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**BANDO a CASCATA**  
**per attività di ricerca condotte da Università Statali, Università non Statali legalmente riconosciute ed**  
**accreditate dal MUR e Enti Pubblici di Ricerca vigilati dal MUR, in forma singola o congiunta,**  
**nell'ambito dello Spoke 6 "Symbiotic AI"**  
**Progetto "Future Artificial Intelligence Research"**  
**Codice Progetto PE00000013**  
**CUP H97G22000210007**

**Allegato A**

<b>Objective #1: Design of SAI systems - from theory to technology</b>
<b>Reference WPs/Tasks: WP6.1</b>
<b>Link to Transversal Projects: TP3 – Learning &amp; Reasoning from individual, to community, and society.</b>
<b>Funding allocated to this objective: 130.894,60 Euro</b>
<p><b>Description of the objective:</b> The applicant is expected to propose a research program developed synergistically with WP6.1 concerning the design of Symbiotic AI (SAI) systems. The design of SAI systems is based on the principles and methodologies of Human-Computer Interaction (HCI). The focus is on the design of new interaction paradigms that can amplify, augment, and enhance human performance, in ways that make systems reliable, safe and trustworthy. The proposed theoretical and technological framework shall be based on the new perspective that AI supports and facilitates human beings' activities by augmenting (and valuing) human cognitive abilities rather than replacing them.</p> <p>The proposed methodological and technological framework should follow a Human-Centred Design (HCD) approach, where the final users are involved in all phases of the system design. In addition, the proposed interaction mechanisms and user interfaces shall allow user control of SAI systems and shall provide explanations easily understandable by end-users. The applicant shall also define the procedures for a multimodal evaluation of the emotional regulation processes, by grounding the evidence on the psychological studies.</p> <p>The applicant is expected to propose an experimental validation with use cases in one of the following sectors: healthcare and well-being, information technology, smart cities, areas and communities, cultural heritage and creative industries.</p> <p>The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP3.</p>
<b>Objective #2: Human understanding capabilities of SAI systems - from human signals to algorithms</b>
<b>Reference WPs/Tasks: WP6.2</b>
<b>Link to Transversal Projects: TP2 – Vision, Language, and Multimodal Challenges</b>
<b>Funding allocated to this objective: 300.000 Euro</b>
<p><b>Description of the objective:</b> The applicant is expected to propose a research program developed synergistically with WP6.2 concerning the endowment of SAI systems with human understanding capabilities. The human-machine collaboration can be boosted only if the SAI system is able to expose human understanding capabilities. The focus is twofold: from one side understanding what is the semantics of the signals coming from the users, and on the other side understanding who is interacting with the system. Therefore, the applicant should propose methods for turning human-understandable signals into machine-understandable semantics, thus creating a semantic layer that can be exploited by systems requiring human-level intelligence. In addition, the applicant should propose methods for understanding human needs.</p> <p>The proposed research program shall include: (i) methods for the detection and interpretation of human signals acquired through different sources with multiple modalities (e.g. textual conversations, speech, video); (ii) proper strategies to acquire and exploit user's personal information. To strengthen the human understanding capabilities of SAI systems, further activities may be related to methods for improving the quality of the data representing human signals as well as for efficiently dealing with large data sets.</p> <p>The applicant is expected to propose synergies and collaboration with the FAIR Spoke 6 consortium partners and partners of TP2.</p>
<b>Objective #3: Improving SAI systems performance with user input - combining learning and reasoning</b>
<b>Reference WPs/Tasks: WP6.3</b>



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**Link to Transversal Projects:** *TP3 – Learning & Reasoning from individual, to community, and society.*

**Funding allocated to this objective:** 300.000 Euro

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.3 concerning the exploitation of user input to improve the performance of the SAI systems. These may benefit from observing how people reason about and interact with the environment when they perform their activities. Two components are relevant for this purpose: user knowledge and reasoning capabilities. Therefore, the focus is twofold: improving the quality of knowledge-intensive components used by SAI systems and providing SAI systems with complex reasoning capabilities. The applicant shall investigate how the deployment of SAI systems can leverage knowledge graphs, and how model-driven reasoning mechanisms can be integrated with data-driven learning techniques.

