





Center of Informatics and Systems of the University of Coimbra (CISUC): Challenges, Opportunities & Outreach Activities

encontro CIÊNCIA, 2018



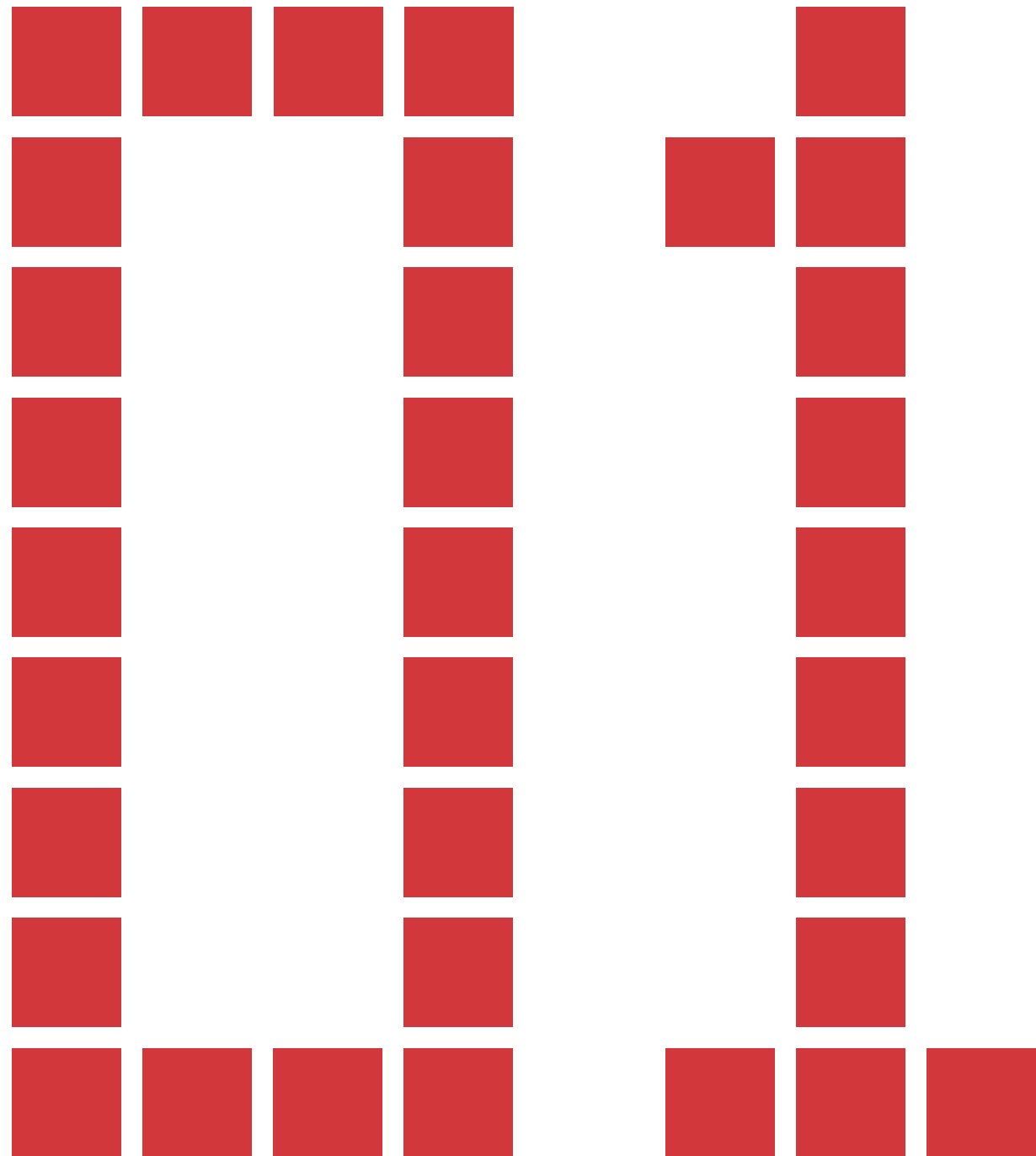
Bernardete Ribeiro, César Teixeira and Penousal Machado

Outline

1. About CISUC
2. Scope & Mission
3. Strategic Priorities & Objectives
4. Scientific Contributions
5. Challenges, Opportunities & Outreach Activities

CISUC

About



CISUC Overview

CISUC Overview

Main scientific area:

Computer science and engineering

72 Integrated Researchers

33 Collaborator Researchers

78 Integrated Phd Students

Coordinator:

Bernardete Ribeiro

Vice-Coordinators:

César Teixeira

and Penousal Machado

A bit of history...

Created in 1991, targets the objectives:

- Carrying out original R&D at a pre-competitive level
- Training highly qualified young researchers
- Cooperating in national and international projects and programs
- Promoting the dissemination of results

CISUC Internal Organization

Research groups

- Adaptive Computation (AC)
- Cognitive and Media Systems (CMS)
- Communications and Telematics (CT)
- Evolutionary and Complex Systems (ECOS)
- Information Systems (IS)
- Software and Systems Engineering (SSE)

CISUC thematic strands

RISE: Resilient software and Internet SystEms (IS, CT, SSE)

Internet architectures & technologies, cloud infrastructures and software services, resilience, and service oriented architectures

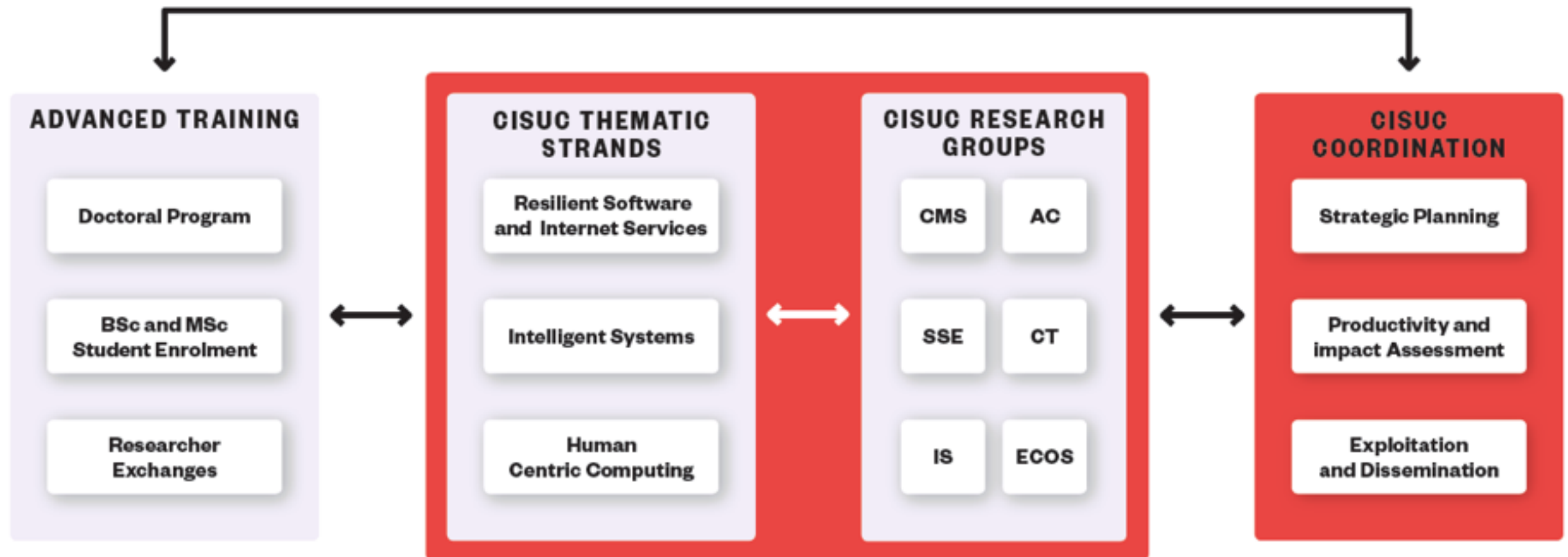
IS: Intelligent Systems (AC, CMS, ECOS)

Computational algorithms and techniques for search, optimisation, learning, modeling, design, visualisation

