

Annual Report 20 | 21

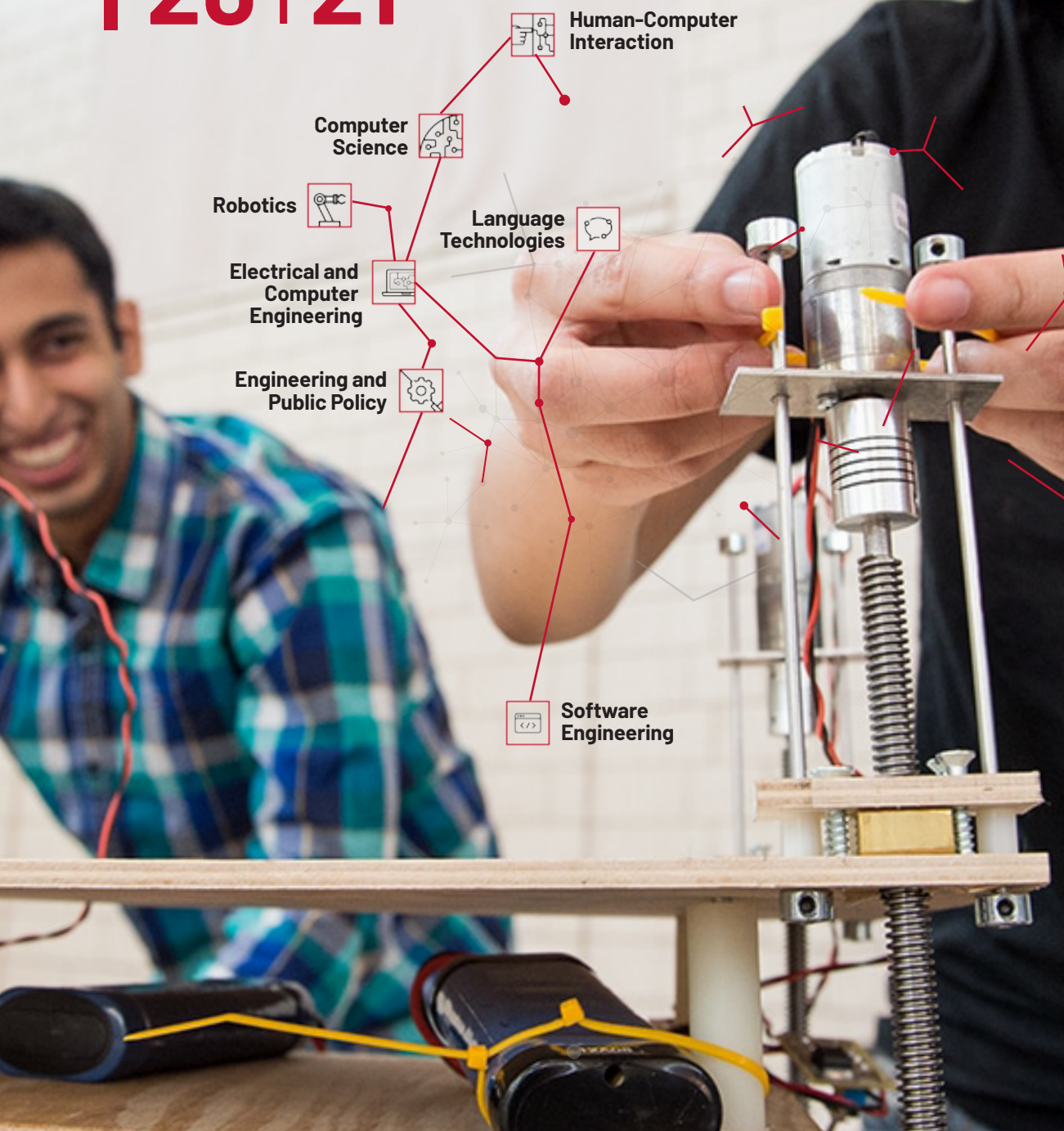


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2020-2021

From the Directors



Inês Lynce

National Director at Portugal of the Carnegie Mellon Portugal Program



Nuno Nunes

National Director at Portugal of the Carnegie Mellon Portugal Program



José M. F. Moura

Director at CMU of the Carnegie Mellon Portugal Program

The mission of the Carnegie Mellon Portugal Program (CMU Portugal) is to place Portugal at the forefront of research and technological development in the area of digital technologies, with a particular focus on the data economy, and foster interdisciplinary collaboration between industry and academia across different levels of the “big data” development stack. **CMU Portugal strives to be the main data-economy driver promoting an ecosystem with a tight coupling between cutting-edge research, world-class graduate education, and highly innovative companies.**

The overarching goal of the 3rd Phase is to foster industry-science relationships as agents of change with a focus on the data economy and research for social and economic impact. Addressing these goals, the 3rd phase deployed a set of new instruments:

i) talent development - by revamping the dual degree Ph.D. programs and establishing the Affiliated Ph.D. programs, a new doctoral education mechanism for the 3rd Phase, and launching a new generation of advance executive training for companies;

ii) knowledge creation - by launching small seed funding research projects that bootstrap small-scale research collaborations leading to new areas of interdisciplinary research;

iii) innovation and entrepreneurship - by establishing and renewing the industry affiliates program and launching a new call for industry-funded flagship projects, and finally

iv) communication and outreach - by renewing the program’s image as a platform for international scientific collaboration that positions Portugal at the forefront of the Digital Economy and raising awareness about the potential of the country and its scientific community and digital ecosystem of companies to compete globally.

Since the renewal of the international partnerships in February 2018, the Program's new leadership has worked on repositioning the Program toward the vision for the third stage. Despite the COVID-19 pandemic and the challenges in promoting exchanges of faculty and students, **we have successfully revamped the cohort of Ph.D. students.** Currently, 34 Ph.D. students are enrolled in the dual degree Ph.D. program and 12 students in the new affiliated Ph.D. program. Since the beginning of the 3rd phase, the share of women who have enrolled in the Program is 24%. 2021 represented a step forward in gender equality within doctoral programs, with 36% of accepted female candidates, demonstrating our commitment to increasing gender equality in ICT.

During the last year, our industry affiliates expanded with the integration of Remote which attained the status of Unicorn company during the pandemic. In addition, Mambu, one of the early spinoffs of the Program, incorporated in Germany, and Feedzai, with its HQ in Portugal, both achieved Unicorn status within the last two years. Portugal is currently the country in Europe with the highest density of ICT unicorn companies (7 out of 70), most of them affiliated and actively engaged with CMU Portugal. Finally, we continued the tradition of the Program of continuously assessing and reviewing the progress and results of the funded projects. In June 2021, we launched a **call for Exploratory Research Projects** funding six projects for a total of 655K€.

We firmly believe that CMU Portugal is at the forefront of the instruments that FCT can promote to leapfrog the Portuguese science and technology system and increase the collaboration with a highly competitive industry ICT ecosystem.

In 2021, Portugal's technology balance of payments multiplied by six from 2018 and we believe CMU Portugal, through the impact of the industry affiliates, is contributing decisively to these results. As we move into the fourth year of this Program's leadership, we want to keep justice to the historical achievement of CMU Portugal and pave the way for a quick recovery and another period of impactful results.



A photograph of a modern, multi-story building with a grid-like facade of windows, partially obscured by a solid red overlay. In the foreground, the silhouettes of two people walking away from the camera are visible against the red background.

CMU Portugal Program at a glance

The Carnegie Mellon Portugal Program (CMU Portugal) is a platform for education, research, and innovation that brings together Carnegie Mellon University (CMU) and several Portuguese universities, research institutions, and companies. CMU Portugal's mission is to place Portugal at the forefront of research and technological development in Information and Communication Technologies (ICT) by fostering industry-science relationships as agents of change, focusing on data economy and research for social and economic impact. The partnership was launched in 2006 and is currently in its 3rd phase, which started in 2018 and will extend to 2030.

This new phase aims to focus on high-impact science and technology that takes advantage of the data economy's extraordinary opportunities as drivers of growth and change.

Addressing the mission requires interdisciplinary efforts, both within ICT areas and across other disciplines. CMU Portugal promotes an innovation ecosystem with a tight coupling between cutting-edge research, world-class graduate education, and highly innovative companies in the data-driven economy to achieve this goal. **Fundação para a Ciência e a Tecnologia** (FCT - the Portuguese Foundation for Science and Technology) supports the Program's activities, which are also sponsored by the **Conselho de Reitores das Universidades Portuguesas** (CRUP) and co-financed by industry partners and by Carnegie Mellon University.

The collaborative network of CMU Portugal extends across the Portuguese universities, represented by CRUP, Associate Laboratories in the area of ICT, and many other research institutions in Portugal, 11 CMU departments, nearly 150 companies, and over 400 faculty and senior researchers in Portugal and at CMU. In its 3rd phase, CMU Portugal has also established collaboration agreements with **16 new industrial affiliates ICT leaders in Portugal and worldwide.**

Principal Instruments of the Carnegie Mellon Portugal Program

| Talent Development

Under the CMU Portugal Program scope, Portuguese universities and Carnegie Mellon University offer **Dual Degree Doctoral Programs** in the following areas: **Computer Science, Electrical and Computer Engineering, Engineering and Public Policy; Human-Computer Interaction; Language Technologies; Robotics and Software Engineering.** Successful candidates for the CMU Portugal Dual Degree Ph.D. Programs spend up to two years at CMU and up to three years at a partner University in Portugal. At the end of their Ph.D., the students are awarded two diplomas, one from each Institution.

