Extensions or Improvements of Apriori

Apriori: Improvements and Alternatives

- Reduce passes of transaction database scans
  - Partitioning (e.g., Savasere, et al., 1995)
  - Dynamic itemset counting (Brin, et al., 1997)

To be discussed in subsequent slides

- Shrink the number of candidates
  - Hashing (e.g., DHP: Park, et al., 1995)
  - Pruning by support lower bounding (e.g., Bayardo 1998)
  - Sampling (e.g., Toivonen, 1996)

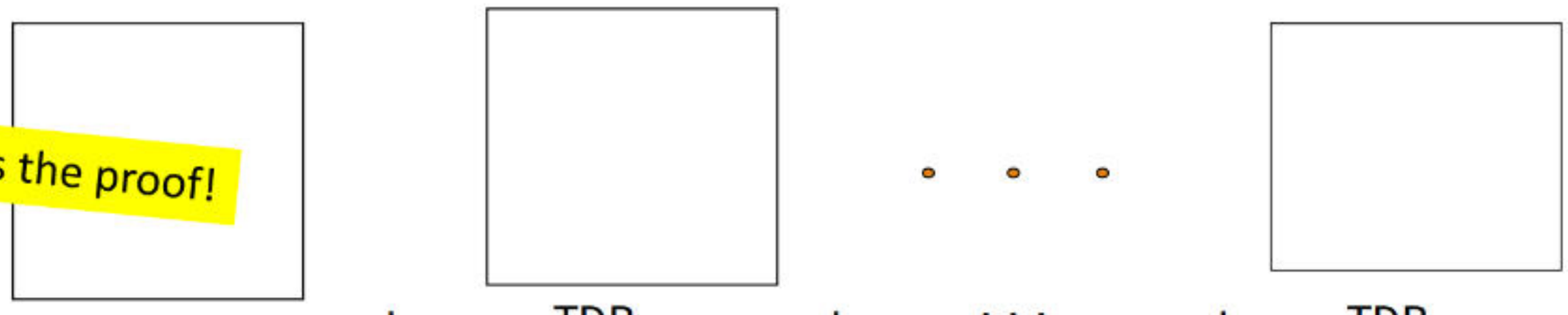
To be discussed in subsequent slides

- Exploring special data structures
  - Tree projection (Agarwal, et al., 2001) FP - Tree
  - H-miner (Pei, et al., 2001)
  - Hypecube decomposition (e.g., LCM: Uno, et al., 2004)

Partitioning: Scan Database Only Twice

- Theorem: *Any itemset that is potentially frequent in TDB must be frequent in at least one of the partitions of TDB* 分成k个部分.

Here is the proof!



TDB_1 + TDB_2 + . . . + TDB_k = TDB

$sup_1(X) < \sigma|TDB_1|$ $sup_2(X) < \sigma|TDB_2|$ . . . $sup_k(X) < \sigma|TDB_k|$ $sup(X) < \sigma|TDB|$

$sup(x) = \sum_{i=1}^{k} sup_i(x) < \sigma \sum_{i=1}^{k} |TDB_i| = \sigma \cdot |TDB| \Rightarrow sup(x) < \sigma \cdot |TDB|$

- Method: (A. Savasere, E. Omiecinski and S. Navathe, *VLDB'95*)
  - Scan 1: Partition database (how?) and find local frequent patterns
  - Scan 2: Consolidate global frequent patterns (how to?)
- Why does this method guarantee to scan TDB only twice?

Direct Hashing and Pruning (DHP)

- DHP (Direct Hashing and Pruning): Reduce the number of candidates (J. Park, M. Chen, and P. Yu, SIGMOD'95)
- Observation: A *k*-itemset whose corresponding hashing bucket count is below the threshold cannot be frequent
  - Candidates: a, b, c, d, e
  - Hash entries
    - {ab, ad, ae}
    - {bd, be, de}
    - …
  - Frequent 1-itemset: a, b, d, e
  - ab is not a candidate 2-itemset if the sum of count of {ab, ad, ae} is below support threshold

Itemsets	Count
{ab, ad, ae}	35
{bd, be, de}	298
… …	…
{yz, qs, wt}	58

Hash Table

count是所有itemsets support的总和.

if count < threshold : itemsets not frequent.
else: maybe frequent