

## SCHOLARSHIPS

### CNR/IIT

**1) Project Title:** *Hybrid Human-AI Systems: Systems where Humans and Artificial Intelligent Agents cooperate synergistically*

**Abstract:**

With the increasing pervasiveness of AI systems, it is more and more common to have direct interaction and collaboration between humans and AI agents working together on a given task. Examples include mixed human-AI driving systems, or collaboration between humans and robots in industrial systems. In these cases, specific decisions on a given problem may be taken either by the human or the AI agent. Therefore, it is fundamental to design proper ways to orchestrate decisions between them. The focus will be on mixed human-AI systems, whereby it would be possible to automatically decide how to shift responsibilities between human beings and AI agents, possibly via higher-level AI which predicts at each point in time the best option for a specific task. The activities will involve a mix of modelling, systems/algorithms design, prototype development, and performance evaluation via experiments, analysis, and simulation.

**Reference Person:** Dr. Andrea Passarella ([a.passarella@iit.cnr.it](mailto:a.passarella@iit.cnr.it))

**2) Project Title:** *Sustainable AI Systems*

**Abstract:**

Energy efficiency of AI systems is one of the key frontiers of AI research. As AI becomes pervasive, and supports energy conservation applications, we must ensure that the carbon footprint of AI itself is as little as possible. One key trend in this perspective is embedded AI, whereby AI becomes pervasive in all devices at the edge of the Internet, including user personal devices, such as smartphones, tablets, and IoT. This limits energy costly data transfer back and forth to big data centres, but requires tight collaboration between devices, as none of them have complete data and comparable resources. The focus of the activities will be to make pervasive AI energy efficient. This entails reducing the memory, computation and communication footprint of both training and inference phases of AI models operating on a collection of collaborating devices. Novel solutions for AI compression, pruning and aggregation will be investigated, prototyped and thoroughly evaluated. The activities will adopt a blend of algorithmic design, analytical modelling, systems prototyping, as well as evaluation both in real scenarios and in simulation.

**Reference Person:** Dr. Andrea Passarella ([a.passarella@iit.cnr.it](mailto:a.passarella@iit.cnr.it))

**3) Project Title:** *Mitigation strategies to tackle social harm caused by generative Artificial Intelligence*

**Abstract:**

This project aims to investigate the impact of generative models on society, in order to devise strategies to mitigate the negative effects. Generative language models, like GPT-4, have demonstrated the ability of generating content that seems human-made. This remarkable feature, alongside novel opportunities, also presents risks and challenges, like the creation of sophisticated scam operations or disinformation campaigns such as spreading fake news, images or memes on social media to mislead users. As various entities rush to integrate poorly tested AI tools into their services, it is urgent for researchers to devise proper measures to ensure users' safety.

In this project, we will first explore the various dimensions of the implications that generative language models may have on our societies. By analyzing real-world case studies, like the production of novel forms of misinformation on social media platforms, we will gain insights into the potential negative consequences of AI tools. To tackle these challenges, our research will focus on investigating techniques for improving the transparency and accountability of generative models. One relevant example is the use of distributed ledger technologies as a potential solution to identify and trace generated content.

The results of our investigation will contribute to a better understanding of the risks associated with the widespread use of AI-enhanced tools. Additionally, our aim is to contribute to the development of effective strategies to promote responsible and safe usage of AI-based tools.

**Reference Person:** Dr. Maurizio Tesconi ([maurizio.tesconi@iit.cnr.it](mailto:maurizio.tesconi@iit.cnr.it))

**UNIVERSITÀ CATTOLICA DEL SACRO CUORE (MILANO)**

**1) Project Title:** *Implementation of Social Norm Acquisition Models for the Development of Multiagent Interactions based on Trust*

**Abstract:**

The project aims to investigate the behaviors associated with multiagent interaction dynamics involving humans and artificial systems, including robotic systems, and between artificial systems themselves. This is in order to develop psychological models of interaction, as well as models of artificial cognitive architectures, within human-centered multiagent systems. Particular attention will be paid to constructs related to social and moral norms that characterize human relationships and that can facilitate the building of trusting relationships between all components of the interaction, whether human or artificial intelligence. Any expertise in the area of computer programming and the development of artificial models of human-robot interaction will be considered during the selection process.



