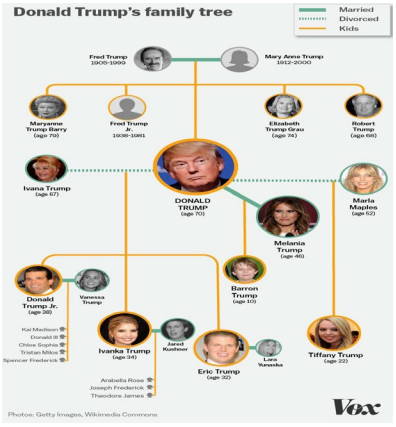
CS/CE 4337 - Assignment#4
Due Date: 11/10/19, 11:59 pm

*Commented version of code in subfolder

*All codes are ran using the **on-line compiler**

1- Using Donald Trump's family tree, write a prolog program (a collection of facts and rules) to answer the following queries about the relationships within Donald trump's family tree.

- Who is the mother of Ivanka trump
- Who is the step mother of Ivanka trump
- Who is the father of Ivanka trump
- Who is the spouse of Donald trump
- Who is the ex-spouse of Donald trump
- Who is the sister of Ivanka trump
- Who is the step sister of Barron trump
- Who is the brother of Ivanka trump
- Who is the step brother of Ivanka trump
- Who is the grandfather of Ivanka trump
- Who is the grandmother of Ivanka trump
- Who is the great grandfather of a Theodore James




```
father(kaiMadison,donaldTrumpJr).
mother(kaiMadison,vanessaTrump).
father(donaldIII,donaldTrumpJr).
mother(donaldIII,vanessaTrump).
father(chloeSophia,donaldTrumpJr).
mother(chloeSophia,vanessaTrump).
father(tristanMilos,donaldTrumpJr).
mother(tristanMilos,vanessaTrump).
father(spencerFrederick,donaldTrumpJr).
mother(spencerFrederick,vanessaTrump).

father(arabellaRose,jaredKushner).
mother(arabellaRose,ivankaTrump).
father(josephFrederick,jaredKushner).
mother(josephFrederick,ivankaTrump).
father(theodoreJames,jaredKushner).
mother(theodoreJames,ivankaTrump).

/**rules
Great grandfather is defined as father of grandpas from father's side (2 of them), and father of grandpas from mother's side (2 of th
sister/brother is defined as female/male siblings with same pair of parents
half sister/brother is defined as female/male siblings who are children of same father but different mother, or siblings who are chil
 */
stepMother(A,B):-father(A,X), married(X,B), female(B).
spouse(A,B):-married(A,B),female(B).
exSpouse(A,B):-divorced(A,B),female(B).
sister(A,B):-female(B),((father(A,X),father(B,X)),(mother(A,Y), mother(B,Y))),A\=B.
halfsister(A,B):-female(B),((father(A,X),father(B,X),mother(A,Y),mother(B,Z),Y\=Z);(mother(A,X),mother(B,X),father(A,Y),father(B,Z),Y
brother(A,B):-male(B),((father(A,X),father(B,X)),(mother(A,Y), mother(B,Y))),A\=B.
halfBrother(A,B):-male(B),((father(A,X),father(B,X),mother(A,Y),mother(B,Z),Y\=Z);(mother(A,X),mother(B,X),father(A,Y),father(B,Z),Y
grandfather(A,B):-male(B),((father(A,X),father(X,B));(mother(A,X),father(X,B))).
grandmother(A,B):-female(B),((mother(A,X),mother(X,B));(father(A,X),mother(X,B))).
greatGrandfather(A,B):-male(B),(father(A,X),father(X,Y),father(Y,B));(father(A,X),mother(X,Y),father(Y,B));(mother(A,X),father(X,Y),f
```

```
mother(ivankaTrump,Mum); stepMother(ivankaTrump,StepMum); father(ivankaTrump,Dad);
spouse(donaldTrump,Spouse); exSpouse(donaldTrump,ExSpouse); sister(ivankaTrump,Sis);
halfSister(barronTrump,HalfSis); brother(ivankaTrump,Bro); halfBrother(ivankaTrump,HalfBro);
grandfather(ivankaTrump,GFather); grandmother(ivankaTrump,GMother); greatGrandfather(theodoreJames,GGFather).
