



2022 ANNUAL REPORT

 **VRAIN**

Valencian Research Institute
for Artificial Intelligence

vrain.upv.es

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Foreword

December 2022

Artificial Intelligence (AI) is one of the most important technologies of the 21st century. Just like the steam engine or electricity once brought about significant changes in society, AI is transforming the world. AI enables the creation of autonomous and self-adaptive systems, sensitive to context and with a focus on human beings. We can already see this in smart environments and the Internet of Things that we have in our homes and in increasingly intelligent cities. The advantages that AI can bring to almost all areas of science, health, the environment, energy, manufacturing, meteorology, etc., are enormous, but it is essential to ensure its ethical and responsible use.

VRAIN conducts research in almost every branch of AI, with notable developments that we see every day in the media. This includes natural language processing, predictable artificial intelligence, intelligent agents/multiagent systems, generative artificial intelligence, multilingual voice conversion, digital twins, human centered artificial intelligence, and emotion detection in social networks, without forgetting security and privacy. Through simulations of organizations, we can enhance human interaction and simulate scenarios such as pandemics or other crises. We are also capable of recommending and facilitating negotiations between artificial agents and humans to improve decision-making. We apply these principles to industrial processes to enhance production methods and anticipate errors.

In the software domain, we work with model-driven developments that automatically generate code while preserving security and requirements. In the field of healthcare, we study the application of personalized medicine by analyzing genomic data, always with an emphasis on explainable AI.

VRAIN conducts both basic and applied research across diverse sectors, including healthcare, industry, automotive, security, agriculture, audiovisual, services, energy, robotics, and the environment. This translates into numerous contracts with companies, both local and national, as well as international collaborations. We are not only a national but also an international reference for technology transfer, working on the forefront of AI research in new computing models and their relationship with the human brain.

At VRAIN, we are committed to responsible, ethical, and reliable AI. We are an international reference in Trustworthy Artificial Intelligence Research. VRAIN is a partner of the European Network of Excellence in Artificial Intelligence Research, TAILOR, a key initiative for the future of AI in Europe. We are also part of CLAIRE, the European association of AI centers and laboratories.



Vicent Botti
 Director, Valencian Research
 Institute for Artificial Intelligence
 (VRAIN)

1 | About Us



The Valencian Institute of Artificial Intelligence Research (VRAIN) was established in 2021 through Decree 78/2021 of June 4, 2021, by the Council of the Valencian Government. It is a leading research center in AI in Spain and Europe, maintaining a proper balance between basic and applied research. VRAIN places special emphasis on doctoral training and

technology transfer. The VRAIN institute has been recognized by the European Commission as a center of excellence in artificial intelligence (AI) research.

VRAIN emerged from the merger of two Research Units at the Universitat Politècnica de València, with aligned research interests in the field of Artificial Intelligence: the "Valencian Institute of Artificial Intelligence Research (VRAIN)," established in April 2019, and the "Research Center on Software Production Methods (PROS)," founded in 2008. The constituent groups of VRAIN and PROS have been actively engaged in AI research for over 30 years

within the framework of the Department of Computer Systems and Computation (DSIC), making them a national and international benchmark in AI research with results supported by their extensive scientific output and international recognition.

The spaces allocated to VRAIN are located on two campuses. On one hand, they are situated in the building of the Department of Computer Systems and Computation, on the VERA Campus of the Universitat Politècnica de València. On the other hand, the VertexLit group has its facilities on the Alcoy Campus.



Since its establishment, VRAIN has been located on the VERA campus of the Universitat Politècnica de València

The spaces of VRAIN are located in the Dept. of Computer Systems and Computation



Research Areas of VRAIN

The research activity of VRAIN focuses on **nine main research areas**: Natural Language Processing, Planning and Reasoning, Software Analysis, Verification and Testing, Machine Learning and Deep Learning, Natural Computing, Computational Logic and Automatic Reasoning, Intelligent Agents and Human-Centered Artificial Intelligence, Artificial Intelligence, Privacy and Security, and Software Production Methods.



Natural Language Processing



Planning and Reasoning



Software analysis, verification and testing



Machine Learning and Deep Learning



Natural Computing



Computational Logic and Automated Reasoning



Intelligent Agents and Human Centered AI



AI, Privacy and Security



Software Production Methods

Research Groups of VRAIN

For the development of its activities, the institute is structured into **eight research groups**:

Automata,
Formal
Languages
and its
Applications
(ALFA).

alfa.upv.es

Language
Engineering
and Pattern
Recognition
(ELiRF).

elirf.upv.es

Extensions of
Logic
Programming
(ELP).

[elp.webs
.upv.es](http://elp.webs.upv.es)

Software
Production
Methods
(PROS).

[pros.webs
.upv.es/](http://pros.webs.upv.es/)

Machine
Learning and
Language
Processing
(MLLP).

mlp.upv.es

Information
Technology
and Artificial
Intelligence
(GTIIA).

gti-ia.upv.es

Multi-
paradigm
Software
Technology
(MiST).

[personales
.upv.es](http://personales.upv.es)

Interactive
Tehnologies
Lab
(VertexLit).

vertexlit.com

These research areas are applied to the development of innovative applications in a large number of strategic sectors, such as health, agriculture, industry, privacy/security, autonomous robots, services and energy, and environmental sustainability.

Organizational Structure of VRAIN

The Valencian Institute of Artificial Intelligence Research operates under the following organizational structure:

The Director, along with the Secretariat and Subdirections, the Institute Council and its delegated Scientific-Technical Committee, constitute the governing bodies of the Institute. These bodies, in conjunction with the Research, Innovation, and Transfer Management Unit and the Administration Area, provide the necessary support to the eight research groups of VRAIN to carry out their research activities.

The leadership team of VRAIN consists of:

Vicent Botti Navarro
Director

María José Ramírez Quintana
Secretary General

Oscar Pastor López
Director of Internationalization and
Technology Transfer

Jose María Sempere Luna
Scientific Director

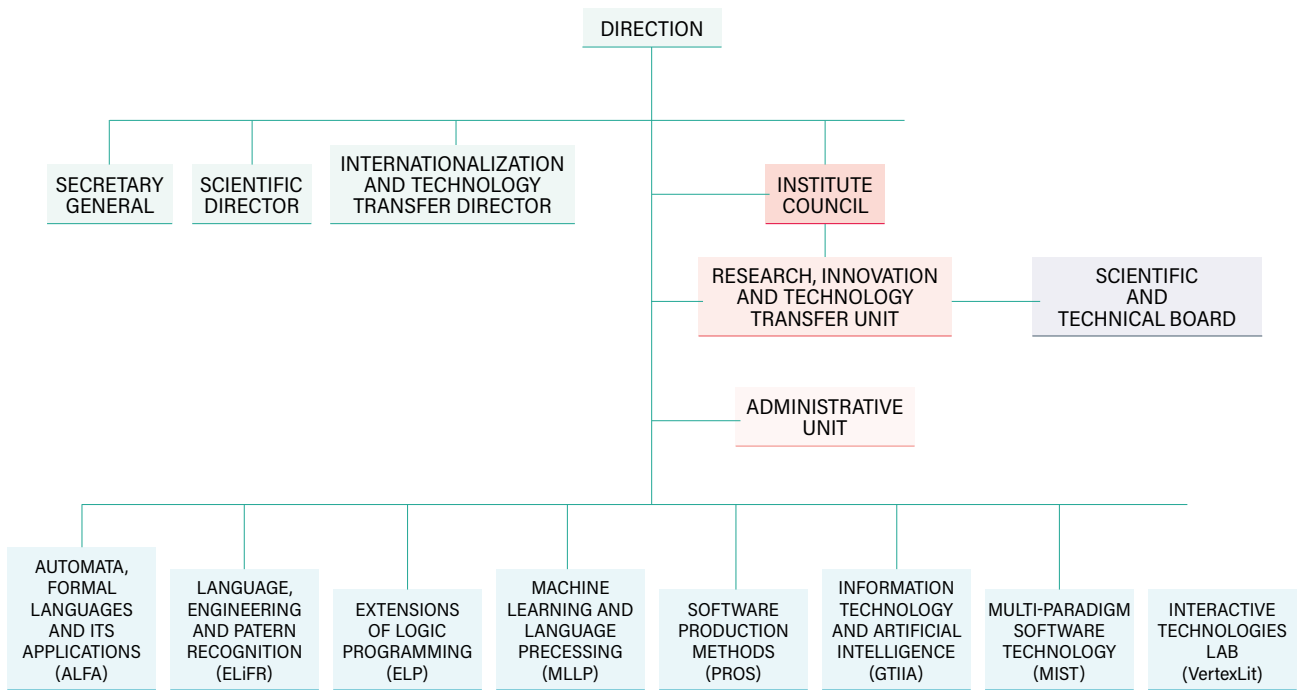
The management unit is composed of:

Lucía Ivana Bernad Palomares

Aída Gil Pérez

Ana Cidat Vila

Governance and management structure of VRAIN





Vicent Botti

Full professor and Director of VRAIN
PhD in Computer Science and Industrial Engineer

One of the pioneers in Artificial Intelligence, Multi-Agent Systems, and Agreement Technologies in Spain, he is a co-founder of the Agreement Technologies area. He is the founder of the Computer Technology and Artificial Intelligence Group. He has served as Vice-Rector for Information and Communication Technologies at UPV, director of the Department of Computer Systems and Computing, vice-director of the School of Computer Science, and Director Commissioner of the Higher Technical School of Computer Engineering. He is the Director General of the Valencian Graduate School and Research Network of Artificial Intelligence (valgrAI). He has been honored with the 2005 Research Award from the Spanish Association for Artificial Intelligence, named a Fellow of the European Association for Artificial Intelligence in 2017, awarded the National Computer Science Prize José García Santemeses in 2018, and received the Sapiens Academic Award in 2019.

He is or has been: Emeritus Member of the Board of the European Association for Multi-Agent Systems (EURAMAS); Treasurer of EURAMAS; Founding Member of EURAMAS; member of the board of the Spanish Association for Artificial Intelligence; member of the Expert Committee on Artificial Intelligence of the Valencian Community.

He has over 400 international publications: 140 in SCI-JCR journals, 2 research books, 237 articles in international conferences, and 29 chapters in international research books. He has participated in 80 research projects, including 9 EU projects, and over 50 national projects, serving as the principal investigator in 50 of them. In the context of these projects, he has been responsible for the development of seven applications that have resulted in

technologies transferred to industrial and technology-based companies (Logifruit, Boeing Europe, Tissat, Marvalsa...).

He has supervised 24 doctoral theses. He has delivered several invited talks at various international and national events, including the 19th International Conference on Practical Applications of Agents and Multi-Agent Systems (PAAMS 2021), Artificial Intelligence: Manufacturing Intelligent Systems. Spanish Automatic Conference 2021, Symposium on university policy and management, CRUE Universidades Españolas y Universia España (5-2021), ValGRAI: Valencian Graduate School and Research Network of Artificial Intelligence, Symposium ESPAITEC Universitat Jaume I de Castelló (2021), Artificial Intelligence and High-Performance Computing, 13th RES Users Conference 2019, International Conference on Agents and Artificial Intelligence (ICAART2010), Seventh International Conference on Intelligent Data Engineering and Automated Learning (IDEAL2006), Conference of the Spanish Association for Artificial Intelligence (CAEPIA2005), and the 4th International Workshop on Practical Applications of Agents and Multi-Agent Systems (IWPAAMS2004).



María José Ramírez

Associate Professor and General Secretary of VRAIN
PhD in Computer Science and Physics Graduate

She belongs to the "Extension of the Logic Programming (ELP)" research group since 1989. In 1997 she co-founded a new research area with the initial goal of extending Inductive Logic Programming to other declarative languages, which lead to the subgroup on "Data Mining and Inductive Programming (DMIP)" in which she is conducting her research, with the focus on inductive logic and functional programming, multiclass and hierarchical classification, model evaluation, model trust and confidentiality. On these topics she has supervised 6 doctoral thesis, and she has published about 100 scientific papers in international and national journals and conferences, as well as, 11 chapters in research books.

She has participated in more than 40 research projects with international funding (European Commission and Air Force Office of Scientific Research, 1 as Principal Investigator), national funding from the State Research Agency, and from other local institutions (in 6 of them as PI). She has also participated in 9 Technology Transfer projects/contracts (4 as PI). She has served as scientific committees of national and international conferences and as a reviewer in several renowned international conferences (ECAI, IJCAI, SIGKDD, ICML, KDD, NIPS, AAAI) and journals (Automated Software Engineering, Computational Intelligence, Machine Learning, Expert Systems with Applications). She has been collaborator of the Division of Coordination, Evaluation and Scientific-Technical Monitoring of the State Research Agency (in the Artificial Intelligence area) from 2017 to 2019.

She has extensive teaching experience at the UPV teaching subjects related to Data Science and

Artificial Intelligence Applications (to business and agriculture) in various degrees and masters. She participates in several MOOCs courses on the theoretical and practice fundamentals of data mining and machine learning, and data science tools. Throughout her teaching career she has directed more than 35 Final Degree and Master's Degree Projects. He has taught several courses and seminars in Spanish universities and abroad. She has been a member of the academic committee of the current PhD program in Computer Science (2012-2017). She has also been the academic director of the Master's Degree in Engineering and Technology of Software Systems (UPV) during the period 2012-2016.



Oscar Pastor López

Full professor and Director of Internationalization and Technology Transfer of VRAIN
PhD in Computer Science and Physics Graduate

Director of the Software Production Methods Center (PROS) at UPV since 2008 to the present. Previously, he served as Director of the Department of Computer Systems and Computing (DSIC) at UPV from 2000 to 2007 and of the research group OO-Method since its founding in 1989. With an h-index of 50 (according to Google Scholar), he is the author of over 500 research articles including international journals, books, book chapters, and conferences. He has served as the principal investigator in more than 50 national and international projects and supervised 33 doctoral theses. He holds 3 patents (approved in the USA) resulting from contracts with software development companies.

As a renowned expert, he has been a keynote speaker at various international universities such as the University of Klagenfurt (Austria), Université de Paris 1-Sorbonne (France), Technical University of Wien (Austria), Université de Louvain-la-Neuve (Belgium), BYU, Provo, Utah, USA, Universidad Nacional de Medellín and EAFIT (Colombia), UTFSM in Valparaiso (Chile), and Universidad Nacional de la Pampa in Argentina. He has participated in numerous doctoral thesis committees at international universities, attended Summer Schools, and founded two spin-off companies from UPV based on conceptual model development technologies.

He has chaired and organized several international conferences such as ICWE 2002, JISBD 2002, ICWE 2003, RE 2005 (Publicity), CAiSE 2005, RCIS 2007, WWW 2007, RE 2008 (Tutorials), ICWE 2009 (Tutorials), CIKM 2009, CibSE 2011 (DC), ICWE 2001 (Workshops), Interact 2011 (Industry), CLEI 2011, CAiSE 2012 (Workshops), ICWE 2012 (DC), CLEI 2012, ESEM 2013, REFSQ 2013 (DC), CoopIS 2014, Bioinformatics

2014, PoEM 2014, ICWE 2015, ER 2015, REFSQ 2016, CAiSE 2016 (DC), BPM 2016, RCIS 2012, CAISE 2013, PoEM 2015, ER 2017, and EICS 2019. He has been the president of the Steering Committee (SC) of CAiSE and ER, a member of the SC of other international conferences such as RCIS, ICWE, CibSE, and a keynote speaker at SBES 2004, CADUI 2006, DEXA 2006, IDEAS 2007, IDEAS 2008, ER 2008, RCIS 2009, INFORSID 2010, DEXA 2010, KMIS 2010, ICSOFT 2011, MODELSWARD 2013, RCIS 2014, MEDI 2015, SBQS 2016. Additionally, he has participated as a program committee member in a large number of conferences and workshops (more than 600 participations) and has organized international conferences such as RCIS 2012, CAISE 2013, PoEM 2015, ER 2017, and EICS 2019.

He is among the most recognized researchers in the field of Conceptual Modeling, having been named an ER Fellow in 2010 and awarded the Peter C. Chen Award in 2017.



José M. Sempere Luna

Associate Professor and Scientific Director of VRAIN.
PhD in Computer Science and Computer Science Graduate

José M. Sempere is an Associate Professor at the Department of Computer Systems and Computation at the Universitat Politècnica de València (UPV), where he has been teaching since 1989. He holds a Ph.D. in Computer Science and a Bachelor's degree in Computer Science.

He has taught in the Bachelor's programs in Computer Engineering and Data Science, as well as in the Master's programs in Biomedical Engineering and Artificial Intelligence, Pattern Recognition, and Digital Image. He has supervised numerous Bachelor's and Master's theses and doctoral dissertations. He also serves as the director of the Roche-UPV Bioinformatics Business Classroom for Personalized Medicine, affiliated with the ETSINF at UPV.