Therefore, the applicant is expected to propose hybrid (model-driven and data-driven) methods for the refinement and completion of knowledge graphs enhanced with deductive reasoning capabilities. The methods for knowledge graph completion shall encompass link prediction techniques to deal with missing knowledge, and reasoning techniques to assess the consistency of the predicted knowledge with respect to the existing one.

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP3.

**Objective #4: Improving the understandability of SAI systems**

**Reference WPs/Tasks:** WP6.4

**Link to Transversal Projects:** *TP3 – Learning & Reasoning from individual, to community, and society*

**Funding allocated to this objective:** 300.000 Euro

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.4 concerning the understandability of SAI systems. Complementing humans with AI requires AI systems to conform to human expectations and promote human trust. This asks for AI systems that are not only accurate but also understandable. To cope with this issue while supporting the user in decision-making processes and knowledge-intensive tasks, it is either possible to endow SAI systems with explanation components for data-driven learning models, or to generate natural language statements that explain and justify the behavior of AI algorithms. Therefore, the applicant is expected to extend the state-of-the-art in the area of explainability of SAI systems as well as to investigate the use of different strategies (i.e., based on knowledge graphs (KGs), user-generated content (UGC), or large language models (LLMs)) to generate natural language explanations and justifications. Methods shall be proposed that also take into account human mental models and their capability to handle uncertainty and imprecision in decision-making processes.

The proposed research program shall include: (i) methods for explainability in hybrid models, (ii) explainability techniques based on post-hoc counterfactuals, (iii) explainability components that increase the robustness of learning models, (iv) generative methods for post-hoc explanations and justifications expressed in natural language, (v) dialogue-based natural language explanations and justifications.

The development of these techniques are expected to play a relevant role in increasing the transparency of these systems.

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP3.

**Objective #5.1: Acceptability of SAI - Legal design**

**Reference WPs/Tasks:** WP6.5.1

**Link to Transversal Projects:** *TP1 – Legal and Ethical Design of Trustworthy AI Systems.*

**Funding allocated to this objective:** 175.000 Euro

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.5.1 concerning the legal acceptability of SAI systems. The growing concern to understand AI decisions, the apprehension for algorithmic bias, the respect of privacy policies for data collected by AI systems, the struggle between security ensured by AI systems and fundamental freedoms, the mitigation of possible safety and health risks due to the pervasive AI, are some of the main challenges for human-AI symbiosis. Acceptability involves value alignment between AI and humans. Therefore, the design of SAI systems shall be investigated from the legal viewpoint.

The applicant is expected to propose basic research in the legal area that face the following question: foundational principles, assessment and design guidelines for legal acceptability of SAI in complex decision-making. The applicant is also expected to contribute to the operationalization process in order to be of practical relevance for the design and implementation of SAI applications. Operationalization will be accompanied by appropriate modeling of the SAI application in hand as socio-technical systems (STS), that is the combination of technical elements (i.e. the code and - if used - the data) and societal elements (i.e. the stakeholders responsible for the system and the society in which the system is deployed).

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and



partners of TP1.

**Objective #5.2: Acceptability of SAI - Ethical design**

**Reference WPs/Tasks: WP6.5.2**

**Link to Transversal Projects: TP1 – Legal and Ethical Design of Trustworthy AI Systems.**

**Funding allocated to this objective: 175.000 Euro**

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.5.2 concerning the ethical acceptability of SAI systems. The growing concern to understand AI decisions, the apprehension for algorithmic bias, the respect of privacy policies for data collected by AI systems, the struggle between security ensured by AI systems and fundamental freedoms, the mitigation of possible safety and health risks due to the pervasive AI, are some of the main challenges for human-AI symbiosis. Acceptability involves value alignment between AI and humans. Therefore, the design of SAI systems shall be investigated from the ethical viewpoint.

