CS 161: Fundamentals of Artificial Intelligence

Spring 2018– Assignment 6

This homework is optional, to replace credit previously lost on other homeworks. This will be a non-coding homework. Please upload a digital copy of your solution on CCLE. Submitted files can be in either PDF or plain text. You may also submit a scanned PDF of a handwritten solution, but please ensure that the scanned file is *clearly legible*.

Questions

1. For each pair of atomic sentences, give the most general unifier if it exists:

(a) P(A, B, B), P(x, y, z).

(b) Q(y, G(A, B)), Q(G(x, x), y).

(c) Older(Father(y), y), Older(Father(x), John).

(d) Knows(Father(y),y), Knows(x,x).

2. Consider the following sentences:

i. John likes all kinds of food.

ii. Apples are food.

iii. Chicken is food.

iv. Anything anyone eats and isn't made sick by is food.

v. If you are made sick by something, you are not well.

vi. Bill eats peanuts and is well.

vii. Sue eats everything Bill eats.

For first-order syntax, feel free to use the following text file notation: `|` (for disjunction), `&` (for conjunction), `-` (for negation), `=>` (for implication), `<=>` (for equivalence), `E` (for existential quantification, e.g., `E x, y, Loves(x, y)`), and `A` (for universal quantification, e.g., `A x, y, Loves(x, y)`).

(a) Translate these sentences into formulas in first-order logic [use different variables each time when quantifying].

(b) Use resolution to show that John likes Apples and Chicken [Hint: convert implications to disjunctions to apply resolution].

(c) Use resolution to show that Sue eats peanuts.

3. Consider the following Knowledge Base:

- $Mother(Tom, Mary)$
- $Alive(Mary)$
- $\forall x \forall y Mother(x, y) \rightarrow Parent(x, y)$
- $\forall x \forall y (Parent(x, y) \wedge Alive(x)) \rightarrow Older(x, y)$

Using resolution show that Mary is Older than Tom.

4. Consider the following data set comprised of three binary input attributes (A_1, A_2, and A_3) and one binary output:

Example	A_1	A_2	A_3	Output y
x1	1	0	0	0
x2	1	0	1	0
x3	0	1	0	0
x4	1	1	1	1
x5	1	1	0	1

Construct a decision tree with one split by choosing an attribute to split on that maximizes information gain.

Submission

- Submit all solution files **on CCLE**.
- Submit your solution in a file **named hw6.pdf** or **hw6.txt**.
- By submitting this homework, you agree to the following honor code.

  You are encouraged to work on your own in this class. If you get stuck, you may discuss the problem with up to two other students, **PROVIDED THAT YOU SUBMIT THEIR NAMES ALONG WITH YOUR ASSIGNMENT. ALL SOLUTIONS MUST BE WRITTEN UP INDEPENDENTLY, HOWEVER**. This means that you should never see another student's solution before submitting your own. You may always discuss any problem with me or the TAs. **YOU MAY NOT USE OLD SOLUTION SETS UNDER ANY CIRCUMSTANCES**. Making your solutions available to other students, **EVEN INADVERTENTLY** (e.g., by keeping backups on github), is aiding academic fraud, and will be treated as a violation of this honor code.

  You are expected to subscribe to the highest standards of academic honesty. This means that every idea that is not your own must be explicitly credited to its author. Failure to do this constitutes plagiarism. Plagiarism includes using ideas, code, data, text, or analyses from any other students or individuals, or any sources other than the course notes, without crediting these sources by name. Any verbatim text that comes from another source must appear in quotes with the reference or citation immediately following. Academic dishonesty will not be tolerated in this class. Any student suspected of academic dishonesty will be reported to the Dean of Students. A typical penalty for a first plagiarism offense is suspension for one quarter. A second offense usually results in dismissal from the University of California.