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The screenshots were included here

Assignment #4

Part I, Question 1

```
:- dynamic(last/2).
```

```
last(List, LastItem):-  
    reverse(List, [Z|T]),  
    write(Z).
```

%The lines starting with last and reverse recursively look through the list tails and then compare them to element with previous function.

```
?- last([],LastItem).  
false.
```

%This is the screenshot of the program run

```
?- last([a],LastItem).  
a  
true.
```

```
?- last([a,b,c],LastItem).  
c  
true.
```

Part I, Question 2

```
eightQueens(Board) :-  
    permutation([1,2,3,4,5,6,7,8],Board),  
    checkDiagonals(Board).
```

```
checkDiagonals([]).
```

```
checkDiagonals([Heads|Tails]) :-  
    checkDiagonals(Tails),  
    nocollision(Heads,Tails,1).
```

```
nocollision(_,[],_).
```

```
nocollision(Y,[Heads|Tails],Dist) :-  
    Heads-Y=\=Dist,  
    Y-Heads=\=Dist,  
    NewDist is Dist + 1,  
    nocollision(Y,Tails,NewDist).
```

%Generating permutations
%Check for the permutations'
diagonals(in case they have two
queens)

%will be true if the consequence of
numbers does not vary on the board

%Here checking the list, i.e., if the first
and last elements would be
consecutive. False if they are, true
otherwise.

?- eightQueens(1,Board).

Board = [1]

false.

?- eightQueens(2,Board).

false.

?- eightQueens(3,Board).

false.

?- eightQueens(4,Board).

Board = [2, 4, 1, 3]

Board = [3, 1, 4, 2]

false.

?- eightQueens(5,Board).

Board = [1, 3, 5, 2, 4]

Board = [1, 4, 2, 5, 3]

Board = [2, 4, 1, 3, 5]

Board = [2, 5, 3, 1, 4]

Board = [3, 1, 4, 2, 5]

Board = [3, 5, 2, 4, 1]

Board = [4, 1, 3, 5, 2]

Board = [4, 2, 5, 3, 1]

Board = [5, 2, 4, 1, 3]

Board = [5, 3, 1, 4, 2]

false.

?- eightQueens(6,Board).

Board = [2, 4, 6, 1, 3, 5]

Board = [3, 6, 2, 5, 1, 4]

Board = [4, 1, 5, 2, 6, 3]

Board = [5, 3, 1, 6, 4, 2]

false.

?- eightQueens(7,Board).

Board = [1, 3, 5, 7, 2, 4, 6]

Board = [1, 4, 7, 3, 6, 2, 5]

Board = [1, 5, 2, 6, 3, 7, 4]

Board = [1, 6, 4, 2, 7, 5, 3]

Board = [2, 4, 1, 7, 5, 3, 6]

Board = [2, 4, 6, 1, 3, 5, 7]

Board = [2, 5, 1, 4, 7, 3, 6]

Board = [2, 5, 3, 1, 7, 4, 6]

Board = [2, 5, 7, 4, 1, 3, 6]

Board = [2, 6, 3, 7, 4, 1, 5]

Board = [2, 7, 5, 3, 1, 6, 4]

Board = [3, 1, 6, 2, 5, 7, 4]

Board = [3, 1, 6, 4, 2, 7, 5]

Board = [3, 5, 7, 2, 4, 6, 1]

Board = [3, 6, 2, 5, 1, 4, 7]

Board = [3, 7, 2, 4, 6, 1, 5]

Board = [3, 7, 4, 1, 5, 2, 6]

Board = [4, 1, 3, 6, 2, 7, 5]

Board = [4, 1, 5, 2, 6, 3, 7]

Board = [4, 2, 7, 5, 3, 1, 6]

Board = [4, 6, 1, 3, 5, 7, 2]

Board = [4, 7, 3, 6, 2, 5, 1]

Board = [4, 7, 5, 2, 6, 1, 3]

