models : 0  Calls : 1  Time : 0.064s (Solving: 0.05s 1st Model: 0.00s Unsat: 0.05s)  CPU Time : 0.063s  **—--------------------------------------------------------------------------------**  **saurabh@ztrimus:~/CSE579\_KRR/Assignment/PA\_1$ clingo -c k=4 -c n=67 pa1\_problem9.txt 0**  clingo version 5.4.1  Reading from pa1\_problem9.txt  Solving...  ^C\*\*\* Info : (clingo): INTERRUPTED by signal!  UNKNOWN  INTERRUPTED : 1  Models : 0+  Calls : 1  Time : 1521.731s (Solving: 1521.65s 1st Model: 0.00s Unsat: 0.00s)  CPU Time : 1517.266s |
| 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 - program completed  67 - program took longer than 10 mins to run | |