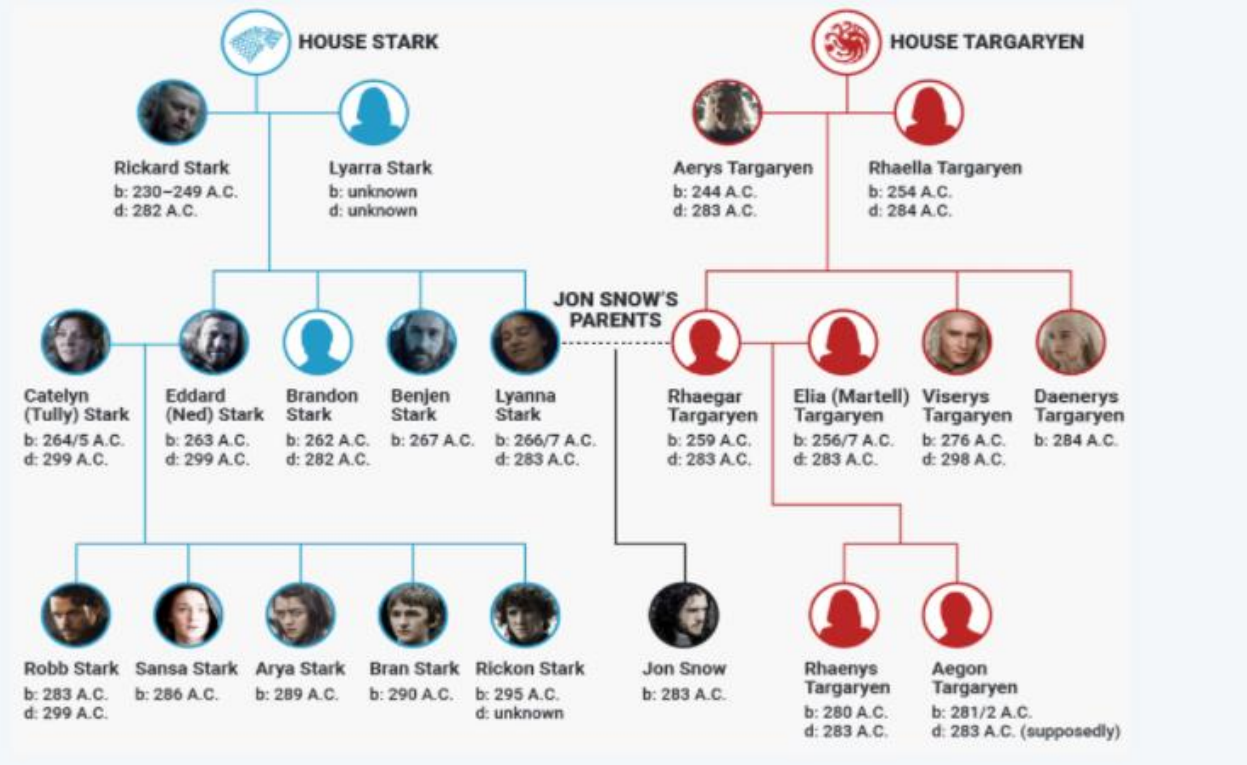
Name: Akash Ahmed
ID: 181-15-1714 || CSE-413
Section: PC-F



1. Declare all facts by using the relations parent(), male() and female() only.

```
parent(eddard,robb).
parent(eddard,sansa).
parent(eddard,arya).
parent(eddard,bran).
parent(eddard,rickon).

parent(catelyn,robb).
parent(catelyn,sansa).
parent(catelyn,arya).
parent(catelyn,bran).
parent(catelyn,rickon).


parent(aerys,rhaegar).
parent(aerys,elia).
parent(aerys,viserys).
parent(aerys,daenerys).
```

Name: Akash Ahmed
ID: 181-15-1714 || CSE-413
Section: PC-F

```
parent(rhaella,rhaegar).
parent(rhaella,elia).
parent(rhaella,viserys).
parent(rhaella,daenerys).



parent(rhaegar,rhaenys).
parent(rhaegar,aegon).



parent(elia,rhaenys).
parent(elia,aegon).

parent(rhaegar,jon).
parent(lyanna,jon).



female(lyarra).
female(catelyn).
female(lyanna).
female(sansa).
female(elia).
female(rhaella).
female(daenerys).
female(rhaenys).
female(arya).

male(rickard).
male(eddard).
male(brandon).
male(benjen).
male(robb).
male(bran).
male(rickon).
male(aerys).
male(rhaegar).
male(viserys).
male(aegon).
male(jon).
```

