CSE 571 – Fall 2015

Project 2

Problem 1:

My constraints did not require like and dislike to be explicitly mentioned as symmetric relations.

Representation:

In a set seat(x,y), x represents table number and y represents guest number.

Test case1:

```
#const n =3.
#const m = 3.

%test case1
like(1,9).
like(2,8).
like(3,7).
like(7,6).
like(8,4).
dislike(1,7).
dislike(1,8).
dislike(7,8).

%generate (table,guest) sets
m{seat(I, 1..m*n)}m  :- I =1..n.
%one person should occupy only one table
:- seat(T1,G), seat(T2,G), T1!=T2.
%remove tables which has 2 persons who dislike each other
:- seat(T,G1), seat(T,G2), dislike(G1,G2).
%remove tables that do not have both persons who like each other
:- seat(T1,G1), seat(T2,G2), like(G1,G2), T1!=T2.

#show seat/2.
```

Online clingo editor:

Output:

```
clingo version 4.5.3
Solving...
Answer: 1
seat(2,1) seat(1,2) seat(3,3) seat(1,4) seat(2,5) seat(3,6) seat(3,7) seat(1,8) seat(2,9)
Answer: 2
seat(3,1) seat(1,2) seat(2,3) seat(1,4) seat(3,5) seat(2,6) seat(2,7) seat(1,8) seat(3,9)
Answer: 3
seat(1,1) seat(3,2) seat(2,3) seat(3,4) seat(1,5) seat(2,6) seat(2,7) seat(3,8) seat(1,9)
Answer: 4
seat(1,1) seat(2,2) seat(3,3) seat(2,4) seat(1,5) seat(3,6) seat(3,7) seat(2,8) seat(1,9)
Answer: 5
seat(2,1) seat(3,2) seat(1,3) seat(3,4) seat(2,5) seat(1,6) seat(1,7) seat(3,8) seat(2,9)
Answer: 6
seat(3,1) seat(2,2) seat(1,3) seat(2,4) seat(3,5) seat(1,6) seat(1,7) seat(2,8) seat(3,9)
SATISFIABLE

Models       : 6
Calls        : 1
```

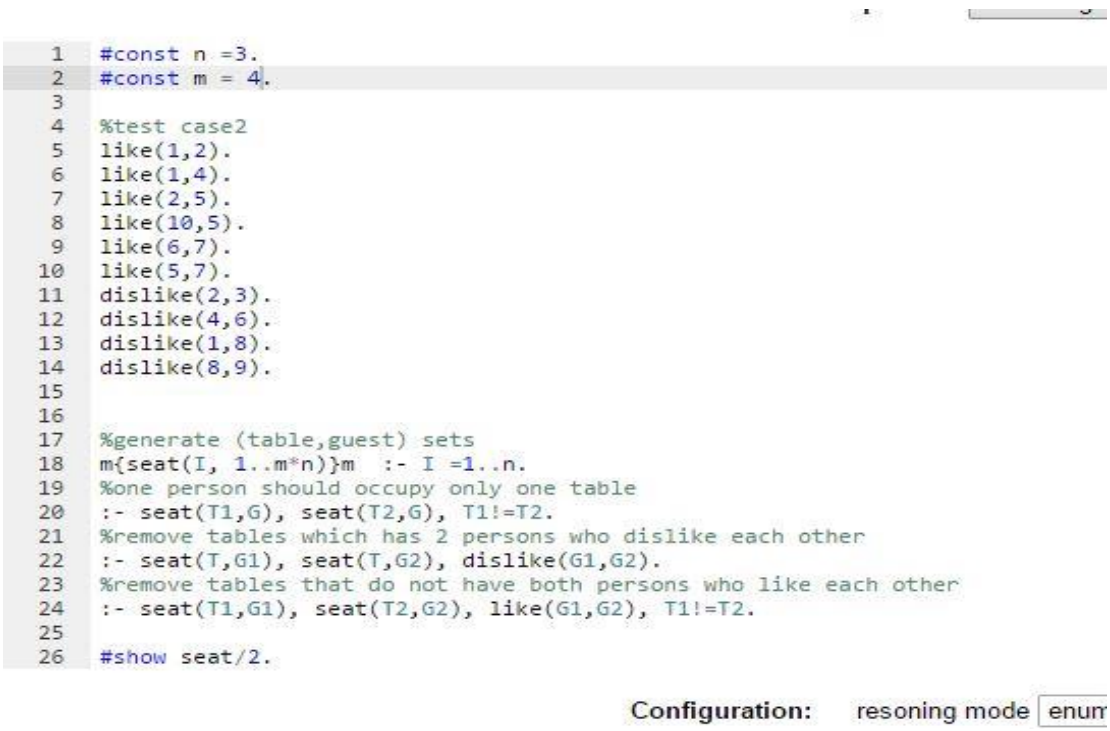
clingo version 4.5.3
Solving...
Answer: 1
seat(2,1) seat(1,2) seat(3,3) seat(1,4) seat(2,5) seat(3,6) seat(3,7) seat(1,8) seat(2,9)
Answer: 2
seat(3,1) seat(1,2) seat(2,3) seat(1,4) seat(3,5) seat(2,6) seat(2,7) seat(1,8) seat(3,9)
Answer: 3
seat(1,1) seat(3,2) seat(2,3) seat(3,4) seat(1,5) seat(2,6) seat(2,7) seat(3,8) seat(1,9)
Answer: 4
seat(1,1) seat(2,2) seat(3,3) seat(2,4) seat(1,5) seat(3,6) seat(3,7) seat(2,8) seat(1,9)
Answer: 5
seat(2,1) seat(3,2) seat(1,3) seat(3,4) seat(2,5) seat(1,6) seat(1,7) seat(3,8) seat(2,9)
Answer: 6
seat(3,1) seat(2,2) seat(1,3) seat(2,4) seat(3,5) seat(1,6) seat(1,7) seat(2,8) seat(3,9)
SATISFIABLE

