Laudatio for Simon A. Levin
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Ladies and gentlemen,

it’s a great pleasure and a privilege for me to deliver this laudatio in honor of Professor Simon Levin, the recipient of the 2014 Luca Pacioli prize.

Graduated in mathematics at the University of Maryland in 1964, Professor Levin spent 27 years at Cornell University, first as an assistant professor of mathematics and then as a professor of applied mathematics and ecology, at a time when, as he himself once said, “most mathematics departments where not ready for a real commitment to applications, especially in biology.” He then moved to Princeton where he is currently the George Moffett Professor of Biology and the Director of the Center for BioComplexity. Over his 50-year-long career, he collected an impressive number of prizes and awards, such as the Kyoto Prize in Basic Sciences (in 2005) and, last year, the Tyler Prize for Environmental Achievement. In recognition of his scientific contributions, he has been elected Fellow in several scientific societies, including the American Association for the Advancement of Science, and the Ecological Society of America.

More than 20 years ago, in 1992, in the same year he moved to Princeton, Professor Levin published one of the most influential papers in modern ecology, which counts almost 5,000 citations to date. This was based on a lecture he gave a few years before in Toronto on the occasion of receiving the prestigious Robert MacArthur Award. In opening his paper (and his speech), he confessed how difficult it was for him to choose the topic of his lecture. He said he considered several options, including the interface between population ecology and ecosystems science, the dynamics of structure populations, diffuse coevolution, life history response to variable environments, and so on, only to conclude:

“as I looked back over my career, which had included flirtations with each of these problems, I was struck by what a patchwork it seemed.”

“What was the thread, if any, that had guided my wanderings?” he then asked himself.
Now, this happened more than 20 years ago. Meanwhile Professor Levin’s scientific interests have broadened substantially to include epidemics, finance, economics and, more generally, social sciences. So, I guess you can imagine how challenging, yet rewarding, it has been for me to prepare this laudatio, trying to find the thread which Levin himself was looking for back in the 1990’s, and to summarize in a few minutes such an outstanding and multifaceted scientific career.

In preparing my speech, it came to my mind that British political philosopher Sir Isaiah Berlin once famously divided intellectuals into two broad categories, the hedgehogs (which, according to an ancient Greek poet, “know one big thing”) and the foxes (which, instead, “know many things”). As he put it, in his book:

“There exists a great chasm between those, on the one side, who relate everything to a single central vision, one system more or less coherent or articulate, in terms of which they understand, think and feel [...] and, on the other side, those who pursue many ends, often unrelated and even contradictory, connected, if at all, only in some de facto way, for some psychological or physiological cause, related by no moral or esthetic principle.”

According to Berlin, men like Plato, Dante, Pascal, Dostoevsky, and Nietzsche, to name just a few, belong to the hedgehogs, while men like Aristotle, Shakespeare, Montaigne, Pushkin, and Joyce belong to the foxes.

Charles Darwin also made a similar distinction between splitters (“those who make many species”) and lumpers (“those who make few”). And in a similar vein, the eminent theoretical physicist Freeman Dyson more recently described two kinds of scientists: the unifiers (“whose driving passion is to find general principles which will explain everything”) and the diversifiers (“people whose passion is to explore details”). Two kinds, as Dyson suggested, typified by two cities, Athens and Manchester, and by two great scientists, Einstein and Rutherford, respectively.

Although all dichotomies look suspicious, and these ones are probably no exception, I think it makes sense to ask which category Simon Levin belongs to. Is he a hedgehog or a fox? A lumper or a splitter? A unifier or a diversifier?
At first sight one might be tempted to say that he looks like a fox, “who knows many things.” Indeed, by looking at his vast scientific production one can’t help being impressed by the breadth and diversity of the problems he worked on. You will find, for example, studies on the reciprocal insurance among Kenyan pastoralists, on the effectiveness and the design of vaccines against influenza and other viral diseases, on the design of marine reserves for interacting species, on the spread of social norms, on collective decision-making in animal populations, such as how birds flock, and so on so forth.