Mum = ivanaTrump
StepMum = melaniaTrump
Dad = donaldTrump
Spouse = melaniaTrump
ExSpouse = ivanaTrump
ExSpouse = marlaMaples
HalfSis = ivankaTrump
HalfSis = tiffanyTrump
Bro = donaldTrumpJr
Bro = ericTrump
HalfBro = barronTrump
GFather = fredTrump
GMother = maryAnneTrump
GGFather = fredTrump

?- mother(ivankaTrump,Mum);
stepMother(ivankaTrump,StepMum);
father(ivankaTrump,Dad);
spouse(donaldTrump,Spouse);
exSpouse(donaldTrump,ExSpouse);
sister(ivankaTrump,Sis);
halfSister(barronTrump,HalfSis);
brother(ivankaTrump,Bro);
halfBrother(ivankaTrump,HalfBro);
grandfather(ivankaTrump,GFather);
grandmother(ivankaTrump,GMother);
greatGrandfather(theodoreJames,GGFather).
Examples History Solutions
table results Run!
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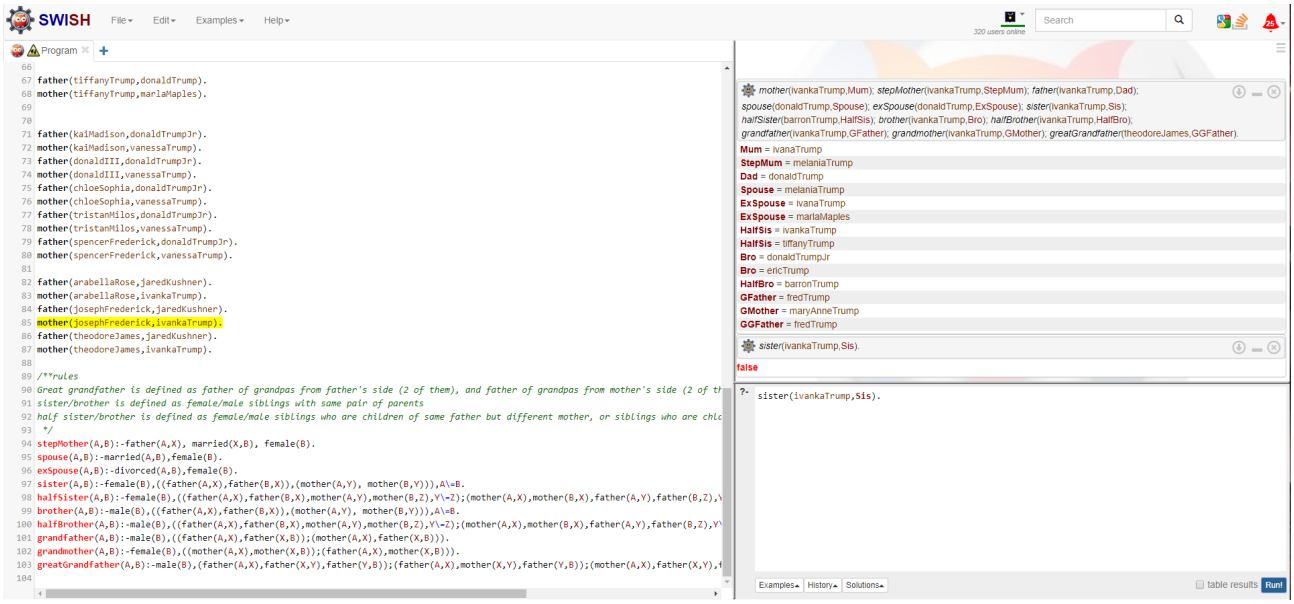
Following picture shows evaluation for sister of Ivanka Trump.



2-Write a prolog program to get a list and append the list to its revered list . For example

?- reverseandappendlist([a,b,c,d],Q).

