# The Issue of Computational Thinking Education

## In European Humanistic Departments

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# IRAFS website: [www.irafs.org](www.irafs.org)



## IRAFS

The **International Research Area on Foundations of the Sciences (IRAFS)** was constituted at the Pontifical Lateran University (PUL) in October of 1997. In seventeen years of activity, the Area has promoted at the Lateran University, several conferences, courses and debates, overall through its active participation in the STOQ Project.

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## Welcome to the IRAFS Portal

The IRAFS - *International Research Area on Foundations of the Sciences* - is the first of the research areas based at the Pontifical Lateran University. Its official foundation dates back to October 1997, just about a year away from the premature death of him who was the first promoter and founder of the Area: ENNIO DE GIORGI. Professor at the "Scuola Normale Superiore di Pisa", Member of the "Accademia dei Lincei" in Italy, of the "Académie de France", of the "National Academy of Sciences in US, and of the "Pontifical Academy of Sciences" in Vatican , he was one of the greatest mathematicians of the twentieth century.

- Professor De Giorgi...
- IRAFS was founded...
- The various disciplines...

## News

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Workshop on
"Ontos & Logos"
PUL, Room "Pope Francis"
February 9th, 2016 - h. 15-17

Presentation of the new book: *Ontologia Formale*, G. Basti, S. Mobeen, APES Ed., Rome, 2015, with contributions of Habermas, Searle, Ales Bello, Basti, Kanakappally, Poli, Mobeen, Giovagnoli.
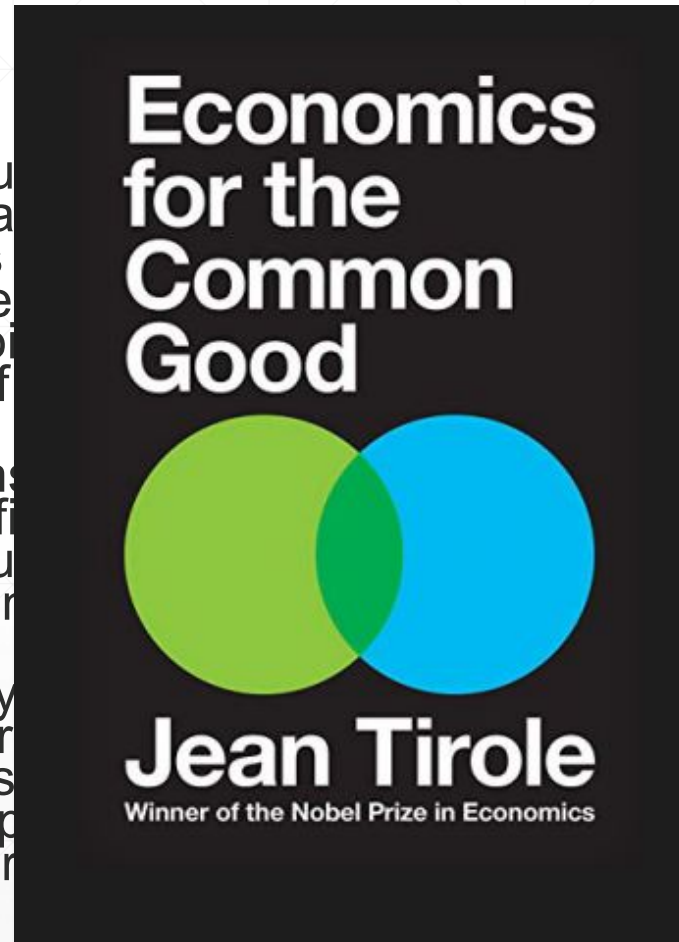Presenters: A. Iodice, G. Traversa, D. Santoro.
Chair: Ph. Larrey
More...