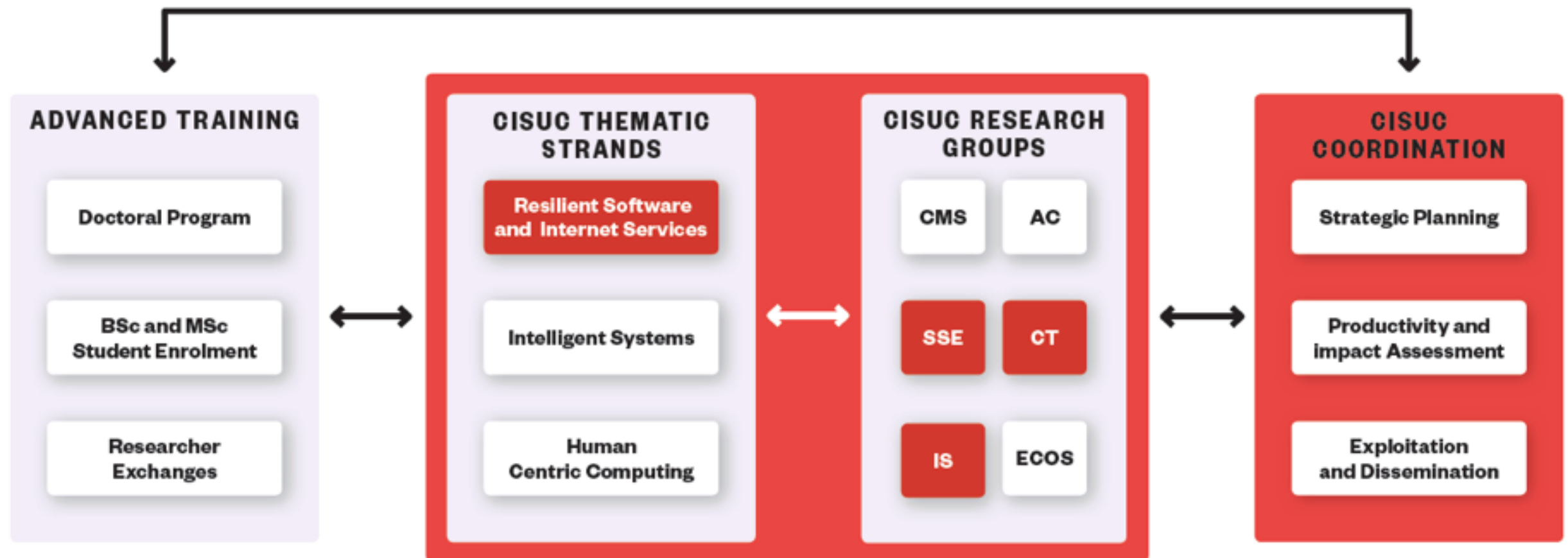
HCC: Human Centric Computing Communications and Telematics (CMS, IS)

Computer-enabled, individual and social phenomena, leading to new emergent extensions of human capabilities and organisational models

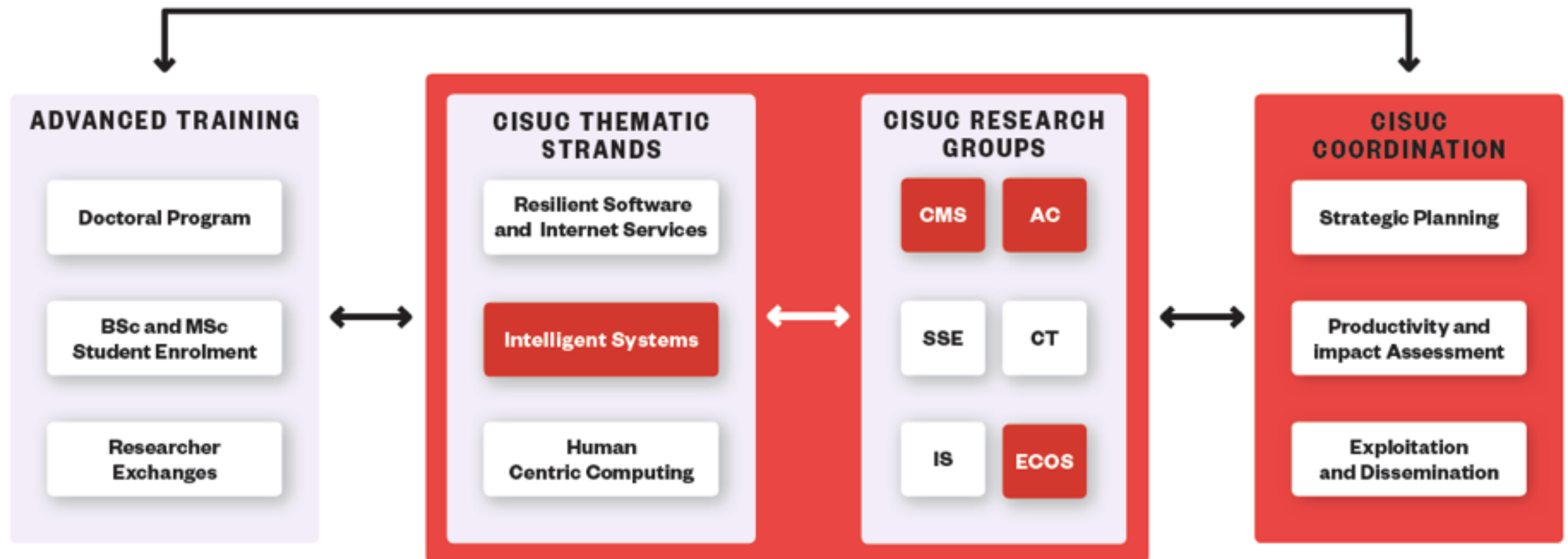
Structure



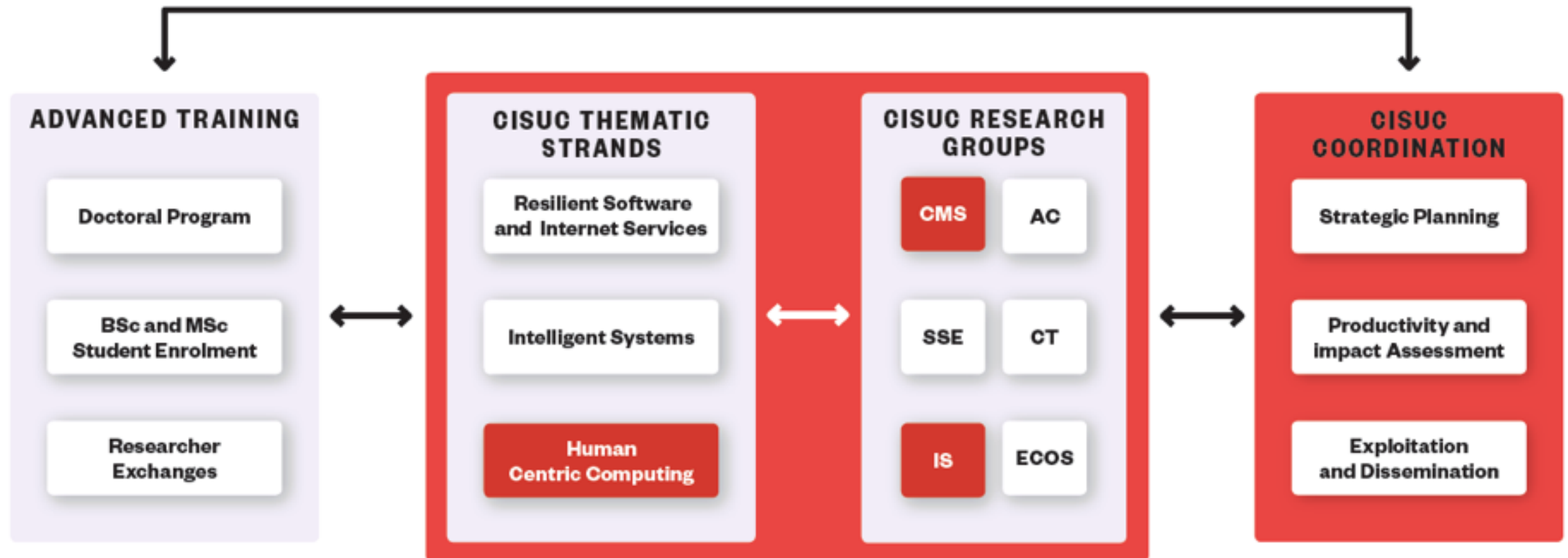
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Structure



Research

- Applications Domains
- Systems and Technologies
- Theoretical and Technological Foundations

Research

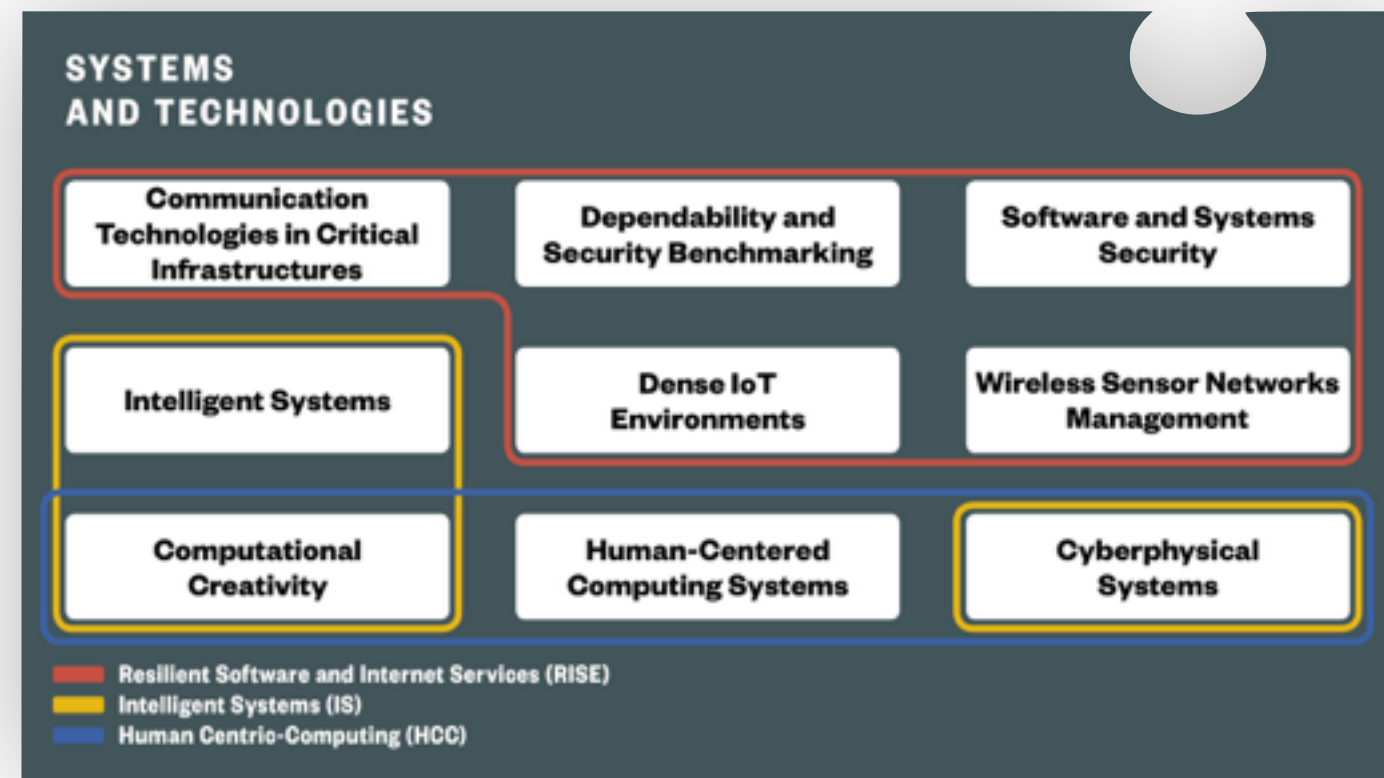
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THEORETICAL AND TECHNOLOGICAL FOUNDATIONS

