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PH-Graphs for Solving Shortest Path Problems with Correlated Edge Weights

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Abstract:

In this talk, an innovative model class for stochastic graphs with correlated weights at the edges is introduced. In the developed PH-Graph model edge weights are modeled by PH distributions and correlations between them can be encoded using transfer matrices for PH distributions of adjacent edge weights. Stochastic graph models including correlations are important to describe many practical situations where the knowledge about system parameters like travelling times and costs is incomplete or changes over time. Based on PH-Graphs efficient solution methods for Stochastic Shortest Path Problems with correlations can be developed. Competing paths from origin to destination in a PH-Graph can be interpreted as CTMDP. Optimal solutions to many realistic shortest path problems can be obtained from finding an optimal policy in a CTMDP. E.g., the problem of finding reliable shortest path to maximize the probability of arriving on time under realistic assumptions can be efficiently treated. We address the parameterization of PH-Graphs based on measured data from some real or simulated system. The formulation of shortest path problems with correlations as solutions of CTMDPs as well as solution methods to them are presented. A realistic example using vehicle mobility trace based on 24-hour car traffic simulation data of the city of Cologne is provided, which contains car traffic on roads with congestion effects. Our example shows that, based on realistic representation of real world road networks, our solution methods are effective and usable.