Between 2018-2022, **five calls for Dual Degree scholarships** took place under the CMU Portugal framework, and **25 scholarships were awarded** to candidates in Computer Science, Human-Computer Interaction, Language Technologies, Software Engineering, Electrical and Computer Engineering, and Engineering and Public Policy. The 2022-2023 call, with up to 10 scholarships available, is still ongoing being currently in the evaluation phase. These scholarships include a monthly stipend and cover tuition fees in Portugal at CMU. Since 2006, CMU Portugal has awarded **144 dual degree doctoral FCT scholarships**. 2021 represented a step forward in gender equality within doctoral programs, with 36% of accepted female candidates versus an average of 10.83% over the past three years.

Currently, the **85 CMU Portugal Ph.D. alumni** are working for renowned universities and research centers in Portugal and worldwide, as well as in highly innovative international companies placing themselves as agents of change, ambassadors for the excellence of the Program's activities, and facilitators of Portugal's embedment in international knowledge and business networks. Many Ph.D. alumni are now leading research and innovation activities in companies, large and small, including some Unicorn companies that started from the Program's activities.

In 2021, the Program launched a new initiative for doctoral degrees, the **CMU Portugal Affiliated Ph.D. Programs**, with **12 new students** admitted under this first edition. Through this new mechanism, CMU Portugal and FCT offer Ph.D. scholarships in selected cutting-edge areas of Information and Communication Technologies (ICT) related to the scope of the CMU Portugal Program. Ph.D. students under this initiative are enrolled at **a Portuguese University and spend a research period at**

Carnegie Mellon for up to 1 year. A key aspect of this initiative is the collaboration with Industry, as candidates are encouraged to develop part of their Ph.D. work plan with a Portuguese ICT company. The 12 new students are developing research across **5 research areas, 6 CMU departments**, and **4 universities** in Portugal. From the **12 selected students**, 8 students developed their thesis in **close collaboration with a Portuguese ICT company.**

A new call was launched in February 2022 for the 2nd edition of the Affiliated Ph.D. Programs, and is currently underway. Up to **12 FCT Ph.D. scholarships** are available for the main research areas of the CMU Portugal Program.

CMU Portugal Mobility Programs support faculty, doctoral, and master students through an intensive immersion period at CMU to experience its educational, research, and cultural environment. **The Visiting Faculty and Researchers Program** is directed to researchers with a doctoral degree and supports an extended exposure to research and education best practices at a global level at Carnegie Mellon University. It fosters the integration of faculty from Portuguese universities into international knowledge networks. **The Visiting Students Program** allows talented master's students to immerse themselves in a research project at Carnegie Mellon for up to 6 months. During this time, they have a chance to develop their knowledge and skills as researchers and explore new perspectives for graduate studies and career opportunities in cutting-edge ICT areas. The CMU Portugal Mobility Programs planned for 2020 and 2021 were suspended due to travel and health constraints caused by the COVID-19 pandemic. However, the initiatives will resume in 2022, with **5 Portuguese faculty** from the 2020 edition already aligned to participate, and a planned new call for Visiting students is expected to open in 2022.

Overall, through its Mobility Programs, CMU Portugal has already admitted **84 faculty and 40 students** to experience life at CMU in all its components: learning, teaching, researching, and fully participating in its academic life. Besides these structured semesters' long stays at CMU, the Program has organized and sponsored numerous visits from CMU researchers to Portugal and Portugal to CMU.

Building on the success of the Dual-Degree master programs, which were active during the 1st and 2nd phases, the Program has been working in close collaboration with Universities in Portugal, CMU departments, and industry partners to establish a new education instrument: **Advanced Training Programs in Data Science & Machine Learning and User Experience Design.** Leading up to the 1st edition of these programs, CMU Portugal organized in 2021 six online talks in Data Science and User Experience Design by CMU faculty and worldwide industry experts. It counted the virtual attendance of hundreds of participants.

Knowledge Creation

CMU Portugal creates new opportunities to develop world-class research and innovation networks, stimulate a culture of highly qualified entrepreneurship in Portuguese universities, and foster an ecosystem of support for R&D activities between companies in close articulation with academic institutions.

CMU Portugal supports research projects in the broad area of Information and Communication Technologies (ICT), focusing on the areas that directly impact the data economy and foster interdisciplinary collaboration between Industry and academia across different levels of the “big data” development stack. This includes research topics spanning from **data science and engineering for large-scale data sets to artificial intelligence, robotics, and machine learning** that extract value from data or the sociotechnical systems and applications catalyzed through these technologies. All projects are selected through competitive research calls and independently evaluated by FCT’s international panel.

In 2020 and 2021, 25 CMU Portugal projects were supported across multiple Portuguese research institutions and CMU departments, strengthening an international collaborative effort across institutions and in close collaboration with industry partners. These projects correspond to **12 Large-Scale Collaborative Research Projects (LSCRPs)**, **7 Exploratory Research Projects (ERPs)**, and **6 Entrepreneurial Research Initiatives (ERIs)**. CMU Portugal’s commitment to knowledge creation was further enhanced through the launch of **a new call for Exploratory Research Projects in 2021**.

In 2019, CMU Portugal launched the most ambitious Call to date for **Large-Scale Collaborative Research Projects (LSCRPs)**. This Call, building on the Program’s past experiences, aims at new types of projects by exposing them to new dynamics. The projects’ leadership is now given to national ICT companies that assume the role of dynamizing networks and collaborative projects, reinforcing the innovation ecosystem, relying on Portuguese R&D institutions, and taking advantage of the experience and research teams of Carnegie Mellon. Under the scope of this new Call, **twelve new projects started in 2020** - and will go on until 2023 - led by 12 research teams, including top national ICT companies. In addition, the projects include partners from **27 other Portuguese Institutions** - from Universities to Research Labs, Hospitals, and Companies - and **eight CMU Departments**. Overall, the Call represents a commitment of **25M€ from public funding** (PT2020 and FCT) and **4,2M€** companies’ investment into ICT R&D, the most significant public and private financial commitment to date in research and technological development under the scope of the CMU Portugal Program. The Call for

Large-Scale projects also allowed CMU Portugal to reinforce previous partnerships with Industry and engage with new companies that have a strong presence in new lines of business and research from online privacy to health, energy, and environment sectors.

In parallel, CMU Portugal continues to support Exploratory Research Projects (ERPs) designed to assist teams of researchers from Portuguese institutions, Carnegie Mellon University, and industry partners in bootstrapping high-impact potential research activities of strategic relevance.

The 2019 **Call for ERPs supported seven new projects across eight Portuguese research institutions and four CMU Departments**, representing an investment of 821k€. The ERPs will explore areas as diverse as robotics, artificial intelligence, intelligent transport systems, and language processing. Of the 12 awardees, three projects began in 2020, and four projects started in early 2021.

In 2021, FCT and CMU Portugal launched a new competitive Call for ERPs. The 33 proposals submitted by researchers from one or more Portuguese institutions in collaboration with a CMU research group were evaluated, and six were recommended for funding, representing an investment of 656K€. The new projects will focus on a diverse set of research areas such as data science applied to healthcare, the creation of satellites (PocketQube), human-robot interaction, traffic supervision for Cybercrime Investigation, applied artificial intelligence for customizable robotic exoskins, and the detection of injection vulnerabilities in node applications. The activities of the ERPs will start in 2022 across **nine Portuguese research institutions and six CMU Departments**.

In 2020 and 2021, **6 Entrepreneurial Research Initiatives (ERIs) projects** ended, bringing to a close the research initiatives that began in the 2nd phase of CMU Portugal but were executed during the 3rd phase. The twelve grants awarded under this Call, were funded with **10.8M€ of public funding** and **2.6M€ through private companies’** investment. ERIs have established collaborations extending to **26 Portuguese research institutions, 46 companies, and 11 CMU Departments**. The collaborative projects can be translated into their scientific achievements with **146 publications** in international peer-review journals, **325 peer-review conference papers, 52 Ph.D.** and **169 Master theses** developed within the context of the ERIs. In the area of innovation, the projects reported the development of **92 prototypes** and the submission of **11 new patents**.

All projects supported by the CMU Portugal Program are selected through **competitive calls** by **international committees** of experts that evaluate the proposals submitted and meet as a panel in Portugal for their final evaluation, ranking, and recommendation for funding.

| Innovation and Entrepreneurship

The CMU Portugal Program has been working to establish a very close relationship with the Portuguese Industry through the companies part of its Industrial Affiliates Program. Since 2018, **16 CMU Portugal Industrial Affiliates** have committed to actively contributing to the partnership's advanced education and research programs and increasing their competitiveness by investing in R&D, advanced training of human resources, and building a highly-skilled workforce dedicated to innovation activities. CMU Portugal Industry Affiliates includes **five Portuguese unicorn companies (Farfetch, Feedzai, Outsystems, Remote, and Talkdesk)** and **ICT leaders (Accenture, Altice, CEiiA, NOS, Priberam, REN, Tekever, Thales, Unbabel, Uniplaces, and Veniam)**. Furthermore, Farfetch, Feedzai, Outsystems, and Unbabel reinforced their commitment to the Program by leading four out of the twelve CMU Portugal Large-Scale Projects that have started in 2020.

