Permuton-induced Chinese Restaurant Process

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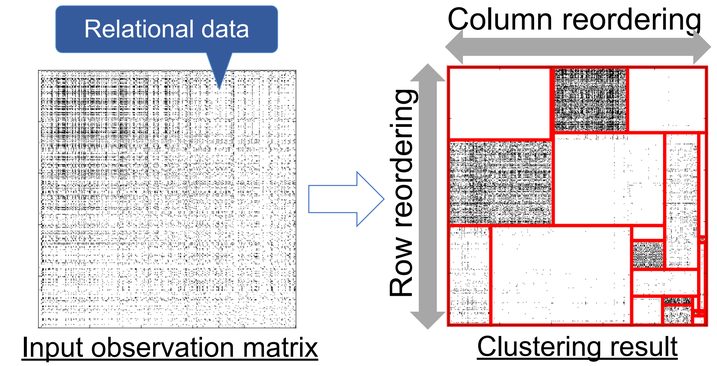
NEURAL INFORMATION PROCESSING SYSTEMS

Introduction and Motivation

Application: Relational data analysis.

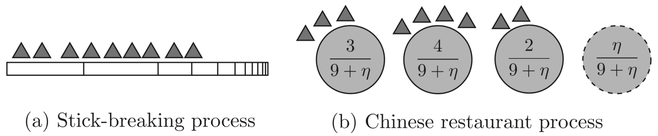


Method: Bayesian nonparametrics (BNP) modeling.

- No need to set the appropriate model complexity (number of clusters) in advance.

Motivation: Variable-order model representation for Bayesian nonparametric model with infinite model complexity

- Most existing BNP models require an infinite number of parameters to obtain an infinite infinite complexity; a model representation method with a finite number of parameters, such as the Chinese restaurant process (CRP), is required.



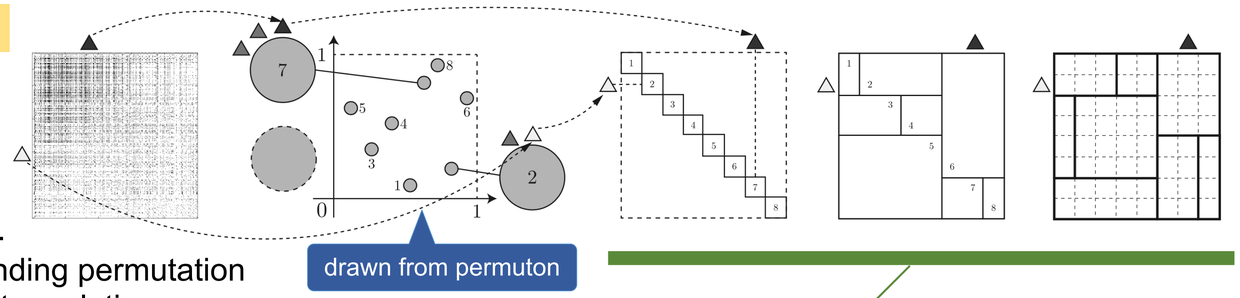
Main contribution:

- Extension of CRP for the representation of Bayesian nonparametric rectangular partitioning.

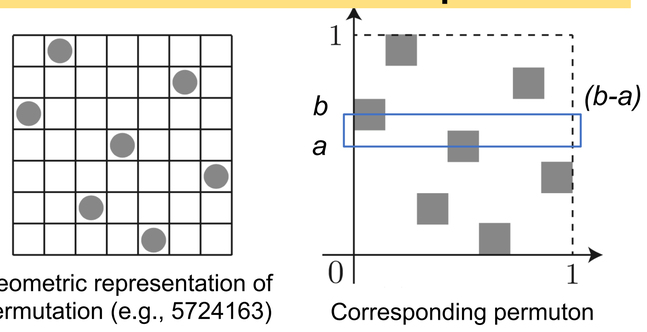
Main contribution: Chinese restaurant process (CRP) with random table coordinates drawn from permuton

Key strategy

- We Introduce random coordinates to the CRP tables.
- We regard the random table coordinates as the geometric representation of a permutation.
- We can transform the corresponding permutation to the table coordinates to a rectangulation.



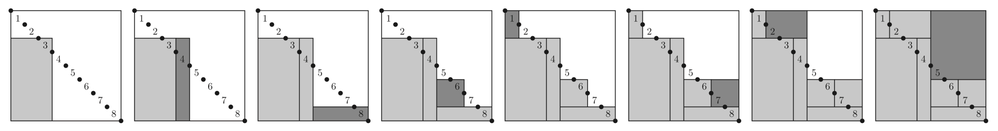
CRP tables are drawn from permuton



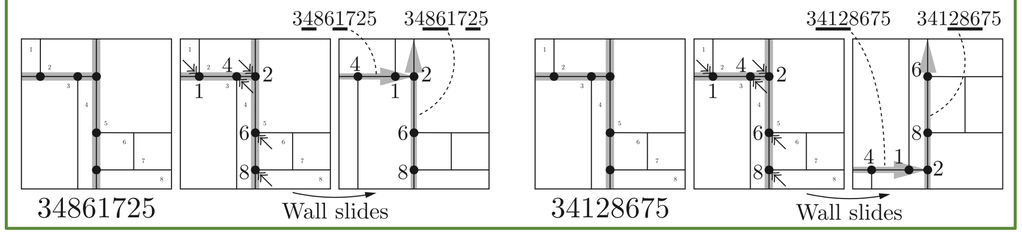
Example: uniform permuton (|σ|=100, 200, 400, 800, 1600)

Theorem [Law&Reading, Reading2012]: *There is surjective maps from permutations to diagonal rectangulations and generic rectangulations.*

- Surjective map from permutations to diagonal rectangulations

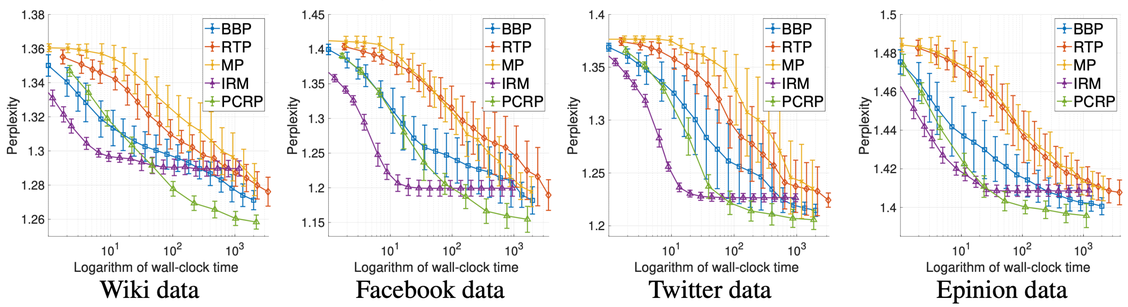


- Surjective map from diagonal rec. to generic rectangulations



Experimental evaluation on relational data analysis

Predictive performance comparison for four real-world relational datasets (training:test=80:20), with the block-breaking process (BBP), the rectangular tiling process (RTP), the Mondrian process (MP), and the infinite relational model (IRM).



Code available at

https://github.com/nttcslab/permuton-induced-crp