Board = [5, 1, 4, 7, 3, 6, 2]

Board = [5, 1, 6, 4, 2, 7, 3]

Board = [5, 2, 6, 3, 7, 4, 1]

Board = [5, 3, 1, 6, 4, 2, 7]

Board = [5, 7, 2, 4, 6, 1, 3]

Board = [5, 7, 2, 6, 3, 1, 4]

Board = [6, 1, 3, 5, 7, 2, 4]

Board = [6, 2, 5, 1, 4, 7, 3]

Board = [6, 3, 1, 4, 7, 5, 2]

Board = [6, 3, 5, 7, 1, 4, 2]

Board = [6, 3, 7, 4, 1, 5, 2]

Board = [6, 4, 2, 7, 5, 3, 1]

Board = [6, 4, 7, 1, 3, 5, 2]

Board = [7, 2, 4, 6, 1, 3, 5]

Board = [7, 3, 6, 2, 5, 1, 4]

Board = [7, 4, 1, 5, 2, 6, 3]

Board = [7, 5, 3, 1, 6, 4, 2]

false.

?- eightQueens(8,Board).

Board = [1, 5, 8, 6, 3, 7, 2, 4]
Board = [1, 6, 8, 3, 7, 4, 2, 5]
Board = [1, 7, 4, 6, 8, 2, 5, 3]
Board = [1, 7, 5, 8, 2, 4, 6, 3]
Board = [2, 4, 6, 8, 3, 1, 7, 5]
Board = [2, 5, 7, 1, 3, 8, 6, 4]
Board = [2, 5, 7, 4, 1, 8, 6, 3]
Board = [2, 6, 1, 7, 4, 8, 3, 5]
Board = [2, 6, 8, 3, 1, 4, 7, 5]
Board = [2, 7, 3, 6, 8, 5, 1, 4]
Board = [2, 7, 5, 8, 1, 4, 6, 3]
Board = [2, 8, 6, 1, 3, 5, 7, 4]
Board = [3, 1, 7, 5, 8, 2, 4, 6]
Board = [3, 5, 2, 8, 1, 7, 4, 6]
Board = [3, 5, 2, 8, 6, 4, 7, 1]
Board = [3, 5, 7, 1, 4, 2, 8, 6]
Board = [3, 5, 8, 4, 1, 7, 2, 6]
Board = [3, 6, 2, 5, 8, 1, 7, 4]
Board = [3, 6, 2, 7, 1, 4, 8, 5]
Board = [3, 6, 2, 7, 5, 1, 8, 4]
Board = [3, 6, 4, 1, 8, 5, 7, 2]
Board = [3, 6, 4, 2, 8, 5, 7, 1]
Board = [3, 6, 8, 1, 4, 7, 5, 2]
Board = [3, 6, 8, 1, 5, 7, 2, 4]
Board = [3, 6, 8, 2, 4, 1, 7, 5]
Board = [3, 7, 2, 8, 5, 1, 4, 6]
Board = [3, 7, 2, 8, 6, 4, 1, 5]
Board = [3, 8, 4, 7, 1, 6, 2, 5]
Board = [4, 1, 5, 8, 2, 7, 3, 6]
Board = [4, 1, 5, 8, 6, 3, 7, 2]
Board = [4, 2, 5, 8, 6, 1, 3, 7]
Board = [4, 2, 7, 3, 6, 8, 1, 5]
Board = [4, 2, 7, 3, 6, 8, 5, 1]
Board = [4, 2, 7, 5, 1, 8, 6, 3]
Board = [4, 2, 8, 5, 7, 1, 3, 6]
Board = [4, 2, 8, 6, 1, 3, 5, 7]
Board = [4, 6, 1, 5, 2, 8, 3, 7]
Board = [4, 6, 8, 2, 7, 1, 3, 5]
Board = [4, 6, 8, 3, 1, 7, 5, 2]
Board = [4, 7, 1, 8, 5, 2, 6, 3]
Board = [4, 7, 3, 8, 2, 5, 1, 6]
Board = [4, 7, 5, 2, 6, 1, 3, 8]
Board = [4, 7, 5, 3, 1, 6, 8, 2]
Board = [4, 8, 1, 3, 6, 2, 7, 5]
Board = [4, 8, 1, 5, 7, 2, 6, 3]
Board = [4, 8, 5, 3, 1, 7, 2, 6]
Board = [5, 1, 4, 6, 8, 2, 7, 3]
Board = [5, 1, 8, 4, 2, 7, 3, 6]
Board = [5, 1, 8, 6, 3, 7, 2, 4]
Board = [5, 2, 4, 6, 8, 3, 1, 7]
Board = [5, 2, 4, 7, 3, 8, 6, 1]
Board = [5, 2, 6, 1, 7, 4, 8, 3]
Board = [5, 2, 8, 1, 4, 7, 3, 6]
Board = [5, 3, 1, 6, 8, 2, 4, 7]
Board = [5, 3, 1, 7, 2, 8, 6, 4]