Q = [a,b,c,d,d,c,b,a]

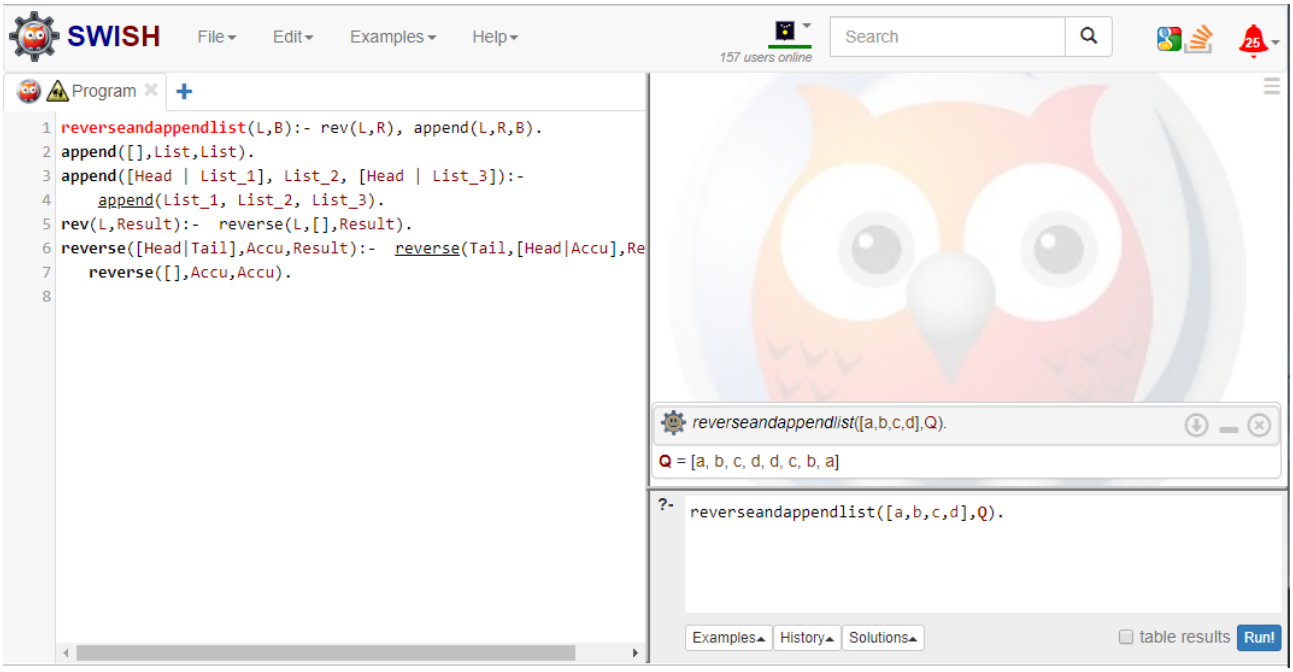
Please also show the tracing model for the above example

Tracing model:

(1)Call: (1) reverseandappendlist([a, b, c, d], Q) ?
(2)Call: (2) rev([a, b, c, d], R) ?
(3)Call: (3) reverse([a, b, c, d], [ ], Result) ?
(4)Call: (4) reverse([b, c, d], [a], Result) ?
(5)Call: (5) reverse([c, d], [b, a], Result) ?
(6)Call: (6) reverse([d], [c, b, a], Result) ?
(7)Call: (7) reverse([ ], [d, c, b, a], Result) ?
(7)Exit: (7) reverse([ ], [d, c, b, a], [d, c, b, a]) ?
(6)Exit: (6) reverse([d], [c, b, a], [d, c, b, a]) ?
(5)Exit: (5) reverse([c, d], [b, a], [d, c, b, a]) ?
(4)Exit: (4) reverse([b, c, d], [a], [d, c, b, a]) ?
(3)Exit: (3) reverse([a, b, c, d], [ ], [d, c, b, a]) ?
(2)Exit: (2) rev([a, b, c, d], [d, c, b, a]) ?
(2)Call: (2) append([a, b, c, d], [d, c, b, a], List_3) ?
(3)Call: (3) append([b, c, d], [d, c, b, a], List_3) ?
(4)Call: (4) append([c, d], [d, c, b, a], List_3) ?
(5)Call: (5) append([d], [d, c, b, a], List_3) ?
