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**Assignment 1 (AIML)**  
**Introduction to the Prolog**

**Given:**

```
% Program: family.pl
% Source: Prolog
%
% Purpose: This is the sample program for the Prolog Lab in AIML %
           It is a simple Prolog program to demonstrate how prolog works.
%
% History: Original code by Barry Drake

% parent(Parent, Child)
%
parent(albert, jim).
parent(albert, peter).
parent(jim, brian).
parent(john, darren).
parent(peter, lee).
parent(peter, sandra).
parent(peter, james).
parent(peter, kate).
parent(peter, kyle).
parent(brian, jenny).
parent(irene, jim).
parent(irene, peter).
parent(pat, brian).
parent(pat, darren).
parent(amanda, jenny).

% female(Person)
%
female(irene).
female(pat). female(lee).
female(sandra).
female(jenny).
female(amanda).
female(kate).
```

```

% male(Person)
%
male(albert).
male(jim). male(peter).
male(brian).
male(john).
male(darren).
male(james).
male(kyle).

% yearOfBirth(Person, Year).
%
yearOfBirth(irene, 1923).
yearOfBirth(pat, 1954).
yearOfBirth(lee, 1970).
yearOfBirth(sandra, 1973).
yearOfBirth(jenny, 2004).
yearOfBirth(amanda, 1979).
yearOfBirth(albert, 1926).
yearOfBirth(jim, 1949).
yearOfBirth(peter, 1945).
yearOfBirth(brian, 1974).
yearOfBirth(john, 1955).
yearOfBirth(darren, 1976).
yearOfBirth(james, 1969).
yearOfBirth(kate, 1975).
yearOfBirth(kyle, 1976).

```

### **Questions:**

Use SWI – Prolog for answering the following questions (load the rules in the file familytree.pl):

1. Is Albert a parent of Peter?
2. Who is the child of Jim?
3. Who are the parents of Brian?
4. Is Irene a grandparent of Brian?
5. Find all the grandchildren of Irene
6. Now add the following rule to familytree.pl and re-consult:
 

```

older(Person1, Person2) :-
    yearOfBirth(Person1, Year1),
    yearOfBirth(Person2, Year2),
    Year2 > Year1.

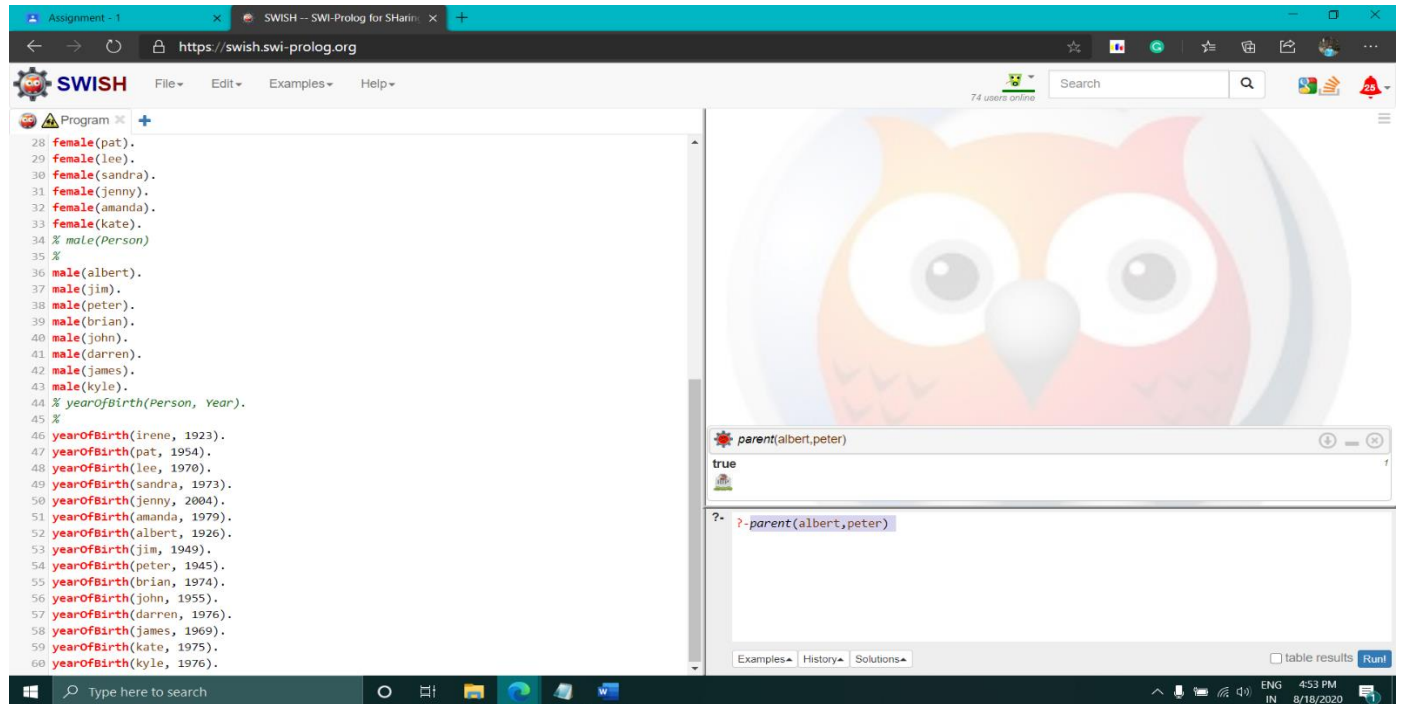
```
7. Who is older than Pat?
8. Who is younger than Darren?
9. List the siblings of Sandra.
10. Who is the older brother of Sandra?