Board = [5, 3, 8, 4, 7, 1, 6, 2]
Board = [5, 7, 1, 3, 8, 6, 4, 2]
Board = [5, 7, 1, 4, 2, 8, 6, 3]
Board = [5, 7, 2, 4, 8, 1, 3, 6]
Board = [5, 7, 2, 6, 3, 1, 4, 8]
Board = [5, 7, 2, 6, 3, 1, 8, 4]
Board = [5, 7, 4, 1, 3, 8, 6, 2]
Board = [5, 8, 4, 1, 3, 6, 2, 7]
Board = [5, 8, 4, 1, 7, 2, 6, 3]
Board = [6, 1, 5, 2, 8, 3, 7, 4]
Board = [6, 2, 7, 1, 3, 5, 8, 4]
Board = [6, 2, 7, 1, 4, 8, 5, 3]
Board = [6, 3, 1, 7, 5, 8, 2, 4]
Board = [6, 3, 1, 8, 4, 2, 7, 5]
Board = [6, 3, 1, 8, 5, 2, 4, 7]
Board = [6, 3, 5, 7, 1, 4, 2, 8]
Board = [6, 3, 5, 8, 1, 4, 2, 7]
Board = [6, 3, 7, 2, 4, 8, 1, 5]
Board = [6, 3, 7, 2, 8, 5, 1, 4]
Board = [6, 3, 7, 4, 1, 8, 2, 5]
Board = [6, 4, 1, 5, 8, 2, 7, 3]
Board = [6, 4, 2, 8, 5, 7, 1, 3]
Board = [6, 4, 7, 1, 3, 5, 2, 8]
Board = [6, 4, 7, 1, 8, 2, 5, 3]
Board = [6, 8, 2, 4, 1, 7, 5, 3]
Board = [7, 1, 3, 8, 6, 4, 2, 5]
Board = [7, 2, 4, 1, 8, 5, 3, 6]
Board = [7, 2, 6, 3, 1, 4, 8, 5]
Board = [7, 3, 1, 6, 8, 5, 2, 4]
Board = [7, 3, 8, 2, 5, 1, 6, 4]
Board = [7, 4, 2, 5, 8, 1, 3, 6]
Board = [7, 4, 2, 8, 6, 1, 3, 5]
Board = [7, 5, 3, 1, 6, 8, 2, 4]
Board = [8, 2, 4, 1, 7, 5, 3, 6]
Board = [8, 2, 5, 3, 1, 7, 4, 6]
Board = [8, 3, 1, 6, 2, 5, 7, 4]
Board = [8, 4, 1, 3, 6, 2, 7, 5]

false.