As a researcher at the VRAIN institute, he coordinates the research group on Automata, Formal Languages, and their Applications (ALFA). His research areas include natural computing, bioinformatics, computational biology, and machine learning. He has earned recognition for four six-year research periods and has authored over seventy internationally recognized scientific publications. He has actively participated in numerous national and European research projects funded through competitive public calls, often serving as the principal investigator. He coordinates the Spanish Thematic Network on Biomolecular and Biocellular Computing (REDBIOCOM), which integrates leading national research groups in this field. From 2010 to 2016, he was a member of the steering committee for the International Conference on Grammatical Inference (ICGI), and since 2018, he has been part of the

steering committee for the International Conference on Membrane Computing (ICMC). He is also a committee member for the Bulletin of the International Membrane Computing Society (IMCS).



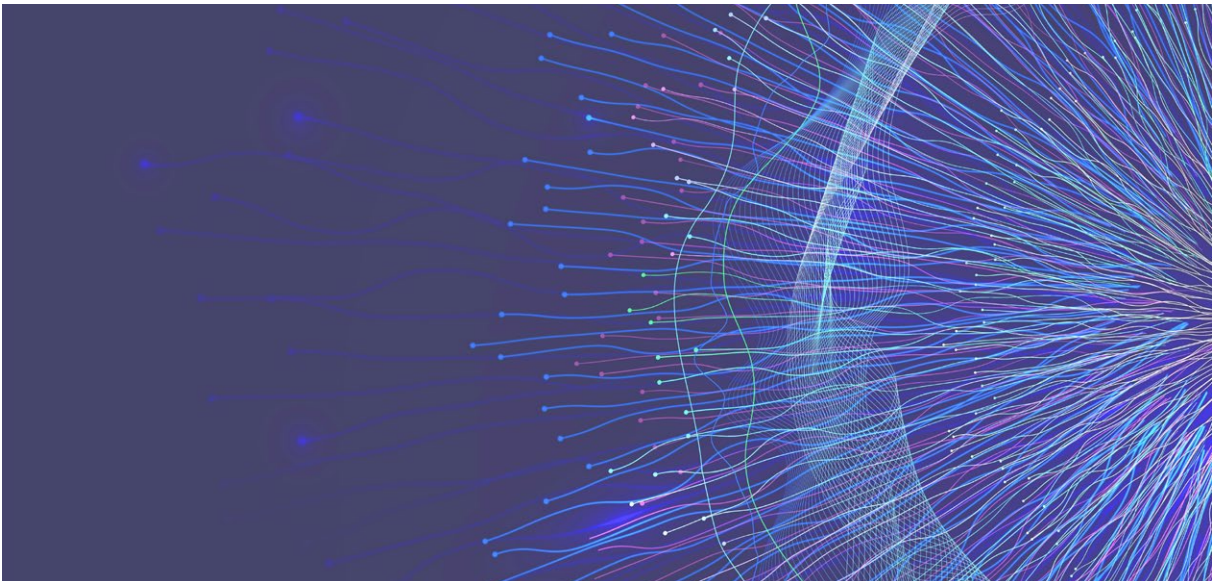
Ana Ciudad Vila

Senior Research Support Technician and R&D Manager at VRRAIN.
Telecommunications Engineer, Master in Marketing and Communication Management
and Master in Telecommunication Technologies, Networks and Systems.

She is R&D Manager at VRRAIN Institute, with responsibilities focused on project management, relations with companies, valorisation and technology transfer.

Telecommunications Engineer by the UPV (1999), Master in Marketing and Communication Management by the UOC (2005) and Master in Network Technologies and Telecommunication Systems by the UPV (2018). Awarded the prize for the best Final Degree Project in 1999 by the Association of Telecommunications Engineers.

In the professional framework, she has more than 20 years of professional experience, having worked in several private companies carrying out technical and management tasks, highlighting her experience for 5 years in Motorola Spain as Senior Systems Engineer. In the public administration, she has been R&D Manager of the Institute of Telecommunications and Multimedia Applications (iTEAM) of the UPV, R&D Manager of the Research Centre for Software Production Methods (PROS) of the UPV, and is currently R&D Manager of the VRRAIN University Institute. She has participated in the processes of creation, constitution and recognition of the three research entities. She has also been co-founder and member of the advisory board of the spin-off GEM Biosoft.





Aída Gil Pérez

Senior Management Technician and Manager at VRAIN.

Bachelor's degree in Philosophy (UV), Master's degree in Project Management (VIU), Postgraduate diploma in Philosophy of Cognitive Science (Sussex University), DEA in Interdisciplinary Communication (UV). Manager of research, development, and innovation at VRAIN, with 15 years of experience as a manager at UPV and two years in the private sector. She has published articles in the press and is a co-author of the "Report on the State of AI in the

Mediterranean region." As a full-time manager, she is responsible for all phases of project application, execution, and justification, from local to international calls. She also manages contracts with private companies and public entities. She organizes events to disseminate VRAIN's results and addresses challenges posed by companies, guiding them towards solutions with the researchers at VRAIN.



Lucía Ivana Bernad Palomares

Senior Management Technician and Manager at VRAIN.

Ph.D. in Agricultural Engineering with a specialization in Biotechnology from the Polytechnic University of Valencia (UPV). With over 20 years of experience in R&D, she completed her doctorate at the Valencian Institute of Agricultural Research in Valencia. Subsequently, she worked as a senior research technician in the Department of Plant Genetics and Breeding at UPV and at the Cavanilles Institute of Biodiversity and Evolutionary Biology at the University of Valencia (UV). She continued her academic career as a postdoctoral researcher at The Rockefeller University in New York for over 3 years, after which she spent 5 years in R&D departments in the private sector. She has been involved in more than 20

research projects at the national and international levels (Ministry of Science and Technology, NIH, and Horizon 2020), has published more than 15 SCI articles, and is part of the inventing teams of 2 patents. Currently, she is innovation agent at VRAIN, with the objective to promote the transfer of Artificial Intelligence (AI)-based technology developed at the Institute, as well as to establish collaborative links with the public/private sector to enhance applied AI research from the University.

2 | VRAIN at a glance



VRAIN's research activity revolves around nine main research areas: Natural Language Processing, Planning and Reasoning, Software Analysis, Verification and Testing, Machine Learning and Deep Learning, Natural Computation, Computational Logic and Automatic Reasoning, Intelligent Agents and Human-Centric Artificial Intelligence, Artificial Intelligence, Privacy and Security, and Software Production Methods.

VRAIN is one of the largest AI research centers in Spain. We are more than 100 researchers, working day by day from the Universitat Politècnica de Valencia. Specifically, VRAIN involves a total of 119 experts from different areas of research.

It's worth noting that out of the 119 members of VRAIN, 81 hold a doctoral degree.

119 members of VRAIN

81 with doctoral degree

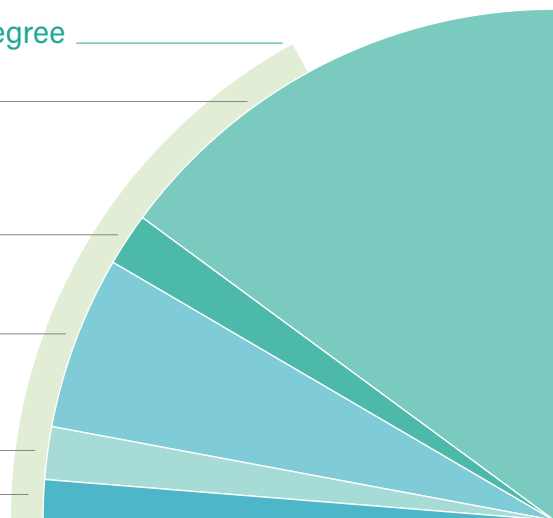
71 Faculty staff

8 Postdoctoral Researcher

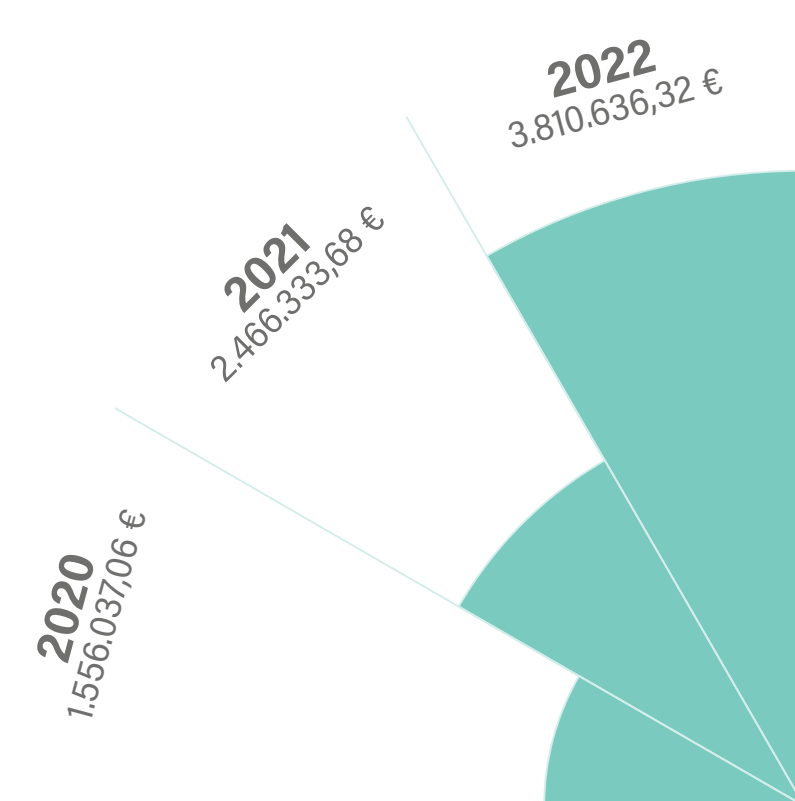
26 Research Assistants

8 Research Assistant in training

6 R & D Management staff and Technical Assistants



Total Funding



Evolution of funding by research projects and contracts



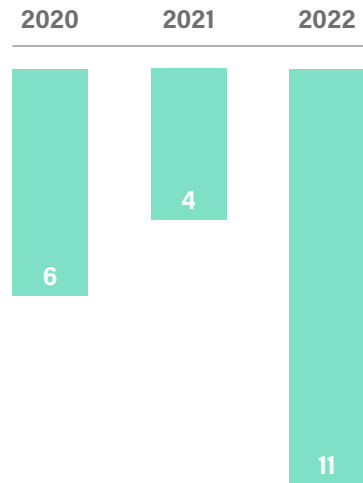
Competitive Research Income

Contracted Research Income

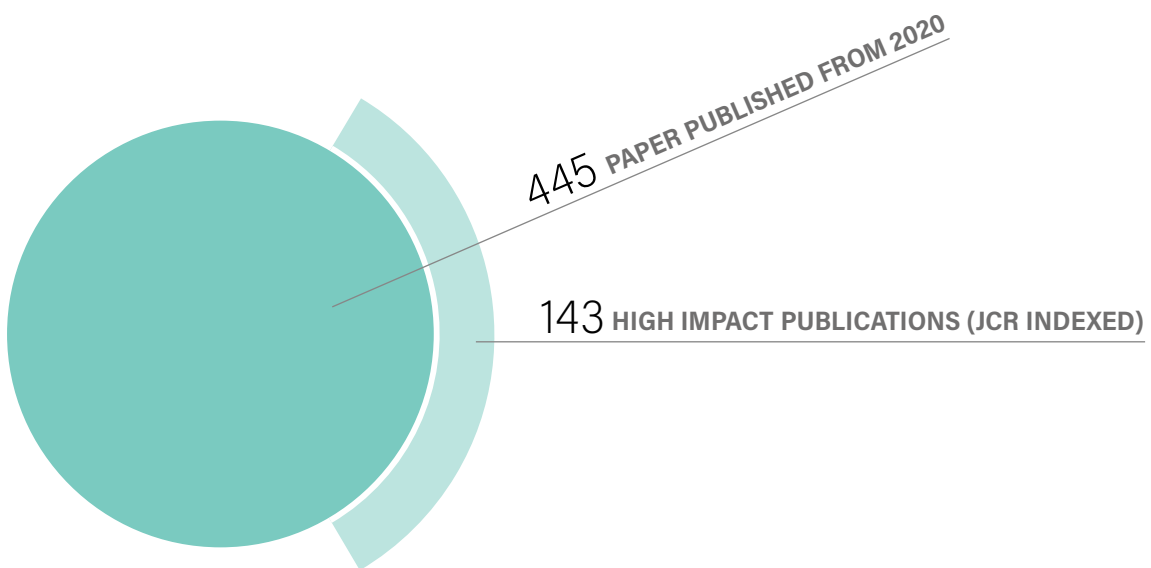
21

Predocctoral Researchers
With Active Grants
From 2020

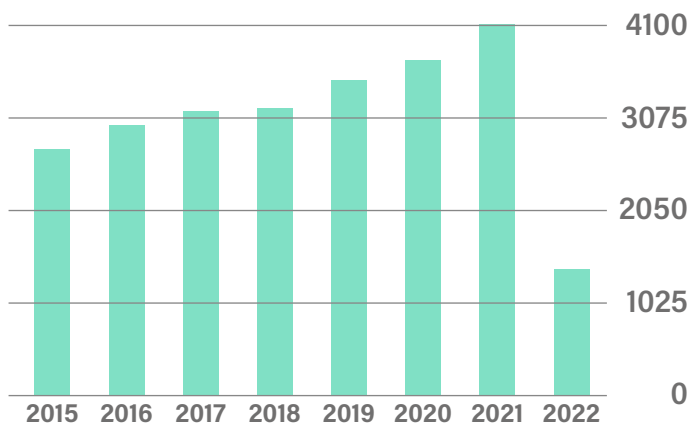
PhD THESIS



Total Publications



	All	Since 2017
Citations	48764	19000
h-index	92	58
i10-index	1074	460



The members of VRAIN maintain a very active participation in the following forums, networks, and associations:



3 | Research

In 2022, VRAIN has jointly accumulated 8,273.28 VAIP (Index of research activity) points, maintaining its 4th position in the ranking of UPV structures.

The activities of various VRAIN groups are developed around the following research lines:

1) Basic and Foundational Aspects of AI

a. Evaluation in machine learning and artificial intelligence and its impacts

ROC analysis, prediction, calibration, and model evaluation for decision support. Evaluation of intelligent agents. Measures of generality. Universal psychometrics. Impacts of AI on cognition (extended cognition) and the labour market.

b. Responsible Artificial Intelligence (Responsible AI -RAI-; Trustworthy AI, AI Safety/Security and Explainable AI -XAI-)

Starting from the premise that artificial intelligence must be responsible, reliable, based on ethical and social values, focused on humans, secure, and interpretable/explainable, we work in several directions. On one hand, concerning learning, we work on techniques for explaining black-box models (mimetic models), on the analysis of adversarial attacks depending on the learning family used, and more recently, on how different AI paradigms relate to their security and robustness. On the other hand, in relation to symbolic methods, we work on provable security, cryptographic protocol analysis, reversible computing, and formal methods for the analysis, modeling, verification, synthesis, debugging, certification, transformation, and optimization of critical and intelligent systems. We apply the theory of normative systems to imbue ethical values into AI systems.

c. Computational Limits of AI

In this line of work, we operate within the framework of computability theory as it pertains to machine learning and AI in general. We study the decidable and undecidable problems associated with machine learning, establish computational complexity bounds for problems that are solvable, and work under the paradigm of hypercomputation (especially using oracles) to study and propose solutions for problems that are not computationally solvable.

d. Conceptual Programming

Making the design and implementation of a "Programming Machine" viable involves determining the canonical conceptual components associated with the programming process as humans conceive it. Currently, "the code is the model" of the constructed software application, making the process entirely dependent on human developers. This line of work aims to exploit the use of advanced AI techniques to identify essential conceptual components with rigorous ontological support and enable "the model to be the code" so that the machine can learn how to design and develop executable conceptual models through an intelligent interactive process. The primary goal is to make this "Programming Machine" viable within an AI context. This "Conceptual Programming" may represent a new step forward in the history of Software Engineering, utilizing abstraction levels increasingly close to human cognitive schemas and further away from the peculiarities of conventional programming environments.

