Bongard Problems and Symbolic Approaches: A Skeptical Look

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Introduction to Bongard Problems

Three decades ago the intelligence theorist Mikhail Bongard (1970) posed an outstanding challenge to artificial intelligence, bringing a remarkable set of 100 visual pattern understanding problems where two classes of figures are presented and the pattern recognizer (either a human or a machine) is asked to identify the conceptual distinction between them. Sometimes the classes are opposite in terms of this conceptual distinction, such as large figures versus small figures, and other times there may be properties or relations holding between boxes in one class, but not in the other, such that there is always some aspect to distinguish the classes.

Figure 1 displays two very simple Bongard problems. One of the most important characteristics of such problems is that, although humans can generally solve them intuitively, their automation is simply daunting: there is always much relevant information to be perceived and much irrelevant information to be discarded.

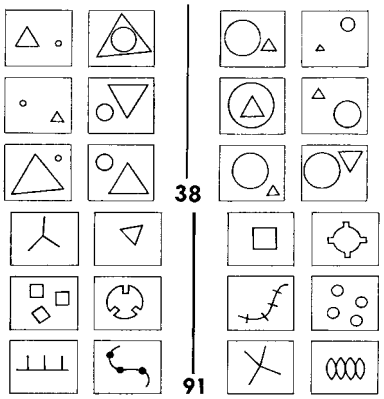

Figure 1: Bongard problems BP#91 and BP#38. What abstract aspect distinguishes the boxes on the right (class 1) from the boxes on the left (class 2)? [From M.M. Bongard (1970) *Pattern Recognition*, Spartan books]

A philosophical problem

Let us focus on the following issue: suppose that a specific Bongard problem includes the following box shown in figure 2. Would it be appropriate (as done in Saito and Nakano 1994; Saito and Nakano 1995) to discard the raw geometrical information in favor of a simple symbolic description, such as that presented?

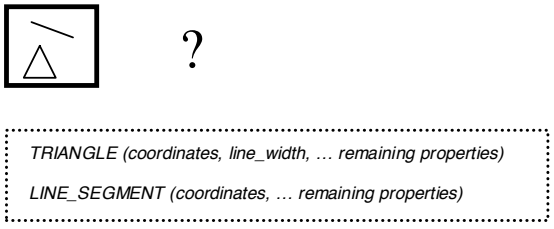

Figure 2: Raw geometrical information versus symbolic descriptions.

This is the core question of our investigation. We argue that such approach is unattainable, as it leads to the inadequate philosophical grounds of *metaphysical realism*. Purely symbolic representations are not capable of containing all forms of concepts and categories expressed (and expressible) in Bongard problems. Furthermore, they lead to inadequate architectural models, which can easily be seen to falter (Linhares, 2000; see also Hofstadter 1979, Hofstadter 1995a, Hofstadter 1995b). Finally, we propose that the philosophical grounds sketched in Smith (1984) are sound alternatives to current theory.

References

Bongard, M.M. (1970) *Pattern Recognition*, Spartan Books, New York.

Hofstadter, D.(1979) Gödel, Escher, Bach: an Eternal Golden Braid, Basic Books, New York.

Hofstadter, D. (1995a) *Fluid Concepts and Creative Analogies*. New York: Basic Books.

Hofstadter, D. (1995b) On seeing A's and seeing As, *Stanford Humanities Review,* 4, 109-121.

Linhares, A. (2000). A glimpse at the metaphysics of Bongard Problems, *Artificial Intelligence*,121, 251-270.

Saito, K. and R. Nakano (1995), A concept learning algorithm with adaptive search, in: K. Furukawa, D. Michie, and S. Muggleton, *Machine Intelligence 14 – Applied Machine Intelligence*, pp. 347-363, Oxford: Oxford University Press.

Saito, K., and R. Nakano (1994) Adaptive concept learning algorithm, *IFIP Transactions A – Computer Science and Technology*, 51, 294-299.

Smith, B.C. (1996) *On the origin of objects*, MIT Press, London.