CMU Portugal has also been a hub for faculty members, students, and alumni to launch their entrepreneurial initiatives. The Program has supported the creation and development of twelve startups: Dognædis, Feedzai, Geolink, **Mambu**, Orange Bird, Prisma, Red Light, Sentilant, Streambolico, Veniam, Virtual Traffic Lights, and Unbabel. In 2021, CMU Portugal saw two of these companies reach Unicorn status. Mambu, a startup company established by three alumni of the CMU Portugal Master's Program in HCI at Universidade da Madeira, is a leading SaaS banking platform and the round of investment in early 2021 raised the company's valuation to over **\$5.5B**. **Feedzai**, the first startup created under the scope of the CMU Portugal Program by CMU Portugal faculty members at University of Coimbra, is the market leader in fighting financial crime, providing today's most advanced cloud-based risk management platform using advanced machine learning techniques and is now valued at well above **\$1 billion**. Other companies supported by CMU Portugal are also references in their sector worldwide. Such as **Veniam**, a company founded by faculty members at Universidade do Porto and Universidade de Aveiro that connects vehicles and to the Internet using vehicular mesh networking technologies; and **Unbabel** founded by a graduate from CMU's Language Technology Institute (LTI) and a CMU Portugal project post-doctoral fellow, that allows modern enterprises to understand and be understood by their customers in dozens of languages by combining human expertise and artificial intelligence. Feedzai, Unbabel, and Veniam are now **CMU Portugal Industrial affiliates in the 3rd phase**.

Additionally, the CMU Portugal Call for Large-Scale Research Collaborative Projects allowed the Program to **strengthen research connections with companies** from its startup and innovation ecosystem (Feedzai and Unbabel), **increase the commitment of industrial affiliates in R&D** (Farfetch, Outsystems, both Unicorn companies), and establish **new partnerships with new partners** (Altran Portugal- now Capgemini Engineering, Compta, DST Solar, First Solutions, Glinnt, Ingeniarius, Hospital da Luz Learning Health, Mobileum). The leading ICT companies are now also promoters of research initiatives. They have also positioned themselves as funding bodies for the projects, **investing 4.2 M€** in the Large-Scale Projects of the Program.

| Communication and Outreach

CMU Portugal's communication strategy is built to support the Program's mission and initiatives while promoting the primary outcomes of the Program through different channels. All communication activities are designed to enrich the Program's visibility, particularly on online platforms; disclose its initiatives, and enhance collaborations with key stakeholders while building a solid communication network to increase its outreach.

The **CMU Portugal website** is the central platform for unveiling all the Program's initiatives, including news, events, and CMU Portugal publications. Between 2020 and 2021, the number of news articles published on the website increased from 21 to 55, a total of 76, and the number of events from 10 to 18.

The Program's communication is also strongly focused on online activities beyond its website, such as **social media networks** Facebook | Twitter | LinkedIn | Youtube. Due to the efforts to produce regular and relevant content on social media, the number of followers on all media channels has been growing considerably in the last few years. The most recent CMU Portugal account is Instagram, launched in 2020 to help the Program reach a younger audience.

Since the beginning of the 3rd phase, the Program has been launching a digital newsletter every two months, **"News from the Fence"**, to promote the latest initiatives, including news, events, and CMU Portugal publications. Other activities include **media communication** through press releases, promoting interviews, opinion articles, or other journalistic content to disclose CMU Portugal to a broader audience.

The CMU Portugal Program organized several **events** to involve academic and Industry communities and raise awareness about its initiatives among new stakeholders and audiences. In 2020, CMU Portugal held the **Orientation Day**, and in 2021, the **CMU Portugal Doctoral Symposium**. The 2021 Symposium gathered active students, alumni, faculty members, and Industry partners, focusing on presentations of the research work that is being developed under the Program in the educational activities and also in CMU Portugal Projects.

In 2020- 2021, CMU Portugal adapted some of its activities to online events. To promote the Program's new initiative "Advanced Training Programs", CMU Portugal organized **two Series of Webinars** "Data Science Talks @CMUPortugal" and "User Experience Design Talks @CMU Portugal" with three sessions, each having CMU Faculty as speakers. The dissemination strategy for the doctoral initiatives was also adapted to an online format with the organization of **Info Sessions** addressed to potential candidates.

In 2020 and 2021, CMU Portugal took part in larger **outreach events** (such as the annual event "**Encontro Ciência**" and **Bahaus of the Seas Conference**) conducted with other institutional partners such as Fundação para a Ciência e a Tecnologia, MAAT, Câmara Municipal de Lisboa, among others.

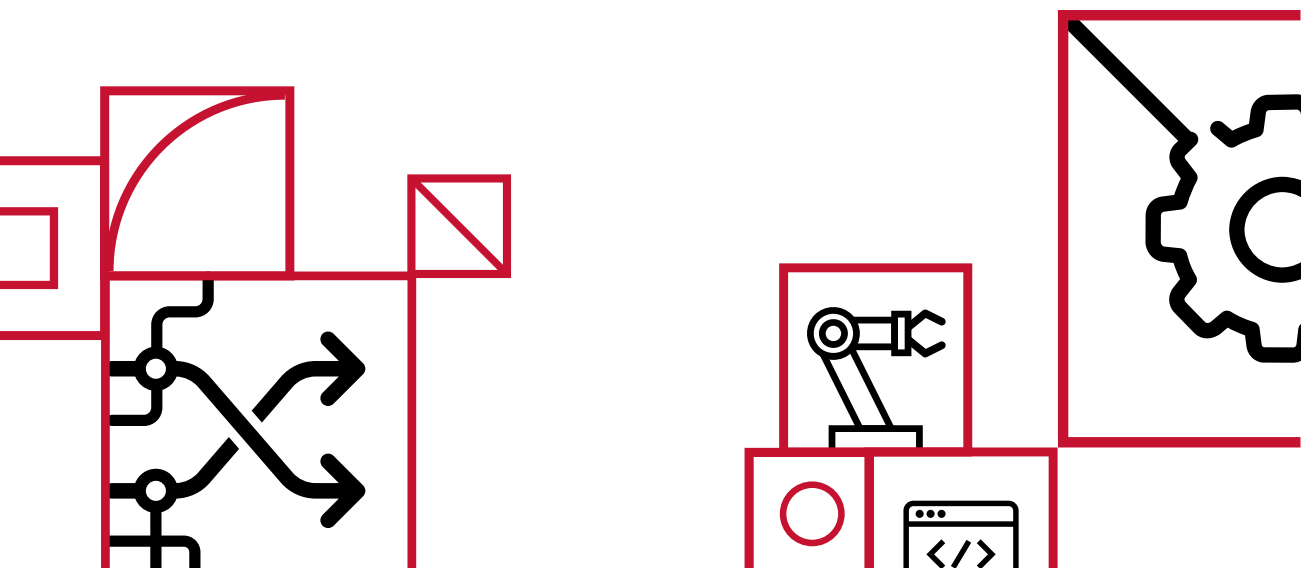
In 2021, CMU Portugal hosted a **visit from the Minister of Science, Technology and Higher Education at Carnegie Mellon University**, focused on strengthening the cooperation between Portugal, Carnegie Mellon University, and Industry through the Carnegie Mellon Portugal Program. Among other activities was the organization of three workshops related to the thematic of the Large-Scale Collaborative Research Projects.

| Building the future

2022 will be a year of innovation and exploration through interdisciplinary research and knowledge sharing. CMU Portugal will continue to assess the social and economic impact and monitor the scientific outputs of its 12 Large-Scale Projects and 7 of its ERPs that are to conclude by the end of this year. The Program also expects to **welcome new Exploratory Research Projects**. This key initiative paves the way for future research initiatives and strengthens the network of Portuguese and CMU researchers, their institutions, and departments. In 2022, **two new calls for dual degree and affiliated doctoral programs** will be launched to select a new cohort of Ph.D. Students. This will also be the year for CMU Portugal to **resume its mobility initiatives**, with 6 Portuguese faculty members already expected to visit CMU and a new call aligned to be soon announced for students. In addition to current initiatives, CMU Portugal Advanced Training Programs User Experience Design was launched in February 2022.

CMU Portugal will pursue its ambition to strengthen collaboration initiatives and resume onsite activities as much as possible. In addition to the governing meeting (External Review Meeting and Board of Directors), a new edition of the CMU Portugal Conference in Portugal in 2022 and a networking event at the CMU campus that gathers leadership, Faculty, and students is already planned. 2022 will be the highest number of CMU Portugal dual degree Ph.D. students at the CMU Pittsburgh campus, with many more researchers associated with CMU Portugal's projects joining in early 2022 as borders open and health directives allow.

With the commitment of all its partners, CMU Portugal will continue strengthening industry-science relationships and building a community of agents of change in a data-driven economy with research for social and economic impact.



Timeline CMU Portugal Activities (2020-2021)

2020

February

Participation at two FLAD Sessions in Porto and Minho, to promote training initiatives in the USA.

April

Keynote Lecture by Jamie Callan, CMU Language Technologies Institute Professor, at ECIR 2020

Announcement of the winning CMU Portugal Large Scale Collaborative research projects, partnering PT companies, Universities and Research Institutions with research groups at CMU.

January

Seminar at UTAD with the Conclusions of CMU Portugal eCSAAP project.

March

Announcement of the Visiting Students Program results
- 9 master students from PT Institutions were selected to visit CMU

May

Announcement of the Visiting Faculty & Researchers Program results
- 6 faculty & researchers were selected

Announcement of the 7 new Exploratory Projects



2020

June

Annual Board of Directors (BoD) Meeting.

October

Open Call for CMU Portugal Dual Degree Ph.D. Scholarships

CMU Portugal Online Info Session “How to apply for a CMU Portugal Dual-Degree Ph.D. Scholarship” with +200 attendees.

CMU Portugal Webinar at Técnico Job Shop
to promote the Program's Education activities.