Artificial Intelligence / Bioinformatics / Machine Learning / Evolutionary Computation / Ambient Intelligence / Information Visualization / Visual Analytics / Big Data / Optimization / Complex Systems / Natural Language Processing / Conceptual Blending / Data Mining and Knowledge Discovery / Operations Research / Interaction Design / Media Design / Service Design and Management / Internet of Services / Business Models / Cloud Computing / Trustworthy and Resilient Software / Efficiency in Software Development / Quality of Service / Quality of Experience / Management and Resilience / Security and Privacy / Intelligent Sensors / Intelligent Logistic / Location Detections Technologies / Internet of Things / System Integration / Ubiquitous Computing / Soft Computing

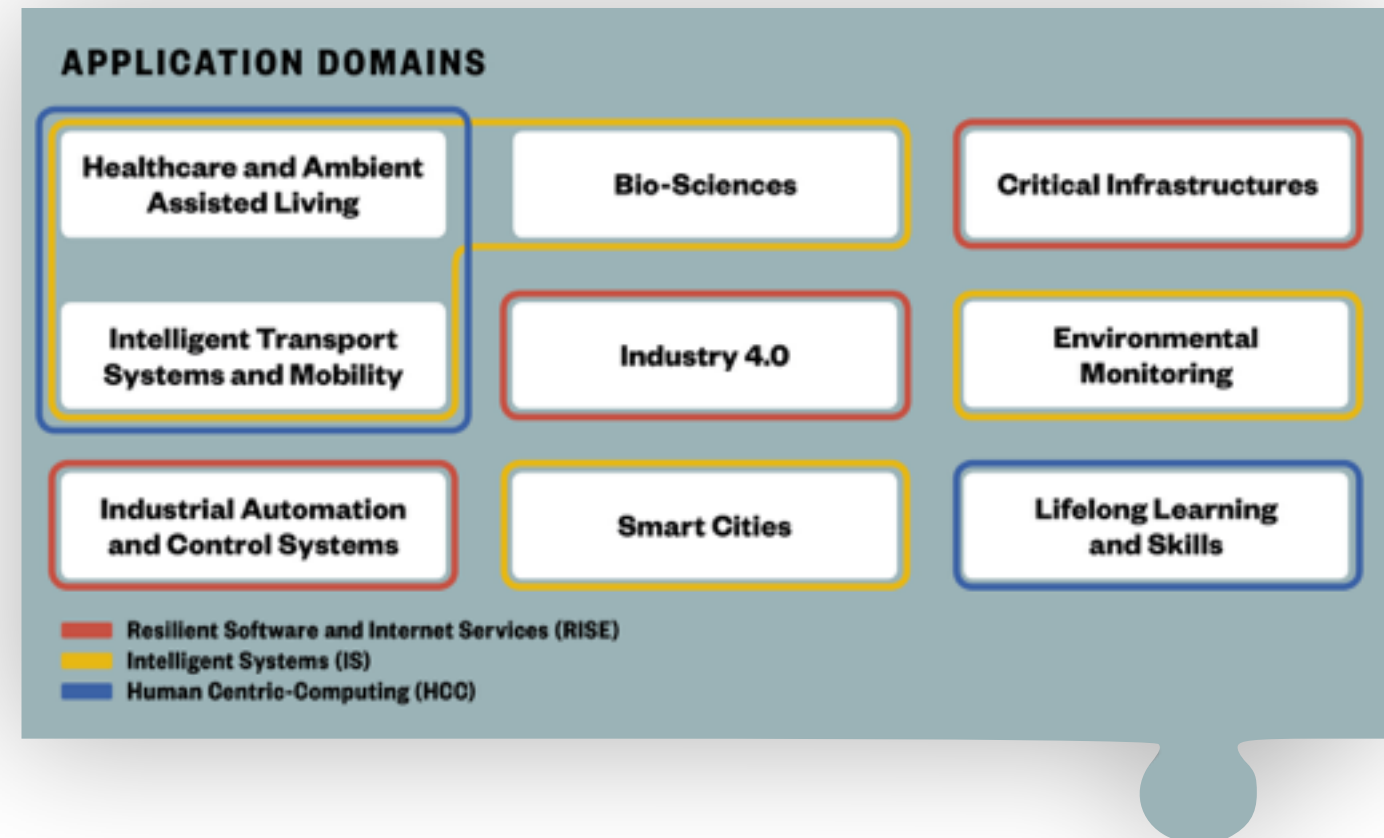