11. Find the predecessors of Kyle.  
12. Does Kate have a sister? 13. How many females and males are there in the knowledge base?  
(Hint: Check the in-built predicate `aggregate_all` in the SWI Prolog manual attached)

### Answers:

1 parent(albert,peter)

Output:



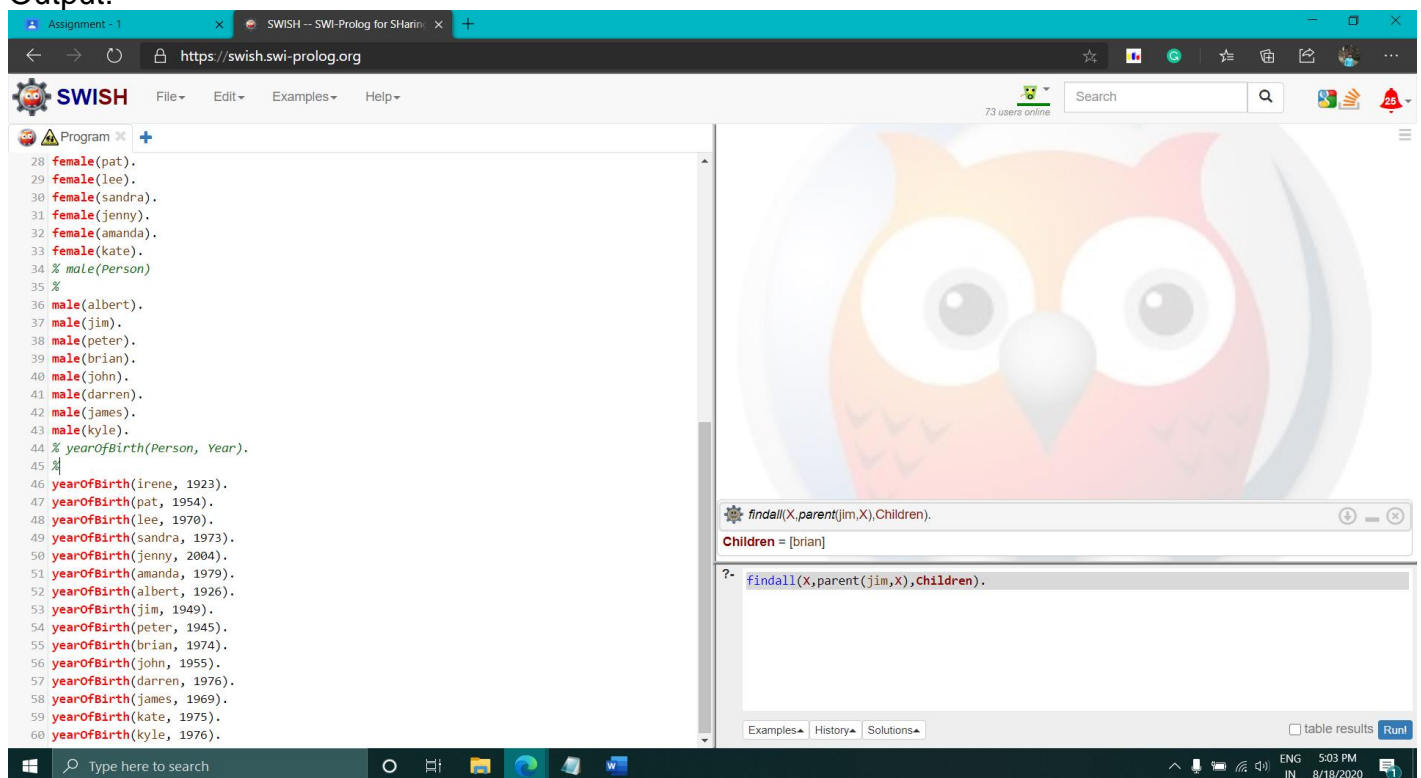
The screenshot shows the SWISH web interface with a Prolog program loaded. The program defines a knowledge base with facts for gender and birth year, and a rule for parentage. The output window shows the query `parent(albert,peter)` returning `true`.

```
28 female(pat).
29 female(lee).
30 female(sandra).
31 female(jenny).
32 female(amanda).
33 female(kate).
34 % male(Person)
35 %
36 male(albert).
37 male(jim).
38 male(peter).
39 male(brian).
40 male(john).
41 male(darren).
42 male(james).
43 male(kyle).
44 % yearOfBirth(Person, Year).
45 %
46 yearOfBirth(irene, 1923).
47 yearOfBirth(pat, 1954).
48 yearOfBirth(lee, 1970).
49 yearOfBirth(sandra, 1973).
50 yearOfBirth(jenny, 2004).
51 yearOfBirth(amanda, 1979).
52 yearOfBirth(albert, 1926).
53 yearOfBirth(jim, 1949).
54 yearOfBirth(peter, 1945).
55 yearOfBirth(brian, 1974).
56 yearOfBirth(john, 1955).
57 yearOfBirth(darren, 1976).
58 yearOfBirth(james, 1969).
59 yearOfBirth(kate, 1975).
60 yearOfBirth(kyle, 1976).
```