But, at a closer scrutiny, it becomes apparent that throughout his entire career Professor Levin has constantly followed a coherent path and has been actually guided by a single unifying idea. If I have to find one sentence to sum up Simon Levin’s scientific profile, I would say that “he is a man in search of patterns” or, more precisely, “in search of the processes which produce them.” Since the beginnings of his research work, in fact, he has been fascinated, I would even say obsessed, with the notion of a pattern, with all its different manifestations in Nature, and with the question of how patterns emerge across different scales within a complex dynamical system. As a matter of fact, it is precisely the interplay between the notion of a pattern and the notion of a scale which has characterized much of Levin’s unique contribution to science. As he pointed out in his 1992 paper I mentioned before “understanding patterns in terms of the processes that produce them is the essence of science.”

Indeed, patterns are everywhere and we seem to have a natural instinct for patterns. Probably the clearest example of pattern formation processes can be found in visual perception. We open our eyes and our visual system immediately and unconsciously tries to make sense of the outside world using the stimuli produced by the retina. And the same of course is true for all the other sensory faculties. Our instinct for patterns is so fundamental to our perceptual processes that we see patterns even where there is none. We see constellations in the night sky, we pretend to see forms in the clouds, and many visual illusions, such as the famous Kanizsa’s triangle, are based precisely on this principle.

In the first half of the XX century psychologists belonging to the so-called Gestalt school tried to understand the basic laws of pattern formation in perceptual processes, and they soon realize that this idea applies far beyond the limits of sensory experience to embrace high-level cognitive processes, such as learning, memory, reasoning, and so forth. Isaiah Berlin, whom we met before, went so far as to contend that “to understand is to perceive patterns.”
But, of course, patterns do not exist only in the eye of the beholder. They are indeed constantly found in Nature as well, at all levels of natural phenomena, ranging from the atomic, to the cellular up to the ecological and the social ones. And most interesting phenomena within these fields have one fundamental thing in common. They can be abstractly thought in terms of a complex adaptive system, namely a system consisting of interacting components whereby the individual behavior of components affects the whole system, and changes at the aggregate level in turn affect how the components behave.

Ecological as well as economic and financial systems are typical examples of complex adaptive systems, in which patterns at the macroscopic level do emerge from interactions and selection processes mediated at many levels of organization. As Professor Levin himself has pointed out in a recent interview:

“Modeling a forest ecosystem in which there are a number of complicated relationships is not that different from the global financial system of banks, investors, businesses and financial markets. Just as the global financial crisis was sparked by a handful of players, a change in one species can impact an entire forest ecosystem.”

Thanks to Levin’s distinctive mathematical approach we now have a deeper understanding of the dynamics underlying the emergence of complex behavioral patterns in Nature, and his studies have shed new light on how groups — whether of humans, animals, plants, or cells — interact, cooperate and compete within a community. His work has had a profound impact in such diverse fields outside the realm of ecology as economics, finance, international relations, epidemics, bioterrorism and health policy, and it has been one of his most fundamental insights to understand that the processes responsible for the emergence of patterns in socio-economic systems are conceptually identical to the ones occurring in ecological systems. As he recently put it:

“we can learn a lot about how individuals cooperate, how leadership occurs, and even why individuals assume different roles in society, by looking to something as far-removed as a slime mold or a school of fish.”

In conclusion, whether Professor Levin belongs to the hedgehogs or to the foxes, to the lumpers or to the splitters, his work does exemplify the pinnacle of achievement in interdisciplinary research, a work which has inspired a generation of researchers all over the world who are carrying on his
unique approach. And I can think of no better recipient of a prize named after Luca Pacioli, a man with an unparalleled breadth of interests, whom Leonardo da Vinci used to call “maestro.”

Thanks for your attention.