1154-35-714 **Mostafa Rezapour*** (mostafa.rezapour@wsu.edu), Department of Mathematics and Statistics, Washington State University, Pullman, WA 99163, **Adebowale Sijuwade** (adebowale.sijuwade@wsu.edu), Department of Mathematics and Statistics, Washington State University, Pullman, WA 99164, and **Thomas J. Asaki** (tasaki@wsu.edu), Department of Mathematics and Statistics, Washington State University, Pullman, WA 99164. *Neural partial differential equation solver with fractional gradient descent.*

We present techniques that use both supervised and unsupervised learning methods to solve partial differential equations problems. The universal approximation theorem guarantees the construction of a feedforward neural network (FNN) that effectively serves as a universal approximator for a continuous function. First, we apply back-propagation neural network using a fractional gradient descent technique with an adjustable learning rate to solve diffusion equations and compare this approach against traditional gradient descent methods. This idea can be used to handle multivariable coupled integrodifferential equations such as those which arise in the field theory for predicting polymer microphase-separated structures. Next, for a given class of initial boundary value problems (IBVPs) and their solutions, we present a supervised machine-learning based solver. We define a set of pairs of well-posed diffusion IBVPs and their general solutions, and then train a model on it. The behavior of the IBVPs can be predicted using the obtained model, which can be trained by using cross-validation and minimizing the corresponding loss function of the equation to reduce error. (Received September 18, 2019)