**Reference Person:** Prof. Cinzia Di Dio ([Cinzia.DiDio@unicatt.it](mailto:Cinzia.DiDio@unicatt.it))

**2) Project Title:** *Creation of Machine Learning Models for the Evaluation of Cognitive Processes through Interaction with Virtual Reality*

**Abstract:**

The project aims to explore the potential of virtual reality as an experiential tool for the assessment of cognitive processes. Specifically, the goal of the project is to use supervised machine learning techniques to assess and recognize cognitive deficits through interaction with immersive virtual reality experiences. Particular attention will be paid to memory, executive functioning and attention as assessed using clinical tools and classical neuropsychology questionnaires. Knowledge of basic principles of neuroscience/cognitive processes as well as knowledge of machine learning techniques and the use of virtual reality is required.

**Reference Person:** Prof. Giuseppe Riva ([giuseppe.riva@unicatt.it](mailto:giuseppe.riva@unicatt.it))

**CNR/ICAR**

**Project Title:** *Technologies of explainable artificial intelligence and extended reality for the analysis of archaeological data*

**Abstract:**

To improve the understanding and interpretation of cultural heritage, this project aims to study and develop innovative methodologies to acquire, process and visualise archaeological data in an immersive way. The combination of artificial intelligence and extended reality, with an emphasis on explainable AI techniques, will offer a multidisciplinary approach for the analysis of archaeological data, including the identification and classification of artefacts, and the reconstruction of historical structures and environments, overcoming the spatial and temporal limitations of traditional research.

**Reference Person:** Dr. Franco Cicirelli ([franco.cicirelli@icar.cnr.it](mailto:franco.cicirelli@icar.cnr.it))

**ENERGEE3 SRL**

**Project Title:** *Human Centered AI for Digital Transformation*



**Abstract:**

This doctoral research, titled "Human Centered AI for Digital Transformation," delves into the integration and application of artificial intelligence (AI) in the realm of digital transformation, placing special emphasis on human-centered perspectives. The study explores the interplay between AI technologies and humans, focusing on how AI can be designed and implemented in a manner that is sensitive to human needs, ethics, values, and social contexts.

In the midst of rapid digital transformation, the research addresses the imperative need to keep the human experience at the center of these changes, while still leveraging the advancements of AI. The project scrutinizes various AI applications, such as in industries, businesses, and social services, and their effects on societal structures and individual lives.

Furthermore, it delves into the development of ethical and inclusive AI models that prioritize human well-being, data privacy, and transparency. Through interdisciplinary approaches, the research contributes to emerging discussions around human-centered AI and offers guidelines for its successful and ethical implementation in the digital age.

**Contact Person:** Prof. Giuseppe Prencipe, Università di Pisa ([giuseppe.prencipe@unipi.it](mailto:giuseppe.prencipe@unipi.it))

**Contact Person:** Dr. Giovacchino Tesi, Energee3 SRL ([giovacchino.tesi@energee3.com](mailto:giovacchino.tesi@energee3.com))

**CNR/ISTI**

**Project Title:** *Machine Learning Techniques for the Analysis of Textual Data*

**2 Positions**

**Abstract:**

This position is open to students who are motivated to work in the fields of machine learning, information retrieval, and natural language processing.

The research topics of interest range from cross-lingual and/or cross-modal learning (e.g. text classification, information extraction, stylometry), to prior probability estimation (quantification) methods, to cost-sensitive learning models (active learning, technology assisted review), deep learning, representation learning and large language models.

**Reference Person:** Dr. Fabrizio Sebastiani ([fabrizio.sebastiani@isti.cnr.it](mailto:fabrizio.sebastiani@isti.cnr.it))



## GRAN SASSO INSTITUTE

### 1) **Project Title:** *Human respectful autonomous and AI-based socio-technical systems*

#### **Abstract:**

Autonomous and AI-based systems are increasingly impactful on human life via implicit and/or explicit human-machines interactions. Then, it becomes more and more important to build systems that are respectful of human values. In this project we will focus on the ethical requirement of human dignity and we will take into account this requirement from the initial phases of the design of the system. The ambition of the project is to demonstrate and experiment the research results on the robotic domain.

**Reference Person:** Prof. Paola Inverardi ([paola.inverardi@gssi.it](mailto:paola.inverardi@gssi.it))

### 2) **Project Title:** *AI solutions for empowering users in their interaction with autonomous systems*

#### **Abstract:**

The project addresses the problem of designing and building software components that can help humans in their interaction with autonomous systems. In particular the project will consider the ethical dimensions that can go beyond privacy protection and encompass other human values like human dignity, and empathy.

