University of Pisa
Computer Science Department

Ph.D. Program in Mathematics for Economic Decisions

Leonardo Fibonacci School

Ph.D. Thesis

Methods and Models for Environmental Conflicts Analysis and Resolution

SSD: MAT/09 - Operations Research

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To Daniela,
mi corazon y mi vida,
and in loving memory of Yuri,
saucy elf
in cat's clothes ...

To Jona
and Juno
cattish little dwarfs ...
past fades into future ...

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Thanks

This dissertation, as every other work of thought, owes much to many people that in these years have helped me in many ways, otherwise I could have never been able to reach any conclusive (though provisional) point.
Hoping not to forget any of them, having already mentioned my lovely Daniela and Yuri (and Jona and Juno) in the dedication, I wish to start with Professor Giorgio Gallo who also supervised me in my Master Degree Thesis and who proved really forbearing and friendly, more about his contributions in the Preface.
Immediately after him I wish to thank my friends Fausto Pascali and Tommaso Pucci without whose help and stimulus I surely could not have succeeded in completing my PhD course. Especially Fausto is really a fantastic guy, witty and clever. We spent also a somewhat long bunch of months in the same office (with our desks face-to-face) and I think I will remember that period for the rest of my life. I wish also thank Raffaella and Francesca, we attended a Game Theory course together but we met also in many other both serious and funny occasions, but also Roberta and Flavia as well as all the other students that entered the PhD course during my enrollment. I learned a lot from them and with them.
No intellectual work, however small it may be, spring up in the desert and the present is by no way an exception. I indeed owe a lot to many people among whom the "team" of the Professors of the PhD course (among them I wish to thank especially Professors Laura Martein, Alberto Cambini, Riccardo Cambini and Domenico Menicucci), the staff of the Library of the Faculty of "Economia" of the University of Pisa (with special thanks to Mara Guazzerotti) and the staff of the Library of the Faculty of "Sociologia" of the University of Florence (with special thanks to Elisabetta Bosi).
Last but not least I wish to thank Professor Fioravante Patrone, for his beautiful on-line course on Game Theory, and Professor Vito Fragnelli for his advice and friendship.
Finally, many thanks also to the many purposely kept anonyms that make evergreen the words of the famous Italian poet Eugenio Montale[1]:

Non domandarci la formula che mondi possa aprirti,
sì qualche storta sillaba e secca come un ramo.
Codesto solo oggi possiamo dirti
ciò che *non* siamo, ciò che *non* vogliamo.

[1]Don't ask us the formula that worlds can open you\ but only some sprain syllable and dried like a branch.\ That only we can tell you\ what we are not, what we want not. (free English translation by myself, may Montale forgive me!)

Basic notes

This thesis[2] is concerned with interactions of actors, stakeholders and the like. In order to avoid cluttering the text with forms like he/she we are going to use male forms but for cases where we describe interactions of pairs of parties where we try to use the male form for one party and the female form for the other. Sorry, but a word to the wise is enough.
The mathematics is kept at a low and colloquial level in the text but when more formal approaches are needed. The notation we use is standard and should cause neither troubles nor misunderstandings. Anyway notes will be used whenever necessary.
As to the written language, we apologize since now for its quality that we strove it was our best possible. We only underline that we tried to follow conventions used in the US version of English and that we tried to formulate our sentences as plain and short as possible, sometimes clumsily failing the target.

Assumptions

As usually, in this dissertation there are terms that we use without any precise definition since they are thought to belong to the common knowledge and since any definition must rely on primitive terms so that it is neither possible nor convenient to define everything. This is true for the term set, for instance, and is common practice in mathematics. Anyway we devote this section to the description of the terms that we are going to use as primitive in this thesis.
The first term is the word **actor**. With this term we denote any [possibly collective] entity that is capable of acting in various contexts according to some deterministic or probabilistic set of rules. In the former case the rules are fixed and are chosen in a predefined way so that they may be arranged to form a recipe or, more formally, an **algorithm** or a **procedure**.
In the latter case every rule has either a objective or a subjective probability of being chosen. In this case the choice of a rule from a given set may be carried out through the drawing of a purposely many faced die. In this case we may speak of stochastic recipes or algorithms. In this thesis we will focus mainly on algorithms and procedures.
The term actor identifies a very wide set so we need some terms to characterize its meaningful and possibly overlapping subsets. Among these terms

[2]We are going to use both the term thesis and dissertation simply to be less monotonous and to show off a richer lexicon.

