Hasso Plattner Institut

Frequent Itemsets

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Motivation

Task: Find items that frequently occur together.

Example: In a store, what *items* do people buy together?

milk & cornflakes (expected)

diapers & beer (unexpected)

Background

Concepts

$i_k := \text{item}$

$B := \text{Basket, a tuple of items } i_k$

$I := \text{itemset}$
$I = \{i_1, i_2, \ldots, i_n\}$
$n := \text{set size}$

Example

(milk, corn flakes, bread, eggs)
(milk, corn flakes, beer, diapers, chips)
(milk, bread, bread, butter, cheese, salad)
(milk, corn flakes, beans, bacon)
...

$I = \{\text{milk}\}, I = \{\text{milk, corn flakes}\}$
$n = 1, \qquad n = 2$

Background

Concepts

$s(I) :=$ support/count of an items set I

$s :=$ support threshold

I is a Frequent Itemset I_F if $s(I) \geq s$.

Example

$s(\{\text{milk}\}) = 4$
$s(\{\text{milk, corn flakes}\}) = 3$
$s(\{\text{milk, corn flakes, bread}\}) = 1$

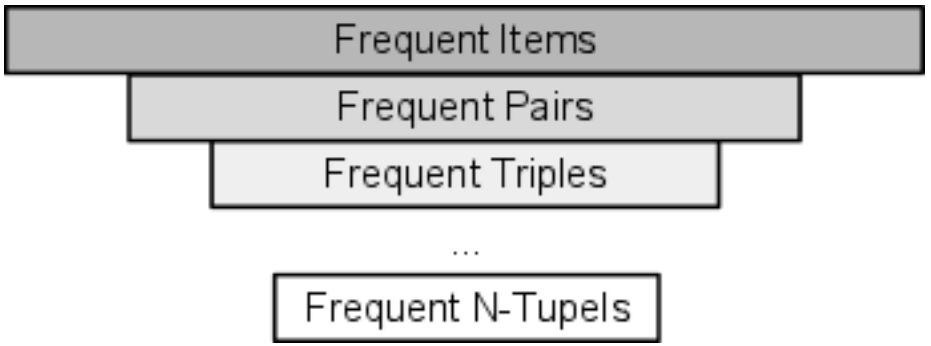
$s = 3$

$I_F = \{\text{milk}\}$
$I_F = \{\text{milk, corn flakes}\}$

Background

Concepts

Monotonicity
If I is not frequent, then its supersets cannot be frequent either



Example

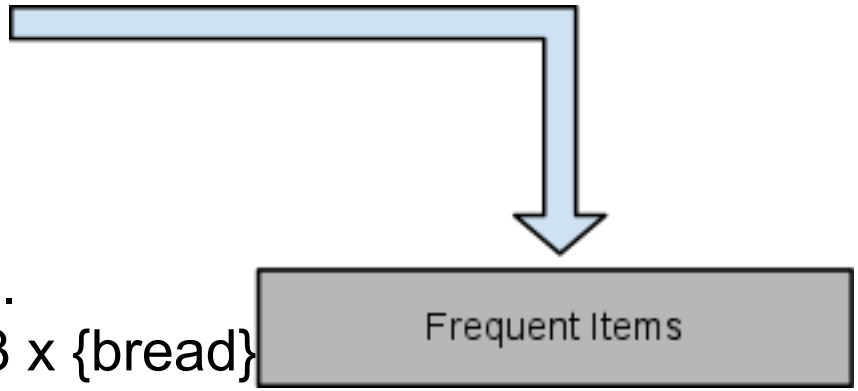
{milk, corn flakes, bread}
is not frequent →
{milk, cornflakes, bread, eggs}
is not frequent

$$s(\{\text{milk}\}) = 4$$
$$s(\{\text{milk, corn flakes}\}) = 3$$
$$s(\{\text{milk, corn flakes, bread}\}) = 1$$

A-Priori Algorithm

Given: a list of baskets with items

(milk, corn flakes, bread, eggs)
(milk, corn flakes, beer, diapers, chips)
(milk, bread, bread, butter, cheese, salad)
(milk, corn flakes, beans, bacon)
...



