Prolog Exercises

1. What does it mean for a problem to be decidable / undecidable?
   - Is sorting decidable?
   - Is propositional logic decidable?
   - Is the termination of a program decidable?
   - Is predicate logic decidable?
2. What logic do we need to represent the Aristotle Syllogism? What is the Aristotle Syllogism?
3. Is $(p \wedge q \wedge r) \vee (w \wedge v)$ a conjunctive normal form? Why?
4. Is $(p \wedge q \wedge r) \vee (w \wedge v)$ a disjunctive normal form? Why?
5. Provide the general form of a conjunctive normal form.
6. Provide the general form of a disjunctive normal form.
7. What is a Horn clause? Provide 3 examples of Horn clauses with variables.
8. Transform $(p \wedge q) \rightarrow r$ into a Horn Clause wirtten "a la Prolog".
9. How is programming in Prolog different from programming in another language? Describe the step of writing and executing a PROLOG program.
10. Execute the following Prolog code and determine the differences between these operators.

```
12 is 2*6.
14 = 2*7.
14 == 2*7.
14 =:= 2*7.
2+3 =:= 3+2.

2+3 == 3+2.

14 =\= 2*6.
7-2 =\= 9-2.
14 \== 2*7.
```

11. Mathematics

    - Write a predicate ($arearectangle$) to compute the perimeter and area of a rectangle.
    - Write a predicate ($areadisk$) to compute the perimeter and area of a disk.
    - How would you use math operations $sqrt$, sin, cos, tan as well as ln and exp in Prolog?
    - Write a predicate ($degrees$) that converts an angle from radians to degrees.

12. Write a predicate ($degreesToFahrenheit$) to convert degrees to fahrenheits.

13. Assume given the following set of facts that describe the father predicate.

    ```
    father(john,paul).
    father(jim,andrew).
    father(john,bill)
    ```

    (a) Define a predicate $brother(X, Y)$ which holds iff X and Y are brothers.

    (b) Define a predicate $cousin(X, Y)$ which holds iff X and Y are cousins.

    (c) Define a predicate $grandson(X, Y)$ which holds iff X is a grandson of Y.

    (d) Define a predicate $descendent(X, Y)$ which holds iff X is a descendent of Y.

14. Write the father, brother, cousin, grandson and descendent predicates in PROLOG. Provide screenshots.

15. Implement the function $f(x) = 1$ if $x = 1$ and $f(x) = 5$ otherwise.

16. Write a predicate $sumN$ that computes the sum of the n first integers without recursion and with recursion.

17. Write a predicate $member$ that determines if an element is in a list.

18. Write a predicate that permits to double all the elements of a list.

19. Write the predicate on lists from the slides.