GUROBI v5.5 (Currently, v5.6)

ILP Formulation of MPE Task

- **MPE Inference**
  - Graphical Model $R \subseteq \{X, D, F, \emptyset\}$
  - Random Variables $X = \{x_1, x_2, \ldots, x_n\}$
  - Domains of Variables $D = \{D_1, D_2, \ldots, D_n\}$, $x_i \in D_i$
- **MPE to 0/1 ILP Conversion**
  - Decision Variables $x_i \in \{0,1\}$
  - k-th row of j-factor Table
  - Selecting a row for factor tables
  - *Constrains*
  - *Mutual Exclusivity* $\sum_{i \in \mathcal{V}} x_{i,j} = 1$, $\forall j \in \{1, \ldots, r\}$
  - $N_j = D_{p_1} \times D_{p_2} \times \cdots \times D_{p_{l+1}}$ 
  - *Cross-Consistency* $\sum_{j \in \mathcal{S}} x_{i,j} \leq 1$, $\forall j \in \mathcal{S}$
  - *MPE Task*
  - max $P(x)$ = max $\prod \Pi_i(x)$

Benchmark on DAOOPT and GUROBI with the PASCAL2 Inference Challenge Problems

**Abstract**

We report the PASCAL2 benchmark for DAOOPT and GUROBI on MPE task with 330 optimally solved instances from 8 benchmark domains. DAOOPT outperformed GUROBI in 3 domains, while GUROBI was faster than DAOOPT in the rest of the 5 domains. We show that DAOOPT performed well in domains where it could have high-quality initial solutions for pruning the AND/OR search space, or skip search when the heuristic upper bounds were converged to the optimal due to MPLP/JGLP algorithms. GUROBI presented excellent performance if cutting planes were applied progressively and its heuristic algorithms could find the optimal solution at the root of branch-and-cut tree.

**2011 PASCAL2 Inference Challenge**

- **Evaluate Inference Algorithms on Large-scale Difficult Problems**
- **Problems were provided as UAI Factor Table Format**
- [http://www.cs.huji.ac.il/project/PASCAL/](http://www.cs.huji.ac.il/project/PASCAL/)

**DAOOPT (Distributed AND/OR Optimization)**

- DAOOPT was the winner of MAP/MPE Task
- Search based on
  - Breadth-Running AND/OR Branch-and-Bound
- Static Heuristic Evaluation From
  - Mini-Bucket Elimination with Memory Matching
  - Factor Graph Join Graph Cost Shifting Schemes
  - Mini-Bucket Elimination with Moment Matching
- **DAOOPT outperformed GUROBI in 3 domains, while GUROBI was faster than DAOOPT in the rest of the 5 domains. We show that DAOOPT performed well in domains where it could have high-quality initial solutions for pruning the AND/OR search space, or skip search when the heuristic upper bounds were converged to the optimal due to MPLP/JGLP algorithms. GUROBI presented excellent performance if cutting planes were applied progressively and its heuristic algorithms could find the optimal solution at the root of branch-and-cut tree.**

**GUROBI v5.5 (Currently, v5.6)**

- Commercial Mathematical Programming Solver
- [http://www.gurobi.com](http://www.gurobi.com)

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- **MPE Inference**
  - Graphical Model $R \subseteq \{X, D, F, \emptyset\}$
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**Benchmark Problem Statistics**

- **Problem Statistics for Graphical Models and Integer Programming**

**Benchmark Settings**

- **DAOOPT Input Parameters**

**References**

[9] Rina Dechter and Irina Rish. Image Alignment 0 10 10