parent(albert,peter)  
true

2 findall(X,parent(jim,X),Children).

Output:



The screenshot shows the SWISH web interface with the same Prolog program. The output window shows the query `findall(X,parent(jim,X),Children).` returning `Children = [brian]`.

```
28 female(pat).
29 female(lee).
30 female(sandra).
31 female(jenny).
32 female(amanda).
33 female(kate).
34 % male(Person)
35 %
36 male(albert).
37 male(jim).
38 male(peter).
39 male(brian).
40 male(john).
41 male(darren).
42 male(james).
43 male(kyle).
44 % yearOfBirth(Person, Year).
45 %
46 yearOfBirth(irene, 1923).
47 yearOfBirth(pat, 1954).
48 yearOfBirth(lee, 1970).
49 yearOfBirth(sandra, 1973).
50 yearOfBirth(jenny, 2004).
51 yearOfBirth(amanda, 1979).
52 yearOfBirth(albert, 1926).
53 yearOfBirth(jim, 1949).
54 yearOfBirth(peter, 1945).
55 yearOfBirth(brian, 1974).
56 yearOfBirth(john, 1955).
57 yearOfBirth(darren, 1976).
58 yearOfBirth(james, 1969).
59 yearOfBirth(kate, 1975).
60 yearOfBirth(kyle, 1976).
```

findall(X,parent(jim,X),Children).  
Children = [brian]

3 findall(X,parent(X,brian),Parent).

Output :

The screenshot shows the SWISH Prolog IDE interface. The left pane contains a list of facts: `female(pat).`, `female(lee).`, `female(sandra).`, `female(jenny).`, `female(amaanda).`, `female(kate).`, `male(Person)`, `male(albert).`, `male(jim).`, `male(peter).`, `male(brian).`, `male(john).`, `male(darren).`, `male(james).`, `male(kyle).`, `yearOfBirth(Person, Year).`, `yearOfBirth(irene, 1923).`, `yearOfBirth(pat, 1954).`, `yearOfBirth(lee, 1970).`, `yearOfBirth(sandra, 1973).`, `yearOfBirth(jenny, 2004).`, `yearOfBirth(amaanda, 1979).`, `yearOfBirth(albert, 1926).`, `yearOfBirth(jim, 1949).`, `yearOfBirth(peter, 1945).`, `yearOfBirth(brian, 1974).`, `yearOfBirth(john, 1955).`, `yearOfBirth(darren, 1976).`, `yearOfBirth(james, 1969).`, `yearOfBirth(kate, 1975).`, and `yearOfBirth(kyle, 1976).`. The right pane shows a query: `findall(X,parent(X,brian),Parent).` with the result `Parent = [jim, pat]`. The bottom status bar shows the system clock as 5:05 PM on 8/18/2020.

