CSC520 Fall 2021 Assignment 3

Due October 11^{th} at 11:59pm

This assignment consists of three questions which involve written answers and code. In order to complete the assignment you must submit a written report in pdf form detailing your answers to the questions as well as your code. As discussed in class all work *must* be your own. You may not use third party libraries or example code to complete the assignment with the exception of csv file loaders. All reports must be clear and well written. All code must be clear, readable, and well-commented. Upload your report as a file called `<unityid>-Assign3.pdf` and your sourcecode in a zip called `<unityid>-Assign3.zip`.

Question 1 FOL (30 pts)

For this question you will use the following English text:

> Alpha, Beta, and Gamma like to watch movies. Each of them likes thrillers, Scifi, or both. Only people who like thriller movies have pet cats. Alpha has all pets that Gamma has, and Gamma has all pets that Alpha has. Gamma doesn't like Scifi. Beta has a pet frog.

1. *(10 pts)* Define your own lexicon for the text and use it to represent the sentences in FOL.
2. *(10 pts)* Convert the sentences to CNF (show your work and label each step).
3. *(10 pts)* Using the results of Subpart 2. Convert the following statement to FOL then CNF showing your work and use resolution to prove it. Show your work using line numbering as shown in class.

   > Somebody likes to watch movies and has a cat.

Question 2 Knowledge Engineering (30 pts)

Here is a database of facts and rules. Write a simple Prolog style database which contains facts and rules representing this information.

- Vehicles come in three types: land vehicles, aquatic vehicles, and aircraft.
- A train is of course one type of land vehicle while cars are another.
- Land vehicles all have four wheels by default. Aircraft have three, and aquatic vehicles have none.
- The FLXDrive is a train with 8 wheels.
- The Silver Bullet is a car.
- The F150 Lightning is an electric car.
- The Opal is a gas car, as is the Pontiac Grand Prix.
- Air Force One is an airplane.
- The QE2 is an aquatic vessel.
- Aircraft typically run on gasoline, as do most aquatic vehicles and land vehicles.
- The Peral is an electric-powered submarine which is a type of aquatic vehicle.
- The Multnomah is a gas powered stern wheeler, an aquatic vessel with one wheel.

a. *(10 pts)* Draw this taxonomy as a frame representation graph, labeling the nodes, and edges as appropriate. Use both concept nodes and fields.

b. *(10 pts)* Represent these facts as FOPL facts in Prolog.

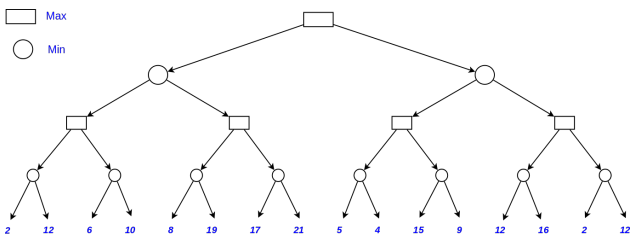
c. *(10 pts)* Using as a top-level rule head the syntax *rel(SourceNode, RelationshipType, DestinationNode)* and any other predicates you need, write a set of additional rules to allow us to infer what type of fuel each vehicle uses, what type of vehicle it is, and the number of wheels.

Your rules must follow strict Prolog syntax, and should allow inference over hierarchies of any depth, not just the depth in this example.

Submit your code answers in a file called `a3q2.pl`

Question 3 Prolog (40 pts)

Prolog is well suited to simple recursive algorithms like $\alpha - \beta$ pruning. For this question consider the tree below from Assignment 2. This tree can be represented as a standard prolog expression in the following form:




```
maximum(
    [minimum(
         [maximum(
              [minimum([1(2),1(12)]),
               minimum([1(6),1(10)])]),
          maximum(
              [minimum([1(8),1(19)]),
               minimum([1(17),1(21)])])]),
     minimum(
         [maximum(
              [minimum([1(5),1(4)]),
               minimum([1(15),1(9)])]),
          maximum(
              [minimum([1(12),1(16)]),
               minimum([1(2),1(12)])])])])
```

For this question you must author prolog code that allows you to apply alpha/beta pruning to a tree in this form using the top-level syntax: `?- alphabeta(T,V)` where $< T >$ is a tree in the form above and $< V >$ is the final value. When called your code should also print out the value for each node processed and the pruning steps as it goes of the form:

```
"Leaf Value:  2"
"Max node Value:  4"
"Min node Value:  2"
"Alpha Prune." "Beta Prune."
```

Submit your code in a well-documented file called `a3q3.pl`