(6)Call: (6) append([ ], [d, c, b, a], List_3) ?
(6)Exit: (6) append([ ], [d, c, b, a], [d, c, b, a]) ?
(5)Exit: (5) append([d], [d, c, b, a], [d, d, c, b, a]) ?
(4)Exit: (4) append([c, d], [d, c, b, a], [c, d, d, c, b, a]) ?
(3)Exit: (3) append([b, c, d], [d, c, b, a], [b, c, d, d, c, b, a]) ?
(2)Exit: (2) append([a, b, c, d], [d, c, b, a], [a, b, c, d, d, c, b, a]) ?
(1)Exit: (1) reverseandappendlist([a, b, c, d], [a, b, c, d, d, c, b, a]) ?

Q = [a,b,c,d,d,c,b,a]

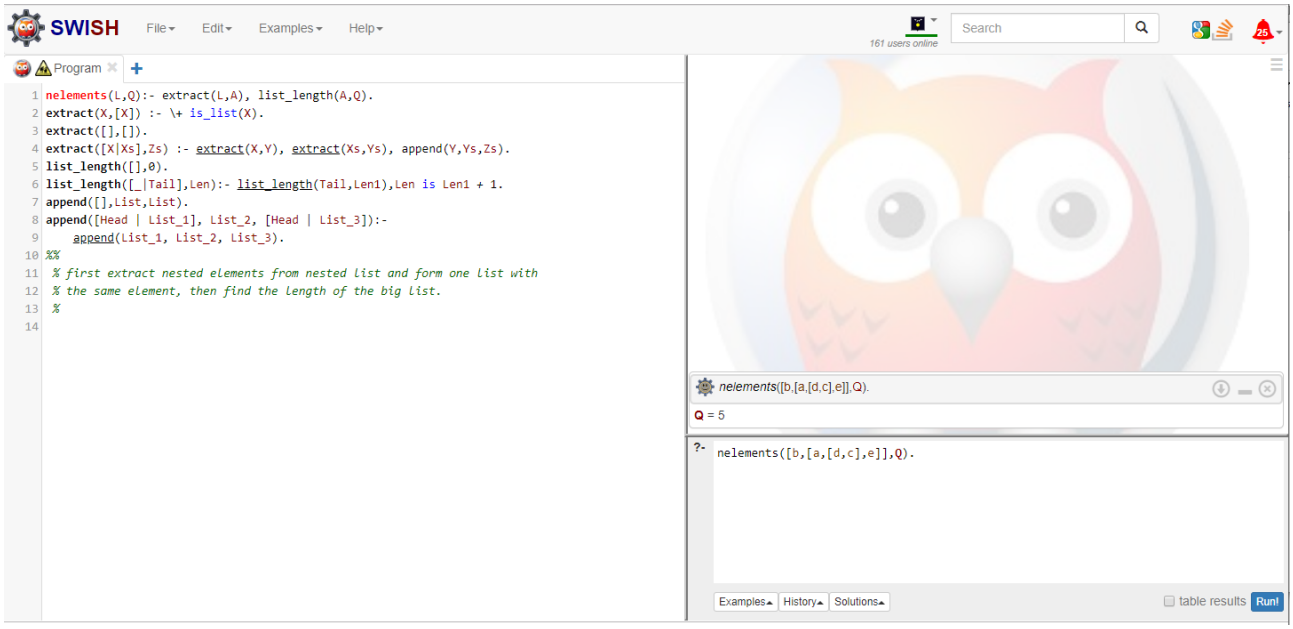
yes



3- Write a prolog program to get a list and return the number of elements in the list. For example

?- nelements([b, [a, [d, c], e]], Q).

