



Mission

The Cognitive Systems Lab is aimed at studying and realizing cognitive systems of new generation, able to learn, reason, and pervasively engage with humans in a natural, personalized, reactive and/or proactive way.

Theoretical, experimental, and applied research activities will be aimed at designing and implementing cognitive systems able to:

- i) engage individually or collectively with humans by combining advanced visualization techniques with adaptive and proactive multi-modal mechanisms based upon natural language and spatial interaction;
- ii) simulate sophisticated models of human-like reasoning in a dynamic manner through the analysis of vast amounts of heterogeneous data in order to extend and enhance skills and cognitive abilities;
- iii) sense and analyze the surrounding environment, personalizing the system's response on the basis of the behavior of users;
- iv) adapt autonomously their own global behavior, in response to external dynamics, when it is different from the attended one or better performance can be obtained.

Fields of application

- Health and Wellness
- Maritime
- Tourism and Cultural Heritage
- Surveillance
- Government
- Energy

Research themes

Reasoning and Learning

Research is oriented to the study and definition of novel techniques and approaches regarding:

- i) representation of heterogeneous, ambiguous and textual knowledge, by integrating spatiotemporal logics, formal methods and semantic models;
- ii) automatic learning for mining information from heterogeneous data sources, by combining symbolic, probabilistic or numeric methods;
- iii) human-like reasoning and neuromorphic problem solving, by integrating probabilistic, fuzzy and goal-oriented/norm-based approaches with adaptive workflow management solutions.

Visual Recognition and Natural Interaction

Research is oriented to the study and definition of techniques and advanced methodologies regarding:

- i) computer vision/pattern recognition, to detect and analyze the surrounding environment recognizing, starting from images and/or videos, objects, categories and events;
- ii) spatial human-computer interaction, to navigate/manipulate n-dimensional data, also by means of virtual, augmented and mixed reality technologies.

Semantic Information Retrieval

Research is oriented to the study and definition of:

- i) novel question analysis and query result diversification techniques, for question-answering systems based on open-domain search strategies expressed in natural language;
- ii) methodologies and content-based techniques, for acquisition, management and semantic integration of information characterized by different nature and format in order to provide a structured, standardized and interoperable representation in question-answering systems.

Cognitive Environments

Research is oriented to the study and definition of:

- i) new Human Behavior Analysis models and methods for the identification of activities and behaviors taken by users within smart environments, customizing the system response to the external stimuli detected;
- ii) models and approaches based on agents and multi-agent systems to realize "cognitive entities" capable of adaptively organizing and integrating themselves in order to perceive and process sensory and context information and develop "cognitive collective capabilities";
- iii) "cognitive apps" able to interact with the surrounding environment to offer support and assistance to the users in a smart and personalized manner.

Cognitive Architectures

Research is oriented to the study and definition of:

- i) software architectures of new generation, designed to specify the infrastructure underlying a cognitive system, in terms of memories, knowledge and functional processes, by integrating Software Engineering techniques for the design process, i.e. Metamodels/Model-driven Design and Design Patterns, and simulation approaches for the evaluation of the models designed;
- ii) reconfigurable and datacentric hardware architectures, to effectively and efficiently process large quantities of data.