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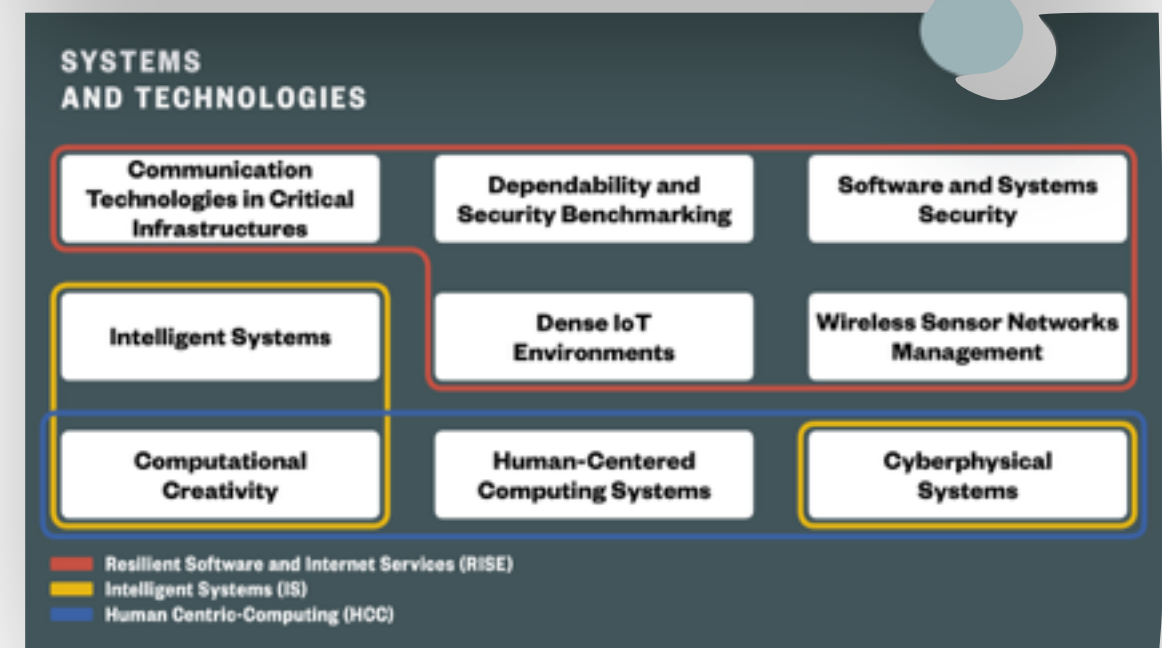
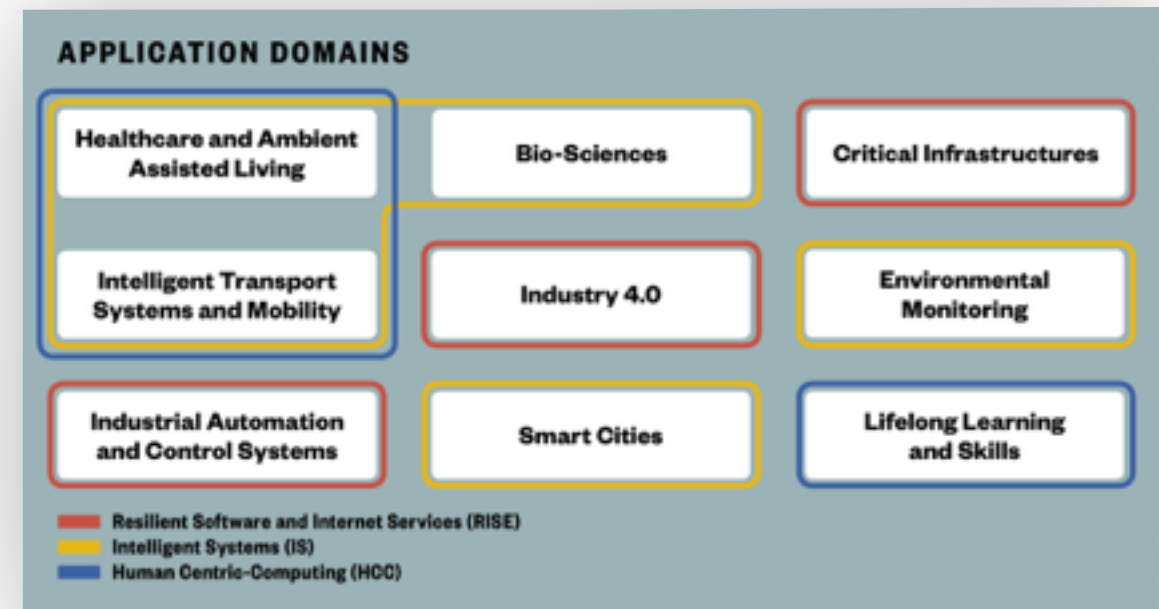
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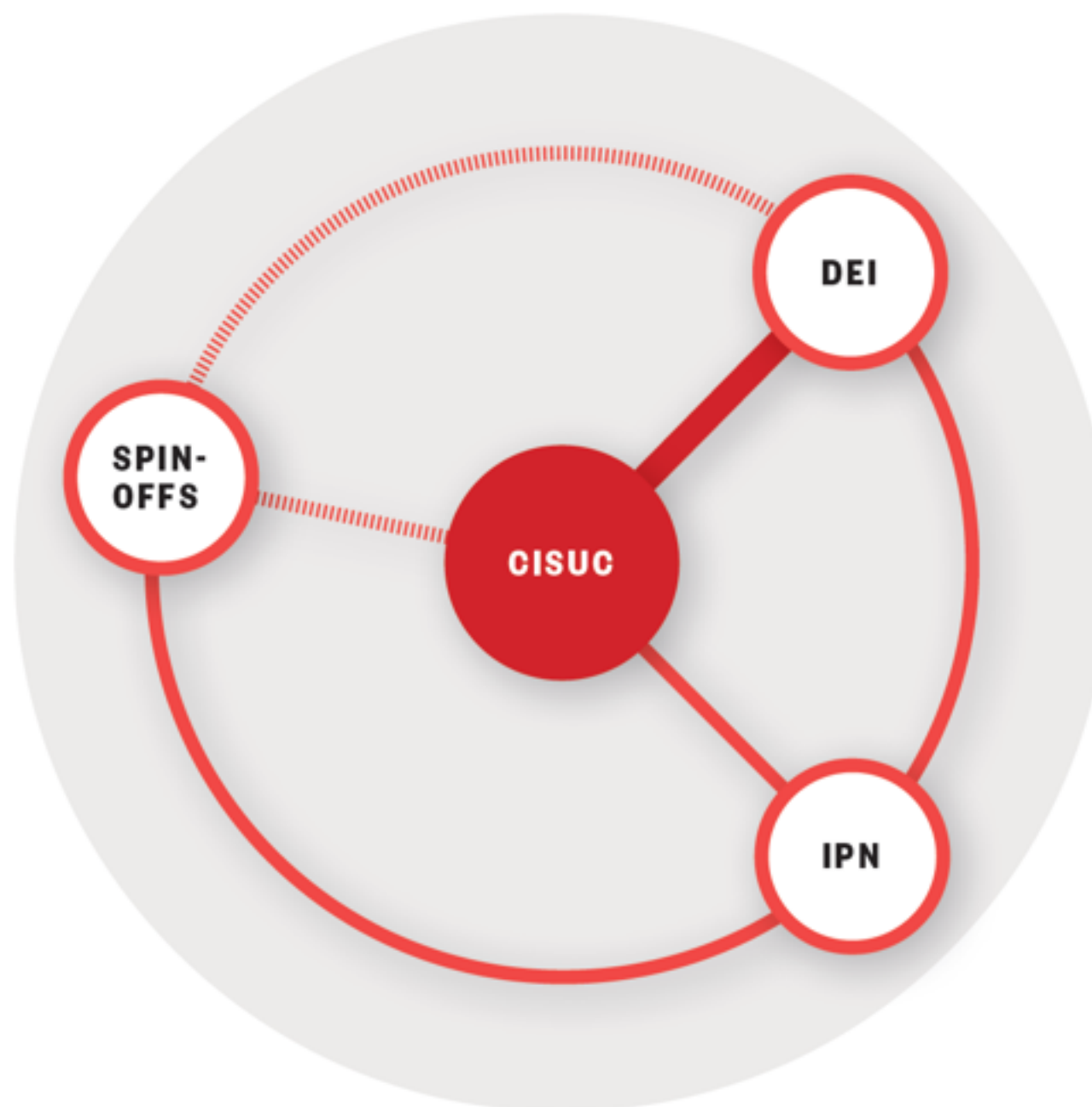
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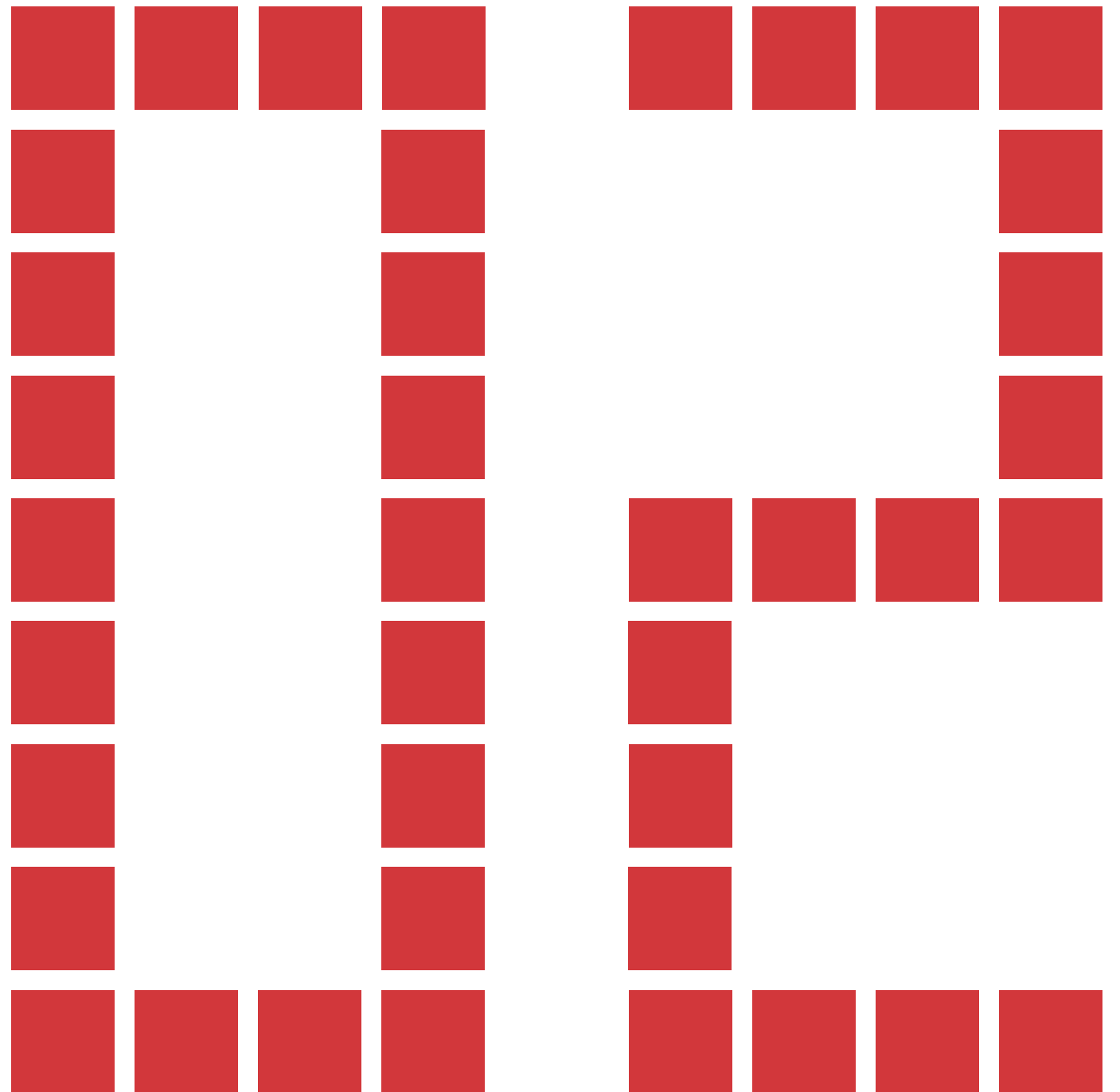
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CISUC Ecosystem



Scope & Mission

expertise and challenges



Scope

The Centre for Informatics and Systems of the University of Coimbra (CISUC) has strong competencies in:

- Computer Science
- Informatics Engineering
- Communication Technologies

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Main characteristics

- dynamic
- multidisciplinary
- generates and applies scientific and technological knowledge

