THE CANVAS OF RATIONALITY

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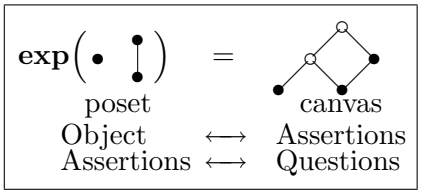
Abstract

Natural objects can often be coded as partially ordered sets (posets). For example, a bridge can't exist without its piers. Hence it makes sense to found inference on posets.

Possible assertions about the elements of a poset cover individual elements and every upward (this-or-that logical-`OR`) combination of them. Assertions form an expanded version of the poset that I call the *canvas* of knowledge. (A canvas is nearly but not quite the same as a finite distributive lattice.) The canvas is always smaller, sometimes by a large factor, than the traditional Boolean lattice that covers all 2^N possibilities including the meaningless ones. The price paid for this reduction is the demise of negation.

Further upward expansion of the canvas of knowledge yields a canvas of questions, which is the framework of possible observations that could usefully guide our learning. If we are ever to automate the acquisition of knowledge, it will be on this canvas.



Numerical assignments on the canvas of knowledge lead uniquely to the standard sum rule for measure, product rule for probability, and "$p \log p$" form for information/entropy. These formulas are surrounded by strong walls of desirable properties, loss of which in any way would expose a proposed modification to convincing counter-examples.

Reference:

Kevin H. Knuth, "*Deriving laws from ordering relations in Bayesian inference and maximum entropy methods*", MaxEnt proceedings 2003.