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# The actual political and social challenge in Europe…

- «All over the world, populists have been having a field day. And while populism comes in many guises, and is triggered by specific causes in each country, it always plays on the electorate's frustrations (unemployment, immigration, the slowdown in economic growth) and fears for the future (rising debt, job-destroying technology, climate change). It exploits these frustrations and fears to foster widespread hostility to immigrants, distrust of free trade, and xenophobia (…)

- «Yes, economics remains an inexact science. Yes, economists' judgment is sometimes impaired by financial conflicts of interest, political friendships, or ambitions for public recognition. But in my view, and contrary to the current mood, economists can play a more important role now than ever.

- «For this to happen, they need to guide their countries through a period of low growth, prepare them for the digital revolution and its many socioeconomic challenges, and design solutions to unemployment, climate change, financial regulation, monopolies, poverty, and inequality. Economists must anticipate change much more than they currently do» (Tirole, 2017, p. 481-483)

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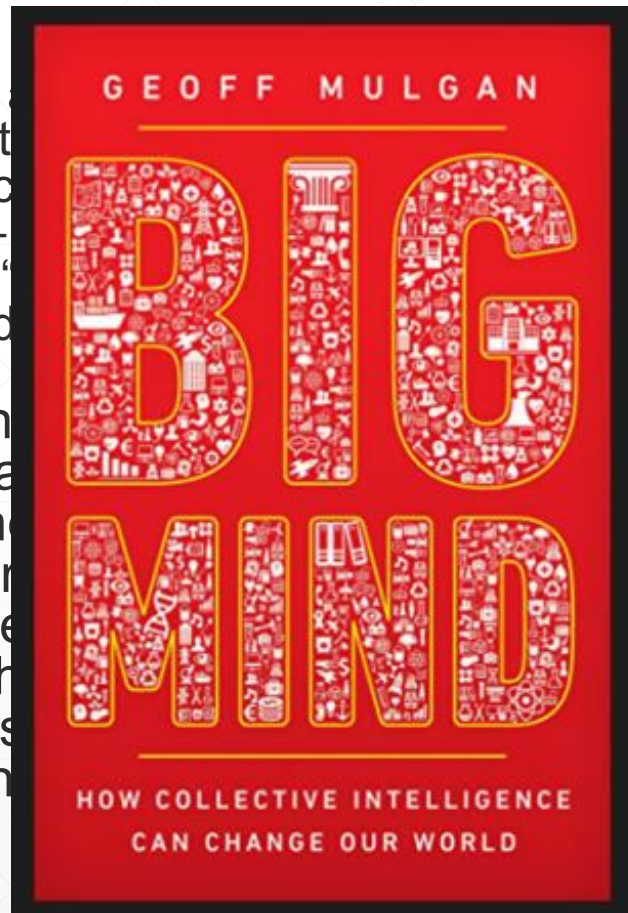
# …and the role of IT and AI

- All of us working in computer science know very well that for helping economists, and policy makers in general, in the tremendous challenges depicted by Tirole, the support of AI for designing and implementing reliable models, both in macro- and in micro-economics realms, is unavoidable.

- Effectively, the realm of social and economic computational models is one of the more significant ones, where the infrastructural integration of machine and human intelligence displays all its unavoidable necessity in our **Information Age** (Basti, 2017).

- → Necessity of an integration between **unconscious communication agents** and **conscious communication agents**.

# From "computer aided *Collective Intelligence*"…

- More recently, Geoff Mulgan, in a visionary book published like Tirole's one by Princeton UP, spoke on this regard about the necessity of developing the new discipline of *collective intelligence*, to support reliable collective choices, before all at the economic and political levels. Surprisingly – probably – for many of us, at the end of the book, Mulgan claimed for the necessity of developing the "collective intelligence", characterizing our "digital civilization", into a "computer-aided *collective wisdom*".

- Indeed, Mulgan recalls, the notion of "wisdom" generally means the ability of human intelligence «to take a long view integration of ethics into thought and decisions, and attention to the details of context rather than simple application of rules or heuristics» (…). Therefore, "a digital civilization" «that was wiser would combine the universal knowledge of science with much more context-based knowledge, and might even have managed to devise machines that could help people to be wise in this sense – for example showing the possible long-term effects of decisions, or making ethics visible» (Mulgan, 2018, p. 224).

