1. **Problem 1**

Formalize each group of sentences (using the given function and predicate symbols), then prove the last from the others using resolution and paramodulation.

1. Done in class.
   \[L(x) = \text{the lover of } x; \ D(x) = x \text{ drives a red car}\]

   - Jane’s lover drives a red car
   - Fred is the only person who drives a red car
   - Therefore, Fred is Jane’s lover

   1. \(D(L(J))\)
   2. \(x = F \lor \neg D(x)\)
   3. \(\neg F = L(J)\)
   4. \(L(J) = F\) \hspace{1cm} 1, 2 \hspace{0.5cm} x/L(J)
   5. \text{false} \hspace{1cm} 3, 4

2. \(T(x) = \text{the teacher of } x; \ G(x) = x \text{ is a good student}\)

   - Mrs. Abbot only teaches good students
   - John and Mary have the same teacher
   - Mrs. Abbot is Mary’s teacher
   - Therefore, John is a good student

   1. \(\neg T(x) = A \lor G(x)\)
   2. \(T(J) = T(M)\)
   3. \(T(M) = A\)
   4. \(\neg G(J)\)
   5. \(\neg T(J) = A\) \hspace{1cm} 1, 4 \hspace{0.5cm} x/J
   6. \(\neg T(M)A\) \hspace{1cm} 2, 5
   7. \text{false} \hspace{1cm} 3, 6
2 Problem 2

\[ M(x) = \text{the manufacturer of part } x; \ W(x, y) = \text{part } x \text{ is stored in the warehouse of company } y; \ T(x) = \text{part } x \text{ is made of titanium}; \ F(x) = \text{part } x \text{ is fragile}; \text{ use a constant for “the part I need”} \]

- Every part is either made by FooCorp or BarCorp
- All fragile parts are stored in the warehouse of their manufacturer
- BarCorp can’t manufacture titanium parts
- The part I need is fragile and made of titanium
- Therefore, the part I need is the FooCorp’s warehouse

1. \[ M(x) = \text{FooCorp} \lor M(x) = \text{BarCorp} \]
2. \[ \neg F(y) \lor W(y, M(y)) \]
3. \[ \neg T(z) \lor \neg M(z) = \text{BarCorp} \]
4. \[ F(\text{I need}) \]
5. \[ T(\text{I need}) \]
6. \[ \neg W(\text{I need}, \text{FooCorp}) \]
7. \[ M(x) = \text{FooCorp} \lor \neg T(x) \]
8. \[ M(\text{I need}) = \text{FooCorp} \]
9. \[ W(\text{I need}, M(\text{I need})) \]
10. \[ W(\text{I need}, \text{FooCorp}) \]
11. \[ \text{false} \]

\begin{tabular}{lll}
7. & \[ M(x) = \text{FooCorp} \lor \neg T(x) \] & 1, 3 \ z/x \\
8. & \[ M(\text{I need}) = \text{FooCorp} \] & 7, 5 \ x/\text{I need} \\
9. & \[ W(\text{I need}, M(\text{I need})) \] & 2, 4 \ y/\text{I need} \\
10. & \[ W(\text{I need}, \text{FooCorp}) \] & 8, 9 \ paramodulation \\
11. & \[ \text{false} \] & 6, 10 \\
\end{tabular}