Q = 5

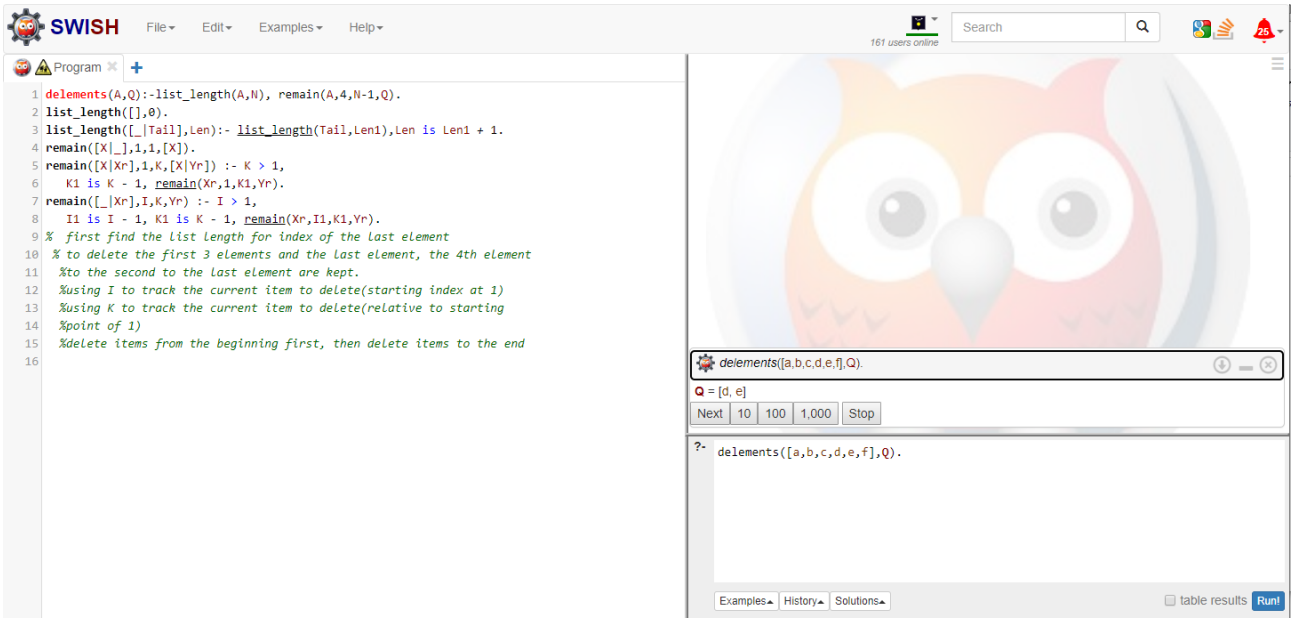


4- Write a prolog program to get a list and delete the first three elements of a list and the last element of the list and returns the list without those elements

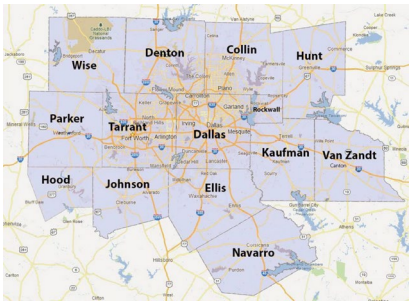
For example

?- delements([a,b,c,d,e,f], Q).

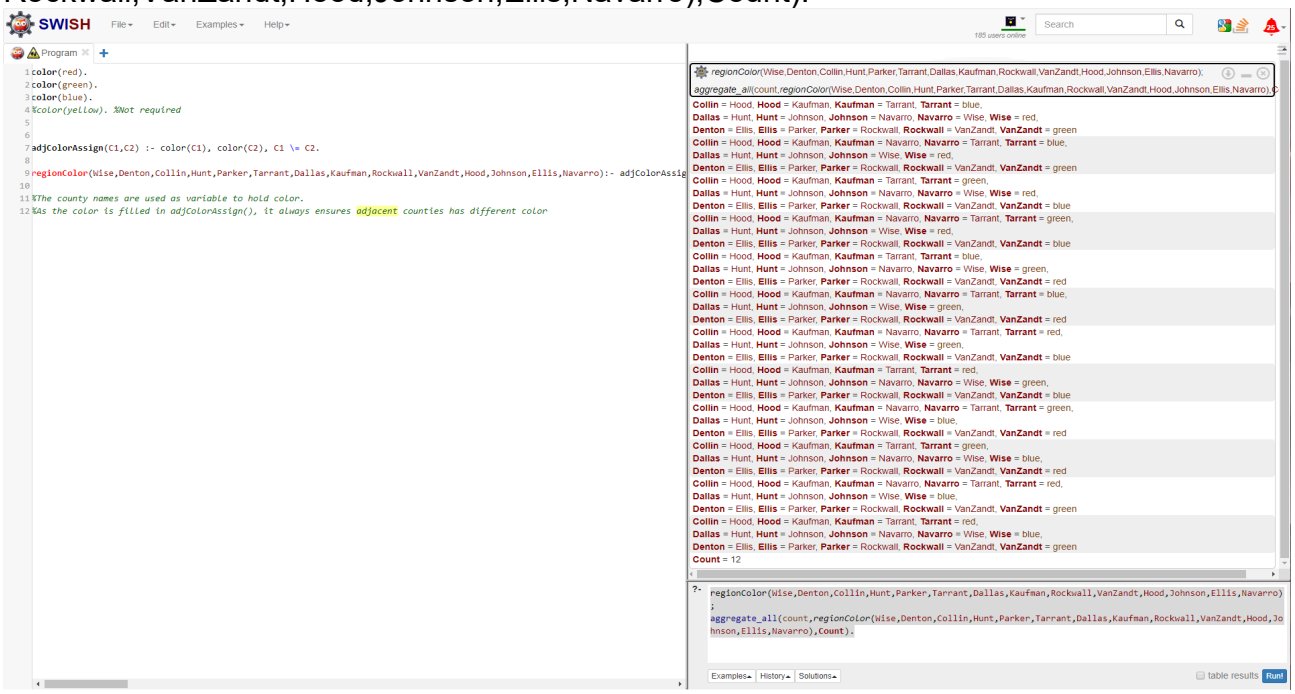
Q = [d,e]



5- The following picture shows DFW Counties. Write a prolog program to find all acceptable coloring of DFW map such that all adjacent Counties have different colors. Your program should color the map using minimum number of colors.



