CS255: Artificial Intelligence
Exercise Sheet 6 - Knowledge Representation

1. Given the following Knowledge Base:

   - A.
   - $A \rightarrow B$
   - $A \rightarrow C$
   - $B \rightarrow E$
   - $B\&C \rightarrow H$
   - $B\&H \rightarrow L$
   - $C\&F \rightarrow D$
   - $C\&K \rightarrow G$
   - $D\&F \rightarrow E\&H$
   - F.
   - $F\&G \rightarrow I\&L$
   - $H \rightarrow K$

   (a) Using the above knowledge base, demonstrate how we would use *Backward Chaining* to derive I.

   (b) Now demonstrate how to use *Forward Chaining* to derive L. List how many extraneous operations you performed.

2. A zoo is thinking of introducing a 'smart feeder'. This system would automatically ensure animals are fed based on a number of factors. It generates a list of the animals to feed each day. An animal is added to the list if the system decides the animal will be hungry today.

   Lions, apes, snakes, giraffes and elephants are all animals.
   Most Lions get hungry after two days.
   The Alpha Lion, Rosco, gets hungry every day.
   Apes get hungry after one day, except for apes older than 30, who get hungry after two days.
   Most Snakes get hungry after seven days.
   A python snake, Shimmer, gets hungry after two days. Giraffes get fed the same day as Shimmer.

   (a) Using object-attribute-value triples, how might we describe Rosco and Shimmer? You should include some way to measure when they were last fed.

(b) Describe, using first order logic, the production rules that the AI system may need to construct it's list of animals to feed that day.

3. Given the following rules in CLIPS syntax, draw the corresponding RETE network.

```
(defrule diagnosis1
    (organism (name ?org1) (stain gramneg) (morphology rod))
      (patient (name ?) (organism ?org1))
   =>
   (assert (organism (identity pseudomonas))))

(defrule diagnosis2
     (organism (name ?org2) (aerobicity aerobic))
   =>
   (assert (organism (stain gramneg))))

(defrule therapy1
     (organism (name pseudomonas))
   =>
   (assert (organism (identity pseudomonas)))
```

Using the RETE network representing the rules above, explain how the RETE network fires rules over multiple Recognize-Act cycles. Assume that the only fact in Working Memory is *(organism (morphology rod) (aerobicity aerobic))*.