Mission

CISUC sets out for:

- excellence in research
- high-quality training of young researchers
- contributing to the development of future technologies
- disseminating research results in high-impact venues
- technology transfer

Mission

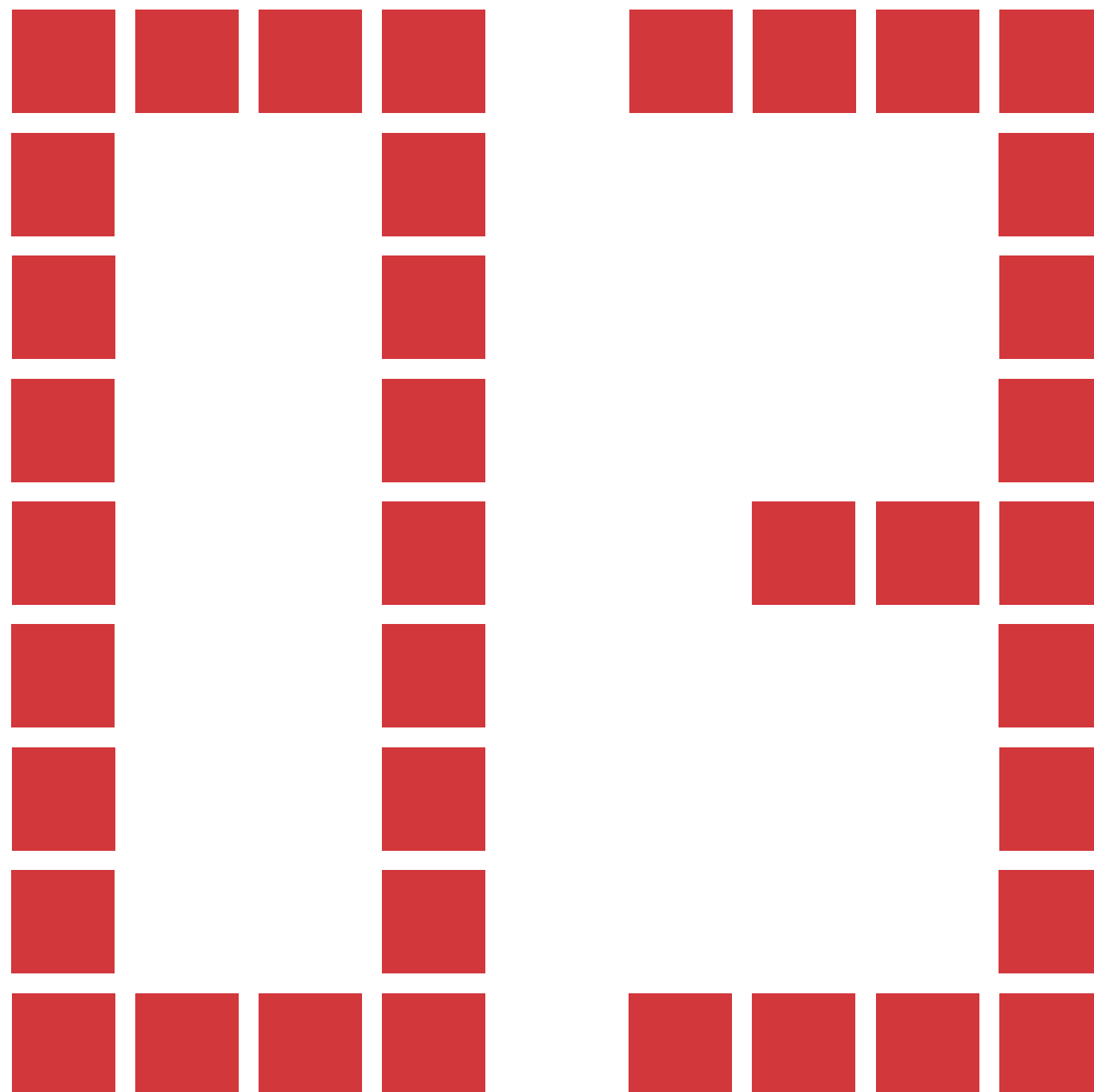
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with impact in

- scientific and societal needs
- enhancing Portugal's competitiveness

Strategic Priorities & Objectives





In furtherance of its mission of excellence

CISUC lays out 5 strategic priorities

1. Elevate its research

Continue to emphasise high-quality research and publications in high-impact journals and top conferences

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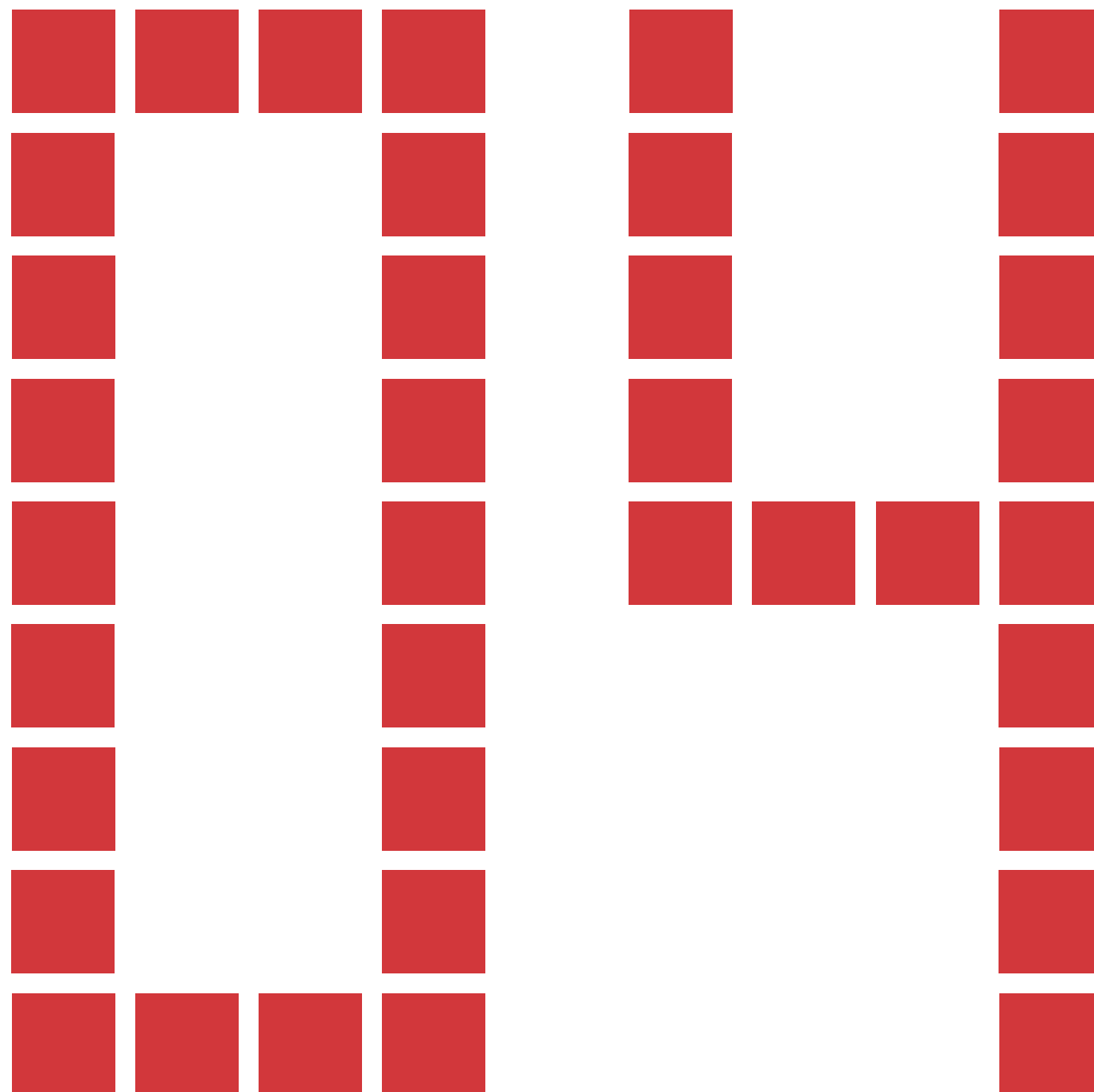
5. Exploit its research outcomes

Promote research addressing societal challenges, encourage entrepreneurship

Strategic Objectives

- Scientific research in the areas of CS and ICT
- Advanced training of highly qualified young researchers
- Participation in national and international projects and research programs
- Dissemination of research results through high quality publications
- Exploitation of research results through patents and contracts with industry
- Contribution to Portugal's competitiveness in the European space
- Contribution to R&D addressing several societal challenges, linking research with innovation & society

