Sample Questions

1. Predicate Logic

Translate the following statements in English into sentences in FOL (First Order Logic).

a. Any course in Mathematics is harder than some courses in Computer Science.
b. If a course is harder than all courses in Computer Science, it must be in Physics.

2. Predicate Logic

Formalize these statements into FOL sentences and put them into clause form.

Some craftsmen are not artisans. Only artisans are highly paid.

Use resolution to answer the question: Who is not highly paid?

You will need to use this information for answering the question: *The clause form for P(X) is P(c) where c is a constant.*

3. Unification

Assume a,b,c are constants; X,Y,Z,W,U are variables. For each pair of sentences, give the most general unifier if it exists:

- P(a,b,c) and P(X, Y, Z)
- P(X, a, g(X)) and P(f(Y), Y,Z)
- Knows(Father(Y), Y) and Knows(X, X)
- Hits(amy,beth) and Loves(X. X)
- L(X,Y,g(a,Y),d), L(Z,c,g(W,U),V)

4. Predicate Logic

Given the set of clauses S ={ ¬C(X) V W(X), ¬C(X) V R(X), C(a), O(a)} and the goal clause G = (O(X) Λ R(X)), show using resolution that S ⊨ G.

5. Concept Learning

Num	Restaurant	Meal	Day	Cost	Reaction
1	The Nines	bkfst	Fri	$	sick (+)
2	Banffs	lunch	Fri	$$	ok (-)
3	The Nines	lunch	Sat	$	sick (+)
4	Moosewood	bkfst	Sun	$	ok (-)
5	The Nines	bkfst	Sun	$$	ok (-)

- [10 points] Apply the version space algorithm to the example above to learn the concept of *Reaction*. Show each step.
- [2 points] List two inadequacies of the algorithm

6. Decision Tree Learning

The following dataset will be used to learn a decision tree for predicting whether a mushroom is edible or not based on its shape, color and odor.

Shape	Color	Odor	Edible
C	B	1	Yes
D	B	1	Yes
D	W	1	Yes
D	W	2	Yes
C	B	2	Yes
D	B	2	No
D	G	2	No
C	U	2	No
C	B	3	No
C	W	3	No
D	W	3	No

a. What is entropy H(Edible | Order = 1 or Odor = 3)?
b. Which attribute would the decision tree algorithm (described in class) choose to use for root of the tree?
c. Draw the full decision tree that will be learned from this training set.

7. Naive Bayes Learning

Suppose we are given the following dataset, where A,B,C are input binary random variables, and y is a binary output whose value we want to predict.

A	B	C	y
0	0	1	0
0	1	0	0
1	1	0	0
0	0	1	1
1	1	1	1
1	0	0	1
1	1	0	1

How would a naive Bayes classifier predict y given this input: A=0, B=0, C=1. Assume that in case of a tie the classifier always prefers to predict 0 for y.

8. For MLE, EM, Clustering – understand the examples in the lecture slides.