1. The family relation is given in the picture (the arrow $X \rightarrow Y$ symbolizes that $X$ is a parent of $Y$):

Define the predicate `parent(X,Y)` which is true when $X$ is a parent of $Y$, and the predicate `male(X)` (`female(X)`) which is true when $X$ is a male (a female). Check the following queries:

- `?- “is tom male?”`
- `?- “who is male?”`

Note that “;” enforces Prolog interpreter to look for the next success whereas RTN-carridge terminates search for new solutions.

Check now the following queries:

- `?- “who is a parent of liz?”`
- `?- “is bob a parent of pat?”`
- `?- “find parent-child relationship”`
- `?- “who is a grandparent of jim?”`
- `?- “who are tom’s grandchildren?”`

Using the above predicates define the predicates: `mother(X,Y)` (`father(X,Y)`) to be true when $X$ is a mother (a father) of $Y$. Check now who is a mother of jim and of joe.

In a similar manner define `child(X,Y)`, `grandparent(X,Y)`, `greatgrandparent(X,Y)` predicates and test them accordingly.
In order to avoid defining great...greatgrandparent(X,Y) predicates, define a predicate ancestor(X,Y) which is true if X is an ancestor of Y (use here a recursive definition).

Check now the following query:

? “who is the ancestor of pat?”

Finally, change the order of two clauses defining predicate ancestor, as well the order of two negative literals and see what happens with the above query.

2. Define now the following graph without a cycle:

Define a predicate edge(p(x, y), p(x', y')) which is true when there is an edge from point p(x, y) to the point p(x', y'). Test some queries regarding existing directed edges between corresponding points. Finally, define a predicate dpath(p(x, y), p(x', y')) which is true when there is a directed path between points p(x, y) and p(x', y'). Check few queries about existing and non existing paths (e.g. ? dpath (p(1,2), p(x,y))).

What happens if the edge (2,1) → (2,2) is enclosed? Note that our graph will then have a cycle (unlike problem 1).