Part II, Question 1

```
n { queen(1..n,1..n) } n.  
:- queen(I,J), queen(I,JJ), J != JJ.  
:- queen(I,J), queen(II ,J), I != II.  
:- queen(I,J), queen(II ,JJ), (I,J) != (II ,JJ), I-J == II -JJ.  
:- queen(I,J), queen(II ,JJ), (I,J) != (II ,JJ), I+J == II+JJ.  
  
#show queen/2.
```

%line 1, we generate queens and fill the board
%line 2,3, deleting queens on the same rows and columns
%line 4,5, deleting boards that have queens in diagonal

```

Models      : 2
Calls       : 1
Time        : 0.001s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time    : 0.001s
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=5 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
Answer: 1
queen(2,3) queen(4,2) queen(3,5) queen(5,4) queen(1,1)
Answer: 2
queen(3,1) queen(2,3) queen(1,5) queen(5,2) queen(4,4)
Answer: 3
queen(2,2) queen(1,4) queen(5,1) queen(4,3) queen(3,5)
Answer: 4
queen(1,2) queen(3,1) queen(2,4) queen(4,3) queen(5,5)
Answer: 5
queen(2,1) queen(1,3) queen(4,2) queen(3,4) queen(5,5)
Answer: 6
queen(2,2) queen(4,1) queen(1,5) queen(3,4) queen(5,3)
Answer: 7
queen(1,3) queen(3,2) queen(5,1) queen(2,5) queen(4,4)
Answer: 8
queen(3,2) queen(2,4) queen(5,3) queen(4,5) queen(1,1)
Answer: 9
queen(1,2) queen(4,1) queen(3,3) queen(2,5) queen(5,4)
Answer: 10
queen(2,1) queen(1,4) queen(3,3) queen(5,2) queen(4,5)
SATISFIABLE

```

```

Models      : 10
Calls       : 1
Time        : 0.001s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time    : 0.001s
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=6 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
Answer: 1
queen(1,3) queen(3,2) queen(5,1) queen(2,6) queen(4,5) queen(6,4)
Answer: 2
queen(2,1) queen(1,4) queen(4,2) queen(3,5) queen(6,3) queen(5,6)
Answer: 3
queen(1,2) queen(4,1) queen(2,4) queen(5,3) queen(3,6) queen(6,5)
Answer: 4
queen(3,1) queen(2,3) queen(1,5) queen(6,2) queen(5,4) queen(4,6)
SATISFIABLE