2) Techniques and Methodologies

a. Multi-agent Systems

The paradigm of multi-agent systems is an area of growing interest in AI. This is due to its

application in solving complex problems where classical techniques fail to provide a solution. Multi-agent systems (MAS) deal with the need for communication and collaboration among autonomous agents (entities whose behavior is guided by themselves).

b. Neural Networks and Deep Learning

In recent years, the introduction of deep learning techniques and their incorporation into neural networks has marked significant progress in various applications of Artificial Intelligence. Deep learning has enabled the tackling of more complex applications due to the vast amount of data available on the internet (Big Data) and improvements in computer architectures, specifically in Graphics Processing Units (GPUs) applied to scientific computing. We also work on the design of new attention mechanisms based on "transformer encoders" (self-attention mechanisms) for sequence processing and their application to Natural Language Processing problems. We focus on continuous representations of linguistic units (words, word segments, sentences, etc.) in terms of embeddings, not only for English but also for other languages and diverse semantic domains (news articles, social media, etc.). Additionally, we propose new loss functions for neural network-based models.

c. Grammatical Inference, Automata, and Formal Languages

We propose new machine learning algorithms under the paradigm of inductive inference as an approach to learning formal concepts and machines, grammars, and automata (Grammatical Inference). We design testbeds for evaluating the performance of these algorithms and explore the theoretical study of machine learning capabilities under different information exchange protocols. We investigate the properties of classes of formal languages and

their automata to explore the possibility of their machine learning.

d. Machine Learning, Data Science, and Data Mining

New machine learning techniques are developed for knowledge discovery in more exploratory data science environments and targeted data mining, especially in cost-sensitive classification problems, model adaptation, automation of the data science process (particularly data wrangling), and data science methodologies. We also develop various machine learning techniques, including supervised, semi-supervised, unsupervised, adaptive, and deep learning. We address model adaptation, hierarchical and multi-class classification, and cost-sensitive learning. We develop tools for analyzing, processing, and extracting knowledge from data from various sources, such as public data and social networks.

e. Natural and Evolutionary Computing

We propose, analyze, and characterize information processing models based on biomolecular and biocellular information processing. These include models based on DNA computing, models based on bio-inspired processors, and membrane computing (P systems). We apply these models to solve highly complex problems. As a generalization of these paradigms, we propose new information processing architectures based on an evolutionary paradigm, especially using genetic algorithms (parallel) and networks of genetic processors.

f. Inductive and Probabilistic Programming, Machine Teaching

A line of work bridging machine learning and declarative programming involves learning declarative models through inductive programming techniques (e.g., logic and functional

programming) with various connections to cognitive models and reasoning systems about events such as event calculus. More recently, we have worked on machine teaching paradigms for universal languages.

g. Real-Time Artificial Intelligence

Real-Time Artificial Intelligence is a discipline that incorporates problem-solving techniques used in AI environments with real-time constraints. These environments require valid responses within limited time intervals to ensure the proper functioning of the system. Classical AI techniques need to be adapted for application in such environments. We have developed computational models that allow the integration of AI techniques, typically with unpredictable computation times, into real-time systems where, through schedulability analysis, a guaranteed response within a predetermined maximum time can be ensured.

h. Use of Logical Models in Automated Reasoning Systems. Automatic Reasoning and Deduction

The semantics of many computing systems (databases, knowledge bases, query systems, programming languages, etc.) are specified using logical theories. In the context of automated reasoning and deduction, we work on rewriting techniques and formal reasoning techniques using multi-paradigm languages (functional, logic, OO, concurrent, constraint). In relation to semantic methods, where queries, goals to be executed, and properties asserted about these systems are formulated using logical expressions (whose truth value is checked against a canonical or designated model of the system), we develop abstract models for verifying these properties. These models are generated automatically from the mentioned logical components and support the construction of automated verification tools.

i. Adaptive Complex Systems

Analysis of social networks, consensus, and other systems. We have developed models and a set of analysis tools to recognize movement patterns in social networks, predict events and behaviors of social network actors, monitor emotional reactions, and detect social communities, among other tasks.

j. Design of Autonomous Systems, Self-Adaptation, and Human-in-the-Loop.

The 'smart world' of the future is being designed as complex ecosystems composed of a wide variety of distributed devices and services that interact with each other and are controlled by a large number of computing elements and users (humans). These systems are crucial to support mobility, quality of life, and the well-being of citizens, as well as prosperity and sustainability, opening up a wide range of possibilities in different application domains such as Smart Cities and Autonomous Vehicles. The main goal of this line is to provide methodological solutions (methods, techniques, and tools) that allow the systematic design and development of software systems with autonomous capabilities, involving humans from the early stages of engineering. We will design solutions that enable engineers to more efficiently and effectively address the activities they face during the construction of these systems.

k. Software Production Methods in the AI Context

This line of work aims to apply AI techniques to continuously improve the various capabilities associated with conventional software production processes in their different phases and perspectives: Organizational and Business Process Modeling, Requirements Engineering, Interaction Modeling, Model-Driven Development, Software Testing, and more. New approaches that incorporate knowledge, methods, algorithms, and tools from an AI perspective in these different dimensions are necessary to go beyond current conventional software creation processes, including maximizing the level of automation possible, and using an integrative, holistic perspective to ensure that the final software corresponds to the initial specifications of the applied production process.

3) Applications and Technologies

a. Agreement Technologies

Agreement Technologies (AT) involve large-scale open distributed computer systems where autonomous software agents negotiate with each other, typically on behalf of humans, to reach mutually acceptable agreements. These

agreements must be consistent with the normative context in which they are established and, once accepted, allow agents to request mutual services and adhere to them. In the field of AT, we work on:

(i) Computational Argumentation and Persuasion Technologies

Computational argumentation explores the application of argumentation theory (psychological/philosophical) to computational systems, where arguments are used to resolve conflicts (social reasoning and agreement-making), address reasoning inconsistencies (individual reasoning), or provide explanations. On the other hand, persuasion technologies are an interdisciplinary research field focusing on the design and development of interactive technologies that can create, maintain, or change human thinking and behavior using persuasive techniques. Although argumentation theory considers persuasion as one of the most studied types of argumentation dialogue, applying computational argumentation to enhance the persuasive potential of intelligent systems is an emerging research area with numerous challenges. Therefore, we work on persuasion technologies that include computational models of argumentation to: explicitly generate and manage arguments and counterarguments; create dialogue protocols that control the exchange of persuasive arguments between involved parties; and develop persuasion strategies that use a user model to persuade individuals to select potentially more effective arguments for each specific moment in the dialogue.

In this context, we are developing persuasive computational argumentation techniques from the perspective of its application:

(1) as a persuasion technique, inducing changes in users' thinking and behavior.

(2) as a method to provide explanations for the decisions of an intelligent system (Explainable AI, XAI).

(3) in recommendation systems and decision support (with a particular focus on Educational Recommendation Systems).

(4) In virtual societies of humans and agents, where agents act as virtual assistants for humans, monitoring the user and providing proactive, personalized, and justified decision-making support.

(5) Application areas: Online commerce; e-Health (medical applications and preventive medicine); Assisted learning environments; Sustainability, energy efficiency; Social networks (especially for teenagers).

(ii) Normative Systems,

where norms are used as a mechanism to address coordination in multi-agent systems, especially in open environments, thus regulating the behavior of agents and their interactions. Specifically, we work on the implementation of normative agents capable of inferring, describing, and deliberating on norms, as well as analyzing and describing social norms that emerge from repeated interactions among agents, serving as a convention within society not imposed by any central authority.

(iii) Virtual Organizations,

which describe the allowed relationships and organizational structures in society, and whose description and functionality can be analyzed by agents with sufficient capacity to decide their participation in the organization and/or the creation of new organizational structures. In this line, we work on the development of methodologies for designing multi-agent systems based on virtual organizations, describing organizational structures, and developing agent platforms with virtual organizations.

b. Emotional AI: Detection of Emotions and Empathetic Behaviors in Intelligent Systems

Humans do not always behave rationally. Our behavior is often influenced by the emotions we feel. Intelligent systems that react in a perfectly rational manner without considering any emotion exhibit an extremely artificial behavior that frequently generates rejection in their interactions with humans. Our work focuses on constructing intelligent systems that adapt their rational

behavior based on the emotions they “feel.” Similarly, by detecting emotions in individuals, these systems can display empathetic behavior that facilitates approachability and acceptance in their relationships with humans in the medium and long term.

In this line of work, we are developing a model of emotional state based on knowledge obtained through sentiment analysis techniques, stress analysis, and analysis of information from biosignals. This model aims to determine the current and future emotional situation of the user.

c. Privacy Advisory Agents

Within the framework of Agreement Technologies, we are working on designing a privacy agent model that integrates mechanisms to acquire information about the user’s emotional state, social norms, and user preferences and values. This enables the agent to establish an informed dialogue about recommended actions to reduce risks associated with the use of social networks and the disclosure of private information. This model will be integrated into a social network demonstrator in an educational environment for children and adolescents, involving real users and their associated advisory agents, as well as other agents representing predefined behaviors in social networks. The goal is to validate the impact of integrating such advisory agents on user privacy in specific scenarios.

d. Information Retrieval

Extracting information from the web is undoubtedly useful for people. For example, we can extract news from a newspaper by removing irrelevant information (such as ads, headers, formatting issues, etc.). It is also useful for many automated processes, such as web page indexing by extracting relevant words from their content. Another example of its interest is detecting the pattern of a website to streamline the processing of its pages.

e. Activity Recognition

Development of tools for the automatic recognition of activities performed by an agent (software or human) with the aim of assisting in future actions.

Many of the current challenges in society (both at a general and individual level) require the development of new cyber-physical systems that exhibit a higher level of autonomy than current systems. Examples can be found in various applications, such as city management, personal assistants, robotics (home, office, or warehouses), logistics planning, game development, or security management. These systems must include functionalities such as perception, representation, reasoning, action, and learning, enabling them to act autonomously.

f. Natural Language Processing and Text Mining

Natural Language Processing (NLP) is a field of computer science, artificial intelligence, and linguistics that deals with the interaction between computers and human (natural) languages. The research focuses on the development of advanced technologies for natural language processing in multiple languages. The main goal is to facilitate multilingual oral and written communication online to overcome language barriers in complex natural language tasks. To achieve this goal, various technologies are combined, including continuous speech recognition, machine translation, and speech synthesis. The ultimate objective is the development of multilingual speech understanding and dialogue systems.

Moreover, natural language processing involves the design of acoustic and language models, entity recognition, morphosyntactic tagging for information retrieval, voice and question-answering search, automatic summarization, and content analysis in social networks (emotion analysis, polarity, reputation analysis).

In the field of text mining, we work on content analysis in social networks (sentiment analysis, emotions, reputation, trends, and positioning, among others), automatic summarization of documents (text and audio), and problems that require semantic representation, such as those related to question answering, double meaning detection, topic classification, etc. Various architectures of neural network-based models are being employed for these applications.

g. Recommendation Systems

A recommendation system is a personalization tool that aims to provide individuals with a list of information items that best suit their individual preferences. It influences user preferences by analyzing available user data, information about other users, and environmental information, selecting items that best fit these preferences. In summary, a recommendation system offers the possibility to customize information filtering to display only information tailored to the needs and preferences of the user.

We have extensive experience in the development of tourism recommendation systems, both for individuals and groups, based on different types of information, such as explicit/implicit preferences, user psychology, etc.

h. AI in Industry: Sustainability and Smart Manufacturing

Sustainable manufacturing is defined as “the creation of manufactured products using processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers, and are economically affordable.” Notions of clean and ecological manufacturing (to name a few) are often used to describe strategies or philosophies that are more or less similar in the context of industrial sustainability. In this research line, we focus on the application of artificial intelligence techniques to achieve optimized solutions for manufacturing systems that combine sustainable objectives with economic, temporal, and other objectives.

Intelligent manufacturing systems are one of the research lines of Factories of the Future and Industry 4.0, conceived as a distributed intelligent system where each manufacturing component, element, and/or resource is modeled and controlled by software “agents” that can cooperate to solve complex problems. Intelligent manufacturing control systems meet the need for reactivity and adaptability in future sustainable manufacturing systems. Agent cooperation enables fair resource allocation (such as energy allocation) that can lead to “social welfare.” Additionally, Cyber Physical Systems, Systems

of Systems, Industrial IoT, and Digital Twins are related sublines that the group is working on.

i. Automated Planning

Development of tools for automated planning and decision support systems for various tasks in a company. Automated planning is an area of Artificial Intelligence that involves finding a course of action or procedures for a system described declaratively to achieve its goals while optimizing overall performance measures. Automated planners find transformations to apply in each given state, beyond the possible transformations for that state. There are many applications of planning in industry, such as robots and autonomous systems, service composition, intelligent resource allocation, business process optimization, or workflow management.

j. AI in Bioinformatics and Biomedical Sciences

Design, adjustment, and evaluation of computational models for problem-solving in genomics and systems biology. Fundamentally, we work with discrete models based on natural computation and formal language theory, whose adjustment, in some cases, is performed using machine learning techniques that allow great adaptability to the problem domain. We use these models for new prediction systems and annotation of genomic information. Additionally, we use natural computation models (especially membrane computing) for the design, implementation, and calibration of simulators for complex biological systems with implications in health sciences.

k. Educational Technologies and Big Data

Big data refers to a collection of massive and complex datasets that are challenging to process using conventional data management tools and applications. Educational technologies are an area where big data is rapidly gaining momentum. Research focuses on studying and implementing innovative solutions for processing massive data in the field of educational technologies. In particular, emphasis is placed on the development and integration of innovative digital tools, solutions, and services for learning and teaching.

I. Cryptography

Proposing new symmetric and asymmetric encryption methods, new encrypted communication protocols, and their applications in collaborative and participatory technology (e.g., electronic voting systems).

m. AI in Health Sciences

Understanding and manipulating the genome implies understanding and manipulating life as we perceive it on our planet. This significant challenge has implications for everything related to the field of health. This line of work aims to develop platforms capable of searching, identifying, retrieving, and interpreting relevant genomic information. This information must be obtained from constantly growing repositories with immense data volumes where machine learning techniques are indispensable to select valuable information in a clinical diagnostic and preventive treatment context that integrates genomic knowledge into medical practice as we understand it. Integrating conventional clinical information with genomic information in an AI context is essential for developing viable and reliable precision medicine. The application of AI techniques is indispensable for interpreting the chaos of genomic data being generated to determine which data is clinically relevant.

n. Integration of IoT in Business Processes

Current IoT devices are intelligent and capable of reacting individually to some events; it is their combined use that provides added and innovative value to their users. In this context, business processes (BPM) appear as an essential component to coordinate and interact between IoT devices, as well as to act as active participants in future business processes. By adopting IoT devices, a business process could, for example, consider real-world data to make more informed decisions and automate process tasks to improve execution. This line proposes the definition of solutions that allow the integration of IoT and business processes, addressing the following challenges: i) Definition of methods and techniques for the engineering and systematic development of IoT systems directed by business processes, ii) Definition of architectural

solutions based on microservices that facilitate the integration of IoT devices in the context of a business process, as well as their subsequent maintenance and evolution, iii) Definition of low-code platforms for configuring and customizing business processes with IoT support.

o. Human-Computer Interaction, Multimodal Interaction, and Artificial Intelligence

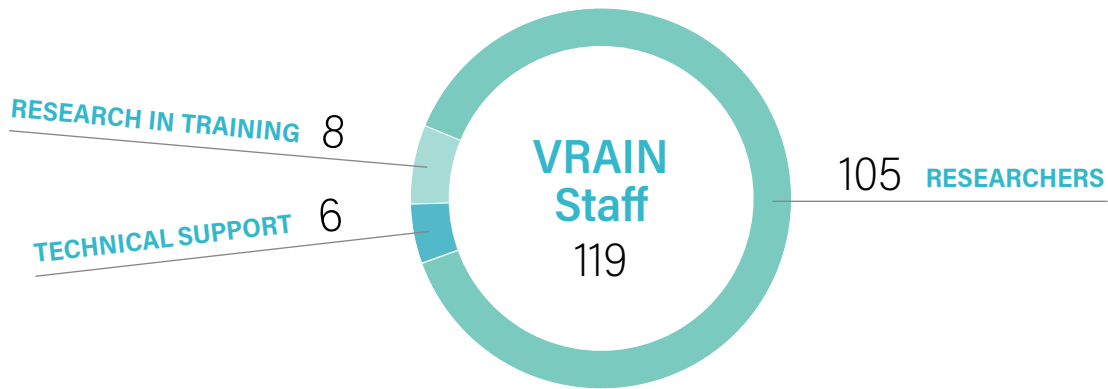
Human-machine interaction has become a multimodal process, where it is necessary to process different sources of information: visual, biometric, geospatial, etc. Bidirectional communication of users with their environment, devices, and ultimately, with other users, involves using elements based on artificial intelligence that complement, assist, and enable the possibilities of new interaction experiences in fields such as industry, healthcare, disability, and more.

p. Virtual/Augmented Reality and Artificial Intelligence

Virtual reality and augmented reality are the interaction paradigms with the greatest disruptive possibilities today. The development of solutions capable of making significant advances in sectors such as education, industry, health, and entertainment almost necessarily involves complementing these interactive technologies with the latest advances in perception, semantic extraction from the environment, bidirectional natural interaction, and dynamic user profile adaptation. AI plays an essential role in achieving these objectives.

4 | People

At VRAIN we are mainly researchers, research trainees and technical support staff.