Carnegie Mellon Portugal 2020 Orientation Day
to welcome the new Dual Degree Ph.D. students



Timeline CMU Portugal Activities (2020-2021)

January to February

Session 1 | Jan. 28

"Conversational Assistants for Complex Search Tasks" by Jamie Callan (CMU)

Session 2 | Feb. 11

"AI Learns to Race: Machine Learning for Autonomous Driving" by Eric Nyberg (CMU)

Session 3 | Feb. 23

"Social, Cultural and Political Biases through the Lens of NLP" by Ashique Khudabukhsh (CMU)

From April to June

"User Experience Design Talks @CMU Portugal"

2021

January

Inês Lynce appointed as CMU Portugal National co-Director

External Review Committee Meeting (ERC) with the evaluation of the Program's performance between 2018 and 2020 (online)

February

Announcement of the **first CMU Portugal Call under the new initiative "Affiliated Ph.D. Programs"** offering up to 12 Scholarships for the 2021/2022 academic year.

Online Info Session: "How to apply to a CMU Portugal Affiliated Ph.D. Program Scholarship".

May

Announcement of the CMU Portugal **Call for Exploratory Research Projects (ERPs)** in strategic emerging areas of ICT.

CMU Portugal participation as partner of the **Bauhaus of the Seas International Conference**



Timeline CMU Portugal Activities (2020-2021)

2021



July

11th edition of the Lisbon Machine Learning Summer School (LxMLS 2021) co-organized by Instituto Superior Técnico, Instituto de Telecomunicações, INESC ID, Unbabel, Priberam and CMU Portugal.

September

Announcement of the **12 CMU Portugal students** selected for the Program's Affiliated Ph.D. Programs 2021/22

2021 CMU Portugal Doctoral Symposium with the participation of CMU Portugal Dual Degree, CMU Portugal affiliated and Ph.D. candidates at research projects

November

Portuguese Minister of Science, Technology and Higher Education visits CMU
Individual meetings with CMU leadership and Faculty
Network-lunch with CMU Portugal Dual- Degree and Advisors
Three workshops addressing the themes of the Program's Large-Scale Collaborative Research Projects:
Presentation of CMU Portugal Exploratory Projects

June

Announcement of the **11 new Dual Degree Ph.D. Students** for the 2021/22 Academic year.

CMU Portugal at Encontro Ciência 2021 Summit with the Session "The contribution of the CMU Portugal international partnership for the high-tech ecosystem in Portugal"

October

"2021 Fall Welcome Back Lunch" organized on campus at Carnegie Mellon University to welcome CMU Portugal Ph.D. students at CMU.

Online Info session "How to apply for a CMU Portugal Dual-Degree Ph.D. Scholarship" with the participation of +90 potential candidates

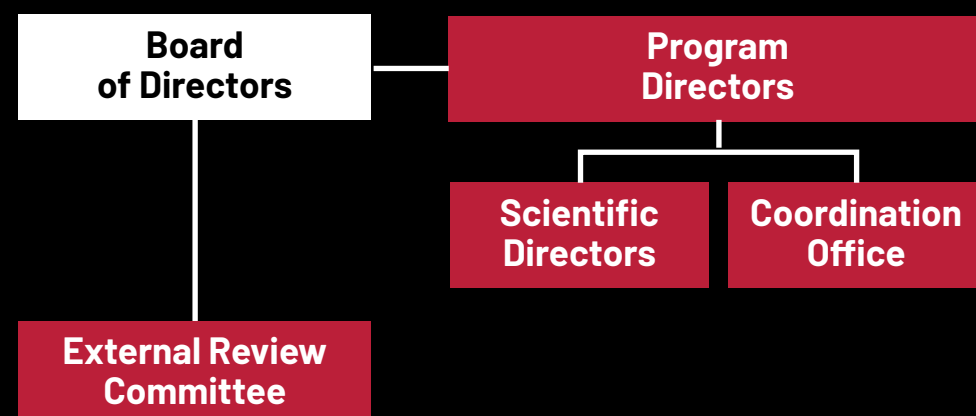
October

Webinar #1 of the AIDA Webinar Series (5 Webinars September 2022) organized by the project with CMU Portugal support.

Announcement of the 6 new Exploratory Research projects supported under the CMU Portugal Program

Governance

The CMU Portugal collaboration is based on a contractual arrangement between CMU and the Portuguese Science and Technology Foundation (FCT). The program's governance comprises the Board of Directors (BoD), the External Review Committee (ERC), CMU Portugal Program Directors, Scientific Directors, and the Coordination Office. All structures work in conjunction as a unified body of leaders and managers to ensure that CMU Portugal works effectively.



The Board of Directors is responsible for policy oversight, approval of the annual plan, and budget allocation for any proposed activities.

The Board of Directors comprises the following four members:

- The President of the FCT or his/her designee (who shall chair the Board)**
- A representative of the Portuguese University partner institutions participating in**
- The CMU Portugal Program or his/her designee, designated by the FCT**
- The President of CMU or his/her designee,**
- The Dean of CMU's College of Engineering or his/her designee,**
- One or more representative(s) of the main Industrial and Institutional Affiliates**

The Program Directors in Portugal and at CMU are non-voting members of the Board of Directors.

The External Review Committee is annually appointed by and at the sole discretion of the Fundação para a Ciência e Tecnologia (FCT). The committee consists of six members who are independent members of the international scientific community (none of whom are employed by FCT or CMU). The ERC reviews the yearly activities implemented by ICTI and the Carnegie Mellon Portugal Program in general; it has an advisory role oriented towards the independent evaluation of the activities of ICTI and the Carnegie Mellon Portugal Program.

CMU Portugal Scientific Directors are selected from a pool of nominations provided by the scientific community. Scientific Directors help the Partnership Directors in refining the strategic areas of research within the broad field of information and communication technologies.

Board of Directors



Helena Pereira

President of the Board of Directors.
President, Fundação para a Ciência e a Tecnologia (FCT)



Paulo Jorge Ferreira

Rector, University of Aveiro
Representative of Council of Portuguese Rectors (CRUP)



James H. Garrett

Provost, Carnegie Mellon University



Bill Sanders

Dean of the College of Engineering at Carnegie Mellon University



Rogério Carapuça

President, Portuguese Association for Development of Communications (APDC)
Representative of Industry

External Review Committee



Professor Sir John O'Reilly (Chairman)

University College London, United Kingdom
Chairman, SERC, A*STAR, Singapore



Ali Sayed

Dean of Engineering, EPFL School of Engineering



Fernando Pereira

VP and Engineering Fellow at Google



Giulio Sandini

Senior Researcher, Founding Director, Italian Institute of Technology



John Guttag

Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology



Yvonne Rogers

Professor and Director, Centre of Excellence in Human-Computer Interaction, University College London

