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10. Exercise for "Algorithmen, KI & Data Science 1"

1 Expert Systems

1. Explain the terms symbolism and connectionism? What are the differences?
2. According to some political pundits, a person who is radical (R) is electable (E) if he/she is conservative (C), but otherwise is not electable. Which of the following is correct? Explain.
   - $(R \wedge E) \iff C$
   - $R \implies (E \iff C)$
   - $R \implies ((C \implies E) \vee \neg E)$
3. Which of the following logical consequences are correct?
   Hint: Formula G is a logical consequence of formula F ($F \implies G$) if and only if every assignment that satisfies F also satisfies G.
   (a) $False \implies True$
   (b) $True \implies False$
   (c) $(A \wedge B) \implies (A \iff B)$
   (d) $(A \iff B) \implies (A \vee B)$
   (e) $(A \iff B) \implies (\neg A \vee B)$
   (f) $((A \wedge B) \implies C) \implies ((A \implies C) \vee (B \implies C))$
   (g) $((A \vee B) \wedge (\neg C \vee \neg D \vee E)) \implies (A \vee B)$
   (h) $((A \vee B) \wedge (\neg C \vee \neg D \vee E)) \implies ((A \vee B) \wedge (\neg D \vee E))$

4. Fill out the table below by applying backward chaining to the fruit example from lecture 19 with the following information:
    - Fruit type: tree
    - Shape: circular
    - Diameter: <10cm
    - Color: green
    - No. Seeds: >1

    Conflict resolution is done by taking the rule with the larger number.

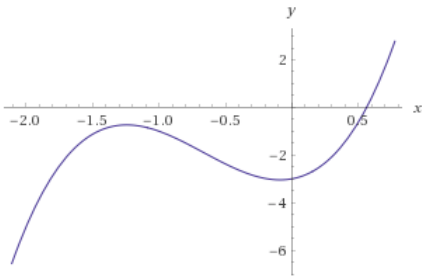
Step	Stack	WM	Conflicting Rules	Action
0	Fruit		R1, R6, R7, R8, R9, R10, R11, R12, R13, **R14**	Add Fruit Type to stack

5. Implement the backward chaining algorithm in the provided $.ipynb$. Implement the following methods as discussed in lecture 19:
    - $value\_valid(ont, var, val)$
    - $rule\_status(rule, wm)$
    - $apply\_rule(rule, wm)$
    - $find\_rules(rules, goal)$
    - $backward\_chain(ont, rules, goal, known\_data)$, where the variable $known\_data$ is a dictionary that replaces the calls to the ask_user function. Instead of asking the user, we provide $known\_data$ that is a dictionary of form $\{var : val\}$ (e.g., $\{shape : circular, diameter :> 10, ...\}$).

2 Numerical Optimization

1. Given the following function (with the function graph shown below):

$$f(x) = 3x^3 + 6x^2 + x - 3$$



   (a) Minimize the function using Newton's method. Your initial parameter value is set to $x^{(0)} = 1$. Computing the first four iterations is sufficient. Would the end result be different if we started from $x^{(0)} = -2$?

   (b) Minimize the function using gradient descent with the learning rate $\eta = 0.1$. Your initial parameter value is set to $x^{(0)} = 1$. Computing the first four iterations is sufficient. Would the end result be different if we started from $x^{(0)} = -2$?