Faculty Staff:

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 Argente Villaplana, Estefania
 Botti Navarro, Vicente Juan
 Campos Francés, Marcelino
 Carrascosa Casamayor, Carlos
 Casamayor Ródenas, Juan Carlos
 Castro Bleda, María José
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 Garcia Fornes, Ana Maria
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 Herrero Cucó, Carlos

Hurtado Oliver, Lluís Felip
 Izquierdo Doménech, Juan Jesús
 Juan Ciscar, Alfons
 Julian Inglada, Vicente Javier
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 Monserrat Aranda, Carlos
 Mota Herranz, Laura
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 Pastor Lopez, Oscar
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 Pérez Hernández, Tomás Ángel
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 Pla Santamaría, Ferran
 Ramírez Quintana, María José

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 Roldán Martínez, David
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 Sanchis Navarro, Albert
 Sapena Vercher, Oscar
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 Sempere Luna, José María
 Silva Galiana, Josep Francesc
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 Such Aparicio, José
 Terrasa Barrena, Andres Martin
 Torres Bosch, Victoria
 Val Noguera, Elena del
 Valderas Aranda, Pedro J.
 Valero Cubas, Soledad
 Vázquez De Parga Andrade,
 Manuel
 Vidal Oriola, Germán
 Villanueva García, Alicia
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 Jordan Prunera, Jaume Magi
 León Palacio, Ana
 Marco Detchart, Cedric
 Marín Campusano, Beatriz Mariela
 Reyes Román, José Fabian
 Rincón Arango, Jaime Andrés
 Sapiña Sanchis, Julia

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 Galindo Jimenez, Carlos Santiago
 Martí Gimeno, Pasqual
 Mehrbakhsh, Behzad
 Noel Lopez, Rene
 Pérez García, Daniel
 Sitanski, Stanislav

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 Davo Gelardo, Borja
 Díez Alba, Carlos
 Diosdado Lopez, Daniel
 Domínguez Samper, Enrique
 Ferrús Aparicio, José
 Fuente Anuarbe, Miguel Ángel de la
 Galán Pascual, Daniel
 Garcés Díaz-Munío, Gonçal
 García Simón, Alberto
 García Valero, Víctor
 Garribo Orts, Oscar
 Gil Pérez, Aída
 Giménez Pastor, Adrià
 Gutiérrez Gil, Raúl
 Iranzo Sánchez, Javier
 Jorge Cano, Javier
 López Rueda, Raúl
 Mansanet Benavent, Ignacio
 Ortiz Amaya, Jesús
 Padró Ferragut, Cristina
 Pastor Ricos, Fernando
 Rabadan Ortega, Laura
 Ruiz Dolz, Ramon
 Schellaert, Wout Willy M.
 Serrano Gil, Lenin Javier
 Taverner Aparicio, Joaquin
 Velasquez Rojas, Rosa Emperatriz
 Vitores Vicente, Miguel



5 | R&D&I Projects

During 2022, VRAIN's research activities have been funded by 44 projects obtained through competitive funding, mainly from the European Union and the National Research Plan, as well as the Valencian Research Plan and Technology Transfer Projects. The total funding obtained in 2022 is 3.810.636,32 euros.

List of projects and contracts developed in 2022 by VRAIN research staff:

International Projects

FOUNDATIONS OF TRUSTWORTHY AI - INTEGRATING REASONING, LEARNING AND OPTIMIZATION

Reference: 952215.

PI: Botti V.

Founded by: EUROPEAN COMMISSION (01-SEP-20 to 01-SEP-23).

INTELLIGENT VERIFICATION/VALIDATION FOR EXTENDED REALITY BASED SYSTEMS

Reference: 856716.

PI: Vos, Tanja Ernestina.

Founded by: EUROPEAN COMMISSION (01-OCT-19 to 01-JAN-23).

ASSIST AND CO-ORDINATE THE INCLUSION OF SOFTWARE TESTING RESEARCH AND EDUCATION AT THE OU. 2021-2023

PI: Vos, Tanja Ernestina.

Founded by: ALGEMEEN (From 01-JAN-21 to 01-JAN-24).

EDUCATIONAL EXPLANATIONS AND PRACTICES IN EMERGENCY REMOTE TEACHING

Reference: 2020-1-SI01-KA226-SCH-093604.

PI: Civera Saiz, Jorge.

Founded by: EUROPEAN COMMISSION (01-APR-21 to 01-APR-23).

EUROPEAN INNOVATION ALLIANCE FOR TESTING EDUCATION

Reference: 101055874

PI: Vos, Tanja Ernestina

Founded by: EUROPEAN COMMISSION (From 01-SEP-22 to 31-AUG-25).

PROVISION AND SUPPORT OF AN AUTOMATED SPEECH RECOGNITION AND MACHINE TRANSLATION SERVICE

Reference: OV9177345

PI: Civera Saiz, Jorge

Founded by: EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (From 05-MAY-22 to 01-AUG-24).

DIGITAL TRANSFORMATION IN HIGHER EDUCATION THROUGH ACTIVE CO-CREATION, TRAINING, INNOVATION, OPEN EDUCATION AND NETWORKING

Reference: 2021-1-DE01-KA220-HED-29333

PI: Valero Cubas, Soledad

Founded by: EUROPEAN COMMISSION (From 01-JAN-22 to 31-DEC-24).

National Projects

PLATAFORMA DELFOS: SISTEMA DE INFORMACIÓN PARA LA GESTIÓN DE VARIACIONES GENOMICAS

Reference: PDC2021-121243-I00.

PI: Pastor López, Oscar.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-DEC-21 a 01-DEC-23).

DESARROLLO DE UN PROTOTIPO PRECOMPETITIVO PARA EL ANÁLISIS AFECTIVO DE INFORMACIÓN MULTIMEDIA- UPV

Reference: PDC2021-120846-C44.

PI: Hurtado Oliver, Lluís Felip.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-DEC-21 a 01-DEC-23).

INGENIERIA DEL SOFTWARE AVANZADA PARA LA CONSTRUCCION DE SISTEMAS Y MICROSERVICIOS AUTO-ADAPTATIVOS. INCLUYENDO TECNICAS DE IA Y DE HUMANS-IN-THE-LOOP

Reference: PID2020-114480RB-I00.

PI: Valderas, Pedro.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-SEP-21 a 01-SEP-24).

SAFER-UPV: ANALISIS Y VALIDACION DE SOFTWARE Y RECURSOS WEB

Reference: PID2019-104735RB-C41.

PI: Silva, Josep.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-JUN-20 a 01-JUN-24).

FORMAL ANALYSIS AND VERIFICATION OF POST-QUANTUM CRYPTOGRAPHIC PROTOCOLS

Reference: PCI2020-120708-2.

PI: Escobar Román, Santiago.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-APR-21 a 01-APR-24).

AGENTES INTELIGENTES AFECTIVOS PARA PERSUADIR COMPORTAMIENTOS CIVICOS EN ENTORNOS VIRTUALES

Reference: PID2020-113416RB-I00.

PI: Argente, Estefanía.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-JAN-21 a 01-JAN-24).

RAZONAMIENTO FORMAL PARA TECNOLOGIAS FACILITADORAS Y EMERGENTES

Reference: RTI2018-094403-B-C32-AR.

PI: Escobar Román, Santiago.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-JAN-19 a 01-OCT-22).

HACIA UNA MOVILIDAD INTELIGENTE Y SOSTENIBLE SOPORTADA POR SISTEMAS MULTI-AGENTES Y EDGE COMPUTING

Reference: RTI2018-095390-B-C31-AR.

PI: Julian Inglada, Vicente Javier.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-JAN-19 a 01-OCT-22).

AMIC-UPV: ANALISIS AFECTIVO DE INFORMACION MULTIMEDIA CON COMUNICACION INCLUSIVA Y NATURAL

Reference: TIN2017-85854-C4-2-R-AR.

PI: Hurtado Oliver, Lluís Felip.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (01-JAN-18 a 01-JUL-22).

APRENDIZAJE PARA PLANIFICACIÓN SENSIBLE AL HUMANO

Reference: PID2021-127647NB-C22

PI: Sebastiá Tarín, Laura

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-SEP-22 to 31-AUG-25).

SUBTITULADO AUTOMÁTICO MULTILINGÜE PARA TRANSMISIÓN EN DIRECTO

Reference: PDC2022-133049-I00

PI: Sanchis Navarro, José Alberto

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-DEC-22 to 30-NOV-24).

SIMULADOR DE FLOTAS URBANAS PARA LA PREDICCIÓN DE LOS COSTES Y BENEFICIOS DE LA APLICACIÓN DE SOLUCIONES QUE FOMENTEN LA MOVILIDAD ACTIVA Y EL TRANSPORTE URBANO SOSTENIBLE

Reference: PDC2022-133161-C32

PI: Julian, Vicente

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-DEC-22 to 30-NOV-24).

MÉTODOS FORMALES ESCALABLES PARA APLICACIONES REALES

Reference: PID2021-122830OB-C42

PI: Escobar Román, Santiago

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-SEP-22 to 31-AUG-25).

DESCUBRIENDO EL SIGNIFICADO Y LA INTENCIÓN MÁS ALLÁ DE LA PALABRA HABLADA: HACIA UN ENTORNO INTELIGENTE PARA ABORDAR LOS DOCUMENTOS MULTIMEDIA

Reference: PID2021-126061OB-C41

PI: Hurtado Oliver, Lluís Felip

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-SEP-22 to 31-AUG-25).

INGENIERIA DE VALORES EN SISTEMAS DE IA: HERRAMIENTAS PARA LA TOMA DE DECISIONES BASADAS EN VALORES

Reference: TED2021-131295B-C32

PI: Botti V.

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-DEC-22 to 30-NOV-24).

DESARROLLO ÁGIL DE SISTEMAS DESDE REQUISITOS A CÓDIGO

Reference: PID2021-123824OB-I00

PI: Pastor López, Oscar

Founded by: SPANISH MINISTRY OF SCIENCE, INNOVATION AND UNIVERSITIES (From 01-SEP-22 to 31-AUG-25).

Regional Projects

DEEPTRUST

Reference: PROMETEO/2019/098.

PI: Alpuente Frasnado, María.

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (01-JAN-19 a 01-JAN-23).

CLASSROOM ACTIVITY RECOGNITION

Reference: PROMETEO/2019/111.

PI: Onaindia De La Rivaherrera, Eva.

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (01-JAN-19 a 01-JAN-23).

SISTEMA INTELIGENTE DE APOYO A LA TOMA DE DECISIONES CLÍNICAS EN MEDICINA DE PRECISIÓN

Reference: INNEST/2021/57.

PI: Pastor López, Oscar.

Founded by: VALENCIAN INNOVATION AGENCY, AVI (01-MAR-21 a 01-OCT-23).

ARQUITECTURA DE INTELIGENCIA ARTIFICIAL Y REALIDAD VIRTUAL PARA GENERACIÓN DE EXPERIENCIAS TURÍSTICAS PERSONALIZADAS Y SOSTENIBLES

Reference: INNEST/2021/233.

PI: Sebastiá Tarín, Laura.

Founded by: VALENCIAN INNOVATION AGENCY, AVI (01-OCT-21 a 01-OCT-23).

PREVENCIÓN Y MEJORA DEL ENVEJECIMIENTO ACTIVO MEDIANTE CALZADO NEUROESTIMULATIVO

Reference: INNEST/2021/317.

PI: Ferri Ramírez, César.

Founded by: VALENCIAN INNOVATION AGENCY, AVI (04-OCT-21 a 04-AUG-23).

DISEÑO Y DESARROLLO DE UN PROTOTIPO BASADO EN INTELIGENCIA ARTIFICIAL. CARDIOVAL

Reference: AP2021-05.

PI: Pastor López, Oscar.

Founded by: POLYTECHNIC UNIVERSITY OF VALENCIA, UPV (01-OCT-21 a 01-OCT-22).

CLUSTERIA: CLUSTER DE COMPUTACIÓN DE ALTAS PRESTACIONES POR INTELIGENCIA ARTIFICIAL CONFIABLE

Reference: IDIFEDER/2021/059.

PI: Vicente Botti Navarro.

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (01-JAN-21 a 31-DEC-22).

HUMAN AS A SERVICE: DESIGNING HUMAN SERVICES TO COLLABORATE WITH AUTONOMOUS SYSTEMS

Reference: CIAICO/2021/39

PI: Pelechano Ferragud, Vicente

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (From 01-JAN-22 to 31-DEC-24).

CREACIÓN DE LA UCIE DE VRAIN

Reference: INNVA2/2022/10

PI: Botti V.

Founded by: VALENCIAN INNOVATION AGENCY, AVI (From 01-JAN-22 to 30-SEP-24).

GUARDIA: GUARDIAN PERSONAL VIRTUAL EN REALIDADES SOCIALES HIBRIDAS

Reference: CIPROM/2021/077

PI: Botti V.

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (From 01-JAN-22 to 31-DEC-25).

RECICLAJE INTELIGENTE Y COOPERATIVO EN TODA LA CADENA DE VALOR ORIENTADO A UNA SOCIEDAD SOSTENIBLE 360°

Reference: INNEST/2022/180

PI: Botti V.

Founded by: VALENCIAN INNOVATION AGENCY, AVI (From 06-MAY-22 to 30-SEP-24).

COMBINING EXPLAINABLE ARTIFICIAL INTELLIGENCE AND CONCEPTUAL MODELLING FOR DATA INTENSIVE DOMAINS MANAGEMENT

Reference: CIPROM/2021/023

PI: Pastor López, Oscar

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (From 01-JAN-22 to 31-DEC-25).

PUNTOS DE ATENCIÓN SANITARIA A DISTANCIA EN ENTORNOS RURALES Y REMOTOS (DISTANCE POINT-OF-CARE ATTENTION IN RURAL ENVIRONMENTS)

Reference: AP2021_19

PI: Alberola Oltra, Juan Miguel

Founded by: POLYTECHNIC UNIVERSITY OF VALENCIA, UPV (From 01-JAN-22 to 30-JUN-23).

DESARROLLO DE UN SISTEMA DE INFORMACIÓN INTELIGENTE PARA UNA GESTIÓN DE DATOS ADAPTADA A LOS CRITERIOS DE CALIDAD, SEGURIDAD Y EFICACIA PARA UNA MEDICINA NUCLEAR DE PRECISIÓN ORIENTADA A LAS NECESIDADES DE LOS PACIENTES

Reference: PI2021_12

PI: Pastor López, Oscar

Founded by: POLYTECHNIC UNIVERSITY OF VALENCIA, UPV (From 01-JAN-22 to 30-JUN-23).

Technology Transfer Projects

ANÁLISIS DE ESTRATEGIAS DE TRATO PERSONALIZADO DE CLIENTES A PARTIR DE FUENTES DE DATOS INTERNAS

PI: Alberola Oltra, Juan Miguel.

Founded by: ENGASA, S.A. (27-DEC-21 a 27-SEP-22).

OPTIPOOL: METODOS DE OPTIMIZACION DE PROCESOS DE LAVADO Y DISTRIBUCION EN EMPRESAS POOL

PI: Botti V.

Founded by: LOGIFRUIT IBERIA S.L.U. (01-APR-16 a 01-APR-22).

HERRAMIENTA DE SOPORTE A LA CONFIGURACION Y GESTIÓN DE LA INFRAESTRUCTURA DE APROVISIONAMIENTO DE SOLUCIONES EN LA NUBE.

PI: Fons Cors, Josep.

Founded by: PRODEVELOP, S. L. (01-SEP-21 a 01-MAR-23).

SUBTITULACIO ASSISTIDA PER ORDINADOR EN TEMPS REAL I BASADA EN LA INTEL·LIGENCIA ARTIFICIAL, DE CONTINGUTS AUDIOVISUALS

PI: Juan, Alfons.

Founded by: CORPORACIO VALENCIANA DE MITJANS DE COMUNICACIO (06-OCT-20 a 06-OCT-22).

UN SISTEMA DE REALIZACIÓN AUTONÓMA DE VÍDEO

Reference:

PI: Botti V.

Founded by: WATCHITY S.L. (From 23-NOV-22 to 23-NOV-25).

MÉTODOS DE ANÁLISIS DE LA PRODUCCION BASADOS EN IOT DE PROCESOS DE LAVADO Y DISTRIBUCIÓN DE EMPRESAS POOL

Reference:

PI: Botti V.

Founded by: LOGIFRUIT IBERIA S.L.U. (From 08-MAR-22 to 08-MAR-25).

SERVICIO DE I+D PARA DOTAR DE IA UNA INTERFAZ BIDIRECCIONAL DE INTERCAMBIO DIRECTO DE INFORMACION PACIENTE/ SISTEMA SANITARIO + SISTEMA ANALITICO PREDICTIVO DE SOPORTE PROFESIONAL MAS SU PLATAFORMA EN BASE DPARA USO CLINICO Y EN INVESTIGACION

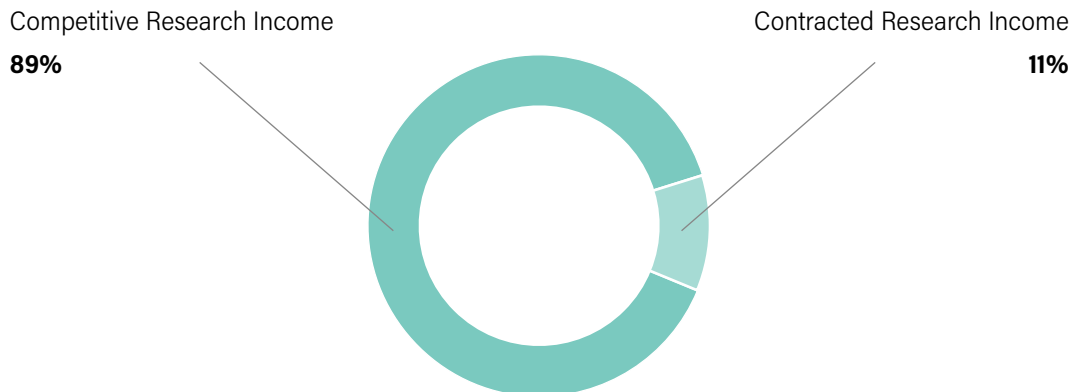
Reference:

PI: Hurtado Oliver, Lluís Felip

Founded by: LABERIT SISTEMAS, S.L. (From 19-APR-22 to 04-OCT-22).