Program Directors



Inês Lynce

National Director at Portugal of the Carnegie Mellon Portugal Program



Nuno Nunes

National Director at Portugal of the Carnegie Mellon Portugal Program



José M. F. Moura

Director at CMU of the Carnegie Mellon Portugal Program

Scientific Directors



Fernando Velez

Instituto de Telecomunicações & Universidade da Beira Interior



João Paulo Cunha

Faculdade de Engenharia da Universidade do Porto



Luís Caires

Faculdade de Ciência e Tecnologia da Universidade Nova de Lisboa



Paulo Marques

CTO of Feedzai



Lia Patrício

Faculdade de Engenharia da Universidade do Porto



Luís Filipe Antunes

Faculdade de Ciências da Universidade do Porto



Rui Maranhão

Instituto Superior Técnico, Universidade de Lisboa



Susana Sargento

Universidade de Aveiro

Coordination Office

Portugal office



Sílvia Castro

Executive Director



João Fumega

Education Officer



Mariana Carmo

Communications and Events Officer



Alexandra Mendes

Project officer

Carnegie Mellon office



Megan Berty

Associate Director



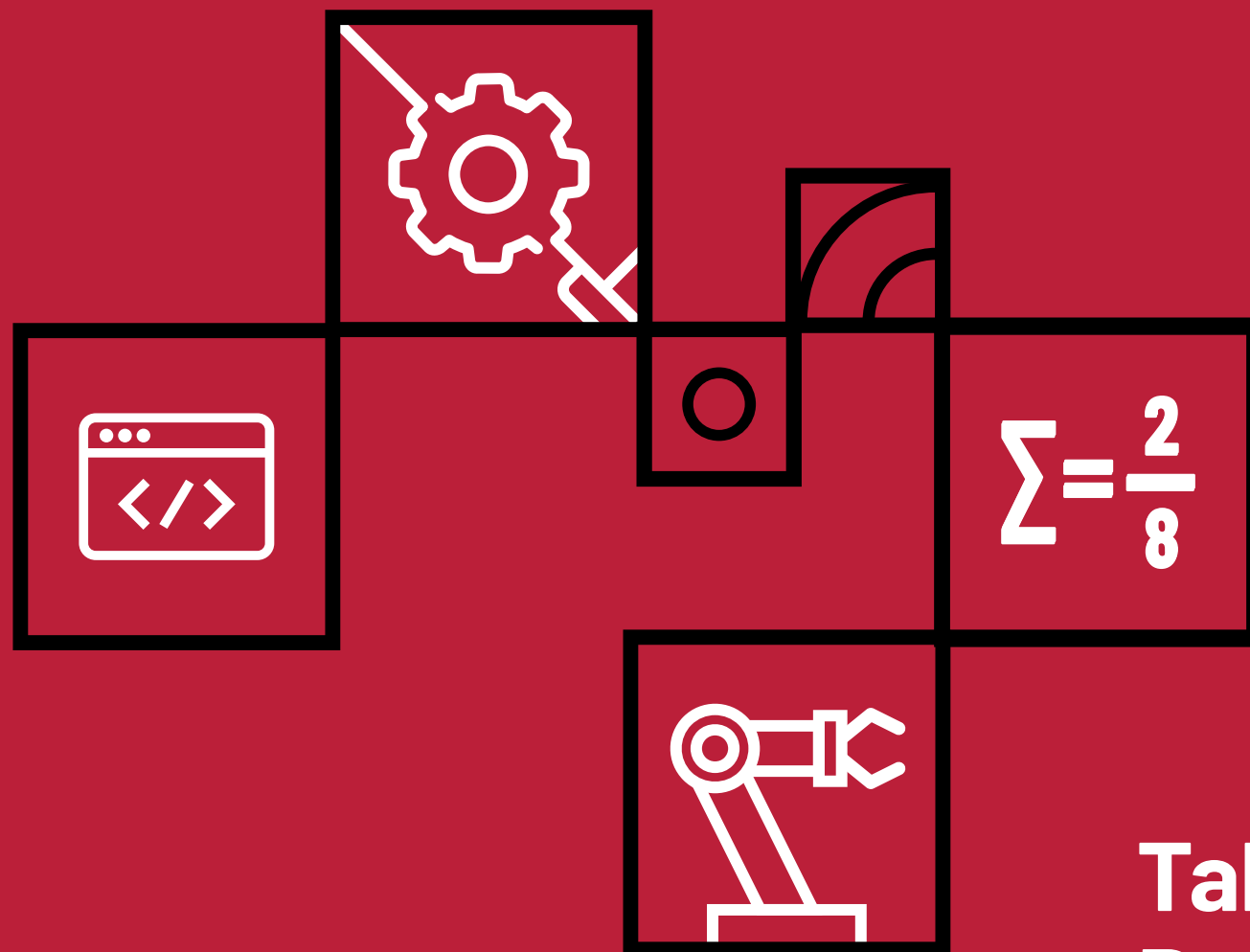
Maya Colacito

Administrative Coordinator



Mary Adelson

Administrative Coordinator



**Talent
Development**



Education and Mobility Programs

During 2020-21, the CMU Portugal Program continued its mission to expand its educational initiatives. The objectives for CMU Portugal's 3rd phase, concerning education and mobility, were to "to maintain legacy initiatives, that is a core component of the Program and a trademark of its excellence, but also to introduce new initiatives that broaden the audience of the Program while responding to particular challenges that societies now face." In this period, the **Dual Degree Ph.D. Programs** initiative has fulfilled its main objectives of expanding to new areas and increasing the number of Ph.D. students. In this respect, a new Dual Degree Ph.D. Program in Human-Computer Interaction was introduced, which saw 2 doctoral students starting their Ph.D. in 2021, affiliated with IST and CMU. **The Dual Degree Ph.D. Programs also registered an increase of 19 students during these two years**, a number that is comparable only to the 1st Phase of the Program. The Dual Degree Ph.D. Programs evaluation process and requirements were also updated to comply with the latest FCT regulations.

The CMU Portugal **Mobility Programs** planned for 2020 and 2021 were suspended due to travel and health constraints caused by the COVID-19 pandemic. However, **the initiatives will resume in 2022, with 5 Portuguese faculty from the 2020 edition already aligned to participate**. The Visiting Faculty and Researchers Program allows faculty to spend up to 4 months at CMU. A new call for Visiting students is expected to open in 2022 for up to 8 scholarships.

In 2021, the CMU Portugal Program launched a new initiative entitled Affiliated Ph.D. Programs which is open to any higher education institution in Portugal and has a high scope of Ph.D. Programs, since it does not require the candidate to be affiliated with a specific Ph.D. Program to be eligible to apply. Candidates must present a Ph.D. work plan aligned with the CMU Portugal main research areas and have a supervisor affiliated with a Por-

tuguese higher education institution and a co-supervisor affiliated with CMU. A key aspect of this initiative is the collaboration with Industry since candidates are encouraged to develop part of their Ph.D. work plan in partnership with a Portuguese ICT company. Upon the Ph.D. conclusion, candidates will be awarded a degree by the Portuguese University. **In the first edition of the Affiliated Ph.D. Programs, 12 new students were admitted.**

In addition, the CMU Portugal Program has been working in close collaboration with Universities in Portugal, CMU departments, and industry partners to establish a new education instrument: **Advanced Training Programs** in Data Science & Machine Learning and User Experience Design. Leading up to the 1st edition of these programs in 2021, CMU Portugal organized 6 online talks in Data Science and User Experience Design by CMU faculty and worldwide industry experts. It counted with the virtual attendance of hundreds of participants.



Dual Degree Ph.D. Programs

Since 2006, the CMU Portugal Program has supported the Dual Degree Ph.D. Programs initiative. Between 2020-2021 the Program has opened 2 calls for scholarships (2020/2021 and 2021/2022) for the following areas: Computer Science, Electrical and Computer Engineering, Engineering and Public Policy, Human-Computer Interaction, Language Technologies, Software Engineering, and Robotics, in a collaboration between six Portuguese Universities and seven departments at CMU.

Students in the Dual Degree Program are actively registered in both Universities and conduct their studies in Portugal and the United States. **Through FCT, CMU Portugal Program provides scholarships that cover up to 5 years of funding, 3 years in Portugal, and 2 years at CMU.** Students are co-advised by at least one faculty from Carnegie Mellon University and one faculty from a Portuguese partner higher education institution. Graduates of the Program receive Dual Degree diplomas conferred by CMU and the affiliated Portuguese University.

Admission to the Dual Degree Ph.D. Programs is highly competitive. The CMU Portugal candidates need to submit an application directly to CMU and be evaluated together with all the candidates applying for that specific Ph.D. Program from all over the world. If they meet the minimum requirements for admission, their application is then evaluated by an admissions committee in Portugal, constituted by faculty from various Portuguese higher education institutions, CMU faculty, and chaired by the Directors of the Program. Together, they evaluate the applications for the FCT - CMU Portugal scholarship awarding. If the candidate attains the required evaluation to be considered for the Program, they will be proposed for admission to the relevant CMU and Portuguese University departments and also to FCT for scholarship funding.

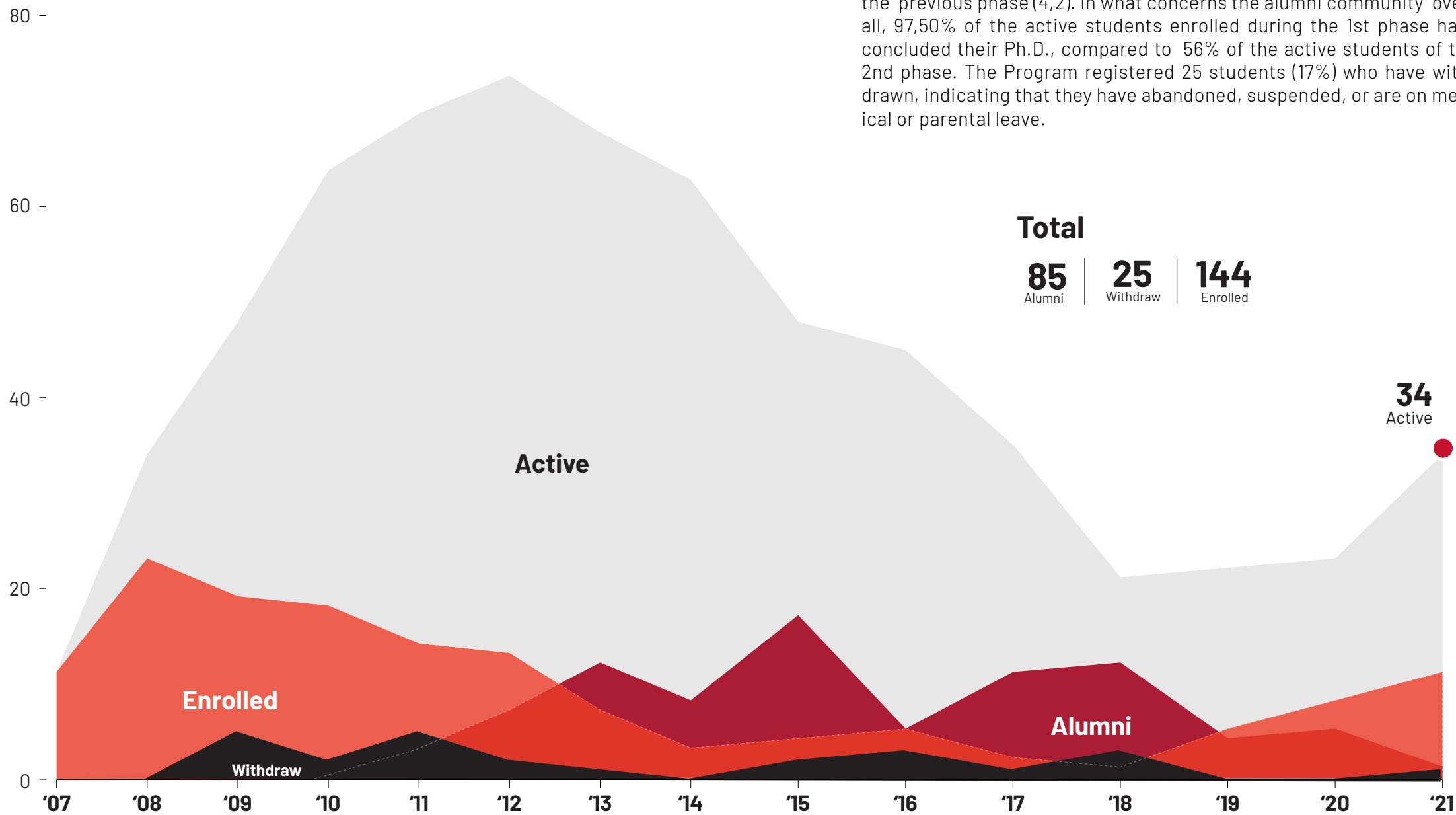
The Dual Degree Program provides a unique opportunity for students to experience the advantages of collaborative research between top-tier research institutions and companies. Through 2021, **23 Dual Degree Ph.D. students and alumni have been part of or are currently involved in company-led CMU Portugal research projects** under the Entrepreneurial Research Initiatives or Large-Scale Collaborative Research Projects calls.