4 First added Function for Grandparent

grandparent(G,P):-

parent(G,X),

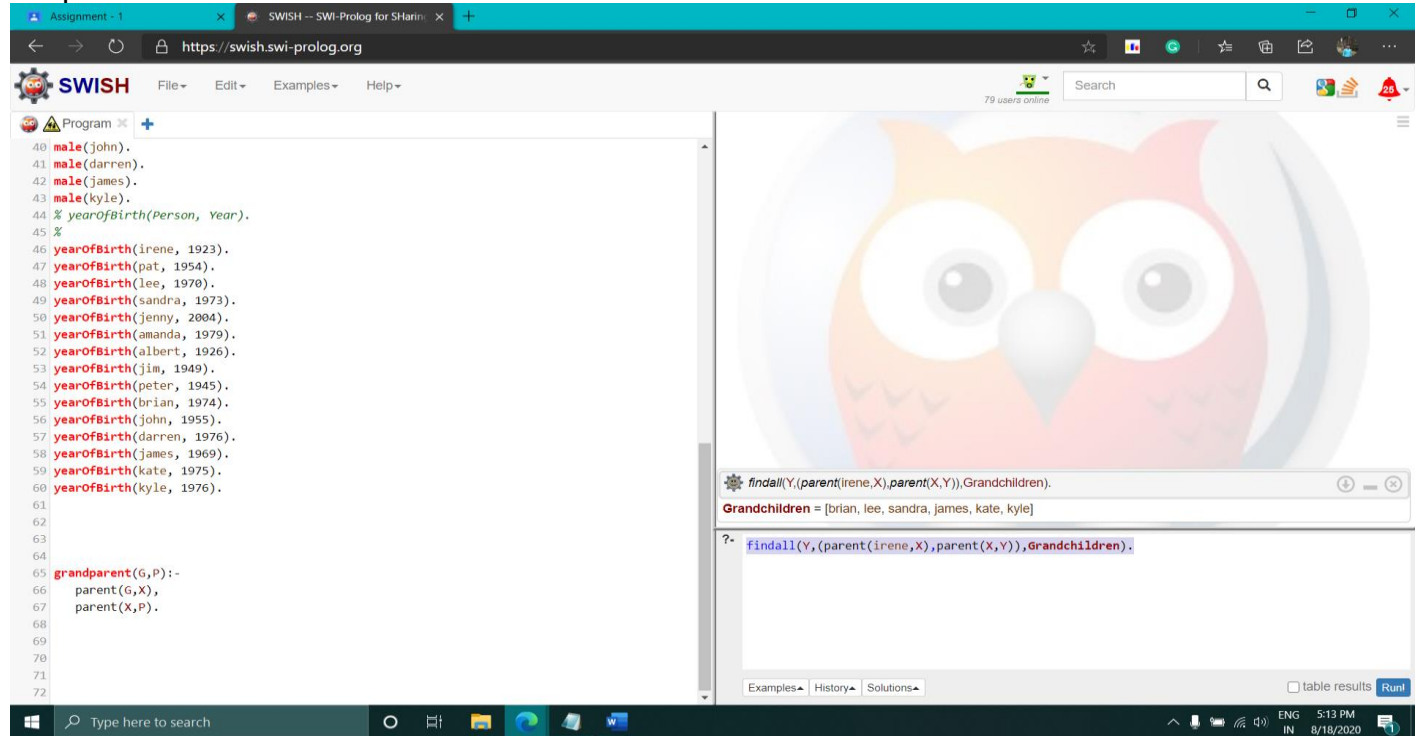
parent(X,P).

Then Run : grandparent(irene,brian)

Output:

The screenshot shows the SWISH Prolog IDE interface. The left pane contains the definition of the `grandparent` function: `grandparent(G,P):-`, `parent(G,X),`, `parent(X,P).`. The right pane shows the query: `grandparent(irene,brian)` with the result `true`. The bottom status bar shows the system clock as 5:07 PM on 8/18/2020.