Minimum number of color used: 3
Total coloring ways: 12.
Query used:
regionColor(Wise,Denton,Collin,Hunt,Parker,Tarrant,Dallas,Kaufman,Rockwall,VanZandt,Hood,Johnson,Ellis,Navarro);
aggregate_all(count,regionColor(Wise,Denton,Collin,Hunt,Parker,Tarrant,Dallas,Kaufman,Rockwall,VanZandt,Hood,Johnson,Ellis,Navarro),Count).

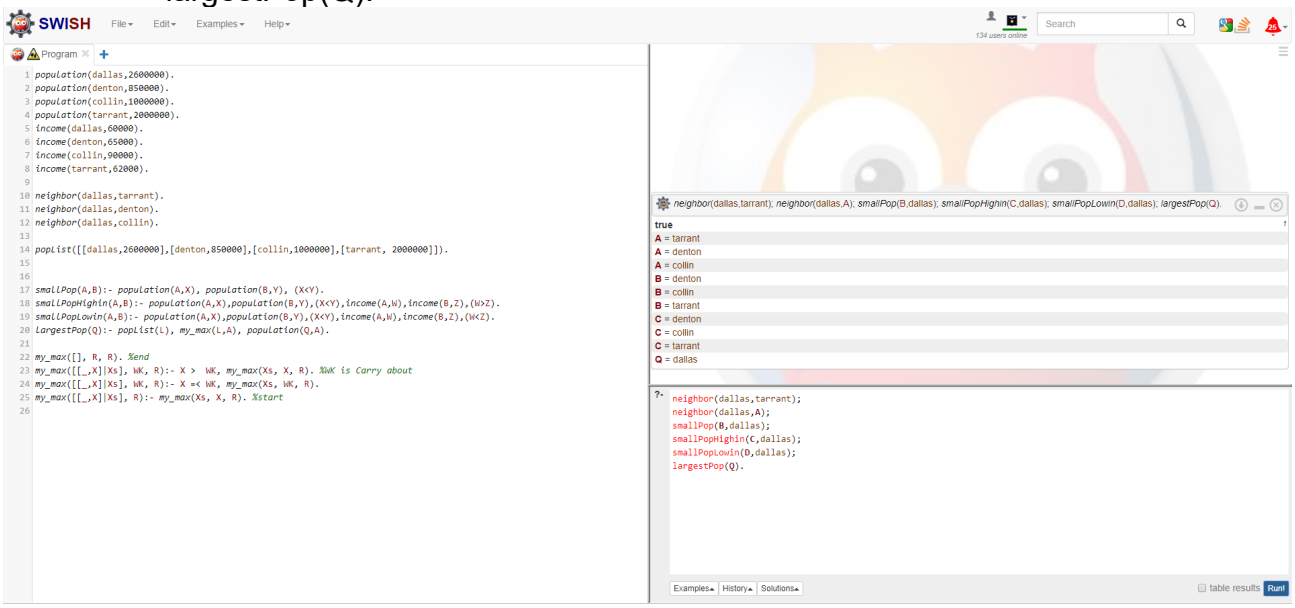


6- The following table shows the population and Median household income of Dallas County, Collin County, Denton County, and Tarrant County on 2018.