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# …To "computer aided *Collective Wisdom"*

- In fact, coming back to Tirole's challenge, we could ask ourselves: how much of the "electorate frustrations" that ignited the contemporary populistic reaction depends on the dramatic lack of such a computer-aided "collective wisdom"? To be more concrete, it is well-known, for example, that more than 40% of economical transactions in the global market are today made by using algorithms that are developed exclusively for maximizing the financial immediate profit, without following any long-term, context-dependent (that means: "people-dependent"!) ethical optimization criterion.

- In other words, our economic and financial practices suffer a "deadly schizophrenia" between computer-aided, often very efficient financial tools like algorithms used in the computer-farms of all the major financial companies, which open and close positions on the world-wide markets in tenths of second, and an ethical and legal control – if any – over transactions.

# Ethics in machines more reliable than in humans

- This is entrusted exclusively to slow and limited human agents. It is evident the disproportion of resources: the "human wisdom" alone is insufficient for managing and controlling efficiently financial choices satisfying also ethical constraints, both in terms of the complexity of the always changing contexts, and, overall, in terms of the velocity of the decision process required.

- Moreover, we must not forget the "ethic visibility" criterion stressed by Mulgan, and that only the deontic automated reasoning can in principle grant (Benzmüller, Farjami, & Parent, 2018), differently from human minds. In other words, the ethical/legal accountability of a "collective wisdom" requires also the full accountability of the ethical/legal optimization criteria effectively used. A requirement that the *conscious* human wisdom cannot in principle grant.

- To complete the picture, other critical fields of application of computer-aided collective wisdom concerns practically all the most critical fields of development of social media, of AI autonomous systems, and of robotics. From unmanned vehicles and aircrafts, to the medical, rescue, and military applications of robotics, to the automated management of sensible data practically in any realm of our "digital society"...

# The necessity of implementing "CS and Philosophy" and "CS and Law" study programs (BA, MA, PhD)

- All this implies a fundamental *educational challenge* for our society, our universities before all. Indeed, the design and development of algorithms and architectures for computer-aided applications in the ethical, legal, and humanistic realms, require **necessarily the implementation of computer science study programs in the humanistic departments**, the philosophy and law departments before all, for preparing skilled researchers and practitioners in these new fields.

- **The design, the development, and the management of** *applied* **computational tools in deontic automated reasoning is necessarily an** *interdisciplinary task* **that cannot be left to the only computer engineers but requires a growing number of philosophers and lawyers, with professional skills in computer science and advanced computational thinking** that make able them to interact effectively with computer scientists.

# The Scheme of a BA in "CS & Phil" in the Philosophy Depts of the Pontifical Universities

| CSP COURSE TABLE | | |
|---|---|---|
| | **Philosophy** | **CS/IT** |
| **First Year** | History of Ancient Philosophy | Engineering Mathematics I (Calculus and Mathematical Anal.) |
| | History of Middle Age Philosophy | Engineering Physics |
| | History of Modern Philosophy | Foundations of Computing and Programming in C |
| | Logic I (Classical and Mathematical) | Communicative English and Technical Writing |
| | Turing Computability and Turing Test in AI (°) | Programming Lab |
| **Second Year** | Epistemology | Engineering Mathematics II (Numerical Calculus and Discrete Mathematics) |
| | Logic II (Philosophical: Modal and Intensional)(°) | |
| | Anthropology | Engineering Mathematics III: Probability, Random Processes and Numerical Techniques |
| | Ethics I | Data Structures and Algorithms |
| | Cognitive Science and Neuroscience (°) | Data Structures Lab |
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| **Third Year** | Ontology & Metaphysics | Engineering Mathematics IV |
| | Formal Ontology and Knowledge Management(°) | Principles of Programming Languages |
| | Ethics II | Object Oriented Design and JAVA Programming |
| | Philosophy of Nature and of Science | Advanced Database Management Systems |
| | Logic III (Category Theory: mathematics, logic, computer science) | System Software Lab |
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