The Program's high scientific standards have served and are expected to educate high-quality researchers, instructors, and innovators in ICT-related areas during CMU Portugal's 3rd phase.

	Ph.D. CS-Robotics	Ph.D. EPP	Ph.D. ECE	Ph.D. CS	Ph.D. LTI	Ph.D. SE	HCI
CMU	✓	✓	✓	✓	✓	✓	✓
IST	✓	✓	✓	✓	✓	✓	✓
FEUP	✓	✓	✓	✓	✓		
FCUL	✓	✓	✓	✓			
UA	✓	✓	✓	✓			
FCTUC	✓	✓	✓	✓			
UMinho	✓	✓	✓	✓			
FCT-UNL	✓	✓	✓				

Dual Degree Ph.D. Programs

| Alumni, active & withdrawn students



The 3rd phase of the CMU Portugal Program introduced important changes in the admission process and the increasing number of scholarships available, which reflects in the number of students enrolled and active students since 2018. Since 2007, 144 students have enrolled in the Dual Degree Ph.D. programs, with 34 current active students. **The number of students enrolled from 2018 until 2021 can be translated into a higher average of enrolled students/ year (6,25)** compared to the previous phase (4,2). In what concerns the alumni community overall, 97,50% of the active students enrolled during the 1st phase have concluded their Ph.D., compared to 56% of the active students of the 2nd phase. The Program registered 25 students (17%) who have withdrawn, indicating that they have abandoned, suspended, or are on medical or parental leave.

Dual Degree Ph.D. Programs

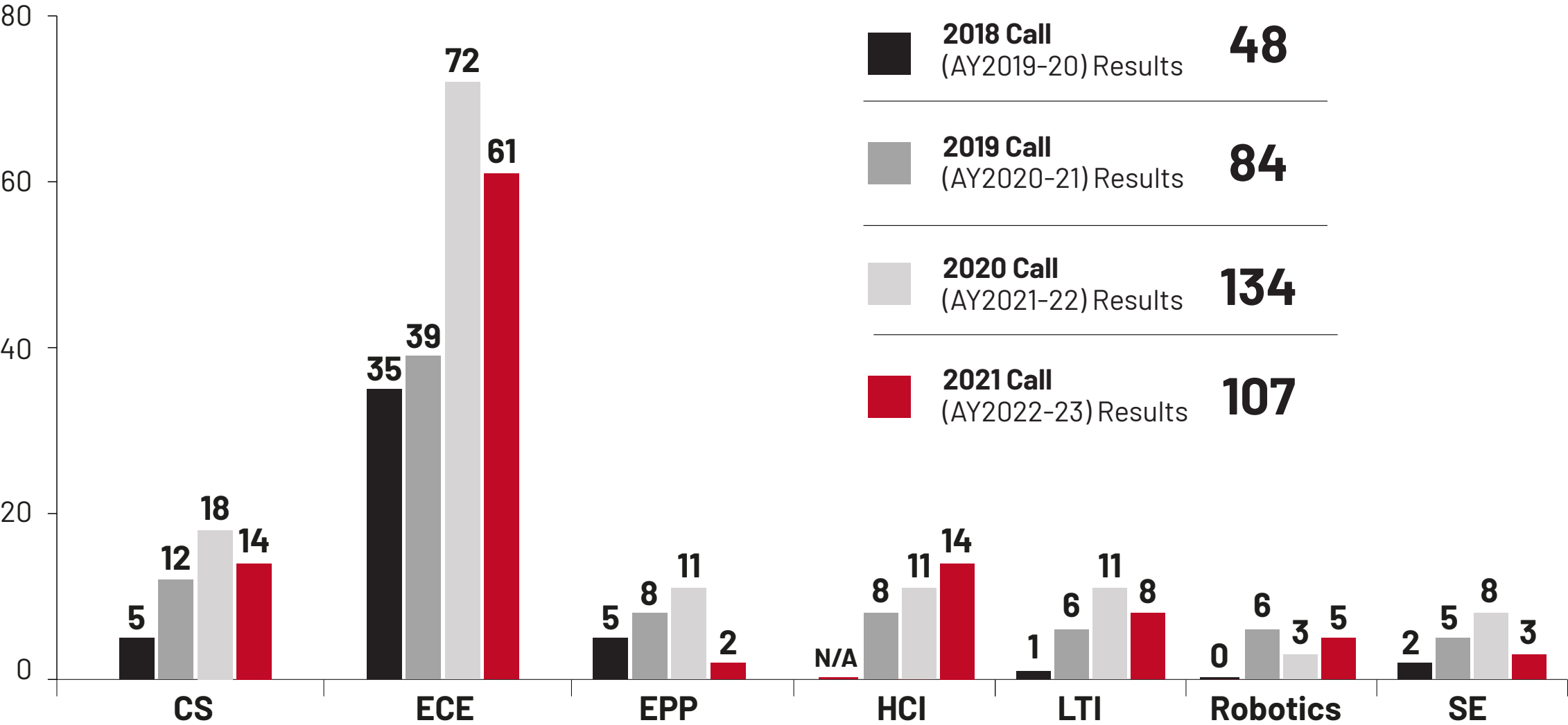
Applications between 2018 and 2021

The 3rd phase of the Program registered an increasing number of applications, with a slight decrease in the last call of 2021. The Electrical and Computer Engineering department registered the largest share

of applications, followed by Computer Science. Although only having applications for the Dual Degree Ph.D. since 2019, the Human-Computer Interaction Institute shows a consistent increase in the number of applications and currently shares with the Computer Science the same number of applications. For the Language Technologies Institute, Robotics, and Software Engineering departments, the Program has attracted an almost constant share of applications. In contrast, a decrease in the number of applications has been observed in the Engineering and Public Policy department.

Legend

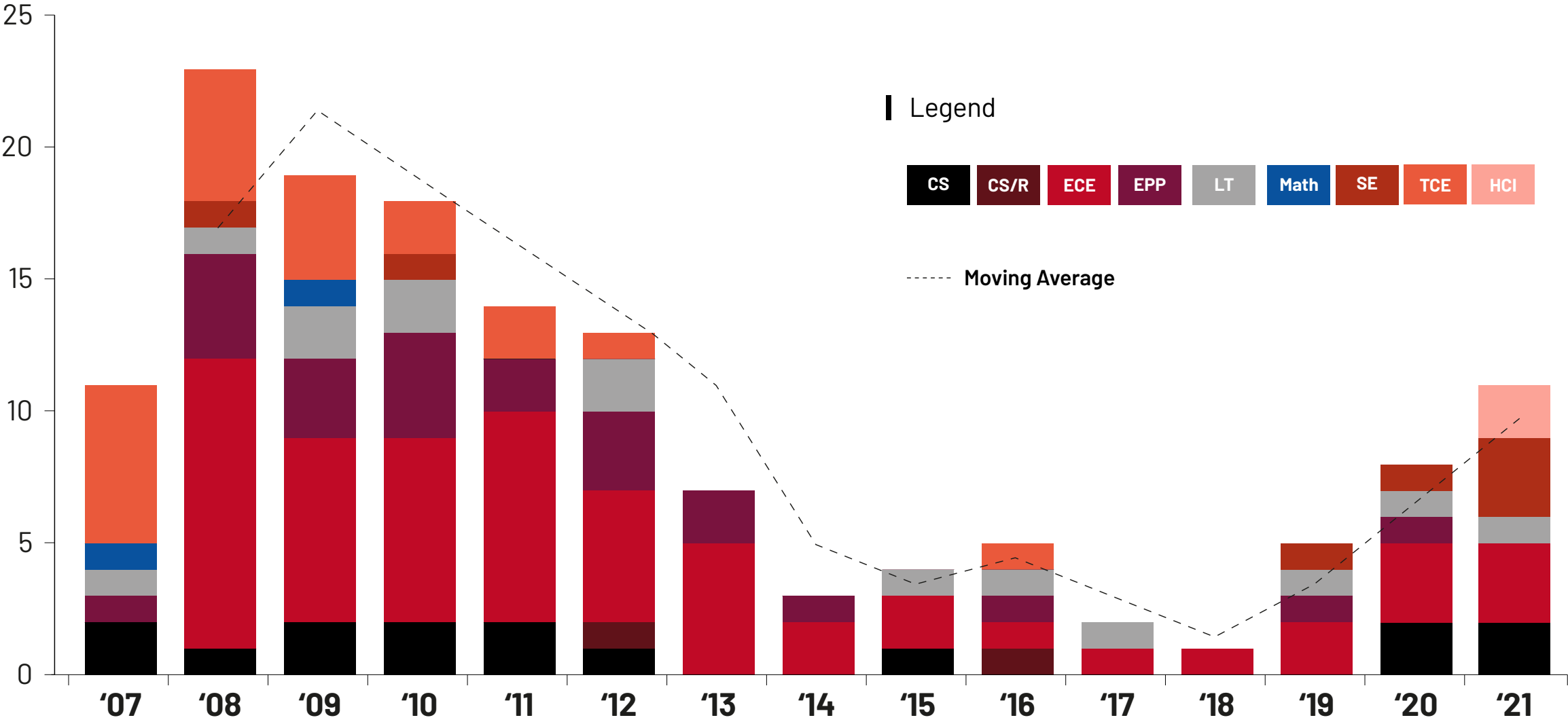
2018 Call (AY2019-20) Results	48
2019 Call (AY2020-21) Results	84
2020 Call (AY2021-22) Results	134
2021 Call (AY2022-23) Results	107