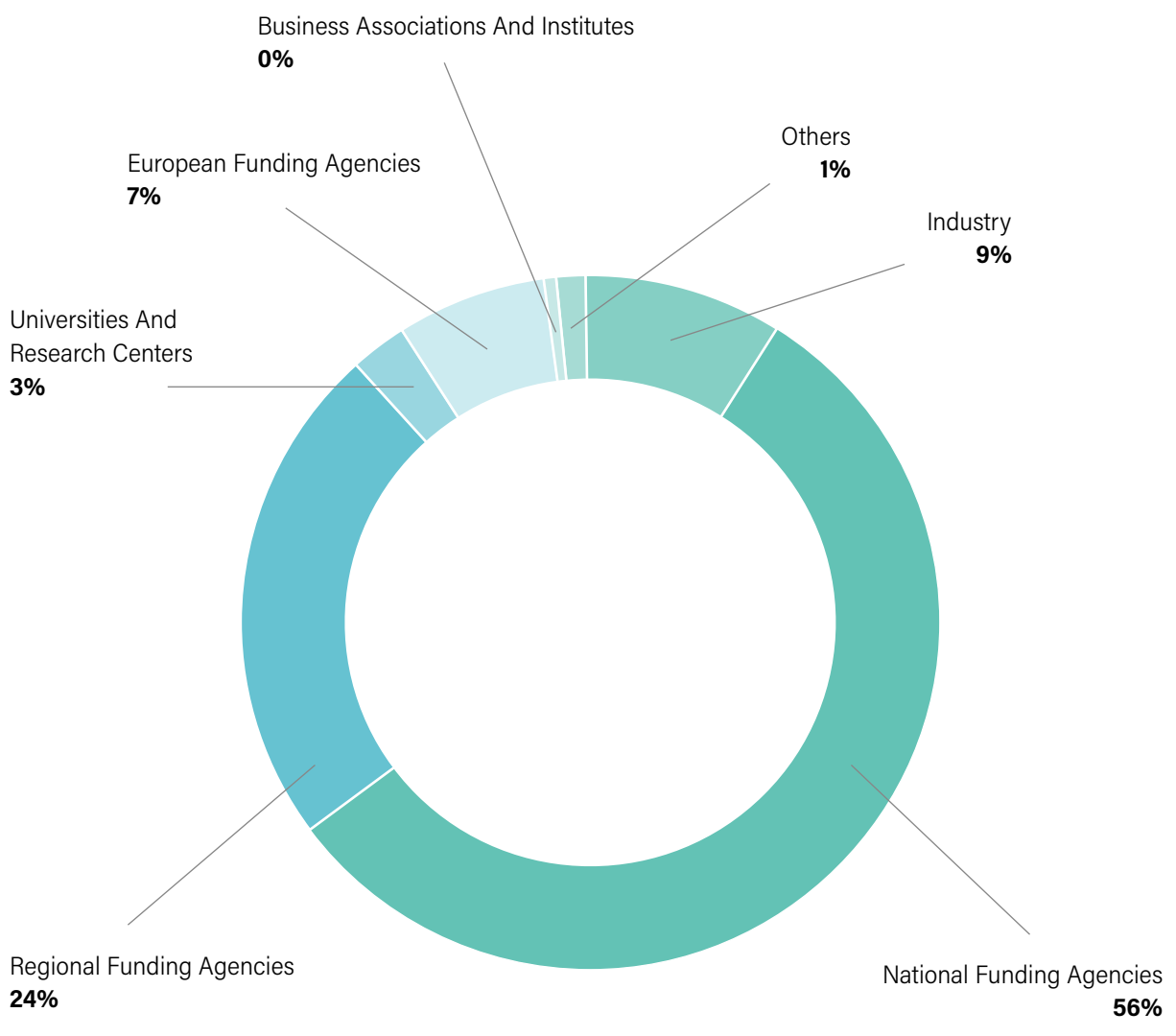
Total income from competitive research and contracted research in 2022:

	2022
Competitive Research Income	3.396.022,81 €
Contracted Research Income	414.613,51 €
TOTAL Income	3.810.636,32 €



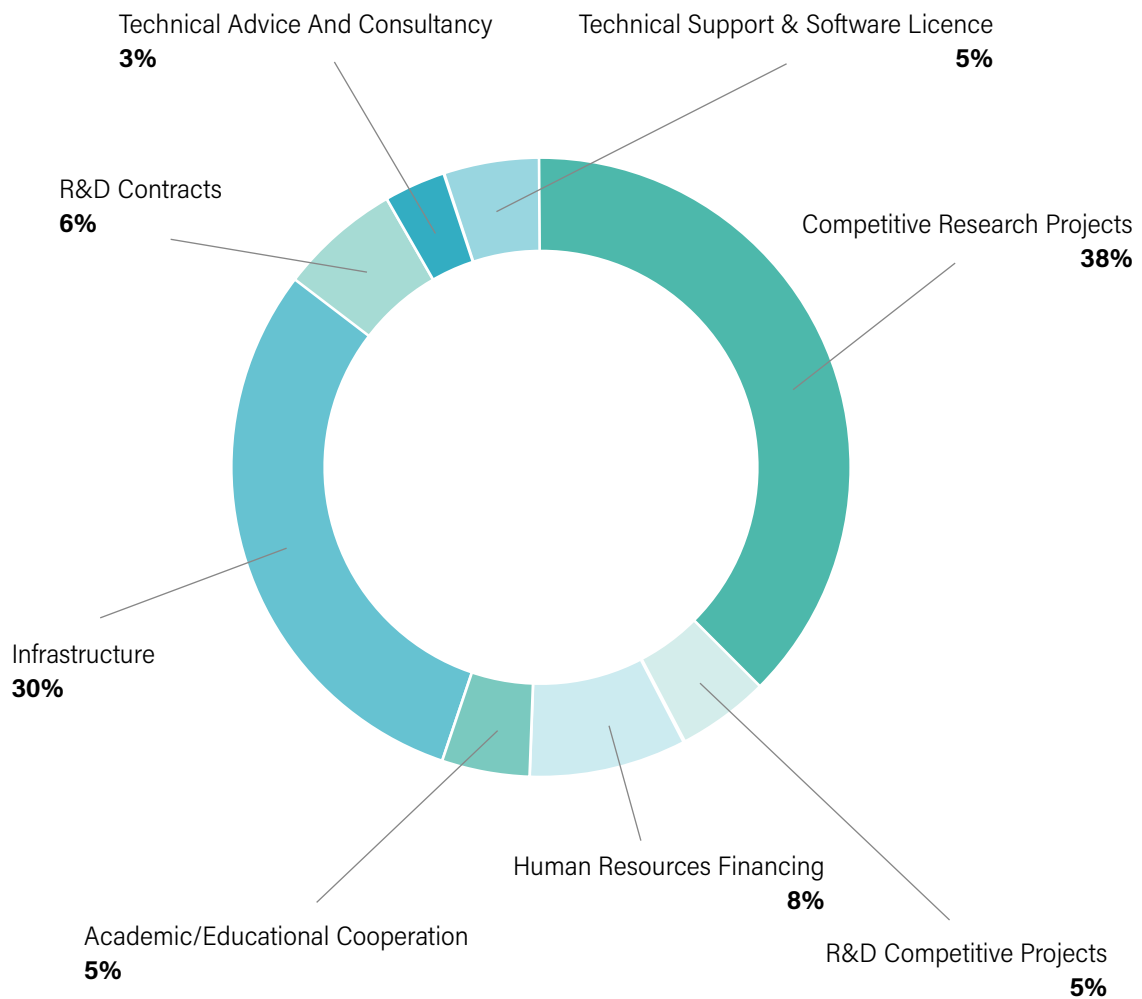
Distribution by type of funding organization:

TYPE OF FUNDING ORGANIZATION	2022
Industry	344.113,51 €
National Funding Agencies	2.125.536,87 €
Regional Funding Agencies	907.835,86 €
Universities And Research Centers	95.706,00 €
European Funding Agencies	266.944,08 €
Business Associations And Institutes	13.500,00 €
Others	57.000,00 €
TOTAL	3.810.636,32 €



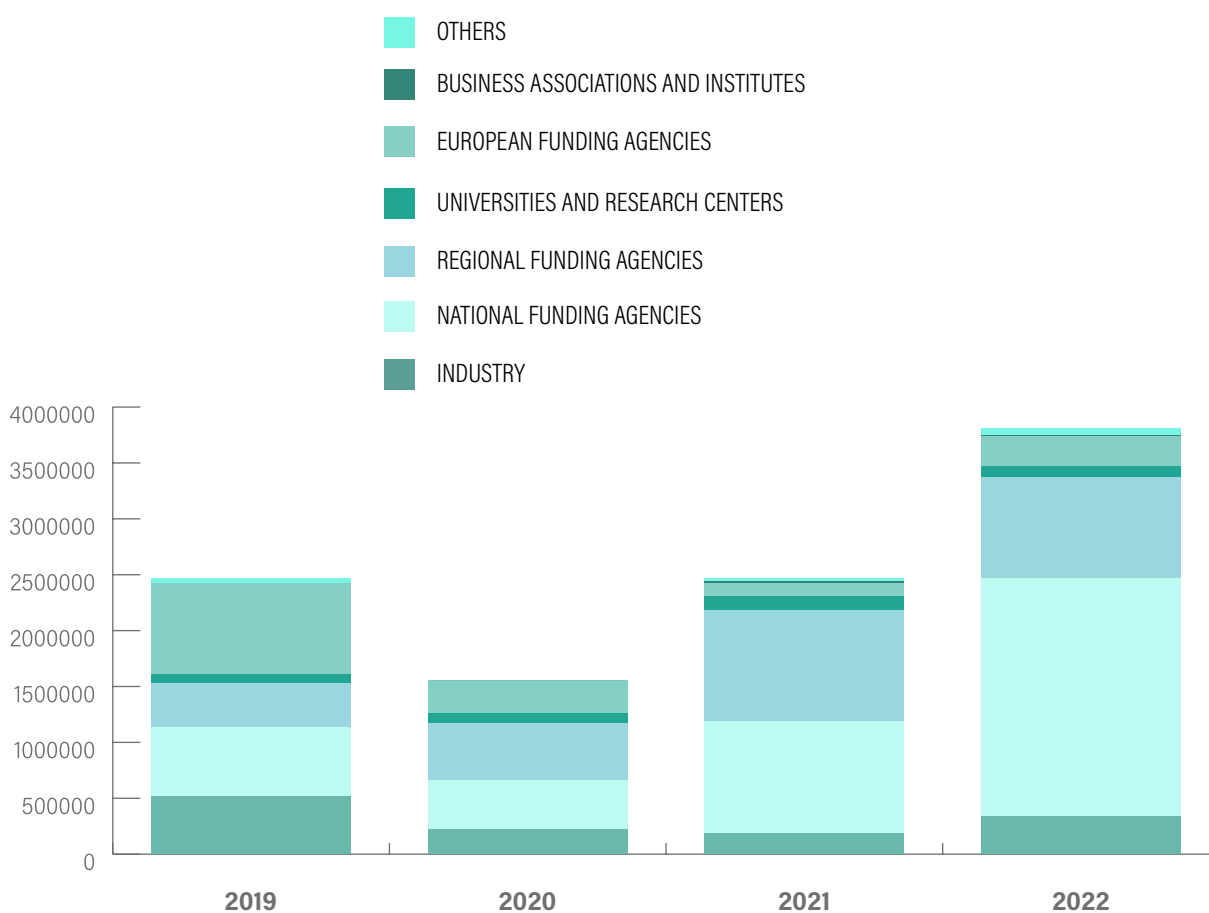
Distribution of income by type of activity:

TYPE OF ACTIVITY	2022
COMPETITIVE RESEARCH PROJECTS	1.428.645,28 €
R&D COMPETITIVE PROJECTS	182.290,88 €
HUMAN RESOURCES FINANCING	313.620,12 €
ACADEMIC/EDUCATIONAL COOPERATION	173.858,16 €
INFRASTRUCTURE	1.159.766,45 €
R&D CONTRACTS	238.924,00 €
TECHNICAL ADVICE AND CONSULTANCY	122.636,51 €
TECHNICAL SUPPORT & SOFTWARE LICENCE	190.894,92 €

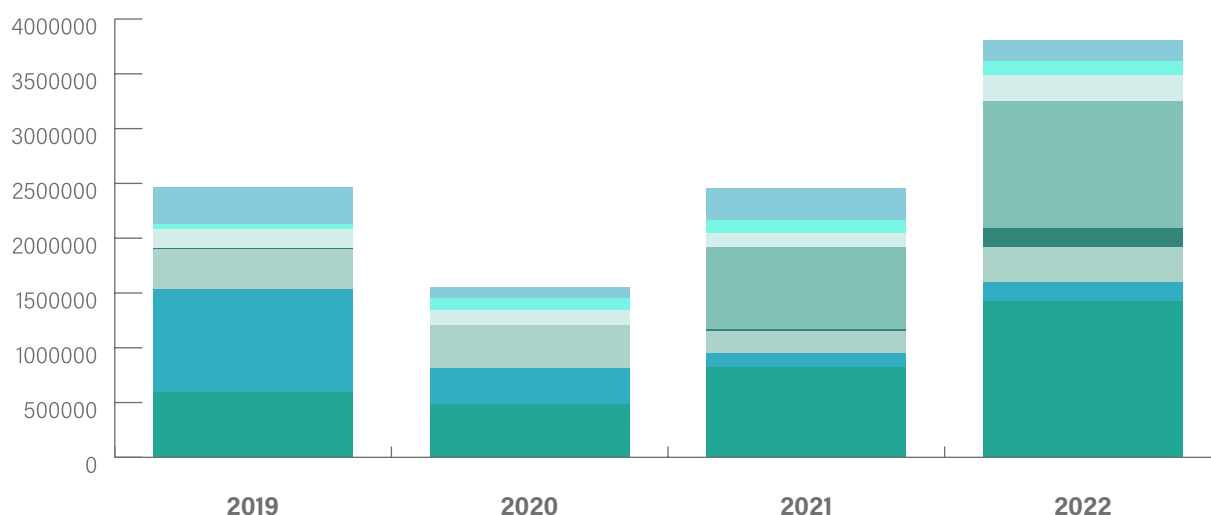


Evolution of economic indicators over the last four years:

TYPE OF FUNDING ORGANIZATION	2019	2020	2021	2022
INDUSTRY	527.597,18 €	224.130,94 €	192.992,67 €	344.113,51 €
NATIONAL FUNDING AGENCIES	612.245,04 €	435.839,37 €	1.002.803,21 €	2.125.536,87 €
REGIONAL FUNDING AGENCIES	391.086,64 €	509.170,50 €	986.858,07 €	907.835,86 €
UNIVERSITIES AND RESEARCH CENTERS	79.960,00 €	99.345,00 €	130.925,00 €	95.706,00 €
EUROPEAN FUNDING AGENCIES	818.911,97 €	287.551,25 €	118.254,73 €	266.944,08 €
BUSINESS ASSOCIATIONS AND INSTITUTES			13.500,00 €	13.500,00 €
OTHERS	43.291,94 €		21.000,00 €	57.000,00 €
TOTAL	2.473.092,77 €	1.556.037,06 €	2.466.333,68 €	3.810.636,32 €



TYPE OF ACTIVITY	2019	2020	2021	2022
COMPETITIVE RESEARCH PROJECTS	608.350,23 €	498.761,84 €	833.042,08 €	1.428.645,28 €
R&D COMPETITIVE PROJECTS	937.317,97 €	322.903,25 €	128.496,33 €	182.290,88 €
HUMAN RESOURCES FINANCING	364.247,39 €	392.596,03 €	194.912,83 €	313.620,12 €
ACADEMIC/EDUCATIONAL COOPERATION	5.620,00 €		24.720,00 €	173.858,16 €
INFRASTRUCTURE			746.744,77 €	1.159.766,45 €
R&D CONTRACTS	174.637,14 €	137.161,00 €	129.120,00 €	238.924,00 €
TECHNICAL ADVICE AND CONSULTANCY	44.363,04 €	107.526,94 €	118.104,67 €	122.636,51 €
TECHNICAL SUPPORT & SOFTWARE LICENCE	338.557,00 €	97.088,00 €	291.193,00 €	190.894,92 €



Projects that will start in 2023

In 2023, the following new projects with funding from the European Commission, NATO, the Regional Government of the Valencian Community, and the Spanish National Cybersecurity Institute has started at VRAIN:



EUROPEAN ARTIFICIAL INTELLIGENCE AND ROBOTICS TESTING AND EXPERIMENTATION FACILITY FOR SMART AND SUSTAINABLE CITIES AND COMMUNITIES

Reference: DIGITAL2022 CLOUDAI02/S8760000

PI: Botti V.