Models : 6
Calls : 1
Time : 0.237s (Solving: 0.01s 1st Model: 0.01s Unsat: 0.00s)
CPU Time : 0.000s

Test case 2:

```
#const n =3.
#const m = 4.

%test case2
like(1,2).
like(1,4).
like(2,5).
like(10,5).
like(6,7).
like(5,7).
dislike(2,3).
dislike(4,6).
dislike(1,8).
dislike(8,9).


%generate (table,guest) sets
m{seat(I, 1..m*n)}m  :- I =1..n.
%one person should occupy only one table
:- seat(T1,G), seat(T2,G), T1!=T2.
%remove tables which has 2 persons who dislike each other
:- seat(T,G1), seat(T,G2), dislike(G1,G2).
%remove tables that do not have both persons who like each other
:- seat(T1,G1), seat(T2,G2), like(G1,G2), T1!=T2.

#show seat/2.
```

Online clingo editor:



Output:

```
clingo version 4.5.3
Solving...
UNSATISFIABLE

Models       : 0
Calls        : 1
Time         : 0.152s (Solving: 0.05s 1st Model: 0.00s Unsat: 0.05s)
CPU Time     : 0.000s
```

clingo version 4.5.3
Solving...
UNSATISFIABLE

Models : 0
Calls : 1
Time : 0.152s (Solving: 0.05s 1st Model: 0.00s Unsat: 0.05s)
CPU Time : 0.000s

Problem 2:

