Exercise 1.1

Which of the following sequences of characters are atoms, which are variables, and which are neither?

1. vINCENT — atom
2. Footmassage — variable
3. variable23 — atom
4. Variable2000 — variable
5. big_kahuna_burger — atom
6. 'big kahuna burger' — atom
7. big kahuna burger — neither
8. 'Jules' — atom
9. _Jules — variable
10. '_Jules' — atom

Exercise 1.2

Which of the following sequences of characters are atoms, which are variables, which are complex terms, and which are not terms at all? Give the functor and arity of each complex term.

1. loves(Vincent,mia) — complex term, loves/2
2. 'loves(Vincent,mia)' — atom
3. Butch(boxer) — not an atom, variable, or complex term
4. boxer(Butch) — complex term, boxer/1
5. and(big(burger),kahuna(burger)) — complex term and/2
6. and(big(X),kahuna(X)) — complex term and/2
7. _and(big(X),kahuna(X)) — not an atom, variable, or complex term
8. (Butch kills Vincent) — not an atom, variable, or complex term
9. kills(Butch Vincent) — not an atom, variable, or complex term
10. kills(Butch,Vincent not an atom, variable, or complex term

Exercise 1.3

How many facts, rules, clauses, and predicates are there in the following knowledge base? What are the heads of the rules, and what are the goals they contain?

```
woman(vincent).

woman(mia).

man(jules).

person(X) :- man(X); woman(X).

loves(X,Y) :- knows(Y,X).

father(Y,Z) :- man(Y), son(Z,Y).
```

```
father(Y,Z) :- man(Y), daughter(Z,Y).
```

There are 3 facts and 4 rules which totals 7 clauses. The predicates are woman/1, man/1, person/1, loves/2, and father/2.

The heads of the rules are the left-hand sides of a rule and are person(X), loves(X,Y), and father(Y,Z).

The goals of the rules are the right-hand sides of a rule and are man(X), woman(X), knows(Y,X), man(Y), son(Z,Y), and daughter(Z,Y).

Exercise 1.4

Represent the following in Prolog:

1. Butch is a killer. `killer(butch).`
2. Mia and Marcellus are married. `married(mia,marcellus).`
3. Zed is dead. `dead(zed).`
4. Marcellus kills everyone who gives Mia a footmassage. `kills(marcellus,X) :- footmassage(mia,X).`
5. Mia loves everyone who is a good dancer. `loves(mia,X) :- good_dancer(X).`
6. Jules eats anything that is nutritious or tasty.
```
eats(jules,X) :- nutritious(X).
eats(jules,X) :- tasty(X).
```

Exercise 1.5

Suppose we are working with the following knowledge base:

```
wizard(ron).

hasWand(harry).

quidditchPlayer(harry).

wizard(X) :- hasBroom(X), hasWand(X).

hasBroom(X) :- quidditchPlayer(X).
```

How does Prolog respond to the following queries?

```
wizard(ron).        Yes

witch(ron).         Undefined procedure witch/1

wizard(hermione).   No

witch(hermione).    Undefined procedure witch/1
```

```
wizard(harry).      Yes

wizard(Y).          Y = ron ; Y = harry

witch(Y).           Undefined procedure witch/1
```