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*Abstract*

# Informational Harmoniums †

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In this paper we introduce a type of harmoniums that uses only computations in the domain of information without resorting to probabilities. Starting from the probabilistic description of binary harmoniums—or Restricted Boltzmann Machines (RBMs)—we use the shifted Rényi information function to obtain a description of harmoniums, hence called informational harmoniums, in terms of some information semifields recently described where the harmonium architecture is concisely expressed by a matrix whose origin and range spaces of visible inputs and hidden units are semi-vector spaces.

On the one hand, inference in an informational harmonium is expressed in terms of vector-matrix operations in information semi-vector spaces. Taking the extreme values of the Rényi parameter in the information semifields we obtain the min-plus semifield and the operation of the harmoniums becomes additively-idempotent. This leads into one of four possible different forms types of Galois connections between the input and output spaces. In this extreme case, we discuss the representation spaces of the input and hidden nodes of informational harmoniums in terms of a variant of formal concept analysis.

On the other hand, learning resembles a process akin to hetero-associative morphological memory construction in a non-idempotent semifield, unless again the value of the Rényi parameter is extremized. In this situation we derive formulas where negative loglikelihood minimisation of training data are carried out algebraically without resorting to derivatives.