The applicant is expected to propose basic research in one of the ethical area that face the following question: ethical principles, assessment and design guidelines for the social acceptability of SAI. The applicant is also expected to contribute to the operationalization process in order to be of practical relevance for the design and implementation of SAI applications. Operationalization will be accompanied by appropriate modeling of the SAI application in hand as socio-technical systems (STS), that is the combination of technical elements (i.e. the code and - if used - the data) and societal elements (i.e. the stakeholders responsible for the system and the society in which the system is deployed).

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP1.

**Objective #6: Improving the sustainability of SAI systems**

**Reference WPs/Tasks: WP6.6**

**Link to Transversal Projects: TP7 – Data centric AI and Infrastructures**

**Funding allocated to this objective: 200.000 Euro**

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.6 concerning the sustainability of SAI systems. The massive adoption of SAI systems naturally brings high computational and human resources costs for data analysis and gathering. This aspect requires addressing the problem of both environmental and economic sustainability of the proposed solutions, also in the light of new AI techniques that allow the reuse of data and models, without sacrificing accuracy. The applicant is expected to propose novel methods that improve the sustainability of SAI applications through different techniques, such as using unlabeled data for model training, domain adaptation, recycling models with transfer learning techniques. Methods shall be proposed that also efficiently transform (big) raw data into smart data, which represent summaries, conceptualization, approximations, or even simplified and directly interpretable versions of the original ones. The overall technological framework shall be designed and developed by applying the Green Software Engineering principles, which are aimed at reducing the carbon footprint of computer systems.

The development of these techniques are expected to play a relevant role in increasing the sustainability of SAI systems.

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP7.

The financed projects will run from the contract signing date up to the end of the project [M36].

**Objective #7.1: Computing technologies for the implementation of AI solutions - Big Data-oriented**

**Reference WPs/Tasks: WP6.7**

**Link to Transversal Projects: TP7 – Data centric AI and Infrastructures**

**Funding allocated to this objective: 250.000 Euro**

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.7.1 which ensures the necessary support of the computing technology, specifically large research infrastructures for big data analysis. Therefore, the focus is on large research infrastructures and expertise in the handling of big-data-oriented systems, where data curation and data size matter.

The proponent is seeking applications for Innovative AI solutions and workflows on the large datasets and/or dataflows. The applications must include aspects on innovative algorithms and/or innovative solutions for ingesting the data.

Possible topics are (just examples):

- Testing a solution on datasets which require particular Big Data-like infrastructures to execute
- Testing a solution where data comes in the form of high rate data streams
- Testing a solution where data is structured in an innovative way optimized for the input data structures



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- Testing a solution using Innovative AI techniques on large datasets

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP7.

**Objective #7.2: Computing technologies for the implementation of AI solutions - Edge-based**

**Reference WPs/Tasks: WP6.7**

**Link to Transversal Projects: TP7 – Data centric AI and Infrastructures**

**Funding allocated to this objective: 250.000 Euro**

**Description of the objective:** The applicant is expected to propose a research program developed synergistically with WP6.7.2 which ensures the necessary support of the computing technology, specifically edge-computing scenarios characterized by devices with limited computing and storage resources. Therefore, the focus is on edge-based SAI and AI solutions challenged by the problem of orchestrating thousands of devices with limited computing and storage resources.

The proponent is seeking applications for edge-based SAI and AI solutions that reduce the effort in data gathering, filtering, labeling, representing and learning by adopting ad hoc designed distributed algorithms that take into account the problem of orchestrating thousand of devices constrained in power and resources terms.

The applicant is expected to propose synergies and collaboration with both the FAIR Spoke 6 consortium partners and partners of TP7.