

Workshop : The Dynamics of Reason
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Title: Exemplar-Based Reasoning in the Natural and Human Sciences

The idea that phenomena are explained by modeling them on exemplars has often been proposed in the literature. Yet, to the best of my knowledge, no exact mechanism exists that models new phenomena on previously explained phenomena, or that describes how problem solutions can be reused to explain new cases in science. In this talk I will propose such a mechanism. I will present a computational model of exemplar-based explanation, termed EBE, which is based on Thomas Kuhn's idea that "scientists solve puzzles by modeling them on previous puzzle-solutions".

I will argue that explanations can be represented by means of derivation trees which describe each step in linking laws to phenomena. Next, I will develop a matching mechanism which explains novel phenomena out of subtrees of explanations of previous phenomena by maximizing derivational similarity. Drawing on examples from classical and fluid mechanics, I urge that exemplar-based explanation is not only possible but also necessary: derivations of real-world phenomena heavily depend on theory-external elements that do not follow from laws but that are taken from concrete exemplars.

Next, I will provide an excursion into a field at the other end of the scientific spectrum, discussing some examples from linguistics and natural language processing. What counts for physics also counts for linguistics: real-world phenomena are derived not from laws but from parts of concrete exemplars. I contend that the EBE model suggests a general methodology for the natural and human sciences.