Program:

```
%assign codes to each of the firstnames
firstname(1,engles).
firstname(2,foster).
firstname(3,gunter).
firstname(4,halevy).
%assign codes to each of the lastnames
lastname(5,abner).
lastname(6,chuck).
lastname(7,duane).
lastname(8,bruce).
%assign codes to each of the pets
pet(9,iguana).
pet(10,jackal).
pet(11,kingcobra).
pet(12,llama).
%generate (firstname,lastname,pet) sets
4{owns(1..4,5..8,9..12)}4.
%2 persons can't have same 1st name
:-owns(I,J,K), owns(I,J1,K1), J!=J1, K!=K1.
%2 persons can't have the same last name
:-owns(I,J,K), owns(I1,J,K1), I!=I1, K!=K1.
%2 persons can't have same pet
:-owns(I,J,K), owns(I1,J1,K), I1!=I, J1!=J.
%a firstname-lastname combination can have only 1 pet
:-owns(I,J,K), owns(I,J,K1), K!=K1.
%a lastname-pet combination can have only one first name
:-owns(I1,J,K), owns(I,J,K), I1!=I.
%a firstname-pet combination can have only one lastname
:-owns(I,J1,K), owns(I,J,K), J!=J1.
%engles and abner are different persons



:-owns(1,5,K).
%foster and abner are different persons
```

```
:-owns(2,5,K).
%chuck doesn't own iguana
:-owns(I,6,9).
%duane doesn't own iguana
:-owns(I,7,9).
%foster doesn't own jackal
:-owns(2,J,10).
%foster doesn't own kingcobra
:-owns(2,J,11).
%duane doesn't own llama
:-owns(I,7,12).
%gunter and abner are different persons
:-owns(3,5,K).
%abner doesn't own kingcobra
:-owns(I,5,11).
%foster and bruce are different persons
:-owns(2,8,K).
%halevy doesn't own iguana
:-owns(4,J,9).
%engles and duane are different persons because their pet names are different
:-owns(1,7,K).
%decode numbers to names
own(I,J,K) :- owns(X,Y,Z), firstname(X,I), lastname(Y,J), pet(Z,K).
%show only own sets
#show own/3.
```

Online clingo editor:

```
%assign codes to each of the firstnames
firstname(1,engles).firstname(2,foster).firstname(3,gunter).firstname(4,halevy).
%assign codes to each of the lastnames
lastname(5,abner).lastname(6,chuck).lastname(7,duane).lastname(8,bruce).
%assign codes to each of the pets
pet(9,iguana).pet(10,jackal).pet(11,kingcobra).pet(12,llama).
%generate (firstname,lastname,pet) sets
4{owns(1..4,5..8,9..12)}4.
%2 persons can't have same 1st name
:-owns(I,J,K), owns(I,J1,K1), J!=J1, K!=K1.
%2 persons can't have the same last name
:-owns(I,J,K), owns(I1,J,K1), I!=I1, K!=K1.
%2 persons can't have same pet
:-owns(I,J,K), owns(I1,J1,K), I1!=I, J1!=J.
%a firstname-lastname combination can have only 1 pet
:-owns(I,J,K), owns(I,J,K1), K!=K1.
%a lastname-pet combination can have only one first name
:-owns(I1,J,K), owns(I,J,K), I1!=I.
%a firstname-pet combination can have only one lastname
:-owns(I,J1,K), owns(I,J,K), J!=J1.
%engles and abner are different persons
:-owns(1,5,K).
%foster and abner are different persons
:-owns(2,5,K).
%chuck doesn't own iguana
:-owns(I,6,9).
%duane doesn't own iguana
:-owns(I,7,9).
%foster doesn't own jackal
:-owns(2,J,10).
%foster doesn't own kingcobra
:-owns(2,J,11).
%duane doesn't own llama
:-owns(I,7,12).
%gunter and abner are different persons
:-owns(3,5,K).
%abner doesn't own kingcobra
:-owns(I,5,11).
%foster and bruce are different persons
:-owns(2,8,K).
%halevy doesn't own iguana
:-owns(4,J,9).
%engles and duane are different persons because their pet names are different
:-owns(1,7,K).
%decode numbers to names
own(I,J,K) :- owns(X,Y,Z), firstname(X,I), lastname(Y,J), pet(Z,K).
%show only own sets
#show own/3.
```

Output:

Configuration: resoning mode enumerate all ▼ project statistics

▶ Run!

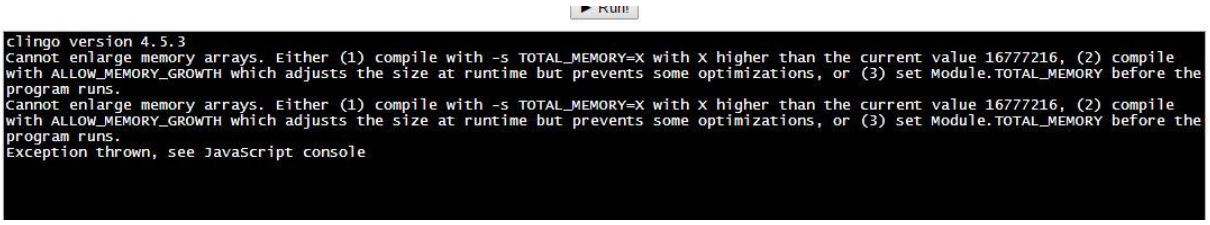
```
clingo version 4.5.3
Solving...
Answer: 1
own(engles,bruce,iguana) own(halevy,abner,jackal) own(gunter,duane,kingcobra) own(foster,chuck,llama)
SATISFIABLE

Models       : 1
Calls        : 1
Time         : 0.032s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time     : 0.000s
```

