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An Extension of Probabilistic Logic with a Fixed Finite Ranges

Seminar 2

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Probabilistic logics represent an important formal framework for reasoning under uncertainty. They extend classical logic with operators that allow the expression of statements of the form 'the formula α holds with probability at least s'. Such an approach has proven to be highly relevant in problems that require drawing conclusions from incomplete or uncertain information.

However, in such logics, issues of compactness and the lack of a finitary axiomatization that guarantees both soundness and strong completeness are common. To address this problem, different solutions are considered - either by introducing extensions in the form of infinitary logics, or by imposing restrictions so that probabilities are taken from finite sets of values.

On the other hand, in modern applications, the notion of similarity also plays a central role, especially in classification and data analysis. One of the best-known and most widely used measures is the Jaccard similarity index, defined as the ratio between the size of the intersection and the union of two sets. Its simplicity, intuitiveness, and broad applicability have contributed to its use in areas such as natural language processing, information retrieval, and biology, while it also provides a basis for comparing logical formulas.

In the lecture, we will present a probabilistic logic that constitutes an extension of the logic $LPP_1^{Fr(n)}$, which employs probabilities from a finite set of rational values. We extend the language of this logic with two lists of probabilistic operators defined over propositional formulas, inspired by the Jaccard similarity index defined over sets.