Artificial intelligence

Homework #3

1 - Using resolution to solve the following problems:

A. Find all possible resolvents of the following

i. Δ = {{a, ¬b}, {a, b, c}, {¬a, c}, {¬c, ¬b}}

ii. Δ = {{a, ¬a, ¬b}, {a, b, c}, {¬a, ¬b, ¬c}, {b}}

B. What is the result of M(x) in the following KB, Using resulotion?(write CNF form of all sentenses and new sentenses that are generated)

P(x) → Q(x) V M(x)

¬Q(x) V R(y,x) V ¬P(y)

¬M(y) → ¬(¬P(x) ∧ R(x,y))

R(John, Pit)

¬R(john, Mary)

P(Pit)

Q(Mary)

2. First Order Logic(FOL) problem:

A. Translation from natural language to first-order logic:

- If Elisabeth is the mother of Charles then someone loves Charles.
- Some dogs hate all cats who eat birds.

B. Translation from first-order logic to natural language:

- ∀x(x < 0 → x 3 < 0)
- ∃x[student(x) ∧ ∀y[student(y) ∧ ¬learn(y) → teach(x, y)]]
- ∀x, student(x) → ∃y, z, friend(y, x) ∧ friend(z, x) ∧ y ≠ z

3 - Minesweeper, the well-known computer game, is closely related to the wumpus world. A minesweeper world is a rectangular grid of N squares with M invisible mines scattered among them. Any square may be probed by the agent; instant death follows if a mine is probed. Minesweeper indicates the presence of mines by revealing, in cach probed square, the number of mines that are directly or diagonally adjacent. The goal is to have probed every umined square.

a. Let $X_{i,j}$ be true iff square [i, j| contains a mine. Write down the assertion that there are exactly two mines adjacent to [1,1] as a sentence involving some logical combination of Xij propositions.

b. Generalize your assertion from (a) by explaining how to construct a CNF sentence asserting that k of n neighbors contain mines.

c. Explain precisely how an agent can use DPLL to prove that a given square does (or does not) contain a mine, ignoring the global constraint that there are exactly M mines in all.

d. Suppose that the global constraint is constructed via your method from part (b). How does the number of clauses depend on M and N? Suggest a way to modify DPLL so that the global constraint does not need to be represented explicitly.

e. Are any conclusions derived by the method in part (c) invalidated when the global constraint is taken into account?

f. Give examples of configurations of probe values that induce long-range dependencies such that the contents of a given unprobed square would give information about the contents of a far-distant square. (Hint consider an N x 1 board.]

4- Assuming predicates Parent (p,q) and Female (p) and constants Joan and Kevin, with the obvious meanings, express each of the following sentences in first-order logic. (You may use the abbreviation $\exists^1$ to mean "there exists exactly one.")

a. Joan has a daughter (possibly more than one, and possibly sons as well).

b. Joan has exactly one daughter (but may have sons as well).

c. Joan has exactly one child, a daughter.

d. Joan and Kevin have exactly one child together.

e. Joan has at least one child with Kevin, and no children with anyone else.