clingo version 4.5.3
Solving...
Answer: 1
own(engles,bruce,iguana) own(halevy,abner,jackal) own(gunter,duane,kingcobra)
own(foster,chuck,llama)
SATISFIABLE

Models : 1
Calls : 1
Time : 0.032s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time : 0.000s

Bonus credit problem:

I first wrote the program for 4x4 chessboard and extended it to 8x8 board. I have attached the program for both. I got the output for 4x4 whereas 8x8 is still running and I could not attach the output at the moment. I will email it to you as soon as the program completes. Running these online gave the following error. So I switched to desktop version of the tool.



Representation:

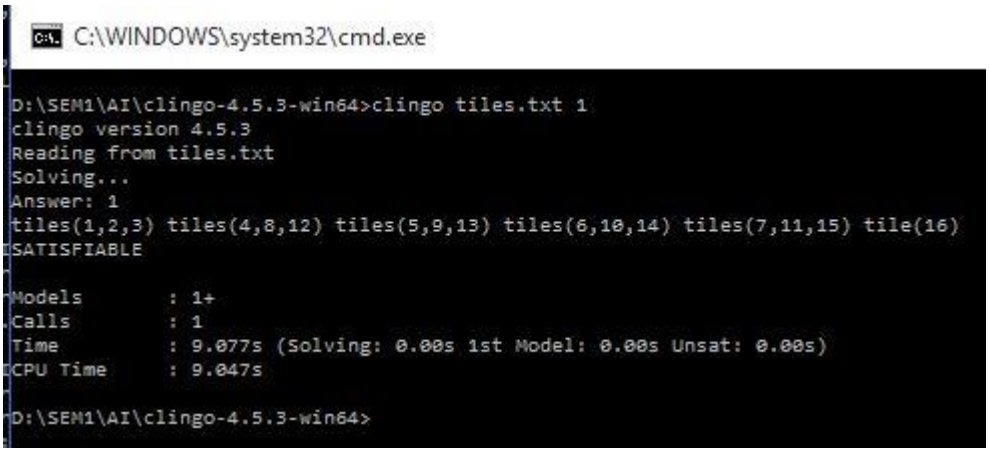
A set tiles(x,y,z) means that it's a 3x1 tile and spans box x, box y, box z on the chess board. tile(i) means that it is a 1x1 tile and occupies box I on the board.

4x4 program:

```
%generate 3x1 tiles exactly 5 numbers
5{tiles(1..16,1..16,1..16)}5.
%generate 1x1 tile exactly 1 number
1{tile(1..16)}1.


%remove duplicates like (1,2,3), (3,2,1) etc
:-tiles(I,J,K), J<I.
:-tiles(I,J,K), K<I.
:-tiles(I,J,K), K<J.

%1x1 tile should not be among any 3x1 tile cells
:-tiles(I,J,K), tile(I).
:-tiles(I,J,K), tile(J).
:-tiles(I,J,K), tile(K).

%only unique elements are allowed within sets
:-tiles(I,J,K), I=J.
:-tiles(I,J,K), J=K.
:-tiles(I,J,K), I=K.


%unique numbers across sets
```

```
:-tiles(I,J,K), tiles(_,I,_).
:-tiles(I,J,K), tiles(_,_,I).
:-tiles(I,J,K), tiles(J,_,_).
:-tiles(I,J,K), tiles(_,_,J).
:-tiles(I,J,K), tiles(K,_,_).
:-tiles(I,J,K), tiles(_,K,_).
:-tiles(I,J,K), tiles(I,J1,K1), J!=J1, K!=K1.
:-tiles(I,J,K), tiles(I1,J,K1), I!=I1, K!=K1.
:-tiles(I,J,K), tiles(I1,J1,K), I!=I1, J!=J1.

%horizontal right end boundary.

:-tiles(I,J,K), I>=2+(F*X), I<=4+(F*X), K=I+2, X=0..3, F=4.
:-tiles(I,J,K), I>=2+(F*X), I<=4+(F*X), J=J+1, X=0..3, F=4.


%vertical constraint for tiles and also boundary
:-tiles(I,J,K), J!=I+1, J!=I+4.
:-tiles(I,J,K), K!=I+2, K!=I+8.
:-tiles(I,J,K), K!=J+1, K!=J+4.
```

