Chapter 1
Introduction: Long and Winding Roads

Once upon a time, *there was a cock and a mouse. One day the mouse said to the cock, "Friend cock, shall we go and eat some nuts on yonder tree?" "As you like." So they both went under the tree, and the mouse climbed up at once and began to eat. The poor cock began to fly, and flew and flew, but could not come where the mouse was. When it saw that there was no hope of getting there, it said, "Friend mouse, do you know what I want you to do? Throw me a nut." The mouse went and threw one and hit the cock on the head. The poor cock, with its head broken and all covered with blood, went away to an old woman. "Old aunt, give me some rags to cure my head." "If you will give me two hairs, I will give you the rags." The cock went away to a dog. "Dog, give me some hairs. The hairs I will give the old woman. The old woman will give me rags to cure my head." "If you will give me a little bread," said the dog, "I will give you the hairs." The cock went away to a baker. "Baker, give me bread. I will give the bread to the dog. The dog will give hairs. The hairs I will carry to the old woman. The old woman will give me rags to cure my head. [5] . . . "* (Fig. 1.1).

We could go on with the story, but to quickly reassure the reader we state that the poor cock finally managed to cure his head after going through several other interesting adventures in the forest. Telling such cumulative tales to children is always great fun. They quickly pick up the rhythm of the story and listen to you with curious eyes throughout. But what makes those cumulative tales, like the Italian one above, so fascinating that children always listen and watch intently? Well, of course they are worried about the little cockerel and wonder if he can cure his head. But if that is all, then the tale could end after the nut hit the cock on the head by saying that "The poor cock, with its head broken and all covered with blood, went away to an old woman who gave him rags, and the cock cured his head." Not so brilliant. If we put it this way, the story would lose its meaning–its essence. But, what is at the heart of the tale that makes it exciting? We could say, a long chain of events that has to happen before the cock can finally heal his head. An intricate *path* of events which can take unexpected turns and may go on forever. A path which we go down with the little cockerel and almost forget why he desperately needs all of

Fig. 1.1 The cover of Italian popular tales by Thomas Frederic Crane [Published by the Riverside Press, Cambridge, Massachusetts, 1885]

those things. When listening to the tale, we are so preoccupied with following his path, that the goal almost vanishes from our horizon.[1] The whole adventure slowly becomes to exist in its own right, perhaps more important than the goal itself, and gains its own, independent meaning. Does it mean that we avoid getting to the goal? Well, not exactly. Wandering around pointlessly would become tiresome over time. But we seem to have a strange desire to meander a bit before finishing the story. Is it maybe to warm up or to attune ourselves to the story? Or is it simply a quest for some pleasure? Or do we just need time to prepare for an important message? Regardless of the reasons, the path eventually becomes the essence of the story, and the goal loses its meaning entirely!

If you have ever watched the classic Columbo crime series with Peter Falk, you will surely understand this idea. Each episode of Columbo starts by showing a murder exactly as it happened. So, from the very beginning, we know who the victim is, who the murderer is and how the murder has been committed. The ending of the story is not a question: Columbo will arrest the murderer. So, we don't watch this series for the excitement of whether the murderer will be caught or not. Then why do we watch it? Well, for the specific way Columbo solves the crime with all the tiny, seemingly insignificant details that are slowly pieced together to create an unwavering proof. In short, we watch it for Columbo's particular *path* towards solving the case. And, of course, for one more thing: Columbo's rigorously funny character.

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[1]This thought is beautifully captured by the painting of Ma Yuan, where the figure in the painting walks on a mountain path, quickly vanishes (see Fig. 1.2).

Fig. 1.2 Ma Yuan, "Walking on a Mountain Path in Spring" [With the permission of the National Palace Museum of Taiwan.]

How universal are those seemingly useless turns in *paths* that humans make in their everyday life, and why do they exist? How winding should they be? Can we collect and analyze data about them to discover their properties? And how can we use such information to predict the behavior of diverse, real-life systems that clearly implement paths? In this book, we try to address those questions. We seek a functional sequence of steps that take us closer to the nature of real-world paths. Searching for a path to paths? This sounds crazy enough. Let's to jump in and start our long and winding journey...