Scientific Contributions



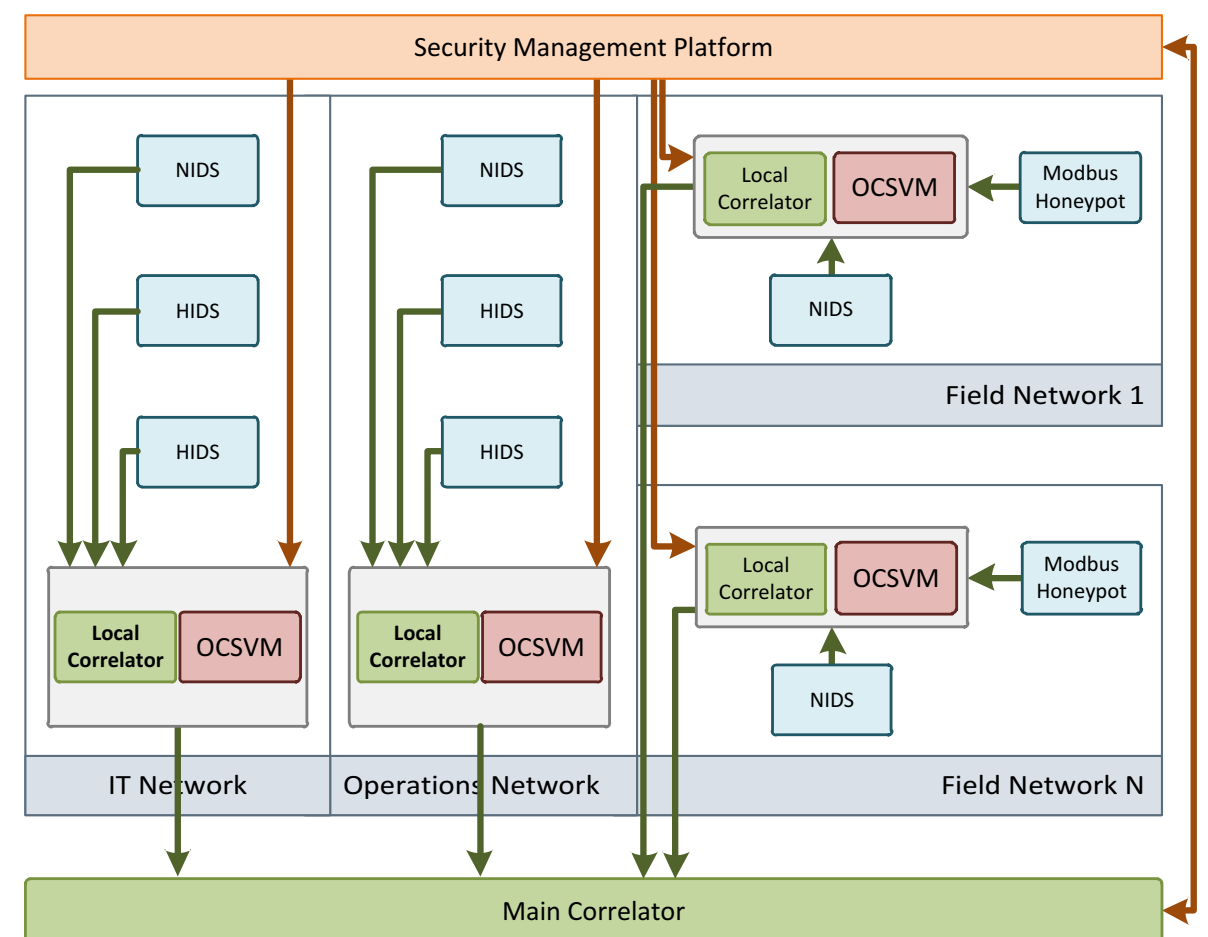
Scientific Contributions

- 1. Cybersecurity and Trustworthiness**
- 2. Assessment & Benchmarking**
- 3. Creation of the Area of Computational Creativity**
- 4. Evolutionary Machine Learning**
- 5. Breaking Frontiers in Epilepsy Seizure Prediction**

1. Cybersecurity and Trustworthiness

Devised a complete framework for online detection of anomalies and cyber threats in modern Industrial and Automation Control Systems (IACS) for protection of critical infrastructures.

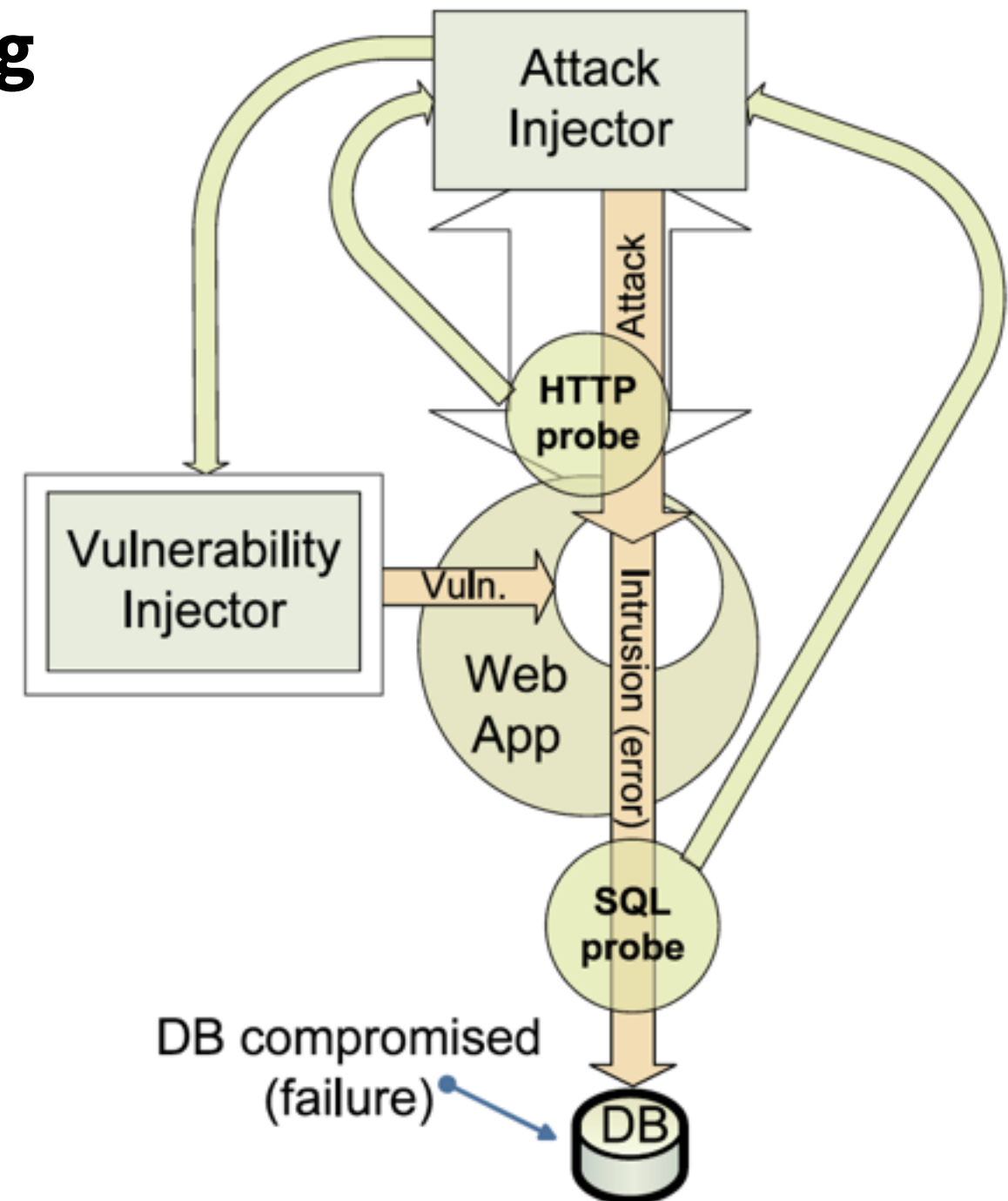
1. Application to energy production and distribution networks (e.g. electricity, gas) and water utilities.
2. This line of research is now integrated within the context of Industry 4.0



2. Assessment & Benchmarking

Contributed to Assessment & Benchmarking research, with current emphasis on cloud services benchmarking for resilience, security and trustworthiness.