5 findall(Y,(parent(irene,X),parent(X,Y)),Grandchildren).  
Output:



The screenshot shows the SWISH Prolog IDE interface. The left pane contains a Prolog program with the following code:

```

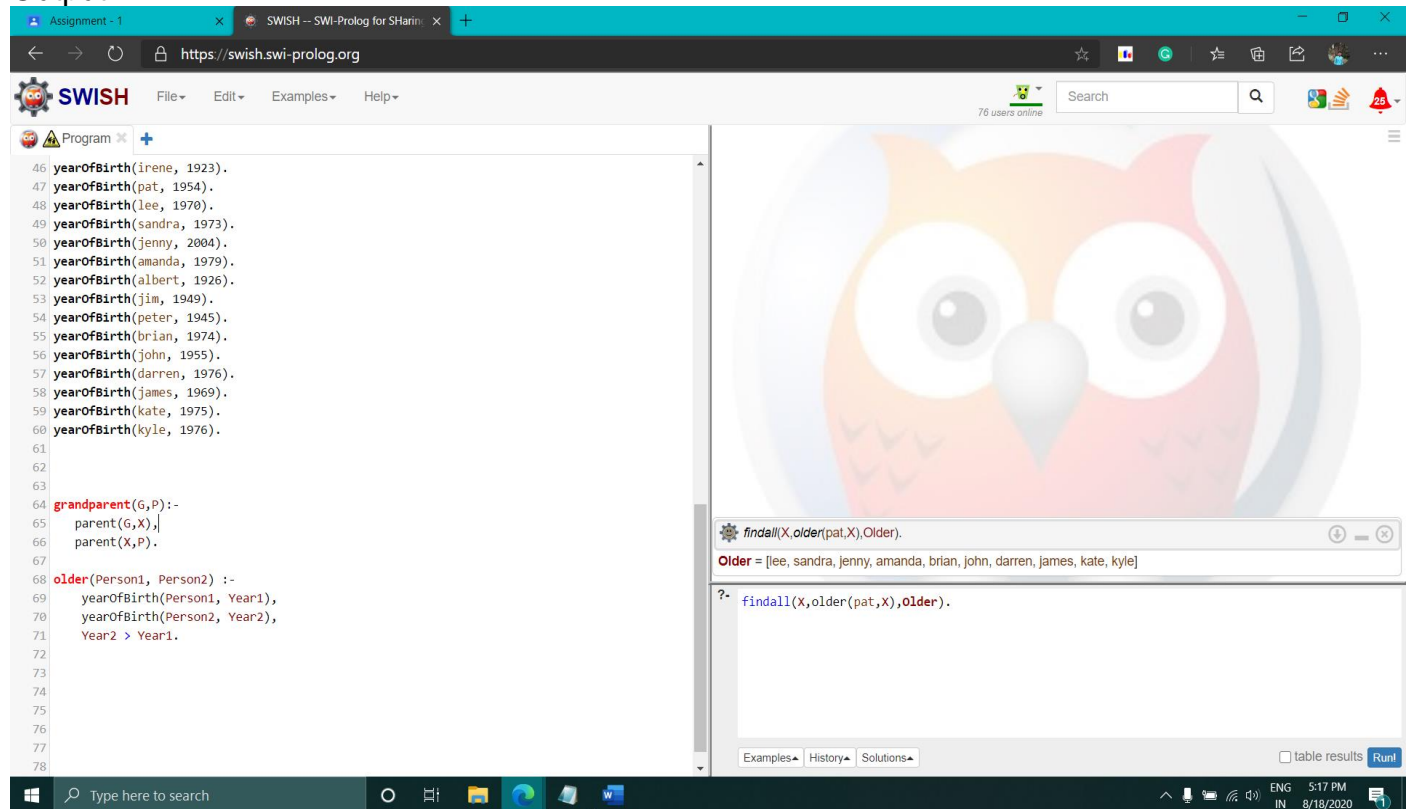
40 male(john).
41 male(darren).
42 male(james).
43 male(kyle).
44 % yearOfBirth(Person, Year).
45 %
46 yearOfBirth(irene, 1923).
47 yearOfBirth(pat, 1954).
48 yearOfBirth(lee, 1978).
49 yearOfBirth(sandra, 1973).
50 yearOfBirth(jenny, 2004).
51 yearOfBirth(amanda, 1979).
52 yearOfBirth(albert, 1926).
53 yearOfBirth(jim, 1949).
54 yearOfBirth(peter, 1945).
55 yearOfBirth(brian, 1974).
56 yearOfBirth(john, 1955).
57 yearOfBirth(darren, 1976).
58 yearOfBirth(james, 1969).
59 yearOfBirth(kate, 1975).
60 yearOfBirth(kyle, 1976).
61
62
63
64
65 grandparent(G,P):-
66     parent(G,X),
67     parent(X,P).
68
69
70
71
72

