From stochastic representations to neural network approximations of solutions to boundary value problems

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It has been known for some time how to represent the solutions of PDEs using stochastic representations. Using the walk on spheres, one can construct various approximation schemes of the solutions. Moreover, from these, one can find an approximation of the solution by a neural network. The key fact that we will reveal is that the dimension of the network depends polynomially on the dimension of the space, in contrast to the exponential dependence in the case of many standard numerical schemes.