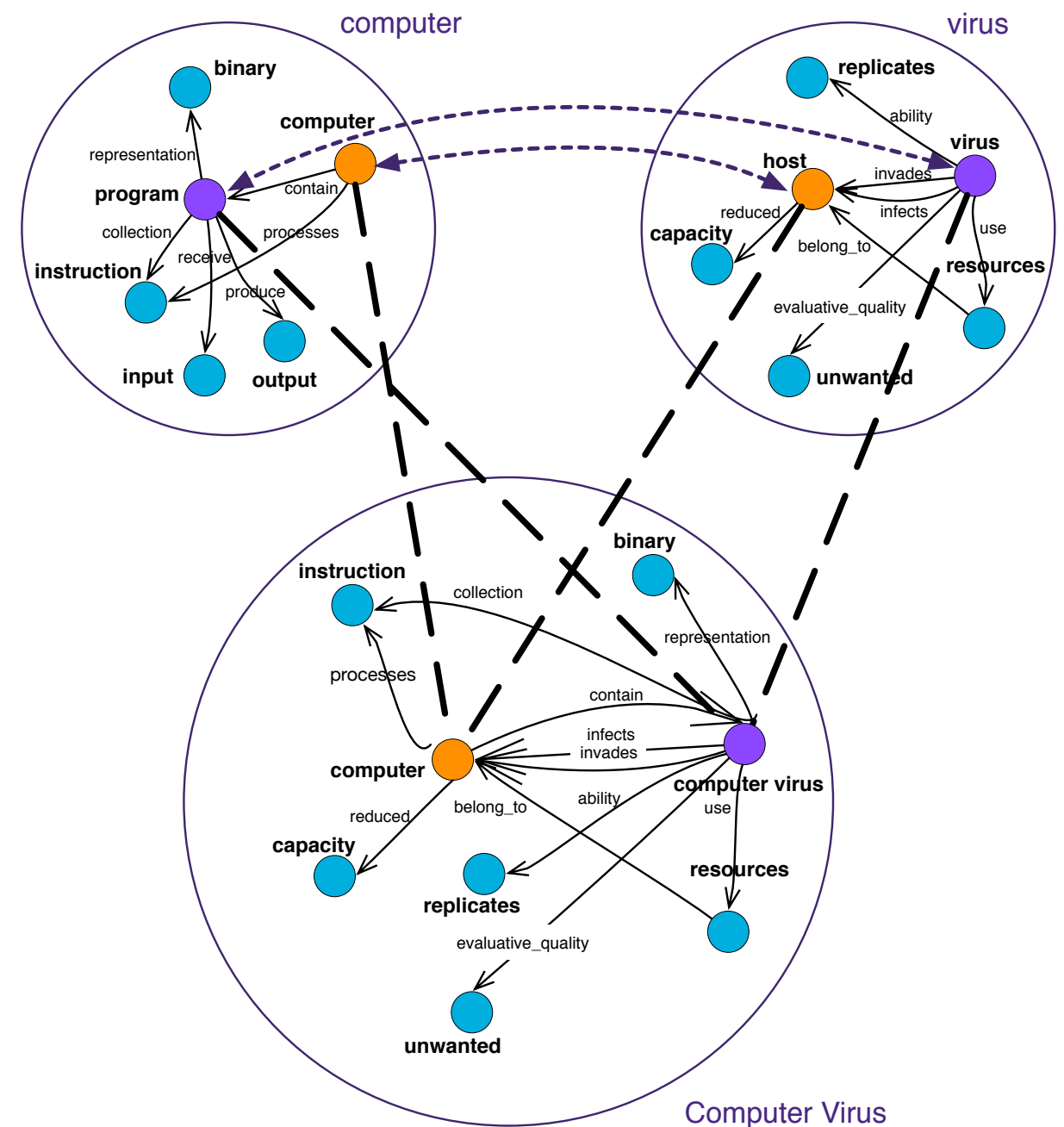
1. Research, developments and assessment of Internet of Things within fog and cloud environments
2. Associate Member of TPC (Transactions on Processing Performance Consulting), the world leading benchmarking organisation



3. Creation of the Area of Computational Creativity

CISUC contributed for the advance of the state of the art in the field of computational creativity (CC) where we consolidated and enlarged our international presence and the impact of our CC research

1. Two ICT-FET projects (ProSeCCo and ConCreTe)
2. Foundation of the new Association for Computational Creativity (ACC)



4. Evolutionary Machine Learning

Contributed to the advance of the state of the art in Evolutionary Machine Learning, by combining the long expertise in Evolutionary Computation (EC) and Machine Learning (ML)

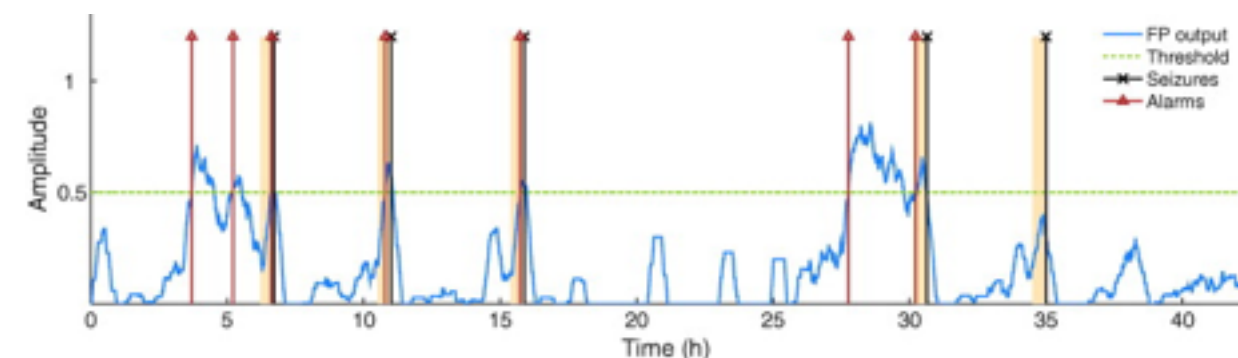
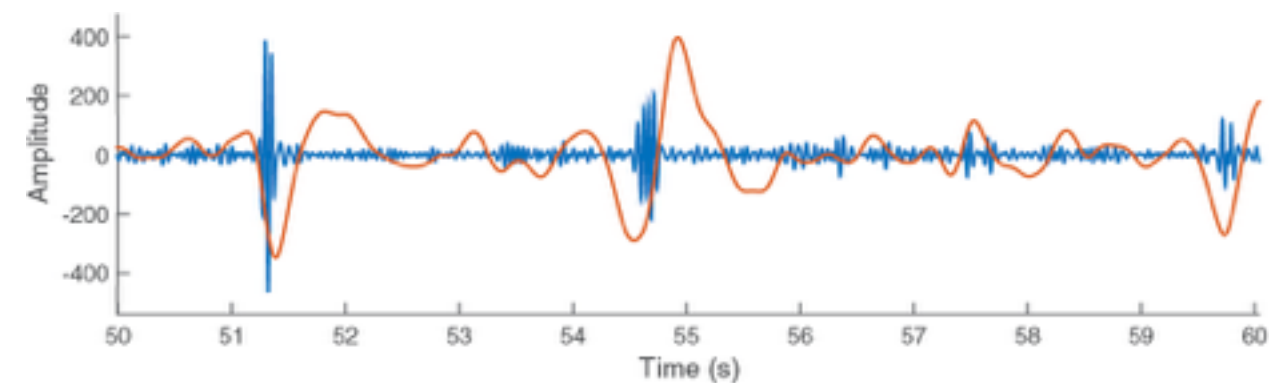
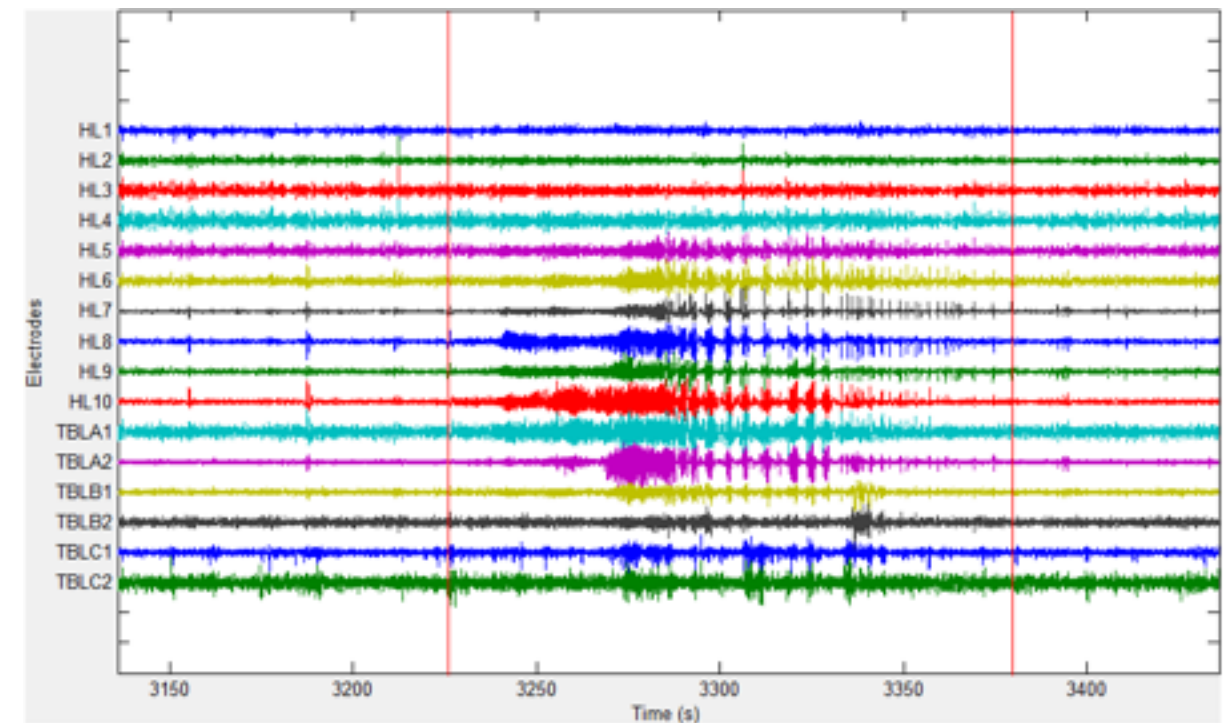
1. Novel evolutionary framework, fostering the automatic design and parameterisation of deep networks.
2. This methodology DENSER (Deep Evolutionary Network Structured Representation) solves problems, with human-competitive performances.