**Reference Person:** Prof. Paola Inverardi ([paola.inverardi@gssi.it](mailto:paola.inverardi@gssi.it))

## CNR/ILC

### **Project Title:** *Improving neural language models with human behavior*

#### **Abstract:**

In last few years, language models based on neural networks and deep learning (Neural Language Model, NLM) have revolutionised Natural Language Processing. Through the analysis of huge amounts of unannotated text, NLMs are able to generate representations of the textual data



(words, sentences or paragraphs), called embeddings or distributed representations, which are a key resource in measurable linguistic and semantic information and extremely useful for both analysis and text generation. The proposed research topic fits into this scenario and aims to develop new NLMs capable of incorporating within them processes derived from the study of human behaviour during reading, analysis and production of text. These NLMs aim to guide the generation of increasingly informative and interpretable representations, while at the same time they attempt to reduce the size in terms of the parameters of the NLMs and the input text required for their training.

To this end, new attention mechanisms and linguistic tasks will be investigated and implemented with the aim of training the starting model and guiding the organisation of information within the different layers of the network. Furthermore, it will be investigated whether explicitly incorporating text complexity phenomena within the learning process -- also defined with respect to empirical evidence in the field of cognitive language acquisition and processing -- allows the model to encode different knowledge about linguistic structures and semantic abstractions.

**Reference Person:** Dr. Felice Dell'Orletta ([felice.dellorletta@ilc.cnr.it](mailto:felice.dellorletta@ilc.cnr.it))

## IMT LUCCA

### 1) **Project Title:** *Complex networks: mathematical models and data science applications*

#### **Abstract:**

This project focuses on the structure, dynamics and physics of complex networks emerging from the intricate interconnectedness of the constituents of large systems. Preference will be given to complex networks involved in societal challenges and encompassing financial, economic, social, neural and biological systems. The project will combine a theoretical approach, largely based on statistical physics, information theory, discrete mathematics, and complexity science, with a data science approach informed by the empirical properties of real-world networks.

**Reference Person:** Prof. Diego Garlaschelli ([diego.garlaschelli@imtlucca.it](mailto:diego.garlaschelli@imtlucca.it))

### 2) **Project Title:** *Causal Machine Learning*

#### **Abstract:**

The goal is to contribute to current approaches to causal inference, including new methods for policy impact analysis that combine statistics, econometrics, and machine learning to describe the differential causal impact of interventions in different subpopulations. Uncovering the sources of heterogeneity in impacts is key to generalizing results to populations other than those studied.



**Reference Person:** Prof. Massimo Riccaboni ([massimo.riccaboni@imtlucca.it](mailto:massimo.riccaboni@imtlucca.it))

## INFN

**1) Project Title:** *Accelerating Physics research using Artificial Intelligence*

**2 Positions**

### Abstract:

This position is open to students who are motivated to work in the fields of machine learning, information retrieval, and natural language processing. The research topics of interest range from cross-lingual and/or cross-modal learning (e.g. text classification, information extraction, stylometry), to prior probability estimation (quantification) methods, to cost-sensitive learning models (active learning, technology assisted review), deep learning, representation learning and large language models.

**Reference Person:** Dr. Alessandra Retico ([Alessandra.Retico@pi.infn.it](mailto:Alessandra.Retico@pi.infn.it))

## UNIVERSITÀ DEGLI STUDI DI MESSINA

**1) Project Title:** *Human Centric Trustful Workflows Extended at the Edge, based on Distributed Machine Learning*

### Abstract:

Compute Continuum, the extension of Cloud facilities towards the Edge is becoming a strategic way for accomplishing new paradigm according to the ICT European Strategy. In particular, it represents the progressive convergence between Cloud Computing and the Internet of Things (IoT) where a middle ground exists between data centers and IoT hyper-local networks of sensors and actuators. In all over Human Centric Workflows, like ad example Natural Disaster Management Systems, eHealth Systems, Smart Mobility with Decision Support Systems, and so on, that involved the use of Dashboards, Apps, Drones, Robots, is becoming important to create Compute Continuum, Trusted and Intelligent. To this end, distributing the Intelligence, like Machine Learning at the Ede with Federated Learning approaches is becoming even more challenging. The Intelligence at the Edge increase the levels of Security and Privacy that can be exposed the domain stakeholders and end-users. A Trustworthy Compute Continuum can rely on those aspects to improve their functionality and then will become the basis for constituting the Data Space basis for the future IT EU platforms.

