



# GrAFCI<sup>+</sup> A fast generator-based algorithm for mining frequent closed itemsets

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## Abstract

Mining itemsets for association rule generation is a fundamental data mining task originally stemming from the traditional market basket analysis problem. However, enumerating all frequent itemsets, especially in a dense dataset, or with low support thresholds, remains costly. In this paper, a novel theorem builds the relationship between frequent closed itemsets (FCIs) and frequent generator itemsets (FGIs) and proves that the process of mining FCIs is equivalent to mining FGIs, unified with their full-support and extension items. On the basis of this theorem, a generator-based algorithm for mining FCIs, called GrAFCI<sup>+</sup>, is proposed and explained in details including its correctness. The comparative effectiveness of the algorithm in terms of scalability is first investigated, along with the compression rate—a measure of the interestingness of a given FIs representation. Extensive experiments are further undertaken on eight datasets and four state-of-the-art algorithms, namely DCI\_CLOSED\*, DCI\_PLUS, FPClose, and NAFCP. The results show that the proposed algorithm is more efficient regarding the execution time in most cases as compared to these algorithms. Because GrAFCI<sup>+</sup> main goal is to address the runtime issue, it paid a memory cost, especially when the support is too small. However, this cost is not high since GrAFCI<sup>+</sup> is seconded by only one competitor out of four in memory utilization and for large support values. As an overall assessment, GrAFCI<sup>+</sup> gives better results than most of its competitors.

**Keywords** Frequent closed itemset mining · Frequent generator itemset · Generator-based itemset mining

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