Practical Class 1

Knowledge Representation in Prolog

Goals:
- Introduction to the Prolog programming language
- Knowledge representation in Prolog – Facts and Rules
- Using the Prolog interpreter – Queries and Variables

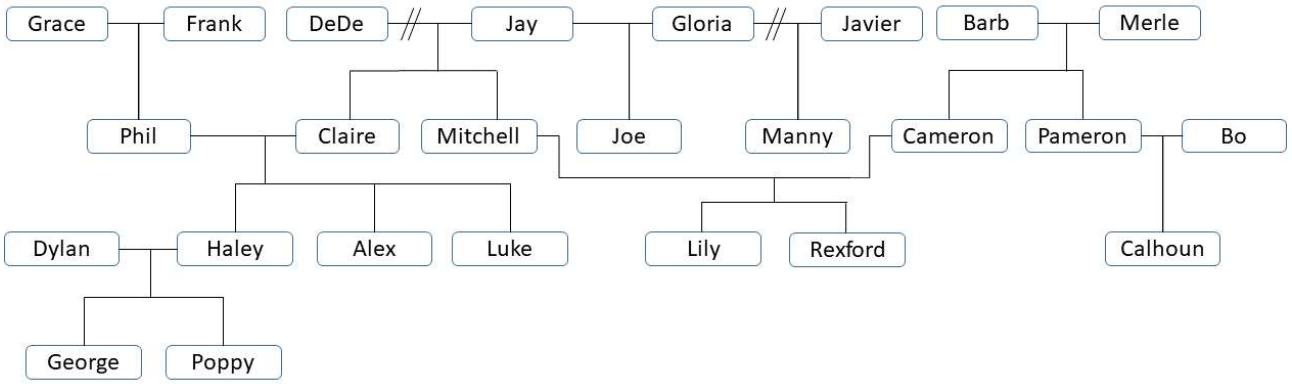
0. Software

If you haven't yet done so, install *SICStus Prolog* (or another interpreter, such as *SWI Prolog*, *YAP*, or other). Optionally, you can also install SPIDER (*SICStus Prolog IDE for Eclipse*).

1. Family Relations

a) Represent in Prolog the information in the family tree below, using only predicates *male/1*, *female/1* and *parent/2*.

Note: *parent(a, b)* is interpreted as '*a* is a parent of *b*'.



b) Using the interpreter, obtain answers to the following questions: haley, alex, luke, lily, rexford

i. Is Haley a female? yes
ii. Is Gil a male? no
iii. Is Frank a parent of Phil? yes
iv. Who are Claire's parents? dede and jay
v. Who are Gloria's children? joe and manny
vi. Who are Jay's grandchildren? dede, jay, barb, merle
vii. Who are Lily's grandparents?
viii. Does Alex have children? no
ix. Who are Luke's siblings (child of both Luke's parents)? haley and alex

c) Write new rules that allow you to define more complex family relations, such as *father/2*, *grandparent/2*, *grandmother/2*, *siblings/2*, *halfSiblings/2*, *cousins/2*, *uncle/2*, or others.

d) Using the interpreter, make queries to test the relations defined in the previous question, such as 'are Haley and Lily cousins?', 'who is Luke's father?', 'who is Lily's uncle?', 'who is a grandmother?', or list all pairs of siblings, or half-siblings. yes Phil no
A grandmother do George é a Claire.

e) What predicates would you use to represent information regarding marriages and divorces? How would you represent Jay and Gloria's marriage in 2008, or Jay and Dede's marriage in 1968 and respective divorce in 2003?

2. Teachers and Students

a) Represent information related to courses, teachers and students, according to the table below, using predicates *teaches/2* and *attends/2*, where the first argument of each represents the taught or attended course.