**Reference Person:** Prof. Massimo Villari ([massimo.villari@unime.it](mailto:massimo.villari@unime.it))



## UNIVERSITÀ DEGLI STUDI DI NAPOLI L'“ORIENTALE”

### 1) **Project Title:** *Identification and mitigation of cultural and social biases in Language Large Models (LLM) applied to translation*

#### **Abstract:**

Although not specifically developed for translation tasks, Large Language Models (LLM) -- like ChatGPT and artificial intelligence chatbots based on generative natural language models -- are emerging as useful translation tools. Trained on huge volumes of text, these models seem to offer greater reliability and flexibility than traditional machine translation tools. A much-debated research issue in recent studies concerning both neural machine translation and these models is the presence of biases, i.e. biases of various kinds: gender, race, religion, etc.

These issues arise from the ability of current natural language processing models to discover and reproduce patterns/schemes in training data. In this data, cultural and social biases are often present, resulting in linguistic choices that the models end up assimilating and, in some cases, even amplifying. Sources of bias can be the data, the annotation process, the input representations, the models themselves, as they are designed and developed. Approaches to solving the problems detected vary from proposals for mitigating bias from the training of such systems and models to the creation of datasets used for the evaluation of specific issues, as well as in the development of *ad hoc* metrics.

The project aims to investigate (i) the type of biases present in LLM used for translation by comparing the results with those produced by state-of-the-art neural machine translation systems and (ii) possible mitigation strategies.

#### **Study and research period in a company or research center:**

**Number of months abroad:** (min 6 months, max 18 months)

**c/o Università di Tilburg, Dr. PhD Eva Vanmassenhove**

9 months

**Reference Person:** Johanna Monti ([jmonti@unior.it](mailto:jmonti@unior.it))

### 2) **Project Title:** *Technologies for automated machine translation and creative texts*

#### **Abstract:**

One of the greatest challenges for neural machine translation (MT) is currently the translation of creative texts, such as literary texts, but also marketing and advertising texts and editorial texts. These text types often use non-literal language -- sarcasm, metaphors, irony, and figurative expressions -- which can represent a source of ambiguity for the systems and thus be translated literally, word by word, thus compromising the rendering of the source text in the target language. With current technological advances, researchers in the field of artificial intelligence have identified the possibility of translating these text types, which were excluded until a few decades ago. For





example, NMT systems are now able to learn the similarity between words and consider the context of the whole sentence, so that they can translate more efficiently than previous statistical systems. This project intends to investigate the problems that arise from machine translation of creative texts and which translation strategies can be integrated into natural language generative models to improve results.

**Study and research period in a company or research center:**

**Number of months abroad:** (min 6 months, max 18 months)

c/o ADAPT Centre - Dublin City University

9 months

**Reference Person:** Johanna Monti ([jmonti@unior.it](mailto:jmonti@unior.it))

## UNIVERSITÀ DEGLI STUDI DI SIENA

### 1) Project Title: *Lifelong Machine Learning*

#### Abstract:

The research will be focussed on problems in which a machine is exposed to a continuous stream of information, and it is expected to learn in a life-long manner, progressively improving its skills. The study is aimed at re-thinking the foundational aspects of machine learning "over time", and also at developing agents that benefit from a small number of interactions with humans or other machines. Neuro-symbolic integration will be evaluated as a tool for increasing the memorization, reasoning, and explanation capabilities of agents that learn over time.

**Reference Person:** Prof. Stefano Melacci ([stefano.melacci@unisi.it](mailto:stefano.melacci@unisi.it))

### 2) Project Title: *Large Language Models in Vertical Domains*

#### Abstract:

The rapidly growing ubiquity of large language models has triggered the attention of a variety of people working in different fields. The research will be focussed on the way large language models can be customized to adapt to specific domains/conditions, involving issues that are typical of Machine Learning solutions that learn over time, as well as several other technological challenges. This will require rethinking the foundational aspects of such models, as well as working on frameworks to make them more easily customizable, being in contact with the industry.

**Reference Person:** Prof. Marco Gori ([marco.gori@unisi.it](mailto:marco.gori@unisi.it))



## SCUOLA SUPERIORE SANT'ANNA

**1) Project Title:** *AI, Statistics and Simulation Techniques for big Data-driven Research in Economics, Management, the Law and Engineering*

**3 Positions**

### Abstract:

This project is focused on the development of statistical, computational, simulation, machine learning and artificial intelligence methods for the integration and analysis of huge amounts of data, and the application of these methods in various fields of economic research (e.g., growth, technological innovation, socio-economic impacts of climate change, empirical and theoretical analysis of complex networks and agent-based model simulations), management (e.g., circular economy, innovation management, healthcare management, public health research and biomedical applications), law (e.g., regulatory profiles, data protection, data governance and intellectual property in the field of intelligence), and intellectual property in the field of intelligence, circular economy, innovation management, healthcare management, public health research and biomedical applications), legal (e.g., regulatory, data protection, data governance and intellectual property profiles in the field of artificial intelligence, development of legal argument extraction and/or textual anonymisation tools) and/or engineering/informatics (e.g., scalable and adaptive infrastructures for big-data processing).

