THE WEST COAST OPTIMIZATION MEETING

Depts. of Mathematics and Applied Mathematics, University of Washington

All talks will be in Guggenheim 317

FRIDAY, NOVEMBER 14

6:30–9:30 Party at Terry Rockafellar's home in Seattle

The cost per person will be $10/"student" and $15/"others."

SATURDAY, NOVEMBER 15

8:30–9:00 ————Refreshments in Guggenheim 408, the Applied Math Lounge

9:00–9:10 "A self-dual regularizing transform for convex functions," Rafal Goebel, PhD student in Mathematics, Univ. of Washington

9:10–9:50 "Fast numerical computation of the Legendre-Fenchel conjugate: from log-linear- to linear-time algorithms," Luc Lucet, CECM (Simon Fraser Univ.)

9:50–10:15 ————Refreshments in Guggenheim 408, the Applied Math Lounge

10:15–10:25 "Localization of biomagnetic sources," Russell Luke, PhD student in Applied Mathematics, Univ. of Washington)

10:25–11:05 "Local differentiability of distance functions," René Poliquin, Dept. of Mathematics, Univ. of Alberta, Edmonton

11:05–11:20 ————Refreshments in Guggenheim 408, the Applied Math Lounge

11:20–12:00 "Data mining via bilinear programming," Olvi Mangasarian, Dept. of Computer Science, Univ. of Wisconsin, Madison

12:00–13:40 ————Lunch expedition to University Avenue

13:40–14:20 "On the principle of maximum entropy on the mean," Pierre Marechal, CECM (Simon Fraser Univ.) and the Vancouver Hospital Imaging Group

14:20–15:00 "Envelope representations of value functions in optimal control problems with convexity," Terry Rockafellar, Depts. of Mathematics and Applied Mathematics, Univ. of Washington

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The **West Coast Optimization Meeting** occurs twice each year. Contact:

Prof. J. M. Borwein at the Dept. of Mathematics and Statistics, Simon Fraser University, Vancouver: (604) 291-3070, e-mail jborwein@cecm.sfu.ca

Prof. R. T. Rockafellar at the Dept. of Mathematics, University of Washington, Seattle: (206) 543-1916, e-mail rtr@math.washington.edu

TALK ABSTRACTS for WCOM

Autumn 1997

Rafal Goebel, *"A Self-Dual Regularizing Transform for Convex Functions"*

For a convex function f and a parameter value $\lambda \in (0,1)$, we define $T_\lambda f$ — a finite, strongly convex function of class C^{1+} with the property that $(T_\lambda f)^* = T_\lambda f^*$. The smoothness of $T_\lambda f$ and the epi-convergence of these transforms to f as $\lambda \searrow 0$ can be applied in approximating convex problems of Bolza, and in studying the properties of value functions in Hamilton-Jacobi theory.

Luc Lucet, *"Fast Numerical Computation of the Legendre-Fenchel Conjugate: From Log-Linear- to Linear-Time Algorithms"*

To numerically compute the Legendre-Fenchel conjugate $u^*(s) := \sup_x\{\langle s, x - u(x)\}$ for several values of s, we consider the Discrete Legendre Transform $v(s) := \max_{x\in X}\{sx - u(x)\}$ with X a finite set. The log-linear time Fast Legendre Transform algorithm introduced by Brenier is improved to the faster linear-time Legendre Transform algorithm. We present the latter along with applications to Hamilton-Jacobi equations and computation of the Legendre spectrum of a signal.

Russell Luke, *"Localization of Biomagnetic Sources"*

Superconducting Quantum Interference Devices (SQUID) provide high resolution, non-invasive measurements of the magnetic fields generated by the body. Efforts to reconstruct the electrical sources generating the measured magnetic fields are complicated by the ill-posedness of the inverse problem. We investigate optimization approaches to finding the true source distribution from measured magnetic data.

René Poliquin, *"Local Differentiability of Distance Functions"*

For a closed set C and a boundary point x of C, what does it mean for the distance function d_C to be continuously differentiable outside of C in a neighborhood of x? This turns out to be equivalent to the prox-regularity of C, a key property in second-order variational analysis that is supported by a calculus. It is equivalent further to d_C^2 being locally of class C^{1+} around x, or to the existence of some $r > 0$ such that the function $d_C^2 + r|\cdot|^2$ is convex around x. There are connections also with monotonicity properties of the normal cone mapping N_C.

Olvi Mangasarian, *"Data Mining via Bilinear Programming"*

A fundamental problem of data mining is that of assigning m points in R^n to k clusters and extracting distinct information from the various clusters. This problem is formulated as that of determining k centers in R^n such that the sum of distances of each point to the nearest center is minimized. If a polyhedral distance is used, the problem can be formulated as that of minimizing a piecewise linear concave function on a polyhedral set which is shown to be equivalent to minimizing a bilinear function on a polyhedral set. A fast finite k-Median Algorithm consisting of solving a few linear programs in closed form leads to a stationary point of the bilinear program. Computational testing on a number of real-world databases was carried out. On the Wisconsin Diagnostic Breast Cancer (WDBC) database, k-Median training set correctness was comparable to that of the k-Mean Algorithm, however its testing set correctness was better. Additionally, on the Wisconsin Prognostic Breast Cancer (WPBC) database, distinct and clinically important survival curves were extracted from the database by the k-Median Algorithm, whereas the k-Mean Algorithm failed to obtain such distinct survival curves for the same database.

Pierre Marechal, *"On the Principle of Maximum Entropy on the Mean"*

The Principle of Maximum Entropy on the Mean (PMEM) is an inference mechanism allowing the formal unification of a wide variety of regularization methods. We will show that an approach based on Fenchel duality allows to obtain a rigorous statement of most results of interest. We will also make some critical comments about the use of the PMEM both for statistical inference and for the regularization of ill-posed problems.

Terry Rockafellar, *"Envelope Representations of Value Functions in Optimal Control Problems with Convexity"*

Value functions in optimal control are 'cost-to-go' expressions that have a key role in feedback laws. Much of the research on such functions has revolved around characterizing them in terms of some subgradient version of the Hamilton-Jacobi PDE. In this talk a different characterization will be presented in which, under convexity assumptions, the value function is expressed as a pointwise maximum of simpler functions. The expression involves the Legendre-Fenchel transform of the terminal cost function as well as a certain 'dualizing kernel', which is a value function of special type that propagates linear functions backward or forward in time. This kernel itself is the unique solution to a kind of double Hamilton-Jacobi equation.