Learning to Integrate

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In uncertainty quantification, efficient quadrature rules exist for known distributions like multivariate Gaussians. In this way, expensive simulation runs can be saved. However, in many cases such quadratures are unknown when the distribution is non-Gaussian. We propose to use a flow matching invertible neural network to learn a transformation that maps a data distribution from which it is easy to sample to a multivariate standard normal distribution. Considering the inverse of this map, we are thus able to obtain learned sparse grid quadrature rules for, e.g. mutivariate Lévy distributions. We use this for uncertainty quantification in the ground water flow problem substituting Gaussian random fields with smoothed Lévy white noise fields. This work is based on joint work with Oliver Ernst, Toni Kowalewiz and Patrick Krüger.