## UNIVERSITÀ DEGLI STUDI DI TRENTO

**1) Project Title:** *Operational Optimal Planning for Healthcare Coordination*

### Abstract:

The goal of this PhD scholarship will be to develop novel advanced planning and scheduling algorithms leveraging neuro-symbolic hybrid approaches to orchestrate and coordinate the activities within the healthcare system, by ensuring robustness and resilience to contingencies, accounting for multi-objective cost functions, and eventually providing explanations about the suggested solutions.

**Reference Person:** Prof. Giovanni Iacca ([giovanni.iacca@unitn.it](mailto:giovanni.iacca@unitn.it))

**Reference Person:** Prof. Marco Roveri ([marco.roveri@unitn.it](mailto:marco.roveri@unitn.it))

**2) Project Title:** *Federated multi-targeted domain adaptation*



**Abstract:**

Federated learning methods enable us to train machine learning models on distributed user data while preserving its privacy. However, it is not always feasible to obtain high-quality supervisory signals from users, especially for computer vision tasks. Unlike typical federated settings with labeled client data, this research will consider a more practical scenario where the distributed client data is unlabeled, and a centralized labeled dataset is available on the server. The research will also consider the server-client and inter-client domain shifts into account and pose a domain adaptation problem with one source (centralized server data) and multiple targets (distributed client data).

**Reference Person:** Prof. Nicolae Sebe ([nicolae.sebe@unitn.it](mailto:nicolae.sebe@unitn.it))

**UNIVERSITÀ DEGLI STUDI DI BARI "ALDO MORO"**

**1) Project Title:** *Methodologies and techniques for creating symbiotic intelligent systems*

**Abstract:**

The project is part of the activities of the project FAIR Project - Future AI Research (PE00000013), "Symbiotic AI", WP6.1 "Design of SAI systems". The Human-Computer Interaction (HCI) community acknowledges AI as very valuable to create digital technology that can greatly empower people. At the same time, there is still a lack of understanding on how to benefit from AI while preserving the system's reliability, safeness and trustworthiness for humans. By leveraging the new frontiers of research at the intersection between HCI and AI, foundational research for designing SAI systems will be carried out. The project aims at defining a methodological and technological framework for designing and developing SAI systems. The main contribution of such a framework is a set of design guidelines that highlights what users expect from SAI systems (identified in specific domains). In addition, the framework should suggest novel interaction mechanisms and user interfaces to allow user control of SAI systems and grant transparency of the system behaviour, making it easy for the end users (and all the stakeholders in general) to understand and trust the system decisions.

**Reference Person:** Prof. Rosa Lanzillotti ([rosa.lanzillotti@uniba.it](mailto:rosa.lanzillotti@uniba.it))

**2) Project Title:** *Machine learning model recycling in prediction and forecasting tasks*

**Abstract:**

The project is part of the activities of the project FAIR Project - Future AI Research (PE00000013), "Symbiotic AI", WP6.6 "Sustainability of SAI". The development of new prediction and forecasting methods will be studied, based on model recycling, i.e. on the reuse and combination of pre-trained models to reduce the use of computational resources and the impact on costs and environment deriving from model learning complex. Specifically, an important approach to model recycling is to



adequately consider the potential accuracy of previously learned models for the task at hand. In general, they can be considered weak models, and a possible solution is to combine them or combine their predictions to get a more accurate model by exploiting ensemble learning techniques. This is particularly useful in domains where data arrives as a stream, or more generally where not all training data is available to a machine learning algorithm at the time of training. In this regard, approaches based on multi-view learning, stacked generalization, co-training, and boosting will be investigated and evaluated. The proposed models will then be applied to the analysis scenario of data generated in the form of streams (e.g. data produced by sensors in smart grids).

