

Dualities in and from Machine Learning

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Dualities play a key role in our understanding of dynamical systems appearing in effective field theories from string theory and in general in fundamental physics. Dualities in field theory and string theory are a tool to obtain models describing data at a precision beyond a level standard effective field theory techniques allow. At this stage these techniques are not used explicitly in machine learning.

Based on examples, we identify data questions which are easily answerable in one duality frame but not in the other. Simple neural networks confronted with data in this favoured duality frame can answer data questions, in the other frame they cannot identify the correct answer.

We then discuss the question whether a deeper neural network can learn this favourable dual data representation? We present how, based on feature separation, a dual representation, in this example a Fourier-like transformation, can be learned without knowing about its existence. We then discuss how this framework can be extended to apply to physical systems, in particular the 2D Ising model. We comment on potential uses for effective field theories from string theory.

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