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY; EUROPEAN COMMISSION (From 01-JAN-23 to 31-DEC-27).

BETTER REAL-WORLD HEALTH-DATA DISTRIBUTED ANALYTICS RESEARCH PLATFORM

Reference: 101136262

PI: Pastor López, Oscar

Founded by: EUROPEAN COMMISSION (From 01-DEC-23 to 31-MAY-27).

TECNOLOGIAS DE APRENDIZAJE Y RAZONAMIENTO RAPIDO Y LENTO

Reference: CIPROM/2022/6

PI: Ramírez Quintana, María José

Founded by: REGIONAL GOVERNMENT OF VALENCIAN COMMUNITY (From 01-JAN-23 to 31-DEC-26).

SYMBOLIC REWRITING METHODS FOR SAFETY AND SECURITY OF CRITICAL CYBER-PHYSICAL SYSTEMS

Reference: SPS.MYP.G6133

PI: Escobar Román, Santiago

Founded by: NORTH ATLANTIC TREATY ORGANIZATION (From 13-NOV-23 to 12-NOV-26).

SERIOUS GAMES FOR CREATIVITY AND SOCIAL COHESION IN TEACHER EDUCATION

Reference: 101128757-EDU-2023-CBHE

PI: Linares-Pellicer, Jordi

Founded by: EUROPEAN COMMISSION (From 01-NOV-23 to 31-OCT-26).

CYBERSECURITY FOR ALL

Reference: 101083009

PI: Escobar Román, Santiago

Founded by: EUROPEAN COMMISSION (From 01-JUL-23 to 30-JUN-26).

A 360 DEGREES PERSPECTIVE ON THE VALUE OF MUSIC

Reference: 101094872

PI: Pastor López, Oscar

Founded by: EUROPEAN COMMISSION (From 01-MAR-23 to 28-FEB-26).

SEGURIDAD Y PRIVACIDAD EN SISTEMAS CON INTELIGENCIA ARTIFICIAL

Reference:

PI: Such Aparicio, José Miguel

Founded by: SPANISH NATIONAL CYBERSECURITY INSTITUTE, INCIBE (From 25-OCT-23 to 31-DEC-25).

International industrial and institutional partners



NVIDIA, Canadá	Canadá
Facebook AI Research Paris	Francia
Future of Life Institute	UK
Google DeepMind	UK
Microsoft Research Cambridge	UK
Microsoft Research, Redmond	EE. UU.
Naval Research Laboratory	EE. UU.
NASA Langley Research Center	EE. UU.
SRI International	EE. UU.
Accenture Ltd	Israel
AXINI	Países Bajos
TNO	Países Bajos
Testwerk	Países Bajos
Philips	Países Bajos
Cap Gemini	Países Bajos
Innspire	Países Bajos
Softteam	Francia
IDIR	Irlanda
Sysgo AG	Alemania
CEA - Commissariat a l'Energie Atomique et aux Energies Alternatives	Francia
OW2	Francia
Technikon Forschungs- und Planungsgesellschaft Mbh	Austria
INESC ID	Portugal
Fondazione Bruno Kessler	Italia
Gameware Europe Limited	UK
AGI Research SRO	Rep. Checa
Thales Six Gts France SAS	Francia
Thales Avs France SAS	Francia



6 Publications

Evolution of VRAIN publication metrics in the 2020-2022 triennium:

Ranking\Year	2020	2021	2022
JCR Q1	18	24	16
JCR Q2	26	15	17
JCR Q3	7	6	6
JCR Q4	5	3	-
Journals Not JCR	18	14	4
Chapters	4	6	2
Books	2	3	2
Conferences	83	83	85

Journal Publications 2022

Electric vehicle charging stations emplacement using genetic algorithms and agent-based simulation.

J. Jordán, J. Palanca Cámara, P. Martí, V. Julián, Vicente. Expert Systems with Applications. Vol. 197, pp 1- 15. 2022.

DOI: 10.1016/j.eswa.2022.116739

A CBR for integrating sentiment and stress analysis for guiding users on social network sites.

G. Aguado, V. Julian, A. García-Fornés, A. Espinosa. Expert Systems with Applications. Vol. 208, pp 1-15. 20

DOI:10.1016/j.eswa.2022.118103

A Comprehensive Framework for Learning Declarative Action Models.

D. Aineto, S. Jiménez-Celorrío, E. Onaindía De La Rivaherrera. Journal of Artificial Intelligence Research. Vol. 74, pp 1091-1123. 20

DOI: 10.1613/jair.113073

A Constraint-based Approach to Learn Temporal Features on Action Models from Multiple Plans.

A. Garrido. Constraints. Vol. 27, No. 1-2, pp 134-16. 2022.

DOI:10.1007/s10601-022-09330-3

A framework for conceptual characterization of ontologies and its application in the cybersecurity domain.

B. Franco, L. Serrano-Gil, J. Reyes, J. Panach, O. Pastor, M. Hadad, B. Rochwerger. Software & Systems Modeling Vol. 21, No.4, pp 1437-1464. 2022.

DOI:10.1007/s10270-022-01013-0

A New Methodological Framework for Project Design to Analyse and Prevent Students from Dropping Out of Higher Education.

V. Flores, S. Heras, V. Julián Vicente. Electronics Vol. 11, No. 18, pp 1-19. 2022.

DOI: 10.3390/electronics11182902

A Partial Evaluation Methodology for Optimizing Rewrite Theories Incrementally.

M. Alpuente, D. Ballis, S. Escobar, D. Galán-Pascual, J. Sapiña-Sanchis. *MethodsX* Vol. 9, pp 1-10. 2022.
DOI: 10.1016/j.mex.2022.101802

A Review of Privacy Decision-making Mechanisms in Online Social Networks.

J. Alemany, E. Del Val, A. García-Fornes. *ACM Computing Surveys* Vol. 55, No. 2, pp 1-32. 2022.
DOI: 10.1145/3494067

A Spanish dataset for reproducible benchmarked offline handwriting recognition.

S. España, M.J. Castro-Bleda. *Language Resources and Evaluation* Vol. 56, No.3, pp 1009-1022. 2022.
DOI:10.1007/s10579-022-09587-3

An Advanced Search System to Manage SARS-CoV-2 and COVID-19 Data Using a Model-Driven Development Approach.

A. León-Palacio, A. García-Simón, O. Pastor. *IEEE Access* Vol. 10, pp 43528-43534. 2022.
DOI: 10.1109/ACCESS.2022.3169268

Automating data science.

T. De Bie, L. De Raedt, J. Hernández-Orallo, H. Hoos, P. Smyth, C.K.I. Williams. *Communications of the ACM* Vol. 65, No. 3, pp 76-87. 2022.
DOI:10.1145/3495256

Challenges for Model-Driven Development of Strategically Aligned Information Systems.

R. Noel-López, J. Panach, O. Pastor. *IEEE Access* Vol. 10, pp 38237-38253. 2022.
DOI: 10.1109/ACCESS.2022.3162225

Charging Stations and Mobility Data Generators for Agent-based Simulations.

P. Martí, J. Jordán, J. Palanca, V. Julián. *Neurocomputing* Vol. 484, pp 196-210. 2022
DOI: 10.1016/j.neucom.2021.06.098

Comparison of Predictive Models with Balanced Classes Using the SMOTE Method for the Forecast of Student Dropout in Higher Education.

V. Flores, S. Heras, V. Julián. *Electronics* Vol. 11, No. 3, pp 1-16. 2022.
DOI: 10.3390/electronics11030457

COVID-19 outbreaks analysis in the Valencian Region of Spain in the prelude of the third wave.

D. Fuente, D. Hervás-Marín, M. Rebollo, J.A. Conejero, N. Oliver. *Frontiers in Public Health* Vol. 10, pp 1-14. 2022.
DOI: 10.3389/fpubh.2022.1010124

Demand-Responsive Shared Transportation: A Self-Interested Proposal.

P. Martí, J. Jordán, F. De la Prieta, H. Billhardt, V. Julián. *Electronics* Vol. 11 No. 1, pp 1-14. 2022.
DOI: 10.3390/electronics11010078

Detection and nudge-intervention on sensitive information in social networks.

J. Alemany, V.Botti-Cebriá, E. Del Val, A. García-Fornés. *Logic Journal of the IGPL* Vol. 30, No. 6, pp 942-953. 2022.
DOI: 10.1093/jigpal/jzac004

Developing IoT Artifacts in a MAS Platform.

J. Palanca, J. Rincón-Arango, V. Julián, C. Carrascosa, A. Terrasa. *Electronics* Vol. 11, No. 4, pp 1-16. 2022.
DOI: 10.3390/electronics11040655

Direct Human-AI Comparison in the Animal-AI Environment.

K. Voudouris, M. Crosby, B. Beyret, J. Hernández-Orallo, M. Shanahan, M. Halina, L.G. Cheke. *Frontiers in Psychology* Vol. 13, pp 1-22. 2022
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A. Marcén, F. Pérez, O. Pastor, C. Cetina. *Software Practice and Experience* Vol.52, No. 11, pp 2439-2455. 2022.
DOI: 10.1002/spe.3133

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J. Rincón-Arango, V. Julián, C. Carrascosa. *Applied Sciences* Vol. 12, No. 7, pp 1-14. 2022.
DOI: 10.3390/app12073701

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M. Campos, J.M. Sempere. *Genetic Programming and Evolvable Machines* Vol. 23, No. 1, pp 133-155. 2022.
DOI: 10.1007/s10710-021-09423-7

Learning temporal action models from multiple plans: A constraint satisfaction approach.

A. Garrido. Engineering Applications of Artificial Intelligence Vol. 108, pp 1-14. 2022.
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R. Lapeña, F. Pérez, O. Pastor, C. Cetina. Information and Software Technology Vol. 146, pp 1- 14. 2022.
DOI: 10.1016/j.infsof.2022.106873

Live Streaming Speech Recognition Using Deep Bidirectional LSTM Acoustic Models and Interpolated Language Models.

J. Jorge-Cano, A. Giménez, J.A. Silvestre, J. Civera, J.A. Sanchis, A. Juan. IEEE/ACM Transactions on Audio Speech and Language Processing Vol. 30, pp 148-161. 2022.
DOI: 10.1109/TASLP.2021.3133216

Mapping avocado in Michoacán with Sentinel-2 images and a mixed methodology.

M.L. España, M.J. Castro-Bleda, S. España. Revista de Geografía Agrícola Vol. 69, pp 61-80. 2022.
DOI: 10.5154/r.rga.2022.69.03

Mastering Agile Practice Adoption through a Model-Driven Approach for the Combination of Development Methods.

G.A. Giachetti, J.L. de la Vara, B. Marín. Business & Information Systems Engineering Vol. 65, pp 103-125. 2022.
DOI: 10.1007/s12599-022-00785-5

MLLP-VRAIN Spanish ASR Systems for the Albayzín-RTVE 2020 Speech-to-Text Challenge: Extension.

P. Baquero-Arnal, J. Jorge-Cano, A. Giménez, J. Iranzo-Sánchez, A.M. Pérez-González de Martos, G. Garcés, J.A. Silvestre, J. Civera, J.A. Sanchis, A. Juan. Applied Sciences Vol. 12, No. 2, pp 1-14. 2022.
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Modeling and verification of the post-quantum key encapsulation mechanism KYBER using Maude.

V. García, S. Escobar, K. Ogata. CEUR Workshop Proceedings Vol. 3280, pp 32-49. 2022.

Multimodal Classification of Teaching Activities from University Lecture Recordings.

O. Sapena, E. Onaindía De La Rivaherrera. Applied Sciences Vol. 12, No. 9, pp 1-18. 2022.
DOI: 10.3390/app12094785

Non-identical parallel machines batch processing problem with release dates, due dates and variable maintenance activity to minimize total tardiness.

P. Beldar, M. Moghtader, A. Giret, A.H. Ansariipoor. Computers & Industrial Engineering Vol. 168, pp 1-28. 2022.
DOI: 10.1016/j.cie.2022.108135

Optimization of Rewrite Theories by Equational Partial Evaluation.

M. Alpuente, D. Ballis, S. Escobar, J. Sapiña-Sanchis. Journal of Logical and Algebraic Methods in Programming, Vol. 124, pp 1-29. 2022.
DOI: 10.1016/j.jlamp.2021.100729

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M. Alpuente, S. Escobar, J. Meseguer, J. Sapiña-Sanchis. Annals of Mathematics and Artificial Intelligence Vol. 90, No. 5, pp 499-522. 2022.
DOI: 10.1007/s10472-021-09771-1

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S. Lucas, M. Vítóres-Vicente, R. Gutiérrez. Journal of Logical and Algebraic Methods in Programming Vol. 126, pp 1-20. 2022.
DOI: 10.1016/j.jlamp.2022.100749

Simulating the efficacy of vaccines on the epidemiological dynamics of SARS-CoV-2 in a membrane computing model.

M. Campos, J.M. Sempere, J.C. Galán, A. Moya, R. Cantón, C. Llorens, F. Baquero. microLife Vol. 3, pp 1-13. 2022.
DOI: 10.1093/femsm/luqac018

SUVS: Secure Unencrypted Voting Scheme.

A.M. Larriba, D. López. Informatica Vol. 33, No. 4, pp 749-769. 2022.
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Symbolic Specialization of Rewriting Logic Theories with Presto.

M. Alpuente, S. Escobar, J. Sapiña-Sanchis, D. Ballis. Theory and Practice of Logic Programming Vol. 22, No. 3, pp 444-495. 2022.
DOI: 10.1017/S1471068421000600

System: A core conceptual modeling construct for capturing complexity.

R. Lukyanenko, V.C. Storey, O. Pastor. Data & Knowledge Engineering Vol. 141, pp 1-29. 2022.
DOI: 10.1016/j.datak.2022.102062

Taxi services and the carsharing alternative: a case study of Valencia city.

P. Martí, J. Jordán, P. Chamoso, V. Julián. Mathematical Biosciences and Engineering Vol. 19, No. 7, pp 6680-6698. 2022.
DOI: 10.3934/mbe.2022314

Teaching Modeling in the Time of Agile Development.

O. Pastor A. Pierantonio, G. Rossi. Computer Vol. 55, No. 6, pp 73-76. 2022.
DOI: 10.1109/MC.2022.3144929

The challenge of managing the evolution of genomics data over time: a conceptual model-based approach.

A. García-Simón, M. Costa-Sánchez, A. León-Palacio, O. Pastor. BMC Bioinformatics Vol. 23, pp 1-32. 2022.
DOI: 10.1186/s12859-022-04944-z

Toward Autonomous and Distributed Intersection Management with Emergency Vehicles.

C.L. González-Pinzón, S.L. Delgado; J.M. Alberola, L. Niño, V. Julián. Electronics Vol. 11, No. 7, pp 1-13. 2022.
DOI: 10.3390/electronics11071089

Towards the Prioritised Use of Transportation Infrastructures: The Case of Vehicle-Specific Dynamic Access Restrictions in City Centres.

H. Billhardt, A. Fernández, P. Martí, J. Prieto, S. Ossowski. Electronics Vol. 11, No. 4, pp 1-18. 2022.
DOI: 10.3390/electronics11040576

Awards and Recognitions

Researcher José Ángel González Barba received the award for the best doctoral thesis, titled "Attention-based approaches for Text Analytics in Social Media and Automatic Summarization," during the 38th Conference of the Spanish Society for Natural Language Processing, SEPLN2022, in A Coruña, Spain, from September 20 to 23, 2022.

LOIMOS, the pandemic simulator that helps predict the evolution of pandemics in different epidemiological scenarios, developed with the participation of researchers from the ALFA group at VRAIN, was awarded by the International Membrane Computing Society (IMCS) as the Application of the Year 2021 in membrane computing (October 2022).

7 | PhD Thesis

In total, VRAIN researchers have supervised **204 doctoral theses**, of which 29 have been defended in the last 5 years (2018-2022) within the Doctoral Program in Computer Science at UPV.

This program stems from the synergy between the software research lines of the Department of Computer Systems and Computation (DSIC) and the hardware research lines of the Department of Computer Systems and Computers (DISCA).

The Doctoral Program in Computer Science is designed for students who wish to acquire advanced knowledge in computer science to undertake responsibilities in the industry, administration, or academia. The program's educational objectives enable students to gain a multidisciplinary and generalist education or specialize in one of the four areas that constitute the Official Postgraduate Program in Computer Science:

- » **Cloud and High-Performance Computing (DSIC)**
- » **Computer and Network Engineering (DISCA)**
- » **Software Systems Engineering and Technology (DSIC)**
- » **Artificial Intelligence, Pattern Recognition, and Digital Image (DSIC)**

During 2022, a total of 11 doctoral theses were completed at the VRAIN institute.