```



```
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=1 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
Answer: 1
queen(1,1)
SATISFIABLE
```

```
Models      : 1
Calls       : 1
Time        : 0.002s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time    : 0.001s
```

```
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=2 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
UNSATISFIABLE
```

```
Models      : 0
Calls       : 1
Time        : 0.001s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time    : 0.000s
```

```
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=3 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
UNSATISFIABLE
```

```
Models      : 0
Calls       : 1
Time        : 0.007s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time    : 0.001s
```

```
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=4 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
Answer: 1
queen(1,2) queen(3,1) queen(2,4) queen(4,3)
Answer: 2
queen(2,1) queen(1,3) queen(4,2) queen(3,4)
SATISFIABLE
```

```

Models      : 4
Calls       : 1
Time        : 0.004s (Solving: 0.00s 1st Model: 0.00s Unsat: 0.00s)
CPU Time    : 0.004s
[Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=7 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
Answer: 1
queen(1,2) queen(5,1) queen(2,5) queen(4,4) queen(6,3) queen(3,7) queen(7,6)
Answer: 2
queen(1,2) queen(3,1) queen(2,5) queen(4,4) queen(6,3) queen(5,7) queen(7,6)
Answer: 3
queen(2,1) queen(1,3) queen(5,2) queen(4,4) queen(3,6) queen(7,5) queen(6,7)
Answer: 4
queen(2,1) queen(1,5) queen(5,2) queen(4,4) queen(3,6) queen(7,3) queen(6,7)
Answer: 5
queen(1,3) queen(3,2) queen(6,1) queen(4,4) queen(2,7) queen(5,6) queen(7,5)
Answer: 6
queen(3,2) queen(1,5) queen(6,1) queen(4,4) queen(2,7) queen(7,3) queen(5,6)
Answer: 7
queen(3,1) queen(2,3) queen(1,6) queen(4,4) queen(7,2) queen(6,5) queen(5,7)
Answer: 8
queen(2,3) queen(5,1) queen(1,6) queen(4,4) queen(7,2) queen(3,7) queen(6,5)
Answer: 9
queen(2,2) queen(4,1) queen(1,6) queen(3,5) queen(5,4) queen(7,3) queen(6,7)
Answer: 10
queen(1,2) queen(5,1) queen(4,3) queen(3,5) queen(2,7) queen(7,4) queen(6,6)
Answer: 11
queen(2,3) queen(5,2) queen(3,5) queen(6,4) queen(4,7) queen(7,6) queen(1,1)
Answer: 12
queen(2,1) queen(1,4) queen(4,2) queen(3,5) queen(6,3) queen(5,6) queen(7,7)
Answer: 13
queen(1,4) queen(4,2) queen(6,1) queen(3,5) queen(2,7) queen(7,3) queen(5,6)
Answer: 14
queen(2,3) queen(5,1) queen(1,6) queen(3,5) queen(7,2) queen(6,4) queen(4,7)
Answer: 15
queen(2,1) queen(1,5) queen(3,4) queen(5,3) queen(7,2) queen(4,7) queen(6,6)
Answer: 16
queen(2,2) queen(1,4) queen(6,1) queen(5,3) queen(4,5) queen(3,7) queen(7,6)
Answer: 17
queen(3,2) queen(2,5) queen(5,3) queen(4,6) queen(7,4) queen(6,7) queen(1,1)
Answer: 18
queen(1,2) queen(4,1) queen(2,4) queen(5,3) queen(3,6) queen(6,5) queen(7,7)
Answer: 19
queen(4,1) queen(2,4) queen(1,6) queen(5,3) queen(7,2) queen(3,7) queen(6,5)
Answer: 20
queen(3,2) queen(1,5) queen(6,1) queen(5,3) queen(2,7) queen(4,6) queen(7,4)
Answer: 21
queen(3,1) queen(1,4) queen(4,3) queen(2,6) queen(7,2) queen(5,5) queen(6,7)
Answer: 22
queen(1,2) queen(3,3) queen(6,1) queen(2,6) queen(5,4) queen(4,7) queen(7,5)
Answer: 23
queen(4,2) queen(3,4) queen(2,6) queen(7,3) queen(6,5) queen(5,7) queen(1,1)
Answer: 24
queen(1,3) queen(3,2) queen(5,1) queen(2,6) queen(4,5) queen(6,4) queen(7,7)
Answer: 25
queen(2,3) queen(4,2) queen(6,1) queen(1,7) queen(3,6) queen(5,5) queen(7,4)

