ALGORITHMS IN DISCRETE MORSE THEORY

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Given a smooth real-valued map on a manifold, M, it is relatively easy to find its critical points, gradient flow, etc. But what if one has the values of a function at only a finite sample of points of M? Is it possible to find critical points and to construct a reasonable gradient flow?

In the mid-90's, Forman introduced a version of Morse theory on cell complexes that is particularly well-suited to studying this problem. In this talk, I will present an algorithm for extending an arbitrary function f, defined on the vertices of a finite simplicial complex K (e.g. a triangulated manifold), to a discrete Morse function on K in such a way that the associated gradient flow mirrors the large-scale behavior of f. I will present several examples and applications ranging from terrain mapping to analysis of CT images.