Algorithms	Databases	Compilers	Statistics	Networks
Prof: Adalberto	Prof: Bernardete	Prof: Capitolino	Prof: Diógenes	Prof: Ermelinda
Stud.: Alberto, Bruna, Cristina, Diogo, Eduarda	Stud.: António, Bruno, Cristina, Duarte, Eduardo	Stud.: Alberto, Bernardo, Clara, Diana, Eurico	Stud.: António, Bruna, Cláudio, Duarte, Eva	Stud.: Álvaro, Beatriz, Cláudio, Diana, Eduardo

b) Use the interpreter to answer the following questions:

i. What courses does Diógenes teach? statistics
ii. Does Felismina teach any course? no
iii. What courses does Cláudio attend? statistics and networks
iv. Does Dalmindo attend any course? no
v. Is Eduarda a student of Bernardete? no
vi. Do Alberto and Álvaro attend any course in common? no

algorithms and compilers networks

c) Write rules in Prolog that allow answering the following questions:

i. Is X a student of professor Y?
ii. Who are the students of professor X?
iii. Who are the teachers of student X?
iv. Who is a student of both professor X and professor Y?
v. Who is colleagues with whom? (two students are colleagues if they attend at least one course in common; two teachers are colleagues)
vi. Who are the students that attend more than one course?

3. Red Bull Air Race

a) Represent the following knowledge in Prolog:

- Lamb, Besenyei, Chambliss, MacLean, Mangold, Jones and Bonhomme are pilots;
- Lamb is from team Breitling; Besenyei and Chambliss from team Red Bull; MacLean from Mediterranean Racing Team; Mangold from team Cobra; and Jones and Bonhomme from team Matador;
- Lamb's pilots an MX2; Besenyei, Chambliss, MacLean, Mangold, Jones and Bonhomme all pilot an Edge540;
- Istanbul, Budapest and Porto are circuits;
- Jones won in Porto; Mangold won in Budapest and in Istanbul;
- Istanbul has 9 gates; Budapest has 6 gates; Porto has 5 gates;
- A team wins a race when one of its pilots wins that race.

b) Write the following questions in Prolog:

i. Who won the race in Porto? jones
ii. What team won the race in Porto? matador
iii. Which circuits have nine gates? istambul
iv. Which pilots do not fly an Edge540? lamb
v. Which pilots have won more than one circuit? mangold
vi. What is the plane piloted by the pilot who won the race in Porto? edge540

4. Programming and Errors

A student used to imperative programming languages is developing a compiler in Prolog. One of his tasks consists in translating an error code into a description in English. The code he came up with is the following:

```
translate(Code, Meaning):-
      Code = 1,
      Meaning = 'Integer Overflow'.
translate(Code, Meaning):-
      Code = 2,
      Meaning = 'Division by zero'.
translate(Code, Meaning):-
      Code = 3,
      Meaning = 'ID Unknown'.
```

As you know, this is not the appropriate way to program in Prolog. Improve on this code.

5. Jobs and Bosses

Consider the following fact base in Prolog, with predicates *job/2* and *supervised_by/2*:

```
job(technician, eleuterio).
job(technician, juvenaldo).
job(analyst, leonilde).
job(analyst, marciliano).
job(engineer, osvaldo).
job(engineer, porfirio).
job(engineer, reginaldo).
job(supervisor, sisnando).
job(chief_supervisor, gertrudes).
job(secretary, felismina).
job(director, asdrubal).
supervised_by(technician, engineer).
supervised_by(engineer, supervisor).
supervised_by(analyst, supervisor).
supervised_by(supervisor, chief_supervisor).
supervised_by(chief_supervisor, director).
supervised_by(secretary, director).
```

a) Without using the interpreter, describe in natural language the following queries:

i. `| ?- supervised_by(analyst, _X), job(_X, sisnando).` yes

ii. `| ?- supervised_by(technician, _X), supervised_by(_X, Y).` supervisor

iii. `| ?- job(J, P), supervised_by(J, supervisor).` job list

iv. `| ?- job(_J, asdrubal), supervised_by(_S, _J), job(_S, P).` gertrudes and felismina

b) Without using the interpreter, state with would be the first answer given by Prolog for each of the queries above. Confirm with the interpreter.

c) Write rules that allow answering the following questions:
   i. Is X a direct supervisor of Y?
   ii. Are X and Y supervised by people with the same job?
   iii. Is X responsible for supervising more than one job?
   iv. Is X a supervisor of Y's supervisor?