

Thesis: Set Operators.

Abstract: My research is centered on set operators. These are universally applicable regardless of the internal structure (numeric or non-numeric) of each individual observed datum. In our research, we have developed the theory of set operators to fill holes and gaps in observed data and eliminate paper shred garbage, thereby changing the observed symbolic data set into one whose pattern is closer to the pattern in the underlying population from which the observed data set was sampled with perturbations.

We describe different set operators including increasing operators, decreasing operators, expansive operators, contractive operators, union preserving operators, intersection preserving operators, pseudo inverse for union preserving operators, pseudo inverse for intersection preserving operators, set dilation operators, set erosion operators, dual operators, adjoint operators, opening operators and closing operators. We define the set operators and give detail proofs, and examples of their properties. Applying our set operator theories to multidimensional data, we extend the relation theory to the power relation theory. We describe the power relation projection operators, and its inverse.

We describe the generalization of Mathematical Morphology to non-numeric sets, and set up the category theory connection that describes the bridges between set theory, group theory and topology. For example, dilation and erosion in mathematical morphology are special cases of set operators using our set dilation operators and set erosion operators; they are dual and adjoints of each other. The pairs of closing operators and opening operators, union preserving operators and their inverses, the intersection preserving operators and their inverses, all give rise to a Galois connection. All these high-level theoretical concepts have been completed.

For applications, we illustrate our theorems for complete lattices and simple graphs. For future work, our focus will be on the applications of the theory to the structure of natural language texts, such as graphs of words.

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