

Counting Solution Clusters in Graph Coloring Problems Using Belief Propagation

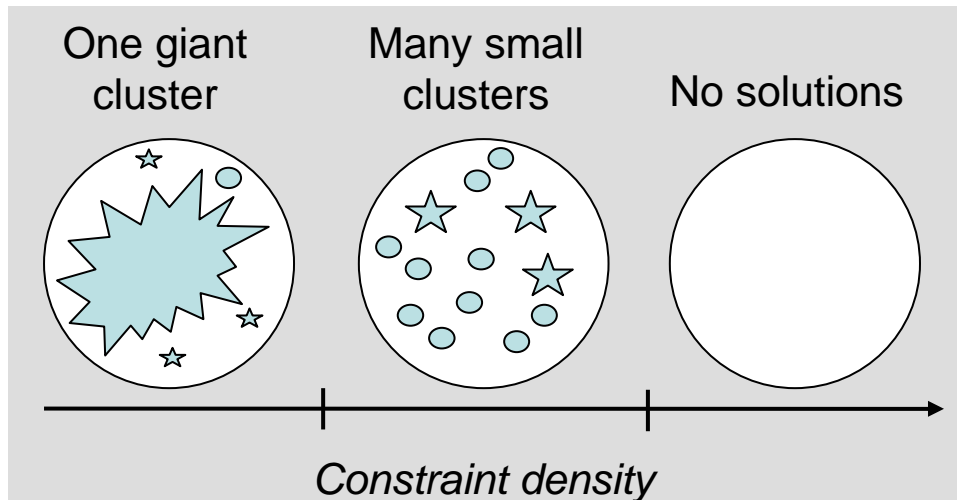
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Known facts:

- Solution space of random combinatorial problems *fractures into clusters* as constraint density (& hardness) increases
- The fastest solution technique relies on *marginal probability estimates over clusters*



- ☆ = cluster of satisfying assignments
- = trap (almost satisfying)

Our results:

- An expression to count the number of clusters with high precision

$$Z_{(-1)} = \sum_{\bar{y} \in \text{DomExt}^n} (-1)^{\#e(\bar{y})} \prod_{\alpha} f_{\alpha}(\bar{y}_{\alpha})$$

- A message-passing scheme similar to BP that approximates $Z_{(-1)}$ well