Temporal Emotion Dynamics in Social Networks

Author: Debashis Naskar

Supervisors: Eva Onaindia de la Rivaherrera; Miguel Rebollo Pedruelo. (18 January 2022)

Abstract: Sentiment analysis in social networks has been widely analysed over the last decade. Despite the amount of research done in sentiment analysis in social networks, the distinct categories are not appropriately considered in many cases, and the study of dissemination patterns of emotions is limited. Therefore, understanding the significance of specific emotions will be more beneficial for various marketing activities, policy-making decisions, and political campaigns. The current PhD thesis focuses on designing a theoretical framework for analyzing the broad spectrum of sentiments and explain how emotions are propagated using concepts from temporal and multilayer networks. More precisely, our goal is to provide insights into emotion influence modelling that solves emotion estimation problems and its temporal dynamics nature on social conversation. To exhibit the efficacy of the proposed model, we have collected posts related to different events from Twitter and build a temporal network structure over the conversation. Firstly, we perform sentiment analysis with the adaptation of a lexicon-based approach and the circumplex model of affect that enhances the effectiveness of the sentiment characterization. Subsequently, we investigate the social dynamics of emotion present in users' opinions by analyzing different social influential characteristics. Next, we design a temporal emotion-based stochastic

model in order to investigate the engagement pattern and predict the significant emotions. Our ultimate contribution is the development of a sequential emotion-based influence model with the advancement of recurrent neural networks. It offers to predict emotions in a more comprehensive manner. Finally, the document presents some conclusions and, also, outlines future research directions.

A BDI empathic agent model based on a multidimensional cross-cultural emotion representation

Author: Joaquín José Taverner Aparicio

Supervisors: Vicente Juan Botti Navarro; Emilio Pedro Vivancos Rubio (28 January 2022)

Abstract: Human beings are, by nature, affective beings; our emotions, moods, personality, or relationships with others guide our motivations and our decisions. One of the main cognitive abilities related to affect is empathy. Empathy is a psychological construct whose definition has evolved over the years and whose meaning refers to a wide range of affective and cognitive competencies that are fundamental in the development of human beings as social beings. The use of empathy in the field of artificial intelligence can revolutionize the way we interact with machines as well as the way we simulate human behavior. On the other hand, it must be considered that human beings usually resort to the use of different words such as "sad" or "happy" to express or verbalize our affective state. However, these words are simplifications that cover a wide spectrum of cognitive processes and mental states. Moreover, it should be considered that these words have a high dependence on the language and culture in which they are used. Therefore, computational representation models of affective states must be adaptable to different cultural environments and to allow an agent to express or represent, by means of words, a given affective state. In this thesis, a new model of empathic agent capable of adapting its behavior to different cultural environments is proposed. To this end, first, a new experiment-based methodology to adapt an emotion representation space based on the dimensions of pleasure and arousal for simulation and affective computational recognition to different cultural environments is presented. The results of an experiment conducted with European Spanish speakers are used to provide a new fuzzy logic-based model for representing affective states in the dimensions of pleasure and arousal using a polar coordinate approach. To

prove that cultural differences affect the pleasure and arousal values associated with each emotion, the experiment was replicated with Portuguese and Swedish participants. Secondly, a new model of emotion elicitation in affective agents using fuzzy logic is presented. The emotions generated in the agent by the fuzzy appraisal rules are expressed in the model of affect representation resulting from the previously described experiments. In addition, a new affect regulation process is proposed to adapt the agent's mood, —iii—represented by a vector in the pleasure-arousal space, when an emotion is elicited. Third, a formalization of the syntax, semantics, and reasoning cycle of Agent Speak to enable the development of affective agents with empathic capabilities is presented. Drawing on the theories of empathic appraisal and empathic regulation, the agent's reasoning structure is modified to allow empathy to affect the decision-making process. Finally, a model of an empathic pedagogical agent for education on good practices in the use of social networks is introduced. The agent is able to recognize the user's emotion when interacting with the social network. Based on the user's emotion and behavior in the social network, the agent estimates a plan to educate the user in the correct and secure use of social networks.

A navigational role-centric model oriented Web approach MoWebA

Author: Magali González Toñáñez

Supervisors: Oscar Pastor López; Luca Cernuzzi (14 February 2022)

Abstract: Some of the major challenges facing Web applications today are those of portability, adaptability and evolution, not only in the environment in which they run, but also in the way in which they must be developed, often requiring different languages, frameworks, tools, environments, platforms, etc. MDD and MDA take into account these issues. However, to achieve portability, adaptability and evolution depends to some extent on the degree of independence that the models adopt. This Thesis presents a method that take into account the problem of evolution and portability towards different environments. The approach is called MoWebA (Model Oriented Web Approach). Some key aspects of MoWebA that could have a positive impact in the portability and adaptability are: i) incorporation of an Architecture Specific Model (ASM) as a new modeling layer, in order to keep the portability of the Platform Independent Model (PIM) regarding the different architectures (e.g., RIA, SOA, Mobile); ii) clear separation of the presentation layer with regard to the navigation and behavior layers; iii) definition of the navigational structure according to a function-oriented approach, which prevents the modification of the navigation design caused by implementation changes; iv) and use of standards in order to facilitate the independence from the tools. We justify MoWebA by highlighting a series of concerns for Web applications development. We present an overview of the method including the dimensions and the diagrams that we propose. Subsequently, we present each step in the modeling process, including the diagrams and notation, its definition (metamodels) and examples of use. Afterwards, we present the transformation process adopted by MoWebA, which includes model-to-model and model-to-code transformations. We have devoted special attention to the validation of the approach. As a first validation, MoWebA has been used for modelling and

generating different types of applications by both novice and experienced modellers and developers. These experiences were done in academic and industrial contexts. The experiences have allowed to identify strengths and weaknesses of the PIM proposal, and to verify that the proposed notation covers the needs of different domains. Next, we present a preliminary validation of the ASM proposal, considering an experience of different ASM definitions made by a group of computer science students at the Catholic University “Nuestra Señora de la Asunción” (Paraguay). This preliminary validation has allowed us to determine how feasible is to adapt the proposal to other architectures. The analysis of the validation sought to answer the following questions: Can the same PIM model be used for different architectures? Is it possible to specify clear limits between platform independent models (PIM) and architectural specific models (ASM)?; How does an architectural specific model facilitate the transformation rules definition?. Finally, we present a Case Study to validate the extensions of MoWebA to three different architectures. The experience was structured taking into account the framework of Runeson et al. This experience have allowed to carry out three complete extensions. In such extensions we could analysed the grade of adaptability of MoWebA and of automation PIM-ASM, as well as the grade of independence of the PIM metamodel. We have also conducted some user’s satisfaction experiences with modelers and developers.

Deep Neural Networks for Automatic Speech-To-Speech Translation of Open Educational Resources

Author: Alejandro Manuel Pérez González de Martos

Supervisors: Alfonso Juan Císcar; José Alberto Sanchis Navarro (15 June 2022)

Abstract: In recent years, deep learning has fundamentally changed the landscapes of a number of areas in artificial intelligence, including computer vision, natural language processing, robotics, and game theory. In particular, the striking success of deep learning in a large variety of natural language processing (NLP) applications, including automatic speech recognition (ASR), machine translation (MT), and text-to-speech (TTS), has resulted in major accuracy improvements, thus widening the applicability of these technologies in real-life settings. At this point, it is clear that ASR and MT technologies can be utilized to produce cost-effective, high-quality multilingual subtitles of video contents of different kinds. This is particularly true in the case of transcription and translation of video lectures and other kinds of educational materials, in which the audio recording conditions are usually favorable for the ASR task, and there is a grammatically well-formed speech. However, although state-of-the-art neural approaches to TTS have shown to drastically improve the naturalness and quality of synthetic speech over conventional concatenative and parametric systems, it is still unclear whether this technology is already mature enough to improve accessibility and engagement in online learning, and particularly in the context of higher education. Furthermore, advanced topics in TTS such as cross-lingual voice cloning, incremental TTS or zero-shot speaker adaptation remain an open challenge in the field. This thesis is about enhancing the performance and widening

the applicability of modern neural TTS technologies in real-life settings, both in offline and streaming conditions, in the context of improving accessibility and engagement in online learning. Thus, particular emphasis is placed on speaker adaptation and cross-lingual voice cloning, as the input text corresponds to a translated utterance in this context.



Inference and Learning with Planning Models

Author: Diego Aineto García

Supervisors: Eva Onaindia de la Rivaherrera; Sergio Jiménez Celorrio (1 July 2022)

Abstract: Inference and learning are the acts of reasoning about some collected evidence in order to reach a logical conclusion regarding the process that originated it. In the context of a state-space model, inference and learning are usually concerned with explaining an agent's past behaviour, predicting its future actions or identifying its model. In this thesis, we present a framework for inference and learning in the state-space model underlying the classical planning model, and formulate a palette of inference and learning problems under this unifying umbrella.

We also develop effective planning-based approaches to solve these problems using off-the-shelf, state-of-the-art planning algorithms. We will show that several core inference and learning problems that previous research has treated as disconnected can be formulated in a cohesive way and solved following homogeneous procedures using the proposed framework. Further, our work opens the way for new applications of planning technology as it highlights the features that make the state-space model of classical planning different from other models.

Experimentation to Evaluate the Benefits of Model Driven Development

Author: María África, Domingo Montes

Supervisors: Oscar Pastor López; Carlos Cetina Englada (12 July 2022)

Abstract: Model Driven Development (MDD) is a software engineering approach in which the code of a software product is generated and evolutionated from conceptual models that abstractly represents the system. For nearly two decades, the scientific community has described many of the advantages of MDD over other approaches. Despite the benefits of MDD, its use in real practical developments is merely anecdotal. To understand why MDD has not replaced other software engineering approaches, I have conducted an empirical investigation through three controlled experiments. The first experiment aims to clarify whether the benefits of MDD compared to

code-centric development (CcD) match the reality of development in real environments. In the second experiment, I compare engineers' assessment of the models they develop with the usefulness of these models to be used in MDD contexts. In the third experiment, I analyze the performance of software professionals in maintenance tasks in MDD contexts. Our results confirm the benefits of MDD over other approaches; however, the intention to use MDD does not reach maximum values. Subjects underestimate the potential of the models they develop and use in MDD contexts. The adoption problem seems to be linked to human factors, not to technical factors.

Human-centred Security and Privacy in Smart Home Personal Assistants (SPAs): Understanding Users' Perceptions, Preferences and Skill Developers' Practices

Author: Noura Abdi

Supervisors: José Miguel Such Aparicio; Luca Viganò (1 September 2022)

Abstract: Smart Home Personal Assistants (SPAs), such as Amazon Alexa and Google Assistant, are a relatively new technology leveraging advances in machine learning and natural language processing that provide seamless voice-based interactions to users and offering a wide range of capabilities. In order to offer these capabilities, SPAs have a complex ecosystem involving many stakeholders, which currently lack usable security and privacy mechanisms, often leading to users' security and privacy incidents and concerns. This thesis focuses on two key stakeholders of the SPA ecosystem: end-users of SPA and developers of third-party SPA skills, which are voice applications that extend the capabilities of SPA. Through this thesis, we study end-users' mental models, perceptions and security and privacy threats/concerns. Also, we study their preferences over the flows of information across the SPA ecosystem. Regarding developers of third-party skills, we study their security and privacy practices when developing, deploying and maintaining skills.

We found that SPA users have incomplete mental models of the ecosystem and different data activities such as how their information is processed, shared, stored and learned by those stakeholders, leading to various of security and privacy concerns. To cope with concerns, users often apply short-term coping

strategies like avoiding the use of certain features, but most users simply do not know how to protect themselves. We also studied users' preferences of the flows of information across the SPA ecosystem based on the contextual integrity theory, and applied association rule mining to distil a set of general privacy norms for SPA, which can be implemented by SPA providers and developers of thirdparty skills as privacy default settings. Regarding third-party developers, we found that security and privacy is often neglected and developers focus on adding and testing new features to boost their skill ratings. Finally, we put together the key findings of this thesis to propose a conceptual framework, highlighting the relationships between the concepts and proposing recommendations for policy, research and practice.

Assessing and Measuring the Privacy Practices of Voice Assistant Applications

Author: Jide Edu

Supervisors: José Miguel Such Aparicio; Guillermo Suarez de Tangil Rotaeché (1 October 2022)

Abstract: Smart Personal Voice Assistants (SPA) are fast becoming popular with the widespread introduction of desktop, phone and home assistants. Over a hundred million users now utilise SPA like Alexa, Siri, Google Assistant, Bixby and Cortana every day, and SPA devices have been sold in massive numbers. However, recent security and privacy incidents involving SPA like Alexa recording a private conversation and sending it to a random contact have increased users' concerns about the security and privacy of these assistants. This thesis studies the security and privacy issues of SPA. In particular, the risks associated with the skills (voice applications) they leverage to extend and expand their functionality. Firstly, we present a classification of SPA security and privacy issues and use it to systematically map current attacks and countermeasures to different architectural elements. We show that those elements expose SPA to various risks, such as the complexity of their architecture, the AI features, the wide range of underlying technologies, and the open nature of the voice channel they use.

We then conduct a systematic study of SPA third-party skills as this is one of the architectural elements offering a large attack surface. In particular, we study the permission model SPA providers offer to developers and investigate how third-party skills use them to collect personal data. We further design a methodology that systematically identifies potential privacy issues in the third-party skills by analysing the traceability between the permissions and the

data practices stated by developers. In addition, we propose a highly accurate system to automate the traceability analysis at scale. Furthermore, we perform a longitudinal measurement study of the Amazon Alexa skills across the marketplaces for three years to demystify developers' data practices and present an overview of the third-party skill ecosystem. Finally, we present an open tool that allows proactive audit of data collection practices in emerging technologies like SPA. The overall study resulted in two new datasets for smart assistants privacy assessment evaluation: the traceability-by-policy dataset (TBPD) and the permission-by-sentence dataset (PBSD). All these aim to contribute to the collective effort towards establishing secure, privacy-aware assistants.

Modeling and analysis of advanced cryptographic primitives and security protocols in Maude-NPA

Author: **Damián Aparicio Sánchez**

Supervisor: **Santiago Escobar Román (17 November 2022)**

Abstract: The Maude-NPA crypto tool is a specialized model checker for cryptographic security protocols that take into account the algebraic properties of the cryptosystem. In the literature, additional crypto properties have uncovered weaknesses of security protocols and, in other cases, they are part of the protocol security assumptions in order to function properly. Maude-NPA has a theoretical basis on rewriting logic, equational unification, and narrowing to perform a backwards search from an insecure state pattern to determine whether or not it is reachable. Maude-NPA can be used to reason about a wide range of cryptographic properties, including cancellation

of encryption and decryption, Diffie-Hellman exponentiation, exclusive-or, and some approximations of homomorphic encryption. In this thesis, we consider new cryptographic properties, either as part of security protocols or to discover new attacks. We have also modeled different families of security protocols, including Distance Bounding Protocols or Multi-party key agreement protocols. And we have developed new protocol modeling techniques to reduce the time and space analysis effort. This thesis contributes in several ways to the area of cryptographic protocol analysis and many of the contributions of this thesis can be useful for other crypto analysis tools.

Understanding the Code of Life: Holistic Conceptual Modeling of the Genome

Author: **Alberto García Simón**

Supervisor: **Oscar Pastor López; Juan Carlos Casamayor Rodenas (22 December 2022)**

Abstract: Over the last few decades, advances in sequencing technology have produced significant amounts of genomic data, which has revolutionised our understanding of biology. However, the amount of data generated has far exceeded our ability to interpret it. Deciphering the code of life is a grand challenge. Despite our progress, our understanding of it remains minimal, and we are just beginning to uncover its full potential, for instance, in areas such as precision medicine or pharmacogenomics. The main objective of this thesis is to advance our understanding of life by proposing a holistic approach, using a model-based approach, consisting of three artifacts: i) a conceptual schema of the genome, ii) a

method for its application in the real-world, and iii) the use of foundational ontologies to represent domain knowledge in a more unambiguous and explicit way. The first two contributions have been validated by implementing genome information systems based on conceptual models. The third contribution has been validated by empirical experiments assessing whether using foundational ontologies leads to a better understanding of the genomic domain. The artifacts generated offer significant benefits. First, more efficient data management processes were produced, leading to better knowledge extraction processes. Second, a better understanding and communication of the domain was achieved.

Streaming Automatic Speech Recognition with Hybrid Architectures and Deep Neural Network Models

Author: Javier Jorge Cano

Supervisors: Alfonso Juan Císcar; Jorge Civera Saiz (21 November 2022)

Abstract: Over the last decade, the media have experienced a revolution, turning away from the conventional TV in favor of on-demand platforms. In addition, this media revolution not only changed the way entertainment is conceived but also how learning is conducted. Indeed, on-demand educational platforms have also proliferated and are now providing educational resources on diverse topics. These new ways to distribute content have come along with requirements to improve accessibility, particularly related to hearing difficulties and language barriers. Here is the opportunity for automatic speech recognition (ASR) to comply with these requirements by providing high-quality automatic captioning. Automatic captioning provides a sound basis for diminishing the accessibility gap, especially for live or streaming content. To this end, streaming ASR must work under strict real-time conditions, providing captions as fast as possible, and working with limited context. However, this limited context usually leads to a quality degradation as compared to the pre-recorded or offline content. This thesis is aimed at developing low-latency streaming ASR with a quality similar to offline ASR. More precisely, it describes the path followed from an initial hybrid offline system to an efficient streaming-adapted system. The first step is to perform a single recognition pass using a state-of-the-art neural network-based language model. In conventional multi-pass systems, this model is often deferred to the second or later pass due to its computational complexity. As with the language model, the neural-based acoustic model is also properly adapted to work with limited context. The adaptation and integration of these models is

thoroughly described and assessed using fully-fledged streaming systems on well-known academic and challenging real-world benchmarks. In brief, it is shown that the proposed adaptation of the language and acoustic models allows the streaming-adapted system to reach the accuracy of the initial offline system with low latency.



