Quiz4

1. Mention the three key components of an expert system.

   Answer:
   - Knowledge base
   - Inference algorithm
   - User interface/communication

2. From "*Horses are animals*" it follows that "*The head of a horse is the head of an animal.*"

   Translate the premise and the conclusion into the language of first-order logic. Use three predicates: **HeadOf(h, x)** (meaning "h is the head of x"), **Horse(x)**, and **Animal(x)**.
   Note: We discussed two systems of logic, (a) propositional logic involving statements that are true or false, and (b) first-order or predicate logic that involves working with truth values of functions applied to objects.

   Answer:
   $\forall$ x Horse(x) $\Rightarrow$ Animal(x)
   $\forall$ x, h Horse(x) $\wedge$ HeadOf(h, x) $\Rightarrow$ $\exists$y Animal(y) $\wedge$ HeadOf(h, y)

3. Here are two sentences in the language of first-order logic:
   (A) $\forall a\ \exists b\ (a \geq b)$
   (B) $\forall b\ \exists a\ (a \geq b)$
   Assume that the variables range over all the natural numbers 0, 1, 2,...,∞ and that the "$\geq$" predicate means "is greater than or equal to." Under this interpretation, translate (A) and (B) into English.

   Answer: (A) translates to “For every natural number there is some other natural number that is smaller than or equal to it.” (B) translates to “There is a particular natural number that is smaller than or equal to any natural number.”

4. Case-based reasoning uses fact matching to infer the solution to a new problem.
   a. True
   b. False

   Answer: using previous cases as evidence to find solutions to new cases is equivalent to considering old cases and their solutions as a matter of fact.

5. List 4 steps that case-based reasoning follows in order to find a possible solution to a new case.

   Answer:
   a. Case representation as features
   b. Case similarity by feature matching
   c. Solution adaptation

d. Solution evaluation and knowledge update

6. Select the correct statement(s).
    a. Backward chaining fails when the knowledge base is cyclical.
    b. Forward chaining fails when the knowledge base is cyclical.
    c. Rule based systems can work with an incomplete base.
    d. Case based systems learn over time.

    Answer:
    - Loops in a knowledge bases will lead to incompleteness and repeated states.
    - Since case-based systems also store the solutions to new cases once they are solved, it essentially builds the knowledge base and learns more information and accurate solutions over time.

7. What is the form of algorithm that best describes solving for backwards chaining?
    a. Parallelization
    b. Sequential
    c. Iteration
    d. Recursion

    Answer: because backward chaining follows a bottom up approach, it is easy to represent it using recursion.

8. List the two main types of knowledge bases.

    Answer: procedural and declarative

9. List three systems of calculation that we discussed for rule building.

    Answer:
    a. Propositional logic
    b. Predicate logic
    c. Bayesian calculus