Command line:



Output:

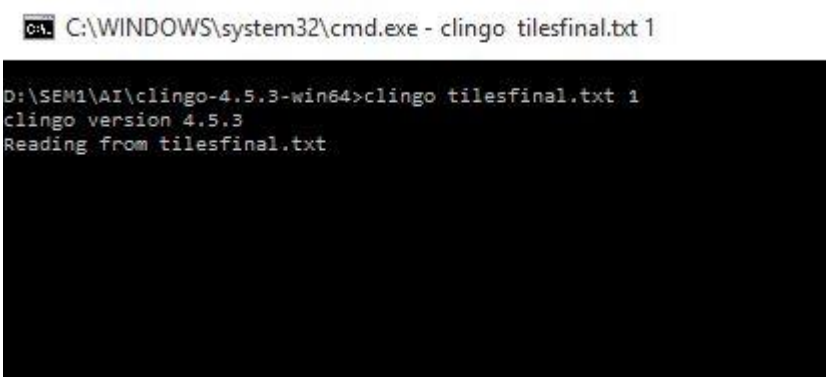
```
D:\SEM1\AI\clingo-4.5.3-win64>clingo tiles.txt 1
clingo version 4.5.3
Reading from tiles.txt
Solving...
Answer: 1
tiles(1,2,3) tiles(4,8,12) tiles(5,9,13) tiles(6,10,14) tiles(7,11,15) tile(16)
SATISFIABLE

Models       : 1+
Calls        : 1
Time         : 9.077s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time     : 9.047s

D:\SEM1\AI\clingo-4.5.3-win64>
```

8x8 program:

```
%generate 3x1 tiles exactly 21 numbers
```

```
21{tiles(1..64,1..64,1..64)}21.
%generate 1x1 tile exactly 1 number
1{tile(1..64)}1.

%remove duplicates like (1,2,3), (3,2,1) etc
:-tiles(I,J,K), J<I.
:-tiles(I,J,K), K<I.
:-tiles(I,J,K), K<J.

%1x1 tile should not be among any 3x1 tile cells
:-tiles(I,J,K), tile(I).
:-tiles(I,J,K), tile(J).
:-tiles(I,J,K), tile(K).

%only unique elements are allowed within sets
:-tiles(I,J,K), I=J.
:-tiles(I,J,K), J=K.
:-tiles(I,J,K), I=K.

%only unique elements are allowed across sets
:-tiles(I,J,K), tiles(_,I,_).
:-tiles(I,J,K), tiles(_,_,I).
:-tiles(I,J,K), tiles(J,_,_).
:-tiles(I,J,K), tiles(_,_,J).
:-tiles(I,J,K), tiles(K,_,_).
:-tiles(I,J,K), tiles(_,K,_).
:-tiles(I,J,K), tiles(I,J1,K1), J!=J1, K!=K1.
:-tiles(I,J,K), tiles(I1,J,K1), I!=I1, K!=K1.
:-tiles(I,J,K), tiles(I1,J1,K), I!=I1, J!=J1.

%horizontal right end boundary.

:-tiles(I,J,K), I>=6+(E*X), I<=8+(E*X), K=I+2, X=0..7, E=8.
:-tiles(I,J,K), I>=6+(E*X), I<=8+(E*X), J=J+1, X=0..7, E=8.

%vertical constraint for tiles and also boundary
:-tiles(I,J,K), J!=I+1, J!=I+4.
:-tiles(I,J,K), K!=I+2, K!=I+8.
:-tiles(I,J,K), K!=J+1, K!=J+4.
```

Command line:



And it’s still running as there is a combinatorial explosion due to 64*64*64.