Healthcare Data Handling Using Markov Decision Processes

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Handling healthcare data is chanllenging, including learning information from disease progression, risk accessment, and medical treatment decisions, etc., which is often sequential and uncertain. Markov decision processes (MDPs) are an appropriate technique for modeling and solving such stochastic and dynamic decisions. This talk gives an overview of MDP models and solution techniques of MDP that enrich reinforcement learning framework. We describe MDP modeling in the context of reinforcement learning and discuss when MDPs are an appropriate technique. We review selected successful applications of MDPs to show opportunities for applying MDPs to healthcare data handling.

Keywords: Markov Decision Processes, Conditional Probabilities, Reinforcement Learning, Optimization Modeling.

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Signal reconstruction by conjugate gradient algorithm based on smoothing l_1-norm

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The l_1-norm regularized minimization problem is a non-differentiable problem and has a wide range of applications in the field of compressive sensing. Many approaches have been proposed in the literature. Among them, smoothing l_1-norm is one of the effective approaches. This paper follows this path, in which we adopt six smoothing functions to approximate the l_1-norm. Then, we recast the signal recovery problem as a smoothing penalized least squares optimization problem, and apply the nonlinear conjugate gradient method to solve the smoothing model. The algorithm is shown globally convergent. In addition, the simulation results not only suggest some nice smoothing functions, but also show that the proposed algorithm is competitive in view of relative error.

Keywords: l_1-norm regularization, compressive sensing, conjugate gradient algorithm, smoothing function.

Continuation methods for Optimization Problems

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In this talk, a continuation method for computing local optimal solution curves of the cost parameterized optimization problem is presented. We recast the problem to a parameterized nonlinear equation derived from its Lagrange function and show that the point where the positive definiteness of the projected Hessian matrix vanishes must be a bifurcation point on the solution curve of the equation. Based on this formulation, the local optimal curves can be traced by the continuation method, coupled with the testing of singularity of the Jacobian matrix. Using the proposed procedure, we successfully compute the energy diagram of rotating Bose-Einstein condensates.

For a nonnegative tensor $\mathcal{A} \in \mathbb{R}^{n_1 \times \cdots \times n_m}$, the rank-1 approximation of the tensor $\mathcal{A}$ can be formulated as an optimization problem. Continuation method [1] is guaranteed to compute a local optimizer of the optimization problem.

Keywords: continuation method, nonnegative tensor, rank-1 approximation.

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Variational Inequality With DC Program as Constraint

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In this paper, we consider the variational inequality with DC programming as constraint. For this, we give several algorithms to study this problem.

Keywords: variational inequality, DC programming

Alternative arrangement of level sets of a pair of quadratic functions

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In this talk, we investigate some geometric properties about the arrangement of level sets of a pair of quadratic functions $\{f < 0\}$ and $\{g = 0\}$; or $\{f = 0\}$ and $\{g = 0\}$. We are especially interested in the cases when $\{f < 0\}$ or $\{f = 0\}$ has two connected components and when all the connected components are in an alternative arrangement with the components of $\{g = 0\}$ in the space. Then, something "bad" could happen. For example, the S-lemma with equality fails; or the joint numerical range of $\{(f(x), g(x))|x \in \mathbb{R}^n\}$ cannot be convex. Applying these results, we can identify some types of non-convex quadratic optimization problems subject to two quadratic constraints, which can be solved in polynomial time.

Keywords: Quadratically constrained quadratic programming, S-lemma, quadratic surfaces, arrangement of level sets.

A Study on Category-level Promotion and Customized Product Assortment under Multinomial Logit Choice Model

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As consumers gradually use network to review some products, a lot companies try to organize a platform for selling their products. Also, companies use their platform to collect guests' data and use data analysis tools to study the demand. Whether collecting data or analyzing the data, companies need to express a customized product assortment to their consumers and collect their choice. Hence to provide a useful assortment is necessary. In this talk, we discuss how a company provides an assortment to their consumers in a web page by solving a fractional programming problem. We employ a robust approach for the category-level promotion and customized assortment optimization problem. We present the structural properties of the problems and organize efficient computational methods to solve the problems. Also, we do some experiments for showing the efficiencies of our method.

Keywords: Customized Product Assortment, Fractional Programming, Robust Optimization

Common Zero to Finite Mappings with Sums of Two Monotone Operators and Applications

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Abstract

In this paper, we establish a parallel algorithm which converges strongly to common fixed point for finite $\rho-$ strongly quasi-nonexpansive mappings. Then we study common zeros for the operators such that each operator is the sum of two operators. From this result, we study the following problems: Common zero to monotone mappings; common minimizer to finite mappings with the sums of two mappings; common minimizer point to finite mappings; common minimizer to finite constrained mappings; common solution to finite mixed type variational inequalities; common solution to finite constrained variational inequalities; common minimizer to finite quadratic optimization problem; common solution to finite signal recovery problems. Strongly convergent theorems are established with parallel algorithms without uniform monotonicity or uniform convexity on any operator we consider. We give a unified treatment to these problems and some special cases of our problems are also studied in this paper.

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The Schatten p-norm on $\mathbb{R}^n$

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It is well known that the Schatten p-norm defined on the space of matrices is useful and possesses nice properties. In this paper, we explore the concept of Schatten p-norm on $\mathbb{R}^n$ via the structure of Euclidean Jordan algebra. Two types of Schatten p-norm on $\mathbb{R}^n$ are defined and the relationship between these two norms is also investigated. This is a joint work with Jein-Shan Chen and Chu-Chin Hu.

Keywords: Schatten p-norm, Euclidean Jordan algebra, second-order cone.

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