POLITECNICO DI MILANO

PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 3 - Systems and Control

PNRR 118 PA Research Field: LEARNING-BASED MODELLING AND CONTROL FOR DIVERSITY-AWARE AND INCLUSIVE DECISION-MAKING

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Data-based and smart technological systems are not intrinsically neutral. Biases due to prejudices related to the social identity of individuals are becoming more and more relevant, and can undermine both their design and their usage. All the more so when these systems or services are endowed with incentive policies and support schemes that take decisions that should in principle augment social justice. At the same time, especially with reference to sustainable technology solutions, their success is strongly tied to mass adoption, which may occur only if such technologies are inclusive, fair and respondent to the socio-economic characteristics of their intended users, and the related decision-making processes can perform cost/effectiveness reasoning bringing equity and fairness within a quantitative framework at design time. The individual characteristics must be appropriately represented within an intersectional framework that defines diversity as the combination of social variables describing each individual, understanding how these features impact on the decision process. Making technology and decision-support systems an active means for the enforcement of social justice and the reduction of inequalities is fundamental to meet the goals of the EU-promoted “Just transition”, which intertwines

	environmental sustainability goals with social development and inclusion. The objectives of the research are to frame learning-based methods and tools to define, model and quantify fairness objectives in dynamic decision-making contexts and embed them within closed-loop decision-making. This will be carried out with reference to different individual diversity dimensions. Applications of the framework will be carried out focusing on significant and representative case-studies, with particular attention to smart mobility and other applications within the ecological transition context.
Methods and techniques that will be developed and used to carry out the research	A theory of human-centered modelling and control for diversity-aware decision-making does not exist yet. To build this new vision, the research program will need to appropriately combine domain-specific competencies of the considered technological context with machine-learning and data-based, control-oriented decision-making tools that will be combined and appropriately extended. The context will be data-driven, to combine quantitative requirements and user's profiles with quantitative representations of opinions and beliefs and socio-economic variables of classes of individuals aggregated via appropriate machine-learning techniques. Their evolution will be taken into account to tune it to the the evolving social context. To pursue diversity-aware, closed-loop decision-making strategies we will work to devise novel “fair-learning” approaches and embed then within constrained decision-making frameworks, both centralized and distributed, to investigate central and participative decision systems. The literature showed that dynamicity can destroy fairness properties, so the research will work to extend existing results and account for a time-varying application horizon. Fairness is key, as the process of analysing data to learn new patterns and take decisions can indeed perpetrate stereotypes and increase -- rather than reduce -- inequalities if not properly managed.
Educational objectives	The candidate will have a unique opportunity of working on a multidisciplinary research project, combining both

	technological and sociological aspects that are needed to address the challenging and timely topic presented above. This entails a growth path for the candidate that will make her/him acquire different competencies – mainly technical and technological, in the disciplines mentioned in the methodology description, but also considering the socio-technical nature of the considered problem, which is key to proposing effective solutions. The research outputs will target publishing on international conferences and journals, with specific attention to all the venues of interest for the different facets of the research.
Job opportunities	Expertise in data analysis, machine-learning and dynamic decision making certainly makes the PhD candidates very appealing for a wide range of high-end positions. These range from the more contro-oriented ones to those more related to policy design. Thus, our candidates might apply for positions both in technical companies and in public institutions or academia.
Composition of the research group	2 Full Professors 3 Associated Professors 32 Assistant Professors 25 PhD Students
Name of the research directors	Mara Tanelli

Contacts
Email: mara.tanelli@polimi.it Phone: +39 02 23993621 https://www.move.deib.polimi.it/

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation

Company where the candidate will attend the stage (name and brief description)	Cnr-Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni (CNR-IEIIT) di Torino
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Technical University of Eindhoven
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Technology has the strongest means to impact on individual lives. Making technology-supported decisions is becoming mainstream. Making them "fair" is a moral imperative. This research aims at contributing to this pivotal issue, devising how to model and design feedback-enabled learning environments to support just and inclusive decisions.

EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.

TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

COMPUTER AVAILABILITY: individual use

DESK AVAILABILITY: individual use