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2. Write the following rules:

- **sister ()**
- **aunt ()**
- **uncle ()**
- **step_brother ()**
- **step_sister ()**
- **mother_in_law ()**
- **married ()**
- **grandmother ()**

Answer:

As the rules are given, we needed to declare some additional relations like: brother, married, mother, father etc.

sister(X,Y):- sibling(X,Y),female(X),X\=Y.

aunt(X,Y):- sibling(X,Z),parent(Z,Y),female(X).

uncle(X,Y):- sibling(X,Z),parent(Z,Y),male(X).

step_brother(X,Y) :- parent(A,X),parent(A,Y),parent(B,X),parent(C,Y),not(A = B),not(A = C),not(B = C),male(Y).

step_sister(X,Y) :-parent(A,X),parent(A,Y),parent(B,X),parent(C,Y),not(A = B),not(A = C),not(B = C),female(Y).

mother_in_law(X,Y) :- female(X),mother(X, Z),married(Z, Y).

married(X, Y) :-mother(X, Z), father(Y, Z);father(X, Z), mother(Y, Z).

grandmother(X,Y) :- female(X),parent(X,S),parent(S,Y).

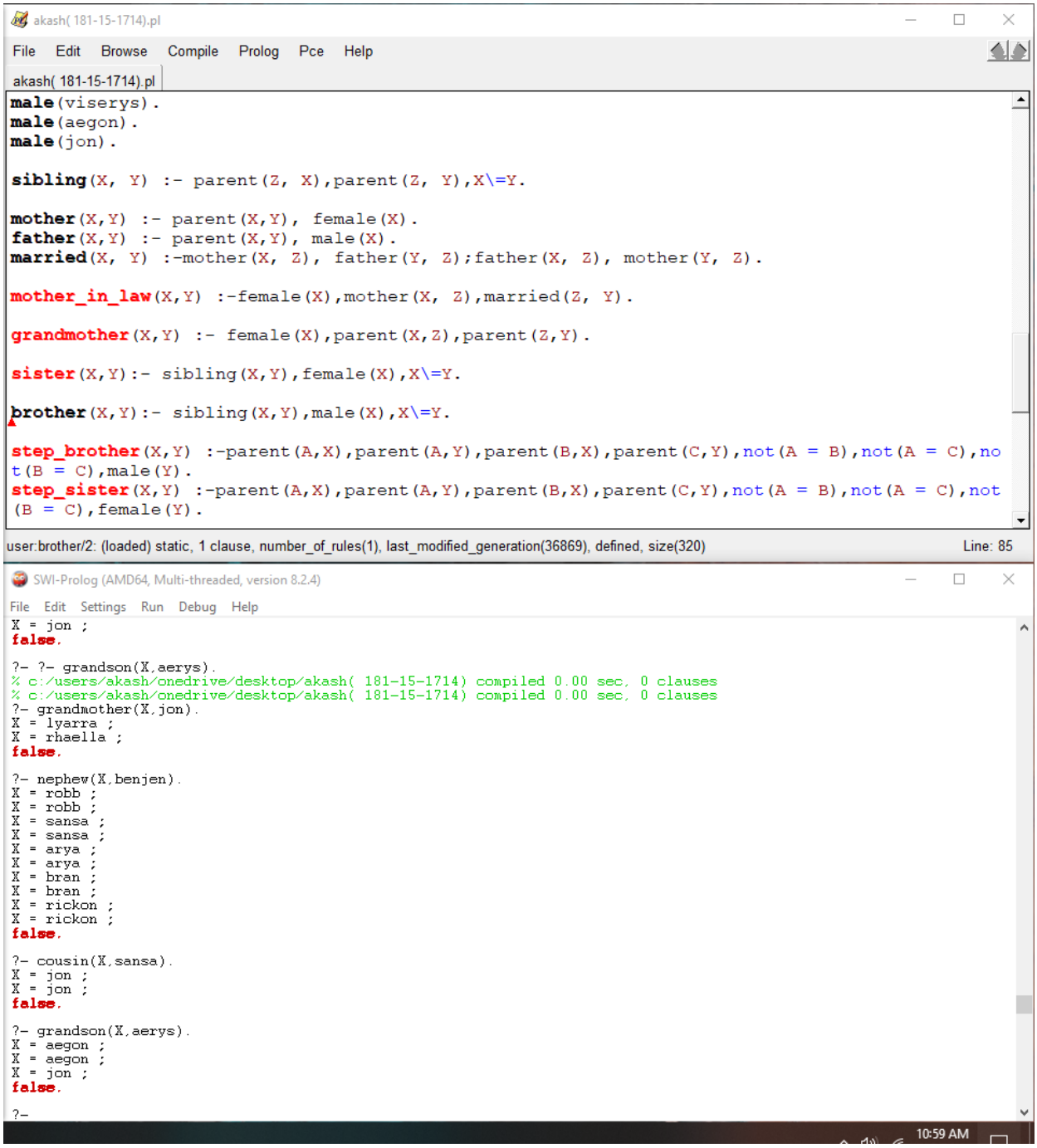
3. Now, find out the answer of the following questions using the rules you have written in no.2. (If necessary write new rules to find answers of below asked questions)