```

The right pane shows the output of the query `findall(Y,(parent(irene,X),parent(X,Y)),Grandchildren).`, which is `Grandchildren = [brian, lee, sandra, james, kate, kyle]`. Below the output, there is a prompt `?- findall(Y,(parent(irene,X),parent(X,Y)),Grandchildren).` and a `Run!` button.

6 Adding this: `older(Person1, Person2) :-`  
`yearOfBirth(Person1, Year1),`  
`yearOfBirth(Person2, Year2),`  
`Year2 > Year1.`

7 findall(X,older(pat,X),Older).  
Output :



The screenshot shows the SWISH Prolog IDE interface. The left pane contains a Prolog program with the following code:

```

46 yearOfBirth(irene, 1923).
47 yearOfBirth(pat, 1954).
48 yearOfBirth(lee, 1978).
49 yearOfBirth(sandra, 1973).
50 yearOfBirth(jenny, 2004).
51 yearOfBirth(amanda, 1979).
52 yearOfBirth(albert, 1926).
53 yearOfBirth(jim, 1949).
54 yearOfBirth(peter, 1945).
55 yearOfBirth(brian, 1974).
56 yearOfBirth(john, 1955).
57 yearOfBirth(darren, 1976).
58 yearOfBirth(james, 1969).
59 yearOfBirth(kate, 1975).
60 yearOfBirth(kyle, 1976).
61
62
63
64 grandparent(G,P):-
65     parent(G,X),
66     parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73
74
75
76
77
78

```

The right pane shows the output of the query `findall(X,older(pat,X),Older).`, which is `Older = [lee, sandra, jenny, amanda, brian, john, darren, james, kate, kyle]`. Below the output, there is a prompt `?- findall(X,older(pat,X),Older).` and a `Run!` button.

8 findall(X,older(X,darren),Younger).

Output :

The screenshot shows the SWISH Prolog IDE interface. The left pane contains a Prolog program with the following code:

```
46 yearOfBirth(irene, 1923).
47 yearOfBirth(pat, 1954).
48 yearOfBirth(lee, 1970).
49 yearOfBirth(sandra, 1973).
50 yearOfBirth(jenny, 2004).
51 yearOfBirth(amanda, 1979).
52 yearOfBirth(albert, 1926).
53 yearOfBirth(jim, 1949).
54 yearOfBirth(peter, 1945).
55 yearOfBirth(brian, 1974).
56 yearOfBirth(john, 1955).
57 yearOfBirth(darren, 1976).
58 yearOfBirth(james, 1969).
59 yearOfBirth(kate, 1975).
60 yearOfBirth(kyle, 1976).
61
62
63
64 grandparent(G,P):-
65     parent(G,X),
66     parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73
74
75
76
77
78
```

The right pane shows the output of the query `findall(X,older(X,darren),Younger).`. The result is `Younger = [irene, pat, lee, sandra, albert, jim, peter, brian, john, james, kate]`. Below the output, the query `?- findall(X,older(X,darren),Younger).` is entered in the input field.

9 findall(Y,(parent(X,sandra),parent(X,Y)),Siblings).

Output :