Dual Degree Ph.D. Programs: Students

Enrolled students in each Ph.D. Program by entering year

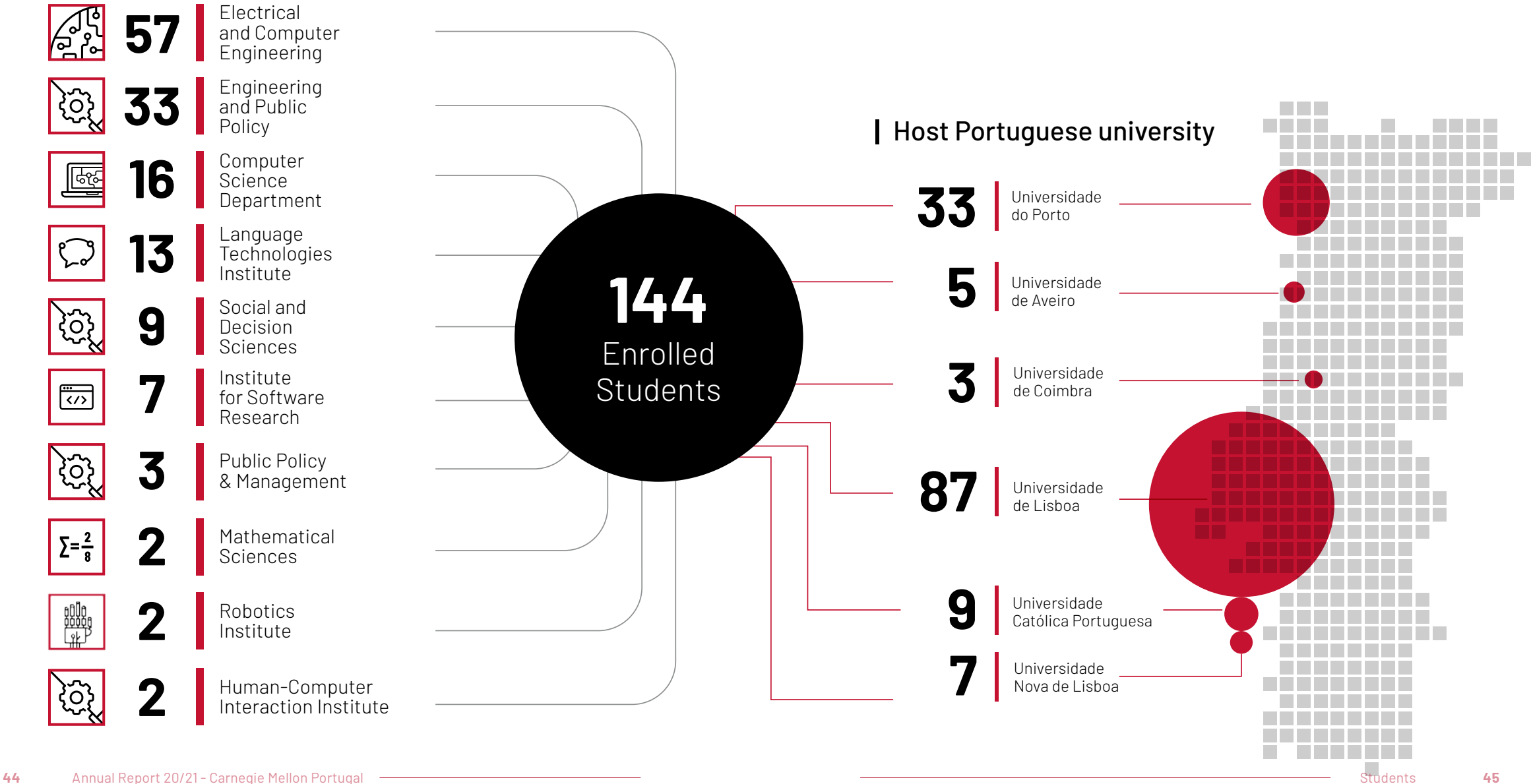
The Electrical and Computer Engineering (ECE), Computer Science, and Software Engineering Ph.D. Programs enrolled the majority of students. **Since 2019, the distribution of enrolled students across the Ph.D. Programs have been more heterogeneous**, with students being admitted to 5 different Dual Degree Ph.D. Programs in 2020 and 2021. In 2021, the first two students were admitted to HCI, and the share of the students admitted to the School of Computer Science represents 68% of the total admissions in the academic years of 2020/2021 and 2021/2022.



Dual Degree Ph.D. Programs: Students

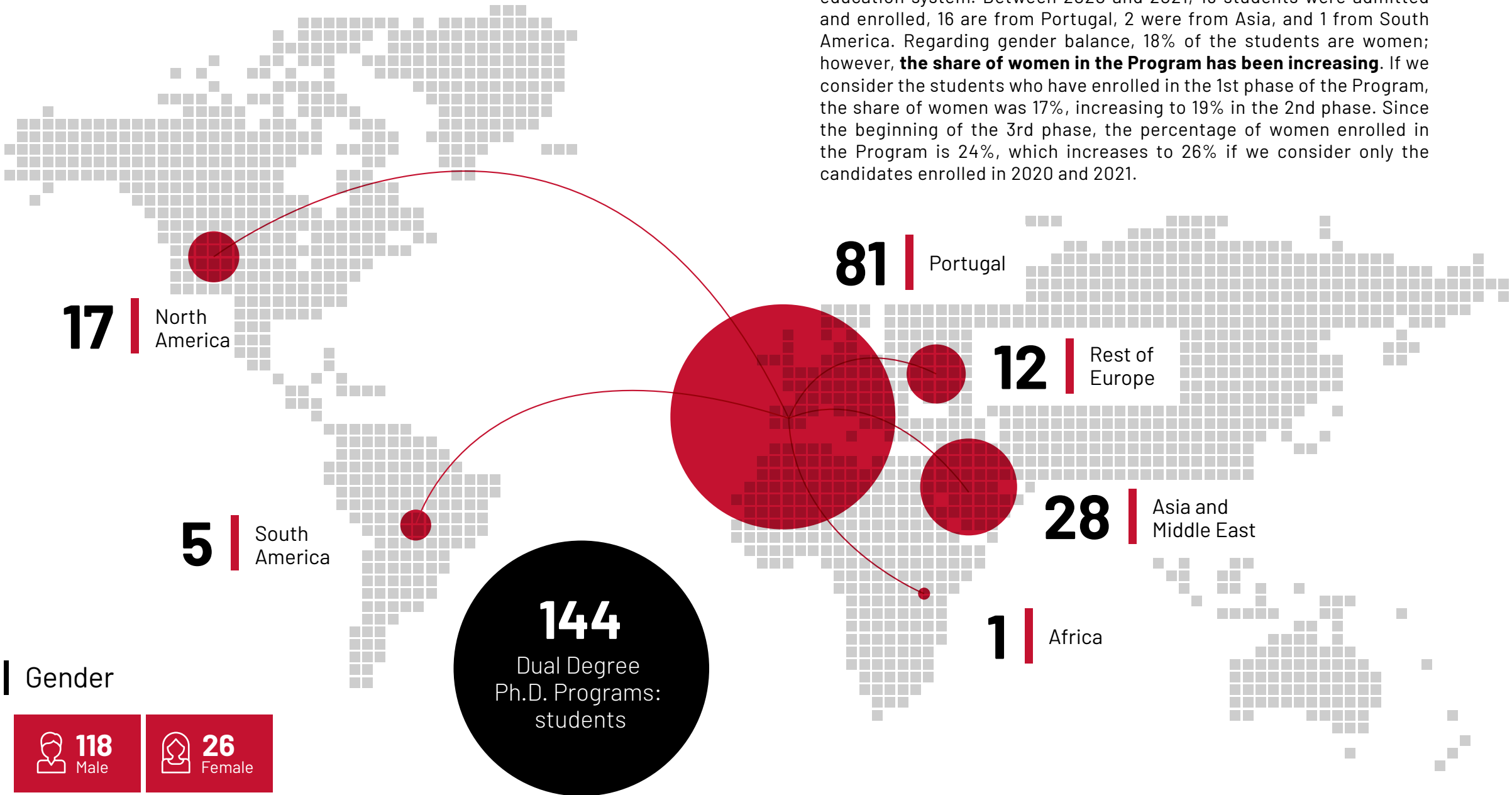
Enrolled students by host CMU department and Portuguese university

Of the 144 enrolled students, 40% were hosted in the Department of Electrical and Computer Engineering, 23% in the Department of Engineering and Public Policy, and 11% in the Department of Computer Science. The other students were enrolled in the Institute for Software Research, Language Technologies Institute, Department of Mathematical Sciences, School of Public Policy & Management, Robotics Institute, Department of Social and Decision Sciences, and the Human-Computer Interaction Institute. In Portugal, 57% of the students were enrolled in the University of Lisbon, 17% in the University of Porto, and others in the Universidade de Aveiro, Universidade de Coimbra, Universidade Católica Portuguesa and Universidade Nova de Lisboa.