- **Who is the grandmother(s) of 'Jon Snow' ?**
- **What is/are the name of nephew of 'Bengen Stark' ?**
- **Who is the first cousin of 'Sansa Stark' ?**
- **Who is/are the grandson of 'Aerys Targaryen' ?**

Answer:
To solve this problem we needed to declare additional relations:

```
grandson(X, Y) :-parent(Z,X),parent(Y,Z),male(X).
cousin(X,Y) :- uncle(Z,X),father(Z,Y).
nephew(X,Y) :- father(F,X), brother(F,Y).
```

Name: Akash Ahmed
ID: 181-15-1714 || CSE-413
Section: PC-F



Name: Akash Ahmed
ID: 181-15-1714 || CSE-413
Section: PC-F

The whole raw code:

```
parent(rickard,eddard).
parent(rickard,brandon).
parent(rickard,benjen).
parent(rickard,lyanna).

parent(lyarra,eddard).
parent(lyarra,brandon).
parent(lyarra,benjen).
parent(lyarra,lyanna).


parent(eddard,robb).
parent(eddard,sansa).
parent(eddard,arya).
parent(eddard,bran).
parent(eddard,rickon).

parent(catelyn,robb).
parent(catelyn,sansa).
parent(catelyn,arya).
parent(catelyn,bran).
parent(catelyn,rickon).


parent(aerys,rhaegar).
parent(aerys,elia).
parent(aerys,viserys).
parent(aerys,daenerys).

parent(rhaella,rhaegar).
parent(rhaella,elia).
parent(rhaella,viserys).
parent(rhaella,daenerys).



parent(rhaegar,rhaenys).
parent(rhaegar,aegon).



parent(elia,rhaenys).
parent(elia,aegon).

parent(rhaegar,jon).
parent(lyanna,jon).
```

Name: Akash Ahmed
ID: 181-15-1714 || CSE-413
Section: PC-F

```
female(lyarra).
female(catelyn).
female(lyanna).
female(sansa).
female(elia).
female(rhaella).
female(daenerys).
female(rhaenys).
female(arya).

male(rickard).
male(eddard).
male(brandon).
male(benjen).
male(robb).
male(bran).
male(rickon).
male(aerys).
male(rhaegar).
male(viserys).
male(aegon).
male(jon).

sibling(X, Y) :- parent(Z, X),parent(Z, Y),X\=Y.

mother(X,Y) :- parent(X,Y), female(X).
father(X,Y) :- parent(X,Y), male(X).
married(X, Y) :-mother(X, Z), father(Y, Z);father(X, Z), mother(Y, Z).

mother_in_law(X,Y) :-female(X),mother(X, Z),married(Z, Y).

grandmother(X,Y) :- female(X),parent(X,Z),parent(Z,Y).

sister(X,Y):- sibling(X,Y),female(X),X\=Y.

brother(X,Y):- sibling(X,Y),male(X),X\=Y.

step_brother(X,Y) :-parent(A,X),parent(A,Y),parent(B,X),parent(C,Y),not(A = B),not(A
= C),not(B = C),male(Y).
step_sister(X,Y) :-parent(A,X),parent(A,Y),parent(B,X),parent(C,Y),not(A = B),not(A =
C),not(B = C),female(Y).
aunt(X,Y):- sibling(X,Z),parent(Z,Y),female(X).
uncle(X,Y):- sibling(X,Z),parent(Z,Y),male(X).
Grandson(X, Y) :-parent(Z,X),parent(Y,Z),male(X).
cousin(X,Y) :- uncle(Z,X),father(Z,Y).
nephew(X,Y) :- father(F,X), brother(F,Y).
```