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abstract	Neural network-based approaches for solving partial differential equations (PDEs) have recently received special attention. However, the large majority of neural PDE solvers only apply to rectilinear domains, and do not systematically address the imposition of Dirichlet/Neumann boundary conditions over irregular domain boundaries. In this paper, we present a framework to neurally solve partial differential equations over domains with irregularly shaped (non-rectilinear) geometric boundaries. Our network takes in the shape of the domain as an input (represented using an unstructured point cloud, or any other parametric representation such as Non-Uniform Rational B-Splines) and is able to generalize to novel (unseen) irregular domains; the key technical ingredient to realizing this model is a novel approach for identifying the interior and exterior of the computational grid in a differentiable manner. We also perform a careful error analysis which reveals theoretical insights into several sources of error incurred in the model-building process. Finally, we showcase a wide variety of applications, along with favorable comparisons with ground truth solutions.	Neural network-based approaches for solving partial differential equations (PDEs) have recently received special attention. However, the large majority of neural PDE solvers only apply to rectilinear domains, and do not systematically address the imposition of Dirichlet/Neumann boundary conditions over irregular domain boundaries. In this paper, we present a framework to neurally solve partial differential equations over domains with irregularly shaped (non-rectilinear) geometric boundaries. Our network takes in the shape of the domain as an input (represented using an unstructured point cloud, or any other parametric representation such as Non-Uniform Rational B-Splines) and is able to generalize to novel (unseen) irregular domains; the key technical ingredient to realizing this model is a novel approach for identifying the interior and exterior of the computational grid in a differentiable manner. We also perform a careful error analysis which reveals theoretical insights into several sources of error incurred in the model-building process. Finally, we showcase a wide variety of applications, along with favorable comparisons with ground truth solutions. shaped domains by building on well-established ï¬nite element and immersed boundary methods. Our neural PDE solver, coined IBN, demonstrates the ability to predict ï¬eld solutions for irregular boundaries immersed in the target domain. We highlight two speciï¬c PDE cases, Poisson and Navier-Stokes, which show promising results. Alongside the empirical results, we have included theoretical results for the error bounds of the optimization process of our ï¬nite element-based loss function. IBN opens up fast design exploration and topology optimization for various societally critical applications such as room ventilation for reduced disease risk, shape design for energy harvesters, and aerodynamic design of vehicles.		
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