

Homework #4: Chapters 18, 19, 20 and 22

The following exercises are due at the beginning of class on April 21.

1. [20 pts.] Consider the training set given below.

Example	Color	Legs	Tail	Fur	Goal Predicate
X ₁	Brown	4	Yes	Yes	Yes
X ₂	Brown	2	No	Yes	No
X ₃	Green	4	Yes	No	No
X ₄	Brown	0	Yes	No	No
X ₅	Black	4	Yes	Yes	Yes
X ₆	Gold	2	Yes	No	No
X ₇	Black	4	No	No	No
X ₈	Gold	4	Yes	Yes	Yes

Use decision tree learning to induce a decision tree for this set. When choosing the attribute to split on, always choose the attribute that immediately classifies the maximum number of examples. Break ties by choosing the left-most of such attributes in the table.

2. [40 pts.] For this problem, assume that the hypothesis space only contains hypotheses whose candidate definitions are positive conjunctive sentences (i.e., a set of unnegated atoms separated by and (\wedge) symbols). Thus, the immediate generalization or specialization of a sentence should differ by only a single conjunct.
- Consider the training set given in exercise #1 above. Convert the training set into a set of first-order logic description and classification sentences. Use the predicates $Color(x,c)$, $Legs(x,n)$, $Tail(x,t)$ and $Fur(x,f)$ in your description sentences and $Q(x)$ for your goal predicate.
 - Which of these examples is the candidate definition $Color(x,Brown) \wedge Fur(x,Yes)$ consistent with? Which ones result in false positives and which ones in false negatives?
 - Give all the immediate specializations of $Tail(x,Yes) \wedge Legs(x,4)$ that are consistent with examples X₁ to X₃.
 - Give all the immediate generalizations of $Legs(x,4) \wedge Color(x,Gold)$ that are consistent with example X₅.
 - Use version space learning on the training set. Assume that the examples are received in the order given. Show your G-set and S-set after each new example is received.
3. [20 pts.] Do exercise 20.11 from the book (p. 761).
4. [20 pts.] Consider the lexicon and grammar given in Figures 22.3 and 22.4 of the book (p. 797). For each sentence below, determine if it is generated by the grammar. Show the corresponding parse trees.
- I see the dead wumpus.
 - I see a glitter to the left.
 - John or Mary is in Boston.
 - Aristotle smell a breeze south.