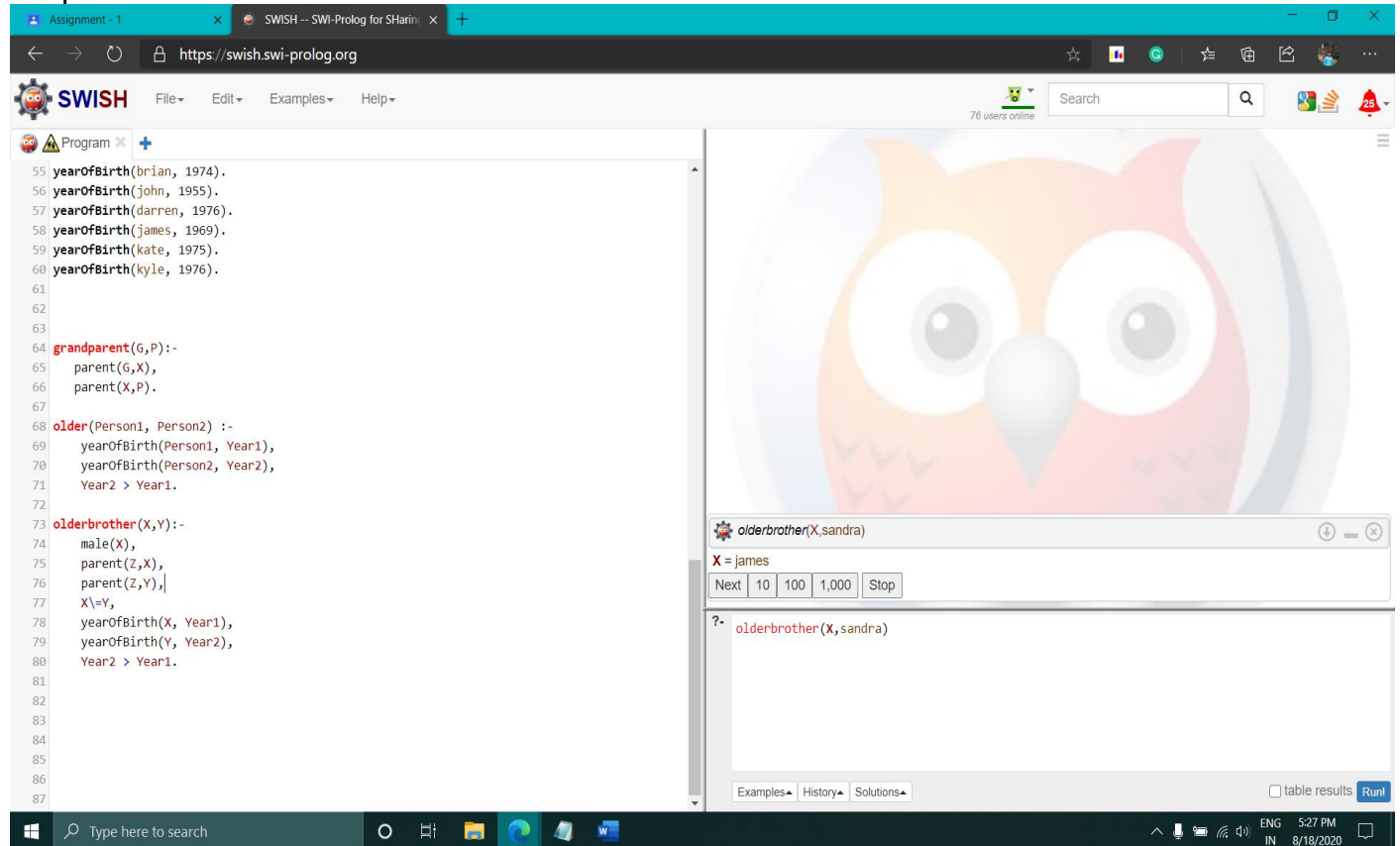
The screenshot shows the SWISH Prolog IDE interface. The left pane contains the same Prolog program as in the previous screenshot. The right pane shows the output of the query `findall(Y,(parent(X,sandra),parent(X,Y)),Siblings).`. The result is `Siblings = [lee, sandra, james, kate, kyle]`. Below the output, the query `?- findall(Y,(parent(X,sandra),parent(X,Y)),Siblings).` is entered in the input field.



10 Adding this : `olderbrother(X,Y):-`  
`male(X),`  
`parent(Z,X),`  
`parent(Z,Y),`  
`X\=Y,`  
`yearOfBirth(X, Year1),`  
`yearOfBirth(Y, Year2),`  
`Year2 > Year1.`

Then: `olderbrother(X,sandra).`

Output :



The screenshot shows the SWISH Prolog IDE interface. The left pane contains the Prolog code:

```

55 yearOfBirth(brian, 1974).
56 yearOfBirth(john, 1955).
57 yearOfBirth(darren, 1976).
58 yearOfBirth(james, 1969).
59 yearOfBirth(kate, 1975).
60 yearOfBirth(kyle, 1976).
61
62
63
64 grandparent(G,P):-
65     parent(G,X),
66     parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73 olderbrother(X,Y):-
74     male(X),
75     parent(Z,X),
76     parent(Z,Y),
77     X\=Y,
78     yearOfBirth(X, Year1),
79     yearOfBirth(Y, Year2),
80     Year2 > Year1.
81
82
83
84
85
86
87

```

The right pane shows the execution of the query `olderbrother(X,sandra)`. The result is `X = james`. Below the result, there are buttons for `Next`, `10`, `100`, `1,000`, and `Stop`. At the bottom right, there are checkboxes for `table results` and a `Run!` button.

