Supplementary Material for “Normative Requirements Operationalization with Large Language Models”

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1 SEMANTICS OF SLEEC RELATIONS

Let σ be a sequence of states $(\mathcal{E}_1, \mathbb{M}_1, \delta_1), (\mathcal{E}_2, \mathbb{M}_2, \delta_2), \ldots (\mathcal{E}_n, \mathbb{M}_n, \delta_n)$ where $\mathcal{E}_i$, $\mathbb{M}_i$, and δ_i are the occurance of events, valuation of measures, and the clock time of state i, repsectively. The semantics of SLEEC relationship are defined on σ in Tab. 1

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\begin{array}{lll}
\sigma \models e_a \textbf{ hypernym } e_b & \text{iff} & f\forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot e_a \in E_i \Rightarrow e_b \in E_i \\
\sigma \models e_a \textbf{ isContradictoryWith } e_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot \neg(e_a \in E_i \wedge e_b \in E_i) \\
\sigma \models e_a \textbf{ happenBefore } e_b & \text{iff} & \exists(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot (e_a \in E_i \wedge \forall(\mathcal{E}_j, \mathbb{M}_j, \delta_j) \in \sigma \cdot (e_b \in E_j \Rightarrow i > j)) \\
\sigma \models e_a \textbf{ equal } e_b & \text{iff} & \sigma \models e_a \textbf{ hypernym } e_b \wedge \models e_b \textbf{ hypernym } e_a \\
\sigma \models p_a \textbf{ imply } p_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot m_i(p_a \Rightarrow pb) = \top \\
\sigma \models p_a \textbf{ mutualExc } p_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot m_i(p_a \wedge pb) = \bot \\
\sigma \models p_a \textbf{ opposite } p_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot m_i(p_a \iff pb) = \bot \\
\sigma \models p_a \textbf{ equal } p_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot m_i(p_a \iff pb) = \top \\
\sigma \models p_a \textbf{ fobids } p_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot e_a \in E_i \Rightarrow M_i(p_j) = \bot \\
\sigma \models p_a \textbf{ indu } p_b & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \in \sigma \cdot e_a \in E_i \Rightarrow M_i(p_j) = \top \\
\sigma \models \textbf{when } e_a \textbf{ then } p_b \textbf{ until } e_c & \text{iff} & \begin{array}{c} \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \cdot e_a \in E_i \Rightarrow (\exists(\mathcal{E}_j, \mathbb{M}_j, \delta_j \cdot e_b \in \mathcal{E}_j \wedge \forall k \in [i, j) \cdot \mathbb{M}_{p_b} = \top) \\ \vee\forall(\mathcal{E}_j, \mathbb{M}_j, \delta_j) \in \sigma \cdot j \geq i \Rightarrow \mathbb{M}_{p_b} = \bot) \end{array} \\
\sigma \models \textbf{when } e_a \textbf{ then } p_b \textbf{ for } t & \text{iff} & \forall(\mathcal{E}_i, \mathbb{M}_i, \delta_i) \cdot e_a \in E_i \Rightarrow \forall(\mathcal{E}_j, \mathbb{M}_j, \delta_j) \in \sigma \cdot (\delta_j \in [\delta_i, \delta_i + \mathbb{M}_i(t))) \Rightarrow \mathbb{M}_{p_b} = \bot)
\end{array}
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Figure 1: The semantics of DSL relations defined on a trace $\sigma = (\mathcal{E}_1, \mathbb{M}_1, \delta_1), (\mathcal{E}_2, \mathbb{M}_2, \delta_2), \ldots (\mathcal{E}_n, \mathbb{M}_n, \delta_n)$.