	Population	**Median Household Income**
Dallas	2600000	60000
Denton	850000	65000
Collin	1000000	90000
Tarrant	2000000	62000

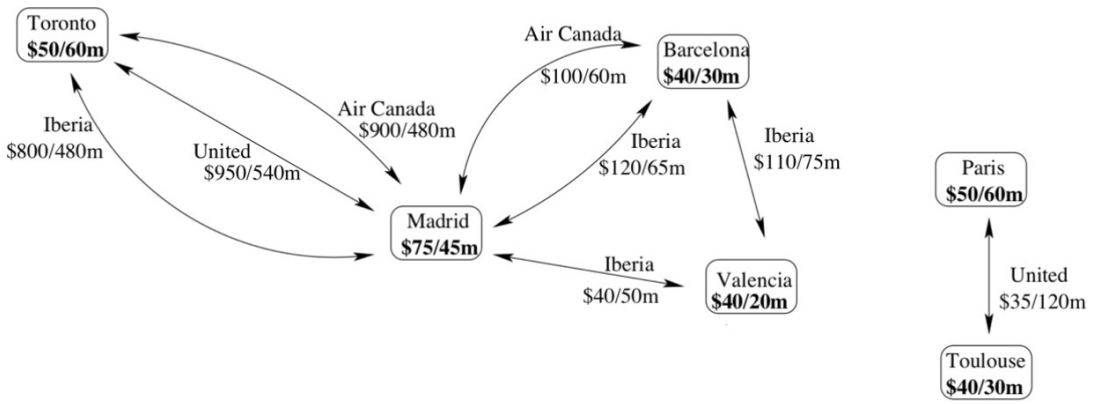
Using above information, Write a prolog program to answer the following queries

- Is Dallas County the neighbor of Tarrant County?
    - neighbor(dallas,tarrant)
- Which counties are the neighbors of Dallas County?
    - neighbor(dallas,A).
- Is there a neighbor of Dallas County that has a smaller population than Dallas County? Which one?
    - smallPop(B,dallas).
- Is there a neighbor of Dallas County that has a smaller population and higher median income than Dallas County? Which one?
    - smallPopHighin(C,dallas).
- Is there a neighbor of Dallas County that has a smaller population and lower median income than Dallas County? Which one?
    - smallPopLowin(D,dallas).
- Which county does have the largest population?
    - largestPop(Q).



7- Write a prolog program representing the following flight network. Each node denotes an airport-city with its corresponding tax and minimum security delay. Each link denotes a flight and is labelled with its corresponding airline name, price, and duration. You should change any names to lower-case letters and re-

move spaces in name.



- Write a query to show tax and minimum security delay for Madrid airport-city
    - madridAirport([MadridTax,MadridDelay]).
- Write a query to tell us if there is a flight from Toronto and Madrid (yes or no)
    - flight(toronto,madrid).
- Write a query to show the airline name, price, and the duration of all the flights from Madrid to Toronto
    - madridTorontoRoute([Airline1,TotalPriceOfAirline1,TotalDurationOfAirline1],[Airline2,TotalPriceOfAirline2,TotalDurationOfAirline2],[Airline3,TotalPriceOfAirline3,TotalDurationOfAirline3]).