**Reference Person:** Prof. Giovanni Semeraro ([giovanni.semeraro@uniba.it](mailto:giovanni.semeraro@uniba.it))

**3) Project Title:** *Understanding language-based human signals: taking into account multimodality and adaptivity through Large Language Understanding Models*

**Abstract:**

The project is part of the activities of the project FAIR Project - Future AI Research (PE00000013), "Symbiotic AI", WP6.2 - Human understanding capabilities of Symbiotic AI systems". Turning human-understandable signals (text documents, conversational data, images, audio, etc.) into machine-understandable semantics is crucial for building Symbiotic AI systems. The requested research activities aim to create a semantic layer that can be exploited by systems requiring human-level intelligence. The project will focus on integrating heterogeneous information (text, video, audio, etc.) from data and semantic models to provide the Symbiotic AI system with the capability of a "deeper understanding" of the information items it deals with.

**Reference Person:** Prof. Michelangelo Ceci ([michelangelo.ceci@uniba.it](mailto:michelangelo.ceci@uniba.it))

**UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA**

**1) Project Title:** *Deep Learning for Fake Image Detection*

**Abstract:**

The objective of the research activity is to study and develop novel Deep Learning-based solutions for the detection of fake images, videos, and media. The activity will involve the collection and generation of multimodal datasets for DeepFake detection, as well as the design of novel large self-supervised and fine-tuned models for the task, starting from the existing literature of large multimodal models. A particular focus will be also devoted to the exploration of novel evaluation measures, and to cases of partial alteration in both images and videos.

**Reference Person:** Prof. Rita Cucchiara ([rita.cucchiara@unimore.it](mailto:rita.cucchiara@unimore.it))

**2) Project Title:** *Computer Vision and Human-Robot Interaction*

**Abstract:**

Deep learning has quickly become the state-of-the-art approach for extracting knowledge from visual data and it is rapidly solving some of the most complex problems in Computer Vision, such as image classification, object detection, and visual-semantic understanding with supervised learning. As Deep Learning gets better at visual and semantic tasks, and new self-attentive operators and architectures emerge to tackle visual understanding, the literature is starting to investigate its application in Embodied AI tasks, where an agent needs to behave intelligently inside an environment. The purpose of this research topic is the design and analysis of novel and data-intensive algorithms for Embodied AI navigation and human-robot interaction, also through the integration of multiple modalities and leveraging and developing Foundational models.

**Reference Person:** Prof. Rita Cucchiara ([rita.cucchiara@unimore.it](mailto:rita.cucchiara@unimore.it))

**3) Project Title:** *Computer Vision and NLP Technologies for Analysis, Understanding, and Generation in Cultural Heritage*

**Abstract:**

The objective of this research topic is to study and develop novel Deep Learning-based solutions for the automatic analysis and understanding of digitized text coming from historical and cultural sources. In particular, the research activities will involve the automatic understanding of the content of both modern and historical documents, the design of language models for historical languages (e.g., Latin, ancient Greek), and the development of NLP architectures for text retrieval. All these research activities will be carried out in line with recent literature on language modeling and exploiting state-of-the-art Transformer-like architectures.

**Reference Person:** Prof. Rita Cucchiara ([rita.cucchiara@unimore.it](mailto:rita.cucchiara@unimore.it))

**4) Project Title:** *Deep Learning Architectures for Multimodal Analysis of Public Administration Data*

**Abstract:**

The research activity will investigate and develop solutions for the analysis, classification, and retrieval of data from the Public Administration. The activity will be carried out with a multimodal approach, which will consider different kinds of data, ranging from documents and text to images and video. The candidate will develop novel Deep Learning architectures for multimodal data understanding and retrieval, starting from existing solutions and training from scratch new large-scale models specifically developed for Public Administration.

**Reference Person:** Prof. Rita Cucchiara ([rita.cucchiara@unimore.it](mailto:rita.cucchiara@unimore.it))

## UNIVERSITÀ DI PISA

- 1) Project Title:** *Human-centered AI: “Explainable AI for Synergistic Human-AI Collaboration”; “System1 and System2” Machine Learning and Reasoning”; “Human-centred Lifelong Learning for Complex Data”; “Human-AI Socio-technical Complex Systems”; “Decentralized, Cooperative Learning”; “Co-design Methodologies for Trustworthiness -by-Design”; “Empirical Studies and Pilots of human-centered AI”*

**10 Positions**

### Abstract:

The aim is to build the foundations of Human-centered AI along three main goals: a) “human-in-the-loop” machine learning and reasoning: allowing humans to understand and steer learning and reasoning of AI systems and interact synergistically to solve complex tasks. Specific goals include explainable AI, neurosymbolic learning and lifelong learning for complex data, all with the “human-in-the-loop”; b) social-aware AI: understanding and governing the societal outcomes of largescale, networked socio-technical systems of humans and AIs, e.g., social media and online marketplaces. Specific goals include modeling such systems and decentralized networked learning; c) design of trustworthy AI systems: the responsible (co-) design, development, validation and use of trustworthy AI systems, including certification, to make sure to incorporate “by-design” European laws, ethical values and human rights. Extensive empirical experiments, case studies and pilots of Human-centered AI systems are integral part of the research plan. The goals will contribute to transversal topics Learning and Reasoning from individual to communities to Society, Frontiers of Machine Learning, Legal & Ethical Design for Trustworthy AI systems, with a strong multidisciplinary focus and synergies between AI and human-computer interaction, cognitive sciences, complex systems, mathematics, ethics, law, and social sciences”.

