# On Shape Preserving Spline Curves

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**Abstract** — For a given set of data, a piecewise linear interpolation "preserves shape" well in the sense that it keeps the features such as linearity, convexity, and monotonicity embedded in the data. However, piecewise linear curves are not smooth and often not accurate enough to represent the given data. We study a smooth spline curve that preserves shapes well and is accurate for higher order approximation of multi-scale data, i.e., data may contain abrupt changes in both magnitude and knot spacing,. Unlike the traditional methods which often minimize the L2 norm of the second derivatives of a underlying spline, our approach searches a cubic spline that minimizes the L1 norm of the difference between the first order derivative of the underlying spline and the slope shown in the given data. The resulting mathematical problem amounts to a nonlinear nondifferentiable convex program. While the primal problem is nonsmooth, we show that its dual (geometric) program via Fenchel's conjugate transformation is a smooth convex programming problem. The coefficients of the spline polynomials can be obtained by solving a linear program.