Solving partial differential equations with sampled neural networks

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Approximation of solutions to partial differential equations (PDE) is an important problem in computational science and engineering. We demonstrate that sampling a specific, data-dependent probability distribution for the weights of neural networks allows us to solve PDE by using individual neurons as basis functions. Compared to random feature networks, our data-driven sampling often requires fewer neurons for the same accuracy. The sampling scheme outperforms iterative, gradient-based optimization regarding training speed and accuracy by several orders of magnitude. We will also discuss benefits and drawbacks of the method compared to classical numerical schemes.