**Reference Person:** Prof. Dino Pedreschi ([dino.pedreschi@unipi.it](mailto:dino.pedreschi@unipi.it))

**Reference Person:** Prof. Anna Monreale ([anna.monreale@unipi.it](mailto:anna.monreale@unipi.it))

## UNIVERSITÀ DEGLI STUDI DI SASSARI

- 1) Project Title:** *Biologically-inspired AI models for Visual Perception and Human-Robot Interaction*

### Abstract:

This doctoral position falls within a general framework for the development of an open, attentive perceptual system for a humanoid robot. Aim of the research is to develop a series of modules for the processing of visual data acquired by a humanoid robot and the consequent motor control to activate specific strategies for data acquisition to facilitate the interaction with the human actors.



The doctoral candidate should investigate both the technology required and the most recent findings in neurophysiology, neural brain modelling, cognitive psychology, computer vision and machine learning to help in the development of the envisaged computational models. In particular, the research will focus on understanding the activation maps of both advanced deep network models and the human neural architecture subduing the recognition of familiar faces. The studies, carried out in collaboration with leading neuroscientists, will be based on fMRI data captured from human subjects during face analysis tasks. The aim will be to design novel deep architectures embedding the neurophysiological findings on the perception of familiar faces.

**Reference Person:** Prof. Massimo Tistarelli ([tista@uniss.it](mailto:tista@uniss.it))

## UNIVERSITÀ DEGLI STUDI DI FIRENZE

**1) Project Title:** *Study of AI tools for the automatic generation of scenarios for the resolution of critical conditions in complex geolocated structures.*

### **Abstract:**

Decision support systems are experiencing a high acceleration also in territorial areas such as smart cities, mobility, local services. Faced with the identification of critical conditions, we find ourselves having to make hypotheses in order to be able to produce feasible scenarios based on multiple objectives, constrained multitargets. On this basis, the generation and subsequent choice must lead to the identification of optimal or sub-optimal solutions. Generative AI tools, on graphs that present KPI measurement points with time series, are complex neuro-symbolic aspects to be solved through AI and XAI techniques, being in any case decision support systems. The AI models will also have to present the ability to be applied in different contexts by reducing or eliminating the fine-tuning / transfer learning activities that have high scalability costs. The applications are to smart cities, mobility and transport, environment. The work will take place at the DISIT Lab, one of the most active labs in these issues <https://www.disit.org>, <https://www.snap4city.org> with the coordination of Prof. Paolo Nesi.

**Reference Person:** Paolo Nesi ([paolo.nesi@unifi.it](mailto:paolo.nesi@unifi.it))

**2) Project Title:** *Casual machine learning in epidemiology*

### **Abstract:**

Advancements in causal inference methods and the rise of big, complex, longitudinal data highlight the potential benefits of integrating machine learning techniques into epidemiological causal studies. However, to accurately evaluate the value of this integration, it is critical to overcome language and technical barriers that exist between these two fields.



In epidemiology, the primary objective is to develop a clear language for expressing causal claims and to provide tools for justifying them, with the ultimate goal of informing public health interventions. On the other hand, advanced machine learning algorithms provide new tools for addressing problems that classical methods are ill-equipped to handle. Research will focus on integrating machine learning algorithms into epidemiological causal studies, bridging the gap between these two fields, to enhance the quality and impact of public health interventions.