8

Dissemination

The strategic plan of VRAIN considers it a priority to develop a communication strategy that contributes to the dissemination of science and the research results achieved by the institute's researchers. In 2022, VRAIN researchers have participated in multiple events related to dissemination and the promotion of science. Some of these events have a purely scientific nature, while others are more oriented towards a non-specialized audience.



WebSeminars

VRAIN already has a tradition of conducting regular seminars. The seminars are primarily delivered by our research staff (researchers, postdoctoral researchers, doctoral students, etc.) as the main mechanism for sharing their latest research work with the institute, as well as researchers from other institutes. They also serve as a platform for international researchers visiting VRAIN to present their work.

Internal seminars contribute to enhancing the training of staff in various areas, including administrative procedures, technical skills, infrastructure, among others.

Scientific dissemination activities

VRAIN researchers regularly participate in science outreach events. Some events are organized by the institute, while others are external events where they participate by invitation. Some of those that have been carried out during 2022 include the following:

Invited Talks by VRAIN Scientists

José Hernández Orallo gave the talk “La intel·ligència artificial i natural per descobrir: es busquen metròlegs, cartògrafs i taxonomista” as part of the cycle ‘La Segona Digitalització’ held at the Centre Cultural La Nau of the Universitat de València, on March 10, 2022.

Joaquin Taverner Aparicio delivered a presentation on “Empathetic Intelligent Agents” at the International Seminar on Affective Artificial Intelligence organized by the University of Valparaíso (Chile) on September 29, 2022.

Vicente Botti gave a talk on recent developments in Artificial Intelligence and its relationship with Industry 5.0 at the I Digital Transformation Meeting organized by AINIA on October 18, 2022.

Vicente Botti delivered a talk on affective intelligent agents at the VI International Congress of Bioethics held in Costa Rica from October 24 to 28, 2022.

María José Ramírez presented a lecture on Business Intelligence during the Turia Innovation Transfer Day held in Bétera, Valencia, on November 17, 2022.



Organisation of Scientific Events



24rd "International Conference on Principles and Practice of Multi-Agent Systems"

From 16 to 18 November 2022, the 24th International Conference on Principles and Practice of Multi-Agent Systems was held in Valencia, where the latest papers on MULTI-AGENT SYSTEMS BASED COMPUTING were presented, addressing the challenges in the management of distributed intelligent systems through interaction, negotiation, and collaborative decision making among computational entities.



11th International Workshop on Approaches and Applications of Inductive Programming.

The AAIP'22 was held within the 2nd International Joint Conference on Learning & Reasoning in Cumberland Lodge, Windsor Great Park, United Kingdom, 28-30 September 2022. The AAIP workshop series aiming at promoting research in Inductive programming (IP), a field of machine learning concerned with learning executable programs in arbitrary programming languages, from incomplete specifications, typically input/output examples.

Activities for youth



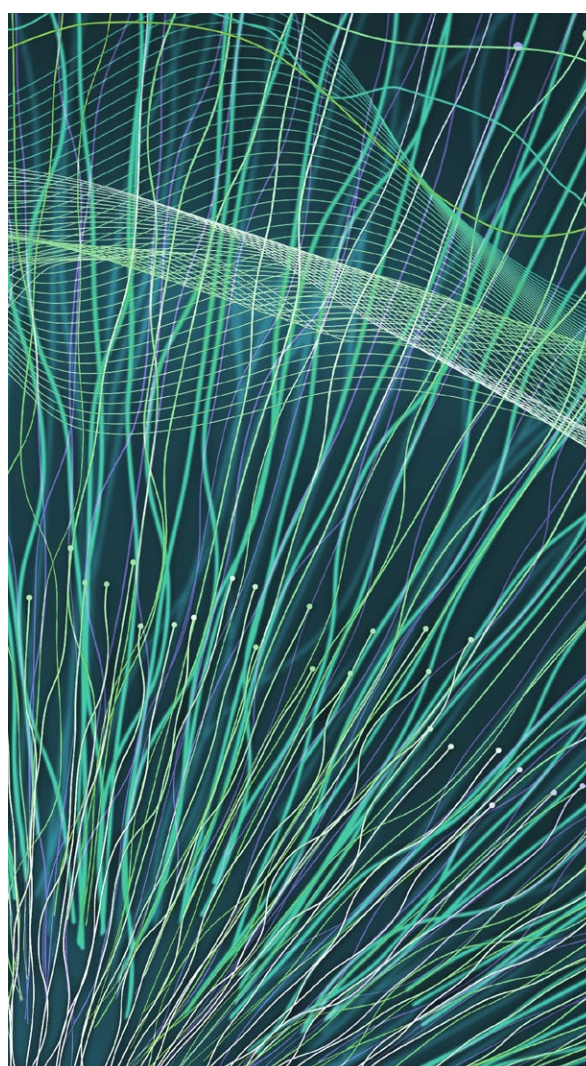
Researchers from VRAIN collaborate in the CiènciaLab program at UPV which has as objective to inspire scientific vocations in secondary school students through the organization of scientific, technological, and artistic workshops.

Scholarships and internships programs

As an indicator of our ongoing strength and reputation as a research institution, VRAIN participates in and promotes talent development initiatives through scholarship programs and other research initiation activities for undergraduate and master's students at UPV.

In 2022, VRAIN's research staff supervised students within the following programs: Collaboration Grants in university departments of the Ministerio de Educación y Formación Profesional, Training Collaboration Scholarships of the UPV, and the curricular internship program of the UPV. In total, through these calls, the following students have joined VRAIN:

Student
María Isabel Benlloch Blasco
Andreu Casamayor Segarra
Lexin Zhou
Francisco Enguix Andrés
Rodrigo Llanes Lacomba
Jaime Martínez Sánchez
Huang Chen Xin
Pablo Llobregat Ruiz
Aaron Raya López
Andreu Simo Vidal
Tomás Catalan López



VRAIN at the media

VRAIN is present in the media and on major social networks (LinkedIn, X, YouTube). The institute also prepares press releases for the dissemination of research and projects carried out at the institute. Additionally, Vrain researchers frequently appear on

television, radio, and other news media, addressing a broad audience outside our usual scientific community. Below are some of the topics covered in the press and media appearances by Vrain researchers during 2022.



The Generalitat, through the Agència Valenciana de la Innovació (AVI) is funding an intelligent platform for tourist recommendations that integrates gamified visits with virtual reality.

El Periódico de aquí (<https://www.elperiodicodeaqui.com/epda-noticias/el-consell-financia-una-plataforma-inteligente-de-recomendaciones-turisticas-que-integra-visitas-gamificadas-con-realidad-virtual/291181>)

elperiodic.com (https://www.elperiodic.com/consell-financia-plataforma-inteligente-recomendaciones-turisticas-integra-visitas-gamificadas-realidad-virtual_843145)

WWW.LANOCION.ES (<https://www.lanocion.es/comunidad-valenciana/20220811/el-consell-de-valencia-financia-una-plata10-15331.html>)

Valencia Plaza (<https://valenciaplaza.com/consell-financia-plataforma-visualizar-propuestas-turisticas-forma-personalizada>).



The Valencian Institute for Research in Artificial Intelligence (VRAIN) receives a grant from the AVI for the creation of a Scientific Unit for Business Innovation (UCIES).

elperiodic.com (https://www.elperiodic.com/generalitat-financia-desarrollo-proyectos-innovacion-valor-millones-euros_841476)

Castellón Plaza (<https://castellonplaza.com/lagen-eralitatfinanciaeldesarrollode103proyectosdeinnovacionpor14millonesdeeuros>)

Valencia Plaza (<https://valenciaplaza.com/generalitat-financia-desarrollo-103-proyectos-innovacion-14-millones>)



The former president of the Dominican Republic, Leonel Fernández, is interested in the Valencian app E-Mobil-ity developed by the Generalitat Valenciana through the Valencian Institute for Research in Artificial Intelligence (VRAIN).

Redacción Valencia noticias (<https://valencianoticias.com/el-expresidente-de-la-republica-dominicana-leonel-fernandez-se-interesa-por-la-app-valenciana-e-mobil-ity/>)

El Periódico de aquí (<https://www.elperiodicodeaqui.com/epda-noticias/el-expresidente-de-la-republica-dominicana-leonel-fernandez-se-interesa-por-la-app-valenciana-e-mobil-ity/289743>)

elperiodic.com (https://www.elperiodic.com/expresidente-republica-dominicana-leonel-fernandez-interesa-valenciana-mobil_839189)

A research group of Enginyeria del Llenguatge i Reconeixement de Formes (ELiRF) integrated in the Valencian Institute for Research in Artificial Intelligence (VRAIN) has developed a system capable of detecting emotions in social networks.

ConSalud.es (https://www.consalud.es/saludigital/tecnologia-sanitaria/desarrollan-sistema-capaz-detectar-emociones-redes-sociales_101782_102.html)



Researchers from VRAIN are involved in the development of an artificial intelligence prototype that will adapt court rulings to easy reading by means of machine learning techniques.

WWW.LAWANDTRENDS.COM (<https://www.lawandtrends.com/noticias/abogacia/la-futura-universalizacion-de-la-lectura-facil-en-los-fallos-judiciales-1.html>)

WWW.ECONOMISTJURISTES (<https://www.economistjurist.es/noticias-juridicas/el-icav-trabaja-en-un-prototipo-de-lectura-facil-para-personas-con-discapacidad/>)

elperiodic.com (https://www.elperiodic.com/icav-presenta-proyecto-utiliza-inteligencia-artificial-para-universalizar-fallos-judiciales-adaptados-lectura-facil_827997)

“¿Cómo nos afecta que Elon Musk haya comprado Twitter?”, article written by the researcher Miguel Rebollo.

ILEÓN.COM (<https://ileon.eldiario.es/128605>)

www.noticanarias.com (<https://www.noticanarias.com/compra-de-twitter-por-elon-musk-como-nos-afecta/>)

www.elboletin.com (<https://www.elboletin.com/elon-musk-compra-twitter-como-nos-afecta/>)

www.tercerainformacion.es (<https://www.tercerainformacion.es/articulo/29/04/2022/elon-musk-compra-twitter-como-nos-afecta/>)

www.agenciasinc.es (<https://www.agenciasinc.es/es/Opinion/Elon-Musk-compra-Twitter-como-nos-afecta/>)



The UPV -through its VRAIN Institute- is one of the partners of IV4XR (Intelligent Verification/Validation for Extended Reality), an international project to guarantee the quality of Extended Reality programs.

20 minutos (<https://www.20minutos.es/noticia/4991049/0/la-upv-participa-en-un-proyecto-internacional-para-garantizar-la-calidad-de-programas-de-realidad-extendida/>)

Europa press (<https://www.europapress.es/comunitat-valenciana/innova-00214/noticia-upv-participa-proyecto-internacional-garantizar-calidad-programas-realidad-extendida-20220426154515.html>)

WWW.GENTEDIGITAL.ES (<http://www.gentedigital.es/valencia/noticia/3371698/la-upv-participa-en-un-proyecto-internacional-para-garantizar-la-calidad-de-programas-de-realidad-extendida/>)

Elperiodic.com (https://www.elperiodic.com/valencia/inteligencia-artificial-para-asegurar-calidad-juegos-mundos-virtuales-simuladores-realidad-extendida_818455)

A team from VRAIN is participating in EuroProofNet, a European research network on digital testing whose aim is to contribute to achieving error-free software.

Valencia plaza (<https://valenciaplaza.com/la-universidad-politecnica-de-valencia-se-suma-a-la-busqueda-del-software-perfecto>)

<https://www.upv.es/noticias-upv/noticia-13516-europroofnet-en.html>



SER, Ciencia y Tecnología (https://cadenaser.com/2022/03/26/buscan-un-software-perfecto-para-evitar-grandes-desastres-humanos-materiales-o-economicos/?rel=buscador_noticias)

The article titled "Inteligencia artificial, ética y confiable" by Vicente Botti was published in Levante (<https://www.levante-emv.com/opinion/2022/12/27/inteligencia-artificial-etica-confiable-80402179.html>) on December 2022.

A team of researchers from VRAIN has developed an artificial intelligence tool applicable in the selection processes of a job portal.

Economía 3 (<https://economia3.com/2022/11/21/511348-la-herramienta-que-emplea-inteligencia-artificial-para-contratar-trabajadores/>)

Elperiodic.com (https://www.elperiodic.com/valencia/equipo-crea-herramienta-inteligencia-artificial-para-seleccion-personas-ofertas-empleo_863729)

<https://www.ciospain.es/capital-humano/inteligencia-artificial-para-reclutar-al-mejor-candidato>

<https://revistanuve.com/upv-inteligencia-artificial-para-la-seleccion-de-personas-en-ofertas-de-empleo/>

<https://coitcv.org/2022/11/18/un-equipo-de-la-upv-crea-una-herramienta-con-inteligencia-artificial-para-la-seleccion-de-personas-en-ofertas-de-empleo/>

<https://lapublicidad.net/el-instituto-vrain-de-la-upv-crea-una-herramienta-de-seleccion-de-candidatos-con-inteligencia-artificial/>



<http://www.gentedigital.es/valencia/noticia/3506233/desarrollan-una-herramienta-con-inteligencia-artificial-para-la-seleccion-de-personas-en-ofertas-de-empleo/>

Europa press (<https://www.europapress.es/comunitat-valenciana/noticia-desarrollan-herramienta-inteligencia-artificial-seleccion-personas-ofertas-empleo-20221117105702.html>)

A team from the VRAIN institute at UPV has developed a virtual guardian with AI for the metaverse.

Levante (<https://www.levante-emv.com/cultura/2022/12/07/guardian-velara-seguridad-usuarios-metaverso-79681125.html>)

Europa press (<https://www.europapress.es/comunitat-valenciana/innova-00214/noticia-desarrollan-guardian-virtual-ia-detectar-comportamientos-maliciosos-metaverso-20221207113356.html>)

SER (<https://cadenaser.com/comunitat-valenciana/2022/12/07/un-guardian-virtual-para-el-lado-oscurο-del-metaverso-made-in-valencia-radio-valencia/>)

Santiago Escobar explains the role of bots in apunt TV.

Santiago Escobar talks about Cryptocurrency mining in an article published at economia3.com

<https://economia3.com/2022/09/19/505468-la-huella-energetica-de-las-criptomonedas-un-sistema-insostenible/>



Santiago Escobar talks about mobile phone cybersecurity in Levante newspaper

<https://www.levante-emv.com/comunitat-valenciana/2022/05/07/espionaje-amenaza-65832767.html>

Santiago Escobar discusses the diverse functions that the Metaverse will have in the future in Levante newspaper

<https://www.levante-emv.com/comunitat-valenciana/2022/05/29/nueva-vida-metaverso-66650232.html>

Miguel Rebollo participated in the UPV radio program "The University of the Future: Can AI replace the teacher?"

Santiago Escobar talks about the problems of internet services concentration in a few companies in the newspaper La Razón

<https://www.larazon.es/medio-ambiente/20221111/7qy3byyzvjglljkd2oyvisiqiu.html>

Laura Sebastiá went to the 91.4 FM station to talk about what AI is capable of doing for the benefit of people.

Onda Zero Valencia interviewed Vicente Botti regarding the Artificial Intelligence project on a virtual guardian for the Metaverse.

9 Towards the future

VRAIN is one of the key players in the international AI research community. We lead many highly influential ongoing initiatives in AI and will continue to forge strategic partnerships with major national, international, and Valencian players in the field.



VRAIN aims to use AI for good and is committed to reliable AI. We are open to new collaborations with research groups worldwide that share these values.

We are also strengthening our communication and outreach activities by publishing more multimodal content on our website and expanding the themes of our seminars to provide a more multidisciplinary perspective on AI.

At VRAIN, we strongly support our various research master's programs:

- » **Artificial Intelligence, Pattern Recognition and Digital Imaging**
- » **Engineering and Technology of Software Systems.**
- » **Biomedical Engineering**
- » **Cloud Computing and High Performance**



Join us on the journey to make AI an enabling technology to change the world and achieve the United Nations Sustainable Development Goals.

Keep up to date through our social networks:

X: https://twitter.com/VRAIN_upv

YOUTUBE: https://www.youtube.com/channel/UC4P_TQ00CT_V0opre1_o9Mg

LINKEDIN: <https://es.linkedin.com/company/vrain>

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