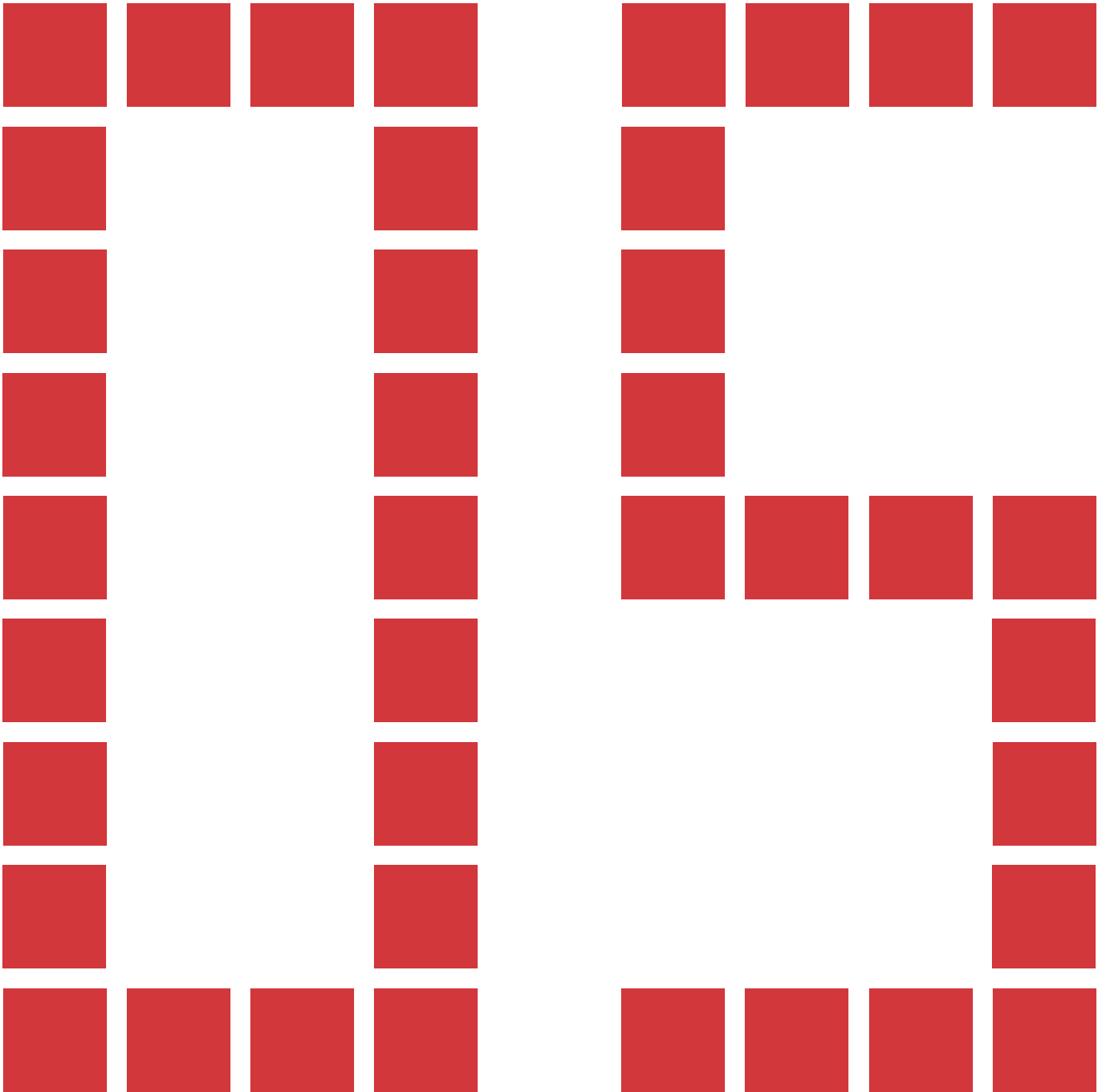
5. Breaking Frontiers in Epilepsy Prediction

Significant contributions to epileptic seizure detection and prediction, makes CISUC now a renowned research Centre in the field.

1. New electroencephalogram (EEG) descriptors were developed:
e.g. the relative spectral power features and the neuronal potential similarity of two intracranial electroencephalogram (iEEG) electrodes
2. Contributed to epilepsy seizure prediction and provide new information on seizure initiation.



Challenges, Opportunities & Outreach Activities



Scientific Challenges

1. Cybersecurity and trustworthiness of industrial systems, and in particular, of critical infrastructures, are one of the main research areas of CISUC. This research will target open problems related to the resilience of cyberphysical systems, within the envisaged systems of systems context
2. Traditional safety assurance (mandatory for safety critical applications) simply do not work with AI; a radical shift in software and systems assurance and certification is needed. This research addresses this goal, supported by the experience of CISUC on dependability (and safety) assessment and benchmarking.

Scientific Challenges

3. In the emergent area of Computational Creativity, more specifically will target conceptual blending mechanisms and domain transfer mechanisms.
4. Capitalising on its expertise in the fields of EC and ML, CISUC is investing on Evolutionary ML, an area that we deem as fundamental for AI. This strategic investment includes selected open problems, defining a research roadmap.
5. The research challenges on health will target open problems in biosignal processing and classification for personalised health and quality of life.

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Strategic Planning

Strengths

1. Scientific Expertise
2. Recognised team at EU level
3. Extensive network and collaboration
4. Regional ecosystem of spin-off companies (LIS/IPN)

Aspirations

1. Impactful fundamental and applied collaborative research
2. Outstanding programs for advanced training of researchers
3. International recognition
4. Enhance funding via EU Projects

Opportunities

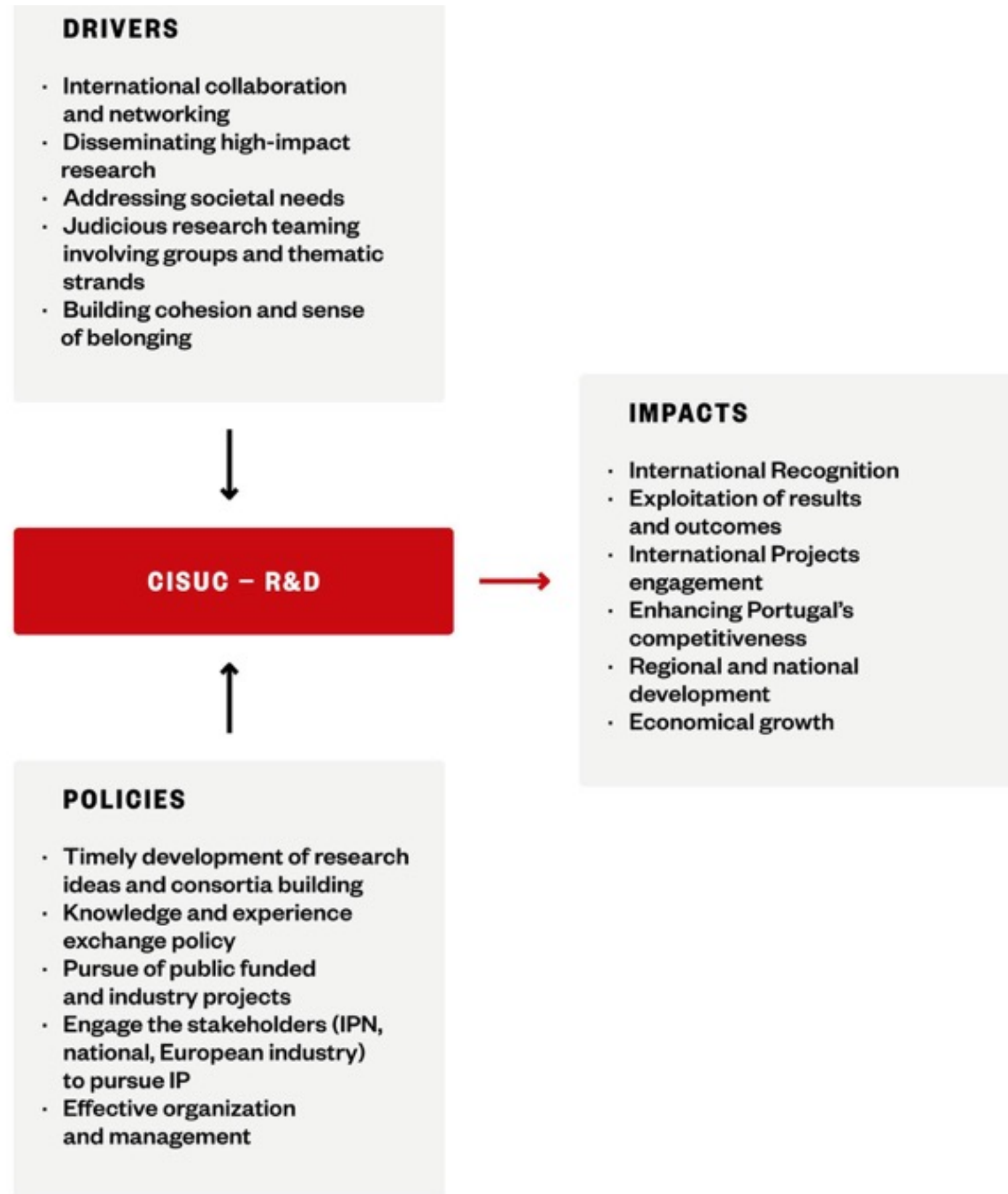
1. Links with international associations
(e.g. TPC, SPEC, IFMBE, IAPR, SPECIES, ACC)
2. Renowned Academic Institutions
3. Synergies improvement via thematic strands
4. UC Reputation in PT speaking countries

Results

1. Enhance CISUC reputation
2. Improve Leadership roles in Conferences and Journals
3. Innovation and technologies development
4. Enhance Knowledge triangle (education, research, innovation)

Looking ahead

The path



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