**Reference Person:** Prof. Michela Baccini ([michela.baccini@unifi.it](mailto:michela.baccini@unifi.it))

## SCUOLA NORMALE SUPERIORE

**1) Project Title:** *Human-centered AI: Learning and Reasoning Methods for Hybrid human-machine Collaboration and their Applications for Data-driven Research in Biology, Finance and Health*

### Abstract:

**This line will focus on the development of paradigms and algorithms for synergistic human-machine learning setting the basis of a** theoretical framework for mutual understanding. For example, which types of explanations best support human understanding and which stimulate deliberate reasoning or intuitive reasoning? A goal might be developing methods for adapting explanations to an interactive scenario, also exploiting the symbolic representation of knowledge used by the neuro-symbolic models. Another focus might be on visual analytics to explore, navigate and reason on the extracted explanations, to facilitate expert users in reconstructing the overall logic of a black box or developers/companies interested in validating the models they want to deploy, or personal assistant (for non-expert users) for personalized explanation of decision/scoring outcomes or personalized what-if simulation also taking into consideration diverse cognitive models. This research will contribute to WP1 of the project FAIR- spoke1 and the ERC project Explainable AI so that the awarded scholarship will collaborate with other researchers active on the same WP

**Reference Person:** Prof. Fosca Giannotti ([fosca.giannotti@sns.it](mailto:fosca.giannotti@sns.it))

**2) Project Title:** *Methods and techniques of Explainable and Trustworthy Machine Learning, Deep Learning, and Foundation Models and their applications for data-driven research in Biology, Finance, and Health*

**2 Positions**

### Abstract:





These are blue sky themes that may be devoted either to the methodological inventions in the area of Trustworthy Foundation Models or contributing toward domain-driven lines of research aiming at investigating appropriate Deep Learning techniques for **critical tasks**. The projects in this line will focus on exploring novel DN architecture **for Finance with a specific interest toward Graph Neural Networks for payments and credit financial networks and toward Recurrent Neural Networks for prediction and filtering of financial time series** or Graph Neural Networks **for proteomic and genomic** or for a wide spectrum of health data. Existing industrial partnerships within the finance sector and research collaborations within the health sector will provide challenging experimental setting.

**Reference Person:** Fabrizio Lillo ([fabrizio.lillo@sns.it](mailto:fabrizio.lillo@sns.it));  
Francesco Raimondi ([francesco.raimondi@sns.it](mailto:francesco.raimondi@sns.it));  
Fosca Giannotti ([fosca.giannotti@sns.it](mailto:fosca.giannotti@sns.it))

## UNIVERSITÀ DI BOLOGNA

**1) Project Title:** *Measuring Trust in AI: Advancing Methodologies and Guidelines for Measuring Trustworthiness in Artificial Intelligence Systems*

**Abstract:**

This research grant proposal aims to advance methodologies and guidelines for measuring trust in artificial intelligence (AI) systems. Trustworthiness is crucial for responsible and ethical deployment of AI technologies across various domains. The project's objectives include developing comprehensive methodologies for quantitatively and qualitatively measuring trust in AI and establishing guidelines for evaluation. The research team will investigate how users perceive trustworthiness in AI systems, considering dimensions like transparency, accountability, fairness, and explainability. Collaborating with experts and policymakers, they will develop a framework that outlines best practices and evaluation criteria for assessing trustworthiness. The project also addresses challenges associated with the black-box nature of some algorithms and potential biases. By leveraging interpretability methods and algorithmic audits, the team aims to capture often overlooked trust-related aspects. The outcomes will empower developers, regulators, and users to effectively evaluate AI systems' trustworthiness, fostering responsible adoption and aligning AI with societal values. This research grant seeks to bridge the gap between AI development and robust trust measurement, promoting the ethical use and widespread acceptance of transformative AI technologies.

**Reference Person:** Prof. Roberta Milano ([roberta.milano@unibo.it](mailto:roberta.milano@unibo.it))



**2) Project Title:** *Trustworthy AI for health and well being*

This research grant proposal focuses on Trustworthy AI for health and well-being, specifically addressing discrimination and bias in healthcare.

The research objectives include establishing ethical guidelines for AI in healthcare, with a focus on addressing discrimination and bias. Collaboration with healthcare professionals, AI experts, ethicists, and social scientists will inform the guidelines, emphasizing fairness, transparency, accountability, and the avoidance of biases in AI algorithms and decision-making.

The project will also explore the application of image recognition technologies to identify and rectify social disadvantages in healthcare. Advanced algorithms will be used to detect patterns of discrimination or bias in diagnostic imaging, treatment recommendations, and patient care processes. The findings will guide the development of mitigation strategies to ensure equal access to quality healthcare for all individuals, regardless of social factors.

**Reference Person:** Prof. Roberta Calegari ([roberta.calegari@unibo.it](mailto:roberta.calegari@unibo.it))

**UNIVERSITÀ DEGLI STUDI DELL'AQUILA**

**1) Project Title:** *Towards Intelligent Empathic Care Robots*

**Reference Person:** Prof. Stefania Costantini