

cases	doc_1		doc_2		decision	id
			authors	<ul style="list-style-type: none">V.I. Avrutskiy	DUPLICATES	10
			title	Neural networks catching up with finite differences in solving partial differential equations in higher dimensions		
			publication_date	2017-12-14 00:00:00		
			source	SupportedSources.INTERNET_ARCHIVE		
			journal			
			volume			
			doi			
			urls	<ul style="list-style-type: none">https://web.archive.org/web/20200831210714/https://arxiv.org/pdf/1712.05067v1.pdf		
			id	id1340507698461480686		
			abstract	Fully connected multilayer perceptrons are used for obtaining numerical solutions of partial differential equations in various dimensions. Independent variables are fed into the input layer, and the output is considered as solution's value. To train such a network one can use square of equation's residual as a cost function and minimize it with respect to weights by gradient descent. Following previously developed method, derivatives of the equation's residual along random directions in space of independent variables are also added to cost function. Similar procedure is known to produce nearly machine precision results using less than 8 grid points per dimension for 2D case. The same effect is observed here for higher dimensions: solutions are obtained on low density grids, but maintain their precision in the entire region. Boundary value problems for linear and nonlinear Poisson equations are solved inside 2, 3, 4, and 5 dimensional balls. Grids for linear cases have 40, 159, 512 and 1536 points and for nonlinear 64, 350, 1536 and 6528 points respectively. In all cases maximum error is less than $8.8\cdot 10^{-6}$, and median error is less than $2.4\cdot 10^{-6}$. Very weak grid requirements enable neural networks to obtain solution of 5D linear problem within 22 minutes, whereas projected solving time for finite differences on the same hardware is 50 minutes. Method is applied to second order equation, but requires little to none modifications to solve systems or higher order PDEs.		
			versions			
	authors		<ul style="list-style-type: none">V. Avrutskiy			
	title		Neural networks catching up with finite differences in solving partial differential equations in higher dimensions			
	publication_date		2020-01-31 00:00:00			
	source		SupportedSources.SEMANTIC_SCHOLAR			
	journal		Neural Computing and Applications			
	volume		32			
	doi		10.1007/s00521-020-04743-8			
	urls		<ul style="list-style-type: none">https://www.semanticscholar.org/paper/d75ce1fa29e8c4da47f100b59c8ab46affaac385			
id		id-7810245992775343072				
abstract		None				
versions						