# Chapter 1 exercises

This document contains the solutions for the exercises going through the prolog primer to prepare for AI.

## Exercise 1.1

(a) *Which of the following are valid Prolog atoms?*

This was verified in SWI-Prolog using `atom()`

`f`: Valid

`loves(john, mary)`: Invalid, this is a compound term

`Mary`: Invalid, this is a variable

`_c1`: Invalid, this is a variable

`'Hello'`: Valid, you can use single quotes to make any string an atom

`this_is_it`: Valid

(b) *Which of the following are valid names for Prolog vairables?*

This was verified in SWI-Prolog using `var()`

`a`: Invalid, must start with uppercase or underscore

`A`: Valid

`Paul`: Valid

`'Hello'`: Invalid, single quotes denote atoms

`a_123`: Invalid

`_` : Valid, anonymous variable

`_abc`: Valid

`x2`: Valid

(c) *What would a Prolog interpreter reply given the following query?*

```
?- f(a, b) = f(X, Y).
```

The interpreter would instantiate X = a and Y = b, as this will evaluate the query to be true:

```
X = a
Y = b
true
```

(d) *Would the following query succeed?*

```
?- loves(mary, john) = loves(John, Mary).
```

This query would suceed. Both John and Mary are variables, so the interpreter would instantiate John = john and Mary = mary, causing the statements to match.

(e) *Assume a program consisting only of the fact* `a(B, B).` *has been consulted by Prolog. How will the system react to the following query?*

```
?- a(1, X), a(X, Y), a(Y, Z), a(Z, 100).
```

Prolog will return **false**. The first query causes X = 1, the subsequent query causes Y = 1, then Z = 1, and the final query will fail as 1 and 100 are different.

## Exercise 1.2

Understand and explain the following queries:

(a) `?- myFunctor(1, 2) = X, X = myFunctor(Y, Y).`

The interpreter will instantiate X = myFunctor(1, 2) to match the first clause. On the following clause, the equality fails, as the numbers inside the compound term X are not the same. As Y cannot be instantiated to both 1 and 2, the query is **false**.

(b) `?- f(a, _, c, d) = f(a, X, Y, _).`

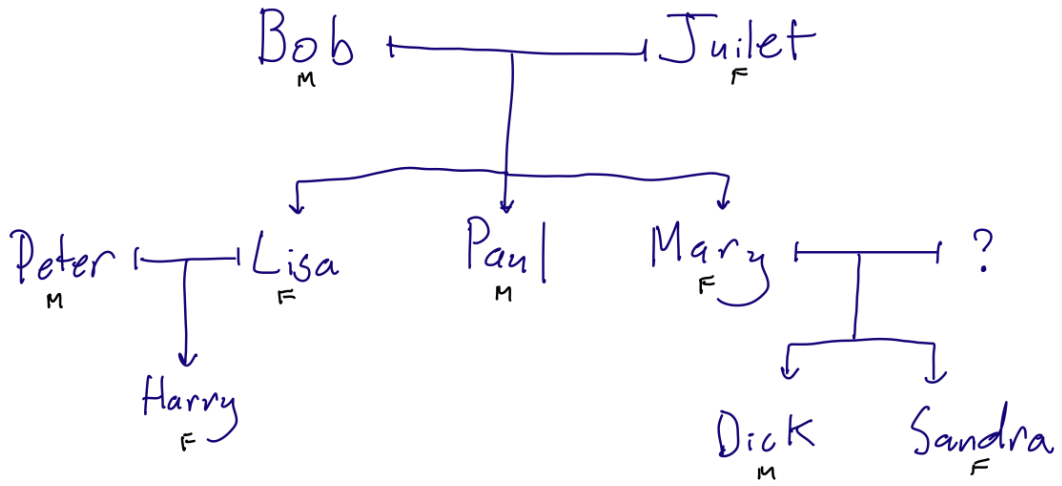
The interpreter will match the _ on the left-hand side to X. It will then instaniate Y = c, and the _ on the right-hand side to d. The query will return **true**. An interesting thing to note from running the query is that only the Y = c instantiation is displayed, as the _ variables are ignorable.

(c) `?- write('One '), X = write('Two ').`

The `write()` predicate always returns true (as well as writing text in the command line). This means the first clause passes, and the string literal "One " is printed. For the second clause, the variable X is initialised as X = write('Two '), meaning the interpreter instead views write() as a compound term that it can assign to X. This makes the equality pass and so the overall query returns **true**.

## Exercise 1.3

*Draw the family tree corresponding to the following Prolog program:*
*N.B. I couldn't be bothered writing out everything, for reference see Exercise 1.3 of PrologPrimer.pdf*




*Define ne predicates (in terms of rules using male/1, female/1 and parent/2) for the following family relations: (/x denotes the number of 'arguments')*

(a) `father(X, Y) :- parent(X, Y), male(X)`

(b) `sister(X, Y) :- parent(A, X), parent(A, Y), parent(B, X), parent(B, Y), female(X)`

(c) `grandmother(X, Y) :- parent(Z, Y), parent(X, Z), female(X)`

(d)
```
cousin(X, Y) :- grandparent(Z, X), grandparent(Z, Y), notsibling(X, Y)
grandparent(X, Y) :- parent(Z, Y), parent(X, Z)
notsibling(X, Y) :- parent(A, X), parent(B, X), \+ parent(A, Y), \+ parent(B, Y)
```