Name:

Worksheet: L06 – Predicate Calculus

CSCI-534: Robot Planning & Manipulation

Spring 2020

http://www.neil.dantam.name/rpm/B06-pred.pdf

1. **Predicates:** Use your "common sense" to assign truth values for the following predicates:
   (a) `transparent` (wood) =
   (b) `transparent` (glass) =
   (c) `transparent` (steel) =
   (d) `flammable` (wood) =
   (e) `flammable` (glass) =
   (f) `flammable` (steel) =
2. For predicate `denser` $(?x, ?y)$, express the following properties in FoL:
   (a) Irreflexive $a \not> a$
   (b) Antisymmetric $((a > b) \implies \neg(b > a)$
   (c) Transitive $((a > b) \wedge (b > c)) \implies (a > c)$
3. **Functions:** Use your "common sense" to assign values for the following functions:
   (a) $\texttt{phase}_{\text{stp}}(\texttt{wood}) =$
   (b) $\texttt{phase}_{\text{stp}}(\texttt{steel}) =$
   (c) $\texttt{phase}_{\text{stp}}(\texttt{helium}) =$
   (d) $\texttt{phase}_{\text{stp}}(\texttt{water}) =$
4. **Quantifiers:** Convert the following English descriptions into quantified first-order logic sentences:
   (a) "Some non-metal is not an insulator."
   (b) "Every noble gas is a gas and is transparent."
   (c) "All gasses are transparent."

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5. **Propositionalization:** Propositionalize the following first-order logic domain:

   Objects: $\{\texttt{methane}, \texttt{nitrogen}, \texttt{water}\}$

   Predicates:

   - $\texttt{gas}\,(?x)$
   - $\texttt{liquid}\,(?x)$
   - $\texttt{flammable}\,(?x)$

   Sentences:

   (a) $\Big(\forall x,\ \texttt{gas}\,(x) \iff \neg\texttt{liquid}\,(x)\Big)$

   (b) $\Big(\exists x,\ \texttt{gas}\,(x) \wedge \texttt{flammable}\,(x)\Big)$