1st pass: find **frequent items** in the baskets.
- 4 x {milk}, 3 x {corn flakes}, 3 x {bread}

2nd pass: find **frequent pairs** based on frequent items.
- 3 x {milk, corn flakes}

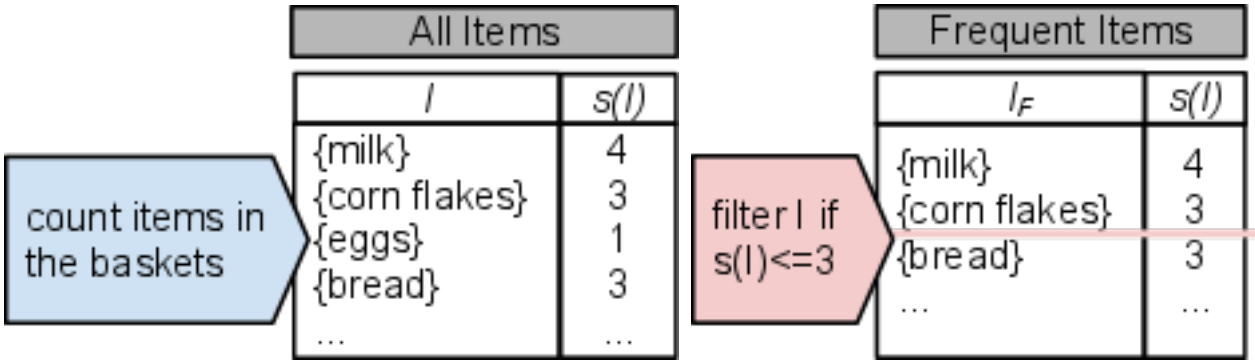
...

n-th pass: find frequent Itemsets of size *n* based on frequent *n-1* itemsets.

