1. Propose one or two project topics with enough detail for us to evaluate them.

2. Provide evidence terms for these formulas from Smullyan page 56:
   - $\forall y. (\forall x. P(x) \Rightarrow P(y))$
   - $\exists x. (P(x) \lor Q(x)) \Rightarrow \exists x. P(x) \lor \exists x. Q(x)$
   - $\exists x. (P(x) \lor Q(x)) \Leftarrow \exists x. P(x) \lor \exists x. Q(x)$

3. Explain why there is no evidence for
   $(\exists x. P(x) \land \exists x. Q(x)) \Rightarrow \exists x. (P(x) \land Q(x))$.

4. Prove $(\exists x. Q(x) \land \forall x. P(x)) \Rightarrow \exists x. P(x)$ in Refinement Logic and in Tableau.

5. Give an argument that if there is evidence for a formula $F$ in a finite domain $D = \{d_1, \ldots, d_n\}$ under the assumption that every atomic predicate $R(x, y)$ is decidable, e.g. $\forall x, y. (R(x, y) \lor \sim R(x, y))$, then $F$ is truth functionally satisfiable.

6. Here is a proposition that is truth functionally valid, the question is what is the lowest dimension for the constructive proof?
   - $(\exists z. I(z) \land (\forall x. (I(x) \land Q(x) \supset \exists y. R(y)))) \land (\forall x. (I(x) \land \sim Q(x) \supset \exists y. R(y)))) \supset \exists y. R(y)$
     
     (a) Explain why an instance (at least one perhaps more) of $P \lor \sim P$ is needed to provide evidence.
(b) Add the necessary evidence among the hypotheses by adding to one or more of the three hypotheses. Do this as economically as possible, e.g. make the smallest addition that is sufficient.

(c) Provide the evidence term for the augmented formula and discuss the dimension of this evidence based on our definition of dimension for IPC formulas.

7. Show \((H \land K) \supset L\), where

\[
H = (\forall x)(\forall y)[Rxy \supset Ryx] \quad (R \text{ is symmetric})
\]

\[
K = (\forall x)(\forall y)(\forall z)[(Rxy \land Ryz) \supset Rxz] \quad (R \text{ is transitive})
\]

\[
L = (\forall x)(\forall y)[Rxy \supset Rxx] \quad (R \text{ is reflexive on its domain of definition}).
\]