This book is an important, substantive contribution to both semiotics and to the formal analysis of programming languages. Tanaka-Ishii’s main goal with this book is to provide a rigorous semiotic analysis of what computers can and cannot do – and to use that analysis to show how computational systems can be developed that overcome some of their current limitations (specifically, problems associated with self-reference).

Readers most likely to benefit from the book are semioticians who would like to understand how concepts from that domain elucidate formal aspects of programming (and how insights from formal program analysis can illuminate and potentially resolve semiotic debates) – and likewise for those engaged in the formal analysis of computer programs. It also explores several key topics relevant for AI researchers (e.g., self-reference, the formalization of semantics, temporal changes to natural language), suggesting an affinity with other work at the intersection of AI and creative systems [4,5,3].

To date, there has been surprisingly little research exploring how semiotics and formal program analysis can inform each other (although, see the early paper [6]). And although there has been semiotic analysis of computational [1] and HCI [2] topics, the authors of such works tend to be primarily either semioticians analyzing technology or technologists using semiotic concepts (sometimes quite broadly) to discuss technology. Tanaka-Ishii is clearly expert in both domains and her analysis has significant formal depth and insight.

The book is structured into three main parts: what signs are (models of signs), what kinds of signs exist and what they represent, and what systems can be constructed from signs. The main concept used to frame this exploration is ‘reflexivity’ (or self-reference); indeed, one of Tanaka-Ishii’s premises is that “a sign is essentially reflexive with its signification articulated by the use of itself” [p. 1]. Self-reference is famously problematic in formal systems, but, she argues, it is essential to meaning-making (signification) in natural language so addressing the issue of reflexivity is crucial to extending the capability of formal systems. The author shows how reflexivity is dealt with by two major semiotic paradigms: that of Ferdinand de Saussure in which signs are modeled as dyadic (a sign consists of a label and a meaning) – and that of Charles S. Peirce in which signs are modeled as triadic (a sign consists of a label, an idea, and a referent). She then argues that the dyadic model corresponds to the functional programming paradigm while the triadic model corresponds to the object-oriented paradigm. By the end of the book, she is able to say a great deal about the different interpretive strategies for reflexive expressions used in different sign systems, about different classes of reflexivity, and about the degree of reflexivity that current computer systems can exploit.

Along the way, Tanaka-Ishii delves into difficult technical problems in both semiotics and the formal study of computer programs. This is, of course, challenging: for work that involves using concepts from two different disciplines to illuminate each other, it is never easy to present the right combination of introductory versus specialized material. For the most part, Tanaka-Ishii succeeds admirably with this. For example, many chapters set the stage for the more detailed discussion of
semiotics and the formal characteristics of programs by first presenting a fundamental semiotic or programming concept (or conceptual distinction) in terms of different works of art.

In some cases, this use of art works to illustrate concepts is less successful. The semiotic paradigms of de Saussure (dyadic) and Peirce (triadic), for example, are introduced in relation to two seemingly realistic paintings. The argument is made that one of them "excludes deeper meanings" but that, in the case of the other painting, "every object … carries a meaning and interpretation, and as a whole the painting conveys a message" [p. 27]. As with the other artistic examples in the book, these are used to effectively highlight the main concepts and issues. However, one of the problems with these particular examples is that the "carried meaning" of the second painting is not immediately obvious – and in order to arrive at an understanding of the several proposed symbolic interpretations requires a great deal of cultural knowledge, familiarity with symbolic conventions and allusions that are period-specific (the painting in question is from the mid-1600s), and the like. This is, of course, consistent with the triadic model of signs, but it is not clear why the same symbolic interpretation might not apply to the other painting.

All in all, however, the point just made is quibbling relative to the significant strengths and merits of the book as a whole. This is a book of depth that will reward careful reading and rereading.

References