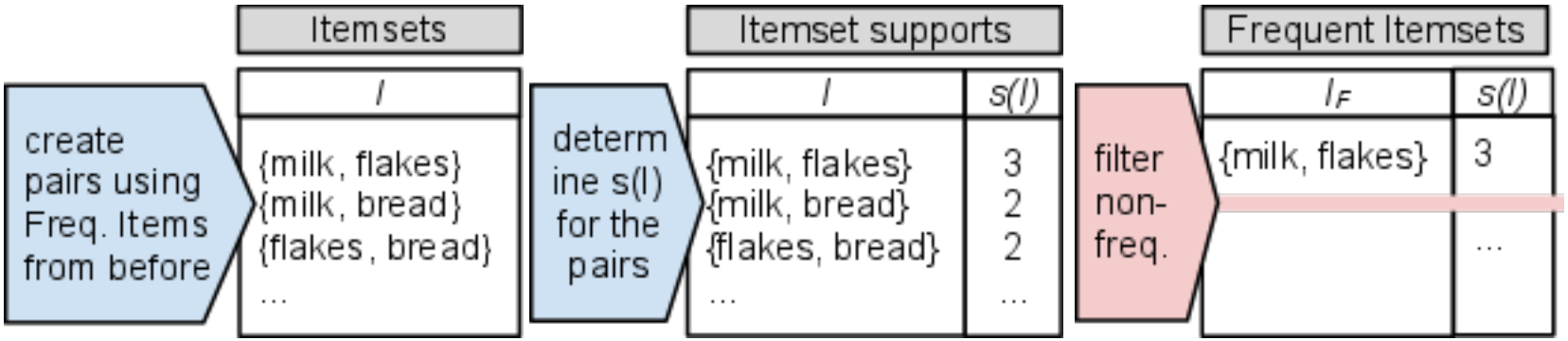
A-Priori Algorithm

Given: a list of baskets with items

Count Itemsets *I* of size 1 (items) and filter result against threshold *s*



Count Itemsets *I* of size 2 (pairs) and filter the results



SON Algorithm

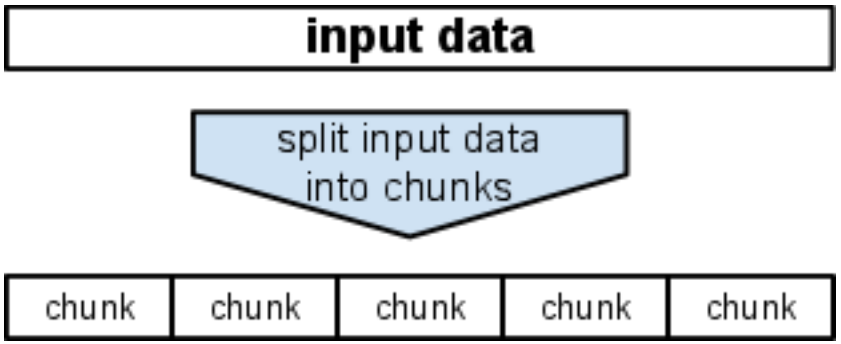
Algorithm of Savasere, Omiecinski, Navathe *(SON Algorithm)*

Problem

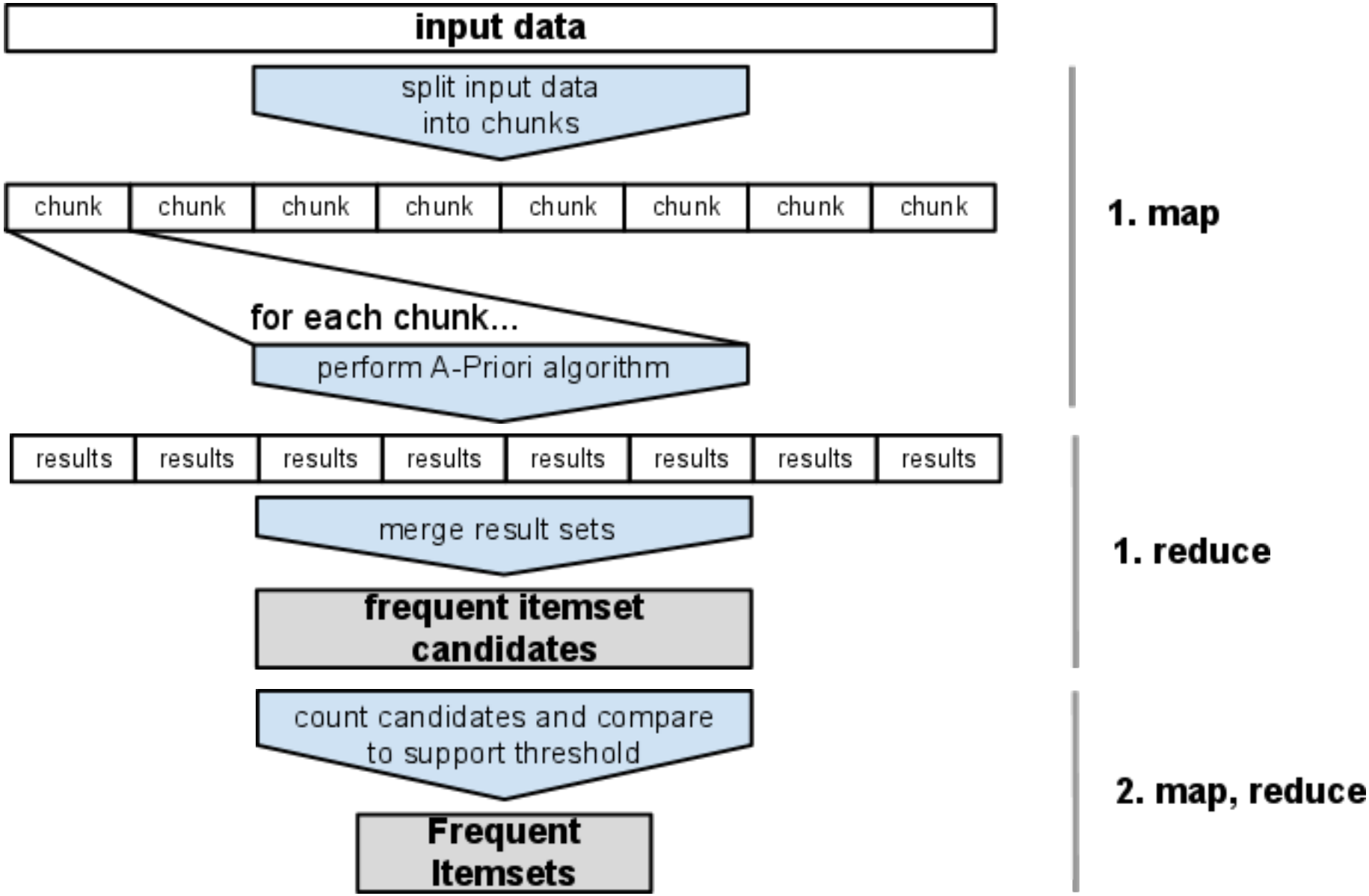
- input data too large for RAM
  - swapping slows down processing