```

Answer: 26
queen(4,1) queen(3,3) queen(2,5) queen(1,7) queen(7,2) queen(6,4) queen(5,6)
Answer: 27
queen(2,2) queen(5,1) queen(3,4) queen(1,7) queen(6,3) queen(4,6) queen(7,5)
Answer: 28
queen(3,1) queen(2,4) queen(5,2) queen(1,7) queen(4,5) queen(7,3) queen(6,6)
Answer: 29
queen(2,1) queen(3,3) queen(1,6) queen(6,2) queen(4,5) queen(7,4) queen(5,7)
Answer: 30
queen(1,3) queen(4,1) queen(3,4) queen(6,2) queen(2,7) queen(5,5) queen(7,6)
Answer: 31
queen(3,1) queen(2,3) queen(1,5) queen(6,2) queen(5,4) queen(4,6) queen(7,7)
Answer: 32
queen(2,4) queen(4,3) queen(6,2) queen(3,7) queen(5,6) queen(7,5) queen(1,1)
Answer: 33
queen(1,3) queen(4,2) queen(2,5) queen(7,1) queen(5,4) queen(3,7) queen(6,6)
Answer: 34
queen(1,4) queen(3,3) queen(5,2) queen(7,1) queen(2,7) queen(4,6) queen(6,5)
Answer: 35
queen(3,2) queen(2,4) queen(1,6) queen(7,1) queen(6,3) queen(5,5) queen(4,7)
Answer: 36
queen(2,2) queen(1,5) queen(4,3) queen(7,1) queen(3,6) queen(6,4) queen(5,7)
Answer: 37
queen(2,1) queen(1,4) queen(3,3) queen(5,2) queen(4,6) queen(7,5) queen(6,7)
Answer: 38
queen(2,1) queen(1,3) queen(4,2) queen(3,6) queen(5,5) queen(7,4) queen(6,7)
Answer: 39
queen(1,2) queen(3,1) queen(2,4) queen(6,3) queen(5,5) queen(4,7) queen(7,6)
Answer: 40
queen(1,2) queen(4,1) queen(3,3) queen(2,5) queen(6,4) queen(5,7) queen(7,6)
SATISFIABLE

```
Models      : 40
Calls       : 1
Time        : 0.034s (Solving: 0.03s 1st Model: 0.00s Unsat: 0.01s)
CPU Time    : 0.029s
Matveys-MBP:Desktop matveyskripchenko$ gringo queens.lp --const n=8 |clasp 0
clasp version 3.3.4
Reading from stdin
Solving...
Answer: 1
queen(2,5) queen(5,3) queen(7,2) queen(4,6) queen(3,8) queen(8,4) queen(6,7) queen(1,1)
Answer: 2
queen(3,2) queen(1,5) queen(6,1) queen(5,3) queen(2,7) queen(4,6) queen(8,4) queen(7,8)
Answer: 3
queen(3,2) queen(1,5) queen(6,1) queen(5,3) queen(2,7) queen(4,6) queen(7,4) queen(8,8)
Answer: 4
queen(2,1) queen(1,5) queen(5,3) queen(7,2) queen(4,6) queen(3,8) queen(8,4) queen(6,7)
Answer: 5
queen(4,1) queen(2,4) queen(1,6) queen(5,3) queen(7,2) queen(3,7) queen(6,5) queen(8,8)
Answer: 6
queen(1,2) queen(4,1) queen(2,5) queen(5,3) queen(3,7) queen(8,4) queen(7,6) queen(6,8)
Answer: 7
queen(2,2) queen(4,1) queen(1,6) queen(5,3) queen(3,7) queen(6,5) queen(8,4) queen(7,8)
Answer: 8
queen(1,2) queen(4,1) queen(5,3) queen(3,6) queen(2,8) queen(6,5) queen(8,4) queen(7,7)
Answer: 9
queen(1,2) queen(2,4) queen(6,1) queen(5,3) queen(3,6) queen(4,8) queen(8,5) queen(7,7)
Answer: 10
queen(2,2) queen(1,5) queen(3,4) queen(5,3) queen(8,1) queen(4,7) queen(7,6) queen(6,8)
Answer: 11
queen(4,1) queen(1,5) queen(3,4) queen(5,3) queen(2,7) queen(8,2) queen(7,6) queen(6,8)
Answer: 12
queen(4,1) queen(1,5) queen(3,4) queen(5,3) queen(7,2) queen(2,8) queen(6,6) queen(8,7)
Answer: 13
queen(3,1) queen(2,3) queen(1,7) queen(7,2) queen(4,6) queen(6,5) queen(8,4) queen(5,8)
Answer: 14
queen(2,1) queen(3,3) queen(1,7) queen(7,2) queen(6,4) queen(5,6) queen(4,8) queen(8,5)
Answer: 15
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