Preface

I remember seeing the movie *Star Wars* as a little girl. I remember being absolutely captivated and fascinated by the two droids, R2-D2 and C-3P0. Their personalities and their antics made them compelling characters, far different from typical sci-fi robots. I actually cared about these droids, unlike the computer HAL, from Arthur C. Clarke's book *2001: A Space Odyssey,* whose cool intelligence left me with an eerie feeling. I remember the heated debates among my classmates about whether the droids were real or not. Some would argue that because you could see the wires in C-3P0's torso that it must be a real robot. Alas, however, the truth was known. They were not real at all. They existed only in the movies. I figured that I would never see anything like those robots in my lifetime.

Many years later I found myself at the MIT Artificial Intelligence Lab with the opportunity to work with Professor Rod Brooks. He told me of autonomous robots, of their biological inspiration, all very insect-like in nature. I remember thinking to myself that this was it—these kinds of robots were the real-life precursors to the *Star Wars* droids of my childhood. I knew that this was the place for me. Trained in engineering and the sciences, I began to specialize in robotics and artificial intelligence. While working at the MIT Artificial Intelligence Lab, my colleagues and I have created a wide assortment of autonomous robots, ranging from insect-like planetary micro-rovers to upper-torso humanoids, their behavior mirroring that of biological creatures. I developed a deep appreciation for the insights that science as well as art have to offer in building "living, breathing" robots. As a well-seasoned researcher, I began to build a robot in the image of my childhood dream. Its name is Kismet, and it is largely the subject of this book.

Beyond the inspiration and implementation of Kismet, this book also tries to define a vision for sociable robots of the future. Taking R2-D2 and C-3P0 as representative instances, a sociable robot is able to communicate and interact with us, understand and even relate to us, in a personal way. It is a robot that is socially intelligent in a human-like way. We interact with it as if it were a person, and ultimately as a friend. This is the dream of a sociable robot. The field is in its infancy, and so is Kismet.

The year 2001 has arrived. The vast majority of modern robots are sophisticated tools, not synthetic creatures. They are used to manufacture cars more efficiently and quickly, to explore the depths of the ocean, or to exceed our human limitations to perform delicate surgery. These and many other applications are driven by the desire to increase efficiency, productivity, and effectiveness in utilitarian terms, or to perform tasks in environments too hazardous for humans. They are valued for their ability to carry out tasks without interacting with people.

Recently, robotic technologies are making their way into society at large, commercialized as toys, cyber-pets, or other entertainment products. The development of robots for domestic and healthcare purposes is already under way in corporate and university research labs. For these applications, the ability to interact with a wide variety of people in a natural, intuitive,

and enjoyable manner is important and valuable. We are entering a time when socially savvy robots could achieve commercial success, potentially transforming society.

But will people interact socially with these robots? Indeed, this appears to be the case. In the field of human computer interaction (HCI), experiments have revealed that people unconsciously treat socially interactive technologies like people, demonstrating politeness, showing concern for their "feelings," etc. To understand why, consider the profound impact that overcoming social challenges has had on the evolution of the human brain. In essence, we have evolved to be *experts* in social interaction. Our brains have changed very little from that of our long-past ancestors, yet we must deal with modern technology. As a result, if a technology behaves in a socially competent manner, we evoke our evolved social machinery to interact with it. Humanoid robots are a particularly intriguing technology for interacting with people, given the robots' ability to support familiar social cues.

Hence, it makes practical sense to design robots that interact with us in a familiar way. Humanizing the interface and our relationship with robots, however, depends on our conceptions of human nature and what constitutes human-style social interaction. Accordingly, we must consider the specific ways we understand and interact with the social world. If done well, these robots will support our social characteristics, and our interactions with them will be natural and intuitive. Thus, in an effort to make sociable robots familiar to people, they will have to be socially intelligent in a human-like way.

There are a myriad of reasons—scientific, philosophical, as well as practical—for why social intelligence is important for robots that interact with people. Social factors profoundly shaped our evolution as a species. They play a critical role in our cognitive development, how we learn from others, how we communicate and interact, our culture, and our daily lives as members of society. For robots to be a part of our daily lives, they must be responsive to us and be able to adapt in a manner that is natural and intuitive for us, not vice versa. In this way, building sociable robots is also a means for understanding human social intelligence as well—by providing testbeds for theories and models that underlie our social abilities, through building engaging and intelligent robots that assist in our daily lives as well as learn from us and teach us, and by challenging us to reflect upon the nature of humanity and society. Robots should not supplant our need to interact with each other, but rather should support us in our quest to better understand ourselves so that we might appreciate, enhance, and celebrate our humanity and our social lives.

As the sociality of these robots begins to rival our own, will we accept them into the human community? How will we treat them as they grow to understand us, relate to us, empathize with us, befriend us, and share our lives? Science fiction has long challenged us to ponder these questions. Vintage science fiction often portrays robots as sophisticated appliances that people command to do their bidding. *Star Wars,* however, endows mechanical droids with human characteristics. They have interesting personalities. They fear personal harm

but will risk their lives to save their friends. They are not appliances, but servants, arguably even slaves that are bought and sold into servitude. The same holds true for the androids of Philip K. Dick's *Do Androids Dream of Electric Sheep?,* although their appearance and behavior are virtually indistinguishable from their human counterparts. The android, Data, of the television series *Star Trek: The Next Generation* provides a third example of an individualized robot, but with an unusual social status. Data has a human-like appearance but possesses super-human strength and intellect. As an officer on a starship, Data outranks many of the humans onboard. Yet this android's personal quest is to become human, and an essential part of this is to develop human-like emotions.

It is no wonder that science fiction loves robots, androids, and cyborgs. These stories force us to reflect upon the nature of being human and to question our society. Robots will become more socially intelligent and by doing so will become more like us. Meanwhile we strive to enhance ourselves by integrating technology into our lives and even into our bodies. Technological visionaries argue that we are well on the path to becoming cyborgs, replacing more and more of our biological matter with technologically enhanced counterparts. Will we still be human? What does it mean to be a person? The quest of building socially intelligent robots forces us to examine these questions even today.

I've written this book as a step on the way to the creation of sociable robots. A significant contribution of the book is the presentation of a concrete instance of a nascent sociable robot, namely Kismet.

Kismet is special and unique. Not only because of what it can do, but also because of how it makes you feel. Kismet connects to people on a physical level, on a social level, and on an emotional level. It is jarring for people to play with Kismet and then see it turned off, suddenly becoming an inanimate object. For this reason, I do not see Kismet as being a purely scientific or engineering endeavor. It is an artistic endeavor as well. It is my masterpiece. Unfortunately, I do not think anyone can get a full appreciation of what Kismet is merely by reading this book. To aid in this, I have included a CD-ROM so that you can see Kismet in action. Yet, to understand the connection this robot makes with so many people, I think you have to experience it first hand.