Solution (Data parallelism)

- split input data into chunks
- process each chunk in parallel
  - Map & Reduce



SON Algorithm

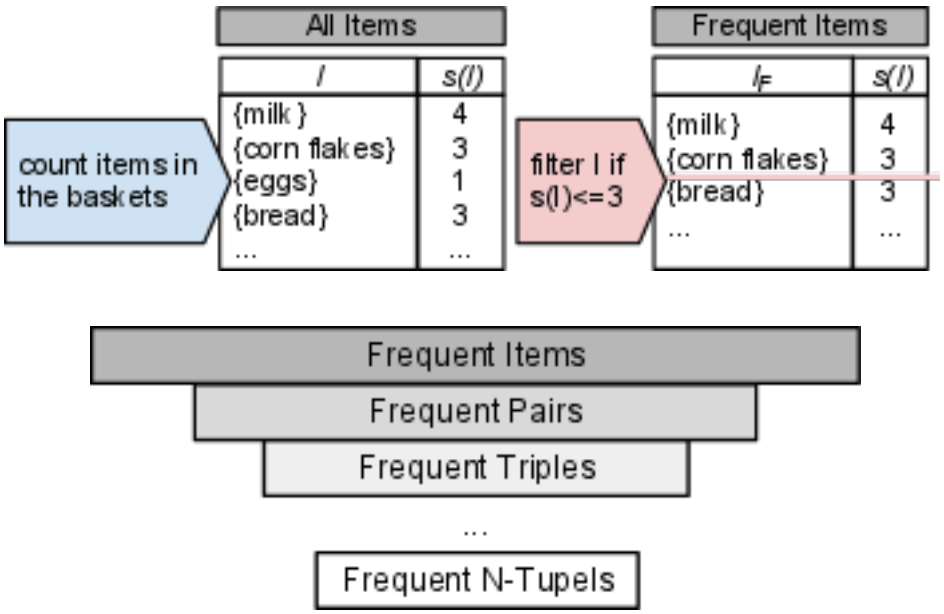


Summary

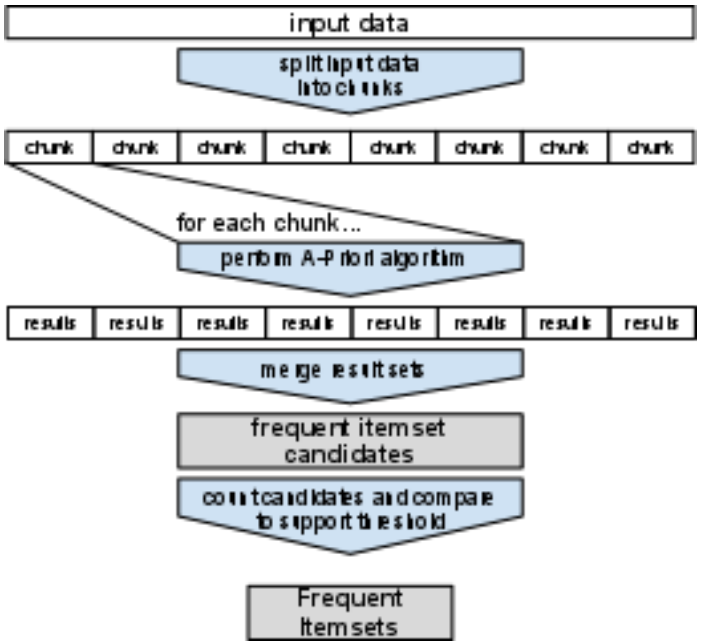
Frequent Itemset applications

- market analysis
- plagiarism detection
- related concepts

A Priori Algorithm



SON Algorithm



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Thank you.

Background

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