we mention here the term **decider**. With this word we translate the Italian word **decisore** with the same meaning of the more classical **decision maker**. There is no rational reason behind this choice but a matter of taste. Other terms include the words **stakeholder** and **expert** that will be defined and characterized at the proper places.
In the thesis we are going to distinguish between deterministic and non-deterministic situations. We refer to [89] for this characterization. With the term **determinism** we denote the fact that any action performed by an actor is guaranteed to have always the same outcome so that, for instance, it always fails or succeeds. If this is not guaranteed so that an actor must check the outcome of his actions to verify their effective outcomes we speak of **non determinism**. We stress how this distinction has nothing to do with probability assignments of success or failure and tries to describe the interactions of the decision processes of autonomous actors that competitively act in the same environment.
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The same is partially true for the term **model** that we are going to use in many places. With this term we mean an abstract description of some aspects of a portion of the "real world", whatever this may mean. As such a model takes in consideration only some aspects in a goal dependent context. Since the word enters in the title of the thesis we are going to examine it in some detail in Chapter 1 together with some of the other words of the title. In this dissertation we are going to use mainly **system dynamics** models but also **game theory** models and models of [collective] **decision** and **choice**. Obviously the basics of such topics are given for granted but for some aspects that are examined in the Appendices in ad hoc footnotes.

Preface or the genesis

"Would you tell me, please, which way I ought to go from here?"
"That depends a good deal on where you want to get to", said the Cat.
"I don't much care where-" said Alice.
"Then it doesn't matter which way you go." said the Cat.
"-so long as I get somewhere," Alice added as an explanation.
"Oh, you're sure to do that", said the Cat, "if you only walk long enough"
L. Carrol

When I decided to engage myself in a PhD course the only thing I had clear in my mind was the person with whom I wished to work, that is to say the supervisor of my Master Degree Thesis, Giorgio Gallo.
From any other point of view I was in Alice's position: I had no idea either of what PhD course I could choose or about the topic of my [future] dissertation thesis or the very nature of a PhD course itself. I had a feeling, a desire of performing some research and, possibly, some teaching, just to go somewhere but without any clear place to go.
I owe all to Giorgio. First of all he was so kind to avoid saying me that maybe my idea was crazy, to say the less, then he directed me to the proper PhD course. He told me that I had to study some economics but that it could have been a somewhat pleasant burden. During the three years of my PhD studies (that became four along the way and are going to be six at the end of the story) I indeed had to study some economics, mainly under the form of formal models from more or less traditional points of view. I also studied some Game Theory and found it interesting but puzzling since its concepts are based on a normative vision of the world that in many cases lacks of a real explanatory power. Moreover the fact that Game Theory (at least in its classical form) pretends to deal with rational and neither benevolent nor malevolent players prevents the analysis of many real situations where the involved actors are guided by such feelings or by spitefulness, grudge or the like.
At the same time I had the chance to attend some regular university courses such as "Mediazione e Conciliazione" (Mediation and Conciliation), "Economia Ecologica" (Ecological Economics), "Decisioni in Situazioni di Complessità e Conflitto" (Decisions in Situations of Complexity and Conflict), "Modellistica Ambientale" (Environmental Modeling) (these two last courses had Giorgio as lecturer) and this broadened my vision of economics and let me know the existence of concepts, processes and points of view that aim at obtaining more holistic solutions to problems and conflicts.
The course of "Mediazione e Conciliazione" proved very valuable since I could

appreciate the importance of consensual procedures aiming at the reaching of win-win agreements in many spheres with particular attention to social conflicts among groups involving also the environment.
Attending the course of "Economia Ecologica" I could appreciate points of view far away from the neoclassical approach. That course introduced me to concepts such as positive and negative externalities and natural capital going beyond the pure economic cycle of demand and supply with the use of environmental constraints represented by the laws of thermodynamics that prevent an unlimited growth of both population and consumption.
Attending the course on "Decisioni in Situazioni di Complessità e Conflitto" I was introduced to new topics but also I could frame my knowledge of other topics within the environmental domain. Among those of the former type I mention here projects evaluation (costs/benefits analysis, costs/effectiveness analysis, multicriteria analysis); conflicts management and transformation; voting and choice methods; co-operation, competition and exploitation. Among those of the latter type I mention here the structuring of problems and system dynamics.
Beyond what I have already said Giorgio's contributions are almost uncountable. First of all he suggested the title of the thesis and many of its topics. He also suggested me a lot of good readings and had to correct the uncountable errors and misspellings of the various versions of this thesis (at least three or four). Then he had to contrast my tendency to "creative" digressions so to keep me on track, surely the labor of Sisyphus. Last but not least he spent a lot of time in trying to convince me that my way of writing the thesis was wrong, that I had to be more precise, cite the sources, avoid to reinvent the wheel and to devise strange ways to heat the water, some self evident (but not for me) applications of Occam's razor.
He also let me act both as a voluntary tutor and as a contract holder (for five consecutive years) in his university course of "Modellistica Ambientale" (Environmental Modeling) where I could both practice some teaching, be in contact with younger and clever students and deepen my knowledge of System Dynamics and apply it to environmental matters.
All this is mirrored in the thesis, both in its structure, in the topics it deals with and the ways through which this is done.
And now "rise up the hem of the skirt, my Lord, since we are going to hell"[3].

[3]Williams Carlos Williams, freely back translated from his preface to the Italian version of "Howl and other poems" by Allen Ginsberg.

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