

# Closed Association Rules

Laszlo Szathmary

University of Debrecen, Faculty of Informatics  
H-4002 Debrecen, Pf. 400, Hungary  
szathmary.laszlo@inf.unideb.hu

## Abstract

In this paper we present a new basis for association rules called Closed Rules ( $\mathcal{CR}$ ). This basis contains all valid association rules that can be generated from frequent closed itemsets.  $\mathcal{CR}$  is a lossless representation of all association rules. Regarding the number of rules, our basis is between all association rules ( $\mathcal{AR}$ ) and minimal non-redundant association rules ( $\mathcal{MNR}$ ), filling a gap between them. The new basis provides a framework for some other bases. We show that  $\mathcal{MNR}$  is a subset of  $\mathcal{CR}$ . The number of extracted rules is less than the number of all rules, especially in the case of dense, highly correlated data when the number of frequent itemsets is much more than the number of frequent closed itemsets.  $\mathcal{CR}$  contains more rules than  $\mathcal{MNR}$ , but for the extraction of closed association rules we *only* need frequent closed itemsets, nothing else. On the contrary, the extraction of minimal non-redundant association rules needs much more computation since frequent generators also have to be extracted and assigned to their closures. Our experiments show that  $\mathcal{CR}$  is a good alternative for all association rules. The number of generated rules can be much less, and beside frequent closed itemsets nothing else is required.

*Keywords:* data mining, frequent itemsets, association rules, algorithms

*MSC:* 97R40