

Function-on-Function Regression Through Separable Neural Operators

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Abstract

We investigate the estimation of the regression operator in function-on-function regression models. While traditional research has predominantly focused on linear models or their immediate nonlinear extensions, we propose a neural operator approach to accommodate general regression operators under mild smoothness assumptions. Operator learning has emerged as an active area of machine learning, particularly for solving physical models governed by partial differential equations. Using this paradigm, we introduce the separable neural operator, a neural-operator architecture that represents the regression operator through input-dependent coefficient functions and output-dependent basis functions. Beyond adapting this architecture to the regression operator estimation problem, we establish the consistency of the estimator under relatively mild smoothness and sampling conditions, allowing functional data to be observed on dense, possibly irregular, discrete grids. We also apply the proposed approach to Argo data and demonstrate its potential for oceanographic research.