Exercise 1.  

(2.5 points)

Run the unification algorithm from the lecture slides on each of these sets \( \{w_i\} \):

1. \( \{P(x, f(y), b), P(z, f(w), b)\} \)
2. \( \{P(x, f(y), b), P(x, f(a), c)\} \)
3. \( \{P(x, f(y), b), P(y, f(h(a, b, w)), b)\} \)
4. \( \{P(x, f(y), b), Q(x, f(y), b)\} \)
5. \( \{P(x, f(y), b), P(x, f(f(y)), b)\} \)

As in the example on the lecture slides, write down the values of \( D_k \), \( s_k \), and \( T_k \) for each iteration of the loop until it stops. Which of the sets \( \{w_i\} \) can be unified?

Exercise 2.  

(5 points)

Consider the following PL1 formulas:

i. \( \forall x[\text{loves}(x, \text{wine}) \Rightarrow \text{loves}(\text{Adam}, x)] \)

ii. \( \text{loves}(\text{Eva}, \text{wine}) \lor \text{loves}(\text{Anna}, \text{wine}) \)

iii. \( \forall x[\text{loves}(x, \text{wine}) \Rightarrow \exists y(\text{food}(y) \land \text{loves}(x, y))] \)

iv. \( \forall x[\text{food}(x) \Rightarrow \neg \text{loves}(\text{Anna}, x)] \)

v. \( \neg \text{loves}(\text{Adam}, \text{Eva}) \)

Transform these formulas into a set \( \Delta \) of PL1 clauses. Use PL1 resolution to show that \( \Delta \) is unsatisfiable.

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1One author per solution. Please either: (A) fill out the cover sheet [http://w5.cs.uni-saarland.de/teaching/ss12/ki/exercises/cover-sheet.pdf](http://w5.cs.uni-saarland.de/teaching/ss12/ki/exercises/cover-sheet.pdf) and attach it to your solution; or (B) give the same information—name, group, date, exercise number, number of sheets—clearly at the top of your solution.
Consider the simple transportation problem illustrated below, where we have one truck (T) and two packages (A, B). A and T are currently on the left-hand side (L), B is on the right-hand side (R). Our goal is to have A on the right-hand side, and B on the left-hand side. The actions we got available are: \textit{drive}(x, y) where \( x, y \in \{L, R\} \) and \( x \neq y \), driving T from x to y; \textit{load}(x, y) where \( x \in \{A, B\} \) and \( y \in \{L, R\} \), loading x onto T at y; \textit{unload}(x, y) where \( x \in \{A, B\} \) and \( y \in \{L, R\} \), unloading x from T at y.

Assume the set of facts \( P = \{at(T, L), at(T, R), at(A, L), at(A, R), in(A, T), at(B, L), at(B, R), in(B, T)\} \). Give a STRIPS planning task \((P, A, I, G)\) that encodes this problem.