Preface

On November 8 and 9, 1997, as a part of a series of colloquia on computers and creativity, Douglas Hofstadter, in conjunction with the Center for Computer Assisted Research in the Humanities (CCARH) and Stanford University, presented a weekend of papers, panels, concerts, and discussions centered around the works of the Experiments in Musical Intelligence program. Presenters included Douglas Hofstadter, Eleanor Selfridge-Field, Bernard Greenberg, Steve Larson, Jonathan Berger, Daniel Dennett, and myself. *Virtual Music: Computer Synthesis of Musical Style* serves as a document to this colloquium, an extension of many of the thoughts presented there, and an annotated publication of sample musical output of the Experiments in Musical Intelligence computer music composing program.

With the exception of the last two chapters, the presentation order of this book closely follows that of the colloquium. Readers will note that both Doug Hofstadter and I discuss the basic principles that Experiments in Musical Intelligence follows. This apparent redundancy proved very effective at the Stanford colloquium in that Doug's informal view of the program effectively serves as an introductory tutorial to my more in-depth presentation.

Virtual Music: Computer Synthesis of Musical Style is divided into four main parts. The first part provides a background of Experiments in Musical Intelligence. It cites precedents such as the eighteenth-century *Musikalisches Würfelspiel* and other composing algorithms and presents a version of what I call The Game—a reader participation–style recognition test. This is followed by a general overview of Experiments in Musical Intelligence as seen and heard through the eyes and ears of Douglas Hofstadter, a renowned cognitive scientist and Pulitzer Prize–winning author of *Gödel, Escher, Bach*. I then respond to Doug's commentary which leads to a description of the fundamental principles upon which the Experiments in Musical Intelligence program operates.

The second part follows the composition of an Experiments in Musical Intelligence work from the creation of a database to the completion of a new work in the style of Mozart. This presentation includes, in sophisticated laypersons' terms, relatively detailed explanations of how each step in the composing process contributes to the final composition, with an example of ineffective as well as effective output.

The third part provides perspectives and analyses of the Experiments in Musical Intelligence program. These scholarly commentaries include analyses, critical evaluation, and relevant history and documentation, as appropriate. These chapters also discuss the implications of the program's compositions. The scholars include Eleanor Selfridge-Field (musicologist, associate director of the Center for Computer Assisted Research in the Humanities at Stanford University), Bernard Greenberg (Bach scholar and co-inventor of the Symbolics Lisp machine), Steve Larson (music theo-

rist), Jonathan Berger (noted composer and theorist), Daniel Dennett (cognitive scientist and author of *Darwin's Dangerous Idea*), and Douglas Hofstadter.

The fourth part provides my response to the commentaries presented in the third part along with thoughts on a variety of implications I see as a result of my work with Experiments in Musical Intelligence. These implications include reflections on artificial intelligence, music cognition, aesthetics, intention, and the future of both Experiments in Musical Intelligence and, indirectly, the use of computers in the new millennium.

Appendix A includes the music of the databases used to create a new Mozart-style movement which appears in appendix B. Appendix C contains a rejected Mozart-style movement, as discussed in chapter 10. Appendix D provides extended musical examples referred to and discussed in *Virtual Music*. The music covers styles from a four-hundred-year span of classical music history and includes such composers as Scarlatti, Bach, Mozart, Beethoven, Schubert, Chopin, Rachmaninoff, Prokofiev, Joplin, Bartók, and others. Each music example is preceded by a brief documentation of its composition or thoughts on its aesthetic value. Appendix E presents the key to The Game in chapter 1 (see figures 1.11–1.13).

I have written *Virtual Music* using nontechnical terminology and in a style which I feel will appeal to the layperson with an interest in classical music, as well as to individuals knowledgeable about artificial intelligence. Since many of the examples are musical scores, an ability to read music will be beneficial. Those unable to play these examples on the piano will find the music available on the accompanying compact disk or on commercially available CDs of Experiments in Musical Intelligence's music: *Bach by Design*, *Classical Music Composed by Computer*, and *Virtual Mozart* (Cope 1994, 1997b, 1999).

Like most computer applications, Experiments in Musical Intelligence has had many incarnations. The program has been revised continually over many years. Therefore, the music from the mid-1980s was created by a substantially different program from the one that exists now. There are definite commonalities among the various forms of the program, and I tend to emphasize these features in my writings and discussions. I mention these versions for several reasons. First, individuals who have followed my work through various writings can become confused by the variations in the descriptions of Experiments in Musical Intelligence they encounter. While I try not to contradict earlier publications, I tend to emphasize important, newer aspects of the program in current writings, aspects which may not have even existed in earlier versions. Readers should be aware of the distinctions of the various incarnations of the program. Second, I do not want listeners of Experiments in Musical Intelligence's music to be searching for compositional processes which, by virtue of

the period in which they were created, do not exist. Finally, I mention these versional differences in Experiments in Musical Intelligence because the approach I take in describing the program in this book is a *current* version, which has only existed in this form since about 1993. Most of the Experiments in Musical Intelligence program's output, therefore, cannot be understood to have been composed using *all* of the processes described in this book. However, the works composed *specifically* for this book in appendixes B and C were created using this version.

I wish to thank the many individuals who have contributed so very much to this body of work, particularly Douglas Hofstadter, who created the series of colloquia on computers and creativity at Stanford University in 1997 which led to the creation of this book. I also wish to thank the Center for Computer Assisted Research in the Humanities, particularly Eleanor Selfridge-Field, Don Anthony, and Walter Hewlett. Without the moral support and advice of colleagues such as these, this book could not have been completed.