11 Adding this: `predecessor(X,Y):-`  
`parent(X,Y).`  
`predecessor(X,Y):-`  
`parent(X,Z),`  
`predecessor(Z,Y).`

Then : `-predecessor(X,kyle).`

Output:

The screenshot shows the SWISH Prolog environment. The left pane contains the following Prolog code:

```

61
62
63
64 grandparent(G,P):-
65     parent(G,X),
66     parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73 olderbrother(X,Y):-
74     male(X),
75     parent(Z,X),
76     parent(Z,Y),
77     X\=Y,
78     yearOfBirth(X, Year1),
79     yearOfBirth(Y, Year2),
80     Year2 > Year1.
81
82 predecessor(X,Y):-
83     parent(X,Y).
84 predecessor(X,Y):-
85     parent(X,Z),
86     predecessor(Z,Y).
87
88
89
90
91
92
93

```

The right pane shows the execution of the query `predecessor(X,kyle)`. The results are:

```

X = peter
X = albert
X = irene
false

```

The bottom status bar shows the system time as 5:30 PM on 8/18/2020.

12 Adding this First : `sister(X,Y):-`  
`female(X),`  
`parent(Z,X),`  
`parent(Z,Y),`  
`X\=Y.`

Then : `sister(X,kate).`

The screenshot shows the SWISH Prolog environment with the updated Prolog code:

```

66 parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73 olderbrother(X,Y):-
74     male(X),
75     parent(Z,X),
76     parent(Z,Y),
77     X\=Y,
78     yearOfBirth(X, Year1),
79     yearOfBirth(Y, Year2),
80     Year2 > Year1.
81
82 predecessor(X,Y):-
83     parent(X,Y).
84 predecessor(X,Y):-
85     parent(X,Z),
86     predecessor(Z,Y).
87
88
89 sister(X,Y):-
90     female(X),
91     parent(Z,X),
92     parent(Z,Y),
93     X\=Y.
94
95
96
97
98

```

The right pane shows the execution of the query `sister(X,kate)`. The results are:

```

X = lee
X = sandra
false

```

The bottom status bar shows the system time as 5:33 PM on 8/18/2020.



13

1 aggregate\_all(count,male(X),Y).

Output :

The screenshot shows the SWISH Prolog environment. The left pane contains the following Prolog code:

```
66 parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73 olderbrother(X,Y):-
74     male(X),
75     parent(Z,X),
76     parent(Z,Y),
77     X\=Y,
78     yearOfBirth(X, Year1),
79     yearOfBirth(Y, Year2),
80     Year2 > Year1.
81
82 predecessor(X,Y):-
83     parent(X,Y).
84 predecessor(X,Y):-
85     parent(X,Z),
86     predecessor(Z,Y).
87
88
89 sister(X,Y):-
90     female(X),
91     parent(Z,X),
92     parent(Z,Y),
93     X\=Y.
94
95
96
97
98
```

The right pane shows the query `aggregate_all(count,male(X),Y)` with the result `Y = 8`. The background features a large owl illustration.

2 aggregate\_all(count,female(X),Y).

Output :

The screenshot shows the SWISH Prolog environment. The left pane contains the following Prolog code:

```
66 parent(X,P).
67
68 older(Person1, Person2) :-
69     yearOfBirth(Person1, Year1),
70     yearOfBirth(Person2, Year2),
71     Year2 > Year1.
72
73 olderbrother(X,Y):-
74     male(X),
75     parent(Z,X),
76     parent(Z,Y),
77     X\=Y,
78     yearOfBirth(X, Year1),
79     yearOfBirth(Y, Year2),
80     Year2 > Year1.
81
82 predecessor(X,Y):-
83     parent(X,Y).
84 predecessor(X,Y):-
85     parent(X,Z),
86     predecessor(Z,Y).
87
88
89 sister(X,Y):-
90     female(X),
91     parent(Z,X),
92     parent(Z,Y),
93     X\=Y.
94
95
96
97
98
```

The right pane shows the query `aggregate_all(count,female(X),Y)` with the result `Y = 7`. The background features a large owl illustration.