1. The following is a definite program:
(1) $p(x1, y1) \leftarrow s(x1), t(x1)$}
(2) $p(x2, y2) \leftarrow q(x2, f(x2)), r(x2, f(y2))$
(3) $q(b, y3)$
(4) $q(a, y4) \leftarrow r(a, f(a))$
(5) $r(a, f(a))$
(6) $r(b, f(b))$
(7) $s(a)$
(8) $s(b)$
(9) $t(a)$.

(a) Given the goal "$\leftarrow p(x, y)$", sketch its SLD-tree using Prolog's computation rule.
(b) Which one from "depth-first with backtracking" and "breadth-first" strategies reaches the solution faster?
(c) What changes and where we should make to reach the solution faster in both cases?

2. The following set of formulas in Clause Normal Form is given (we omit disjunction symbols):

$$\{R, \neg Q, \neg T\}, \{R, \neg Q, \neg P\}, \{\neg S, T, P\}, \{Q\}, \{S\}, \{\neg T\}$$

Use resolution refutation to prove that "R" is a theorem.

3. The following facts are given: "Paul is father of John and Georgia" and "Helen is mother of Maria and Peter". Also, we are given the following rule type knowledge: "Two humans are siblings if they have the same mother or the same father".
(a) Represent the above knowledge as Prolog statements-program.
(b) What will be the answer to the question: "Who are the siblings of John?" (implement the question in Prolog and show the inference flow).
(c) If the answer in (b) includes "John" himself, then modify your program to remove this case.

4. The following binary tree is given for which you are asked to
(a) Write a Prolog program that represents that tree as a series of facts, using the predicate "tree/3".
(b) Add appropriate rules to the program so that it passes the tree in a depth-first manner printing out the names of the nodes (i.e. Giorgos-Giannis-Petros-Kyriakos-Eleni-Anna-Katerina). The program should start using the predicate go/0.
(c) The same as (b) for breadth-first pass (i.e. Giorgos-Giannis-Eleni-Petros-Kyriakos-Anna-Katerina).

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                          ┌─────────┐
                          │ Giorgos │
                          └─────────┘
                         ╱           ╲
                ┌─────────┐           ┌────────┐
                │ Giannis │           │  Eleni │
                └─────────┘           └────────┘
                 ╱        ╲            ╱        ╲
        ┌────────┐  ┌──────────┐  ┌──────┐  ┌──────────┐
        │ Petros │  │ Kyriakos │  │ Anna │  │ Katerina │
        └────────┘  └──────────┘  └──────┘  └──────────┘
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