Dual-Degree Ph.D. Programs: Students

| Enrolled students: nationality and gender



Enrolled Students (2020-2021)



**Afonso
Amaral**

Research topics: National core competencies and dynamic capabilities in times of crisis: Regulation of ventilators and new market entrants in Portugal versus Spain.

Enrollment year: 2020

Ph.D. Program: Engineering and Public Policy

Institution in Portugal: Técnico

CMU Department: Engineering and Public Policy

PT Supervisor: Joana Mendonça

CMU Supervisor: Granger Morgan, Erica Fuchs



**Latifah
Almaghrabi**

Research topics: Biomedical materials and devices

Enrollment year: 2020

Ph.D. Program: Engineering and Public Policy

Institution in Portugal: Universidade de Aveiro

CMU Department: Electrical and Computer Engineering

PT Supervisor: Paula Marques

CMU Supervisor: Pedro Fonseca, Philip Leduc



**Manuel
Carneiro**

Research topics: Multi-electrode stretchable bioelectronic interfaces

Enrollment year: 2020

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: FCTUC

CMU Department: Electrical and Computer Engineering

PT Supervisor: Mahmoud Tavakoli

CMU Supervisor: Carmel Majidi



**Afonso
Tinoco**

Enrollment year: 2020

Ph.D. Program: Computer Science

Institution in Portugal: Técnico

CMU Department: Computer Science Department

PT Supervisor: Rodrigo Rodrigues



**Nuno
Sabino**

Enrollment year: 2020

Ph.D. Program: Computer Science

Institution in Portugal: Técnico

CMU Department: Computer Science Department

PT Supervisor: Pedro Adão, Rui Maranhão

CMU Supervisor: Limin Jia, Lujo Bauer

Enrolled Students (2020-2021)



**Daniel
Ramos**

Research topics: Software Refactoring, Program Repair, Program Synthesis

Enrollment year: 2020

Ph.D. Program: Software Engineering

Institution in Portugal: Técnico

CMU Department: Computer Science Department

PT Supervisor: Vasco Manquinho

CMU Supervisor: Claire Le Goues, Ruben Martins



**Catarina
Fidalgo**

Enrollment year: 2021

Ph.D. Program: Human-Computer Interaction

Institution in Portugal: Técnico

CMU Department: Human-computer interaction Institute

PT Supervisor: Joaquim Armando Pires Jorge, António Maurício Lança Tavares de Sousa

CMU Supervisor: David Lindlbauer



**Pedro
Valdeira**

Enrollment year: 2020

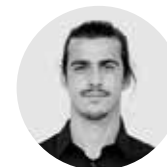
Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: Técnico

CMU Department: Electrical and Computer Engineering

PT Supervisor: Cláudia Soares, João Xavier

CMU Supervisor: Yuejie Chi



**Patrick
Fernandes**

Research topics: Contextual Machine Translation, Interpretability

Enrollment year: 2020

Ph.D. Program: Language Technologies

Institution in Portugal: Técnico

CMU Department: Language Technologies Institute

PT Supervisor: André Martins

CMU Supervisor: Graham Neubig

Neeta Khanuja



Research topics: Designing technologies to enable older adults and people with cognitive disabilities such as dementia, to lead independent and meaningful lives

Enrollment year: 2021

Ph.D. Program: Human-Computer Interaction

Institution in Portugal: Técnico

CMU Department: Human-computer interaction Institute

PT Supervisor: Nuno Nunes, Valentina Nisi

CMU Supervisor: Jodi Forlizzi

Enrolled Students (2020-2021)



**Margarida
Ferreira**

Research topics: Program Synthesis

Enrollment year: 2021

Ph.D. Program: Computer Science

Institution in Portugal: Técnico

CMU Department: Computer Science Department

PT Supervisor: Inês Lynce

CMU Supervisor: Ruben Martins



**Miguel
Ferreira**

Research topics: Network routing

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: Técnico

CMU Department: Electrical and Computer Engineering

PT Supervisor: João Luís Sobrinho

CMU Supervisor: Justine Sherry



**Sofia
Martins**

Research topics: Cloud Offloading, Wireless Networking, Distributed Systems

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: FEUP

CMU Department: Electrical and Computer Engineering

PT Supervisor: Ana Aguiar

CMU Supervisor: Peter Steenkiste



**Paulo
Santos**

Research topics: Program Repair

Enrollment year: 2021

Ph.D. Program: Software Engineering

Institution in Portugal: FCUL

CMU Department: Institute for Software Research

PT Supervisor: Alcides Fonseca, Sara Silva

CMU Supervisor: Christopher S. Timperley

Enrolled Students (2020-2021)



**Pedro
Mendes**

Research topics: Distributed Systems, Cloud Computing, Optimization, Machine Learning, and Artificial Intelligence.

Enrollment year: 2021

Ph.D. Program: Software Engineering

Institution in Portugal: Técnico

CMU Department: Institute for Software Research

PT Supervisor: Paolo Romano

CMU Supervisor: David Garlan



**Gabriel
Moreira**

Research topics: Multimodal Machine Learning, Computer Vision

Enrollment year: 2021

Ph.D. Program: Language Technologies

Institution in Portugal: Técnico

CMU Department: Language Technologies Institute

PT Supervisor: Manuel Marques, João Paulo Costeira

CMU Supervisor: Alexander Hauptmann (LTI)



**Luiz
Sá**

Research topics: Type Systems – Session Types

Enrollment year: 2021

Ph.D. Program: Computer Science

Institution in Portugal: FCT - UNL

CMU Department: Computer Science Department

PT Supervisor: Bernardo Toninho

CMU Supervisor: Frank Pfenning



**Luís
Gomes**

Research topics: Software Engineering, Programming Languages, Artificial Intelligence, Machine Learning

Enrollment year: 2021

Ph.D. Program: Software Engineering

Institution in Portugal: FCUP

CMU Department: Institute for Software Research

CMU Supervisor: Jonathan Aldrich, Vincent Hellendoorn



**Cláudio
Gomes**

Research topics: Quantum Computing applied to Sustainability

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: FCUP

CMU Department: Electrical and Computer Engineering

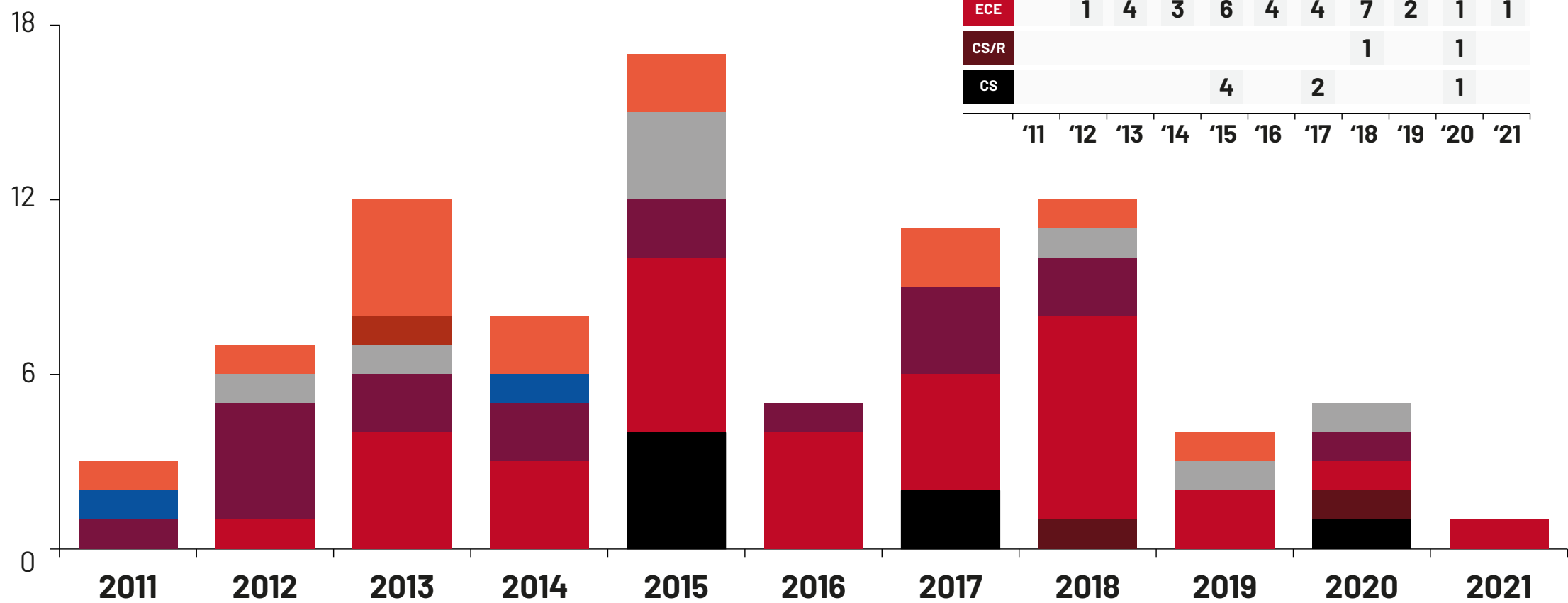
PT Supervisor: João Paulo Fernandes

CMU Supervisor: Sridhar R. Tayur, Soumya Kar

Dual Degree Ph.D. Programs: Alumni

Alumni by Ph.D. Program and graduation year

Considering the alumni average of each phase of the Program, the 1st phase had an average of 5 alumni/year; the 2nd phase had an average of 10,6 alumni/year; and the 3rd phase (with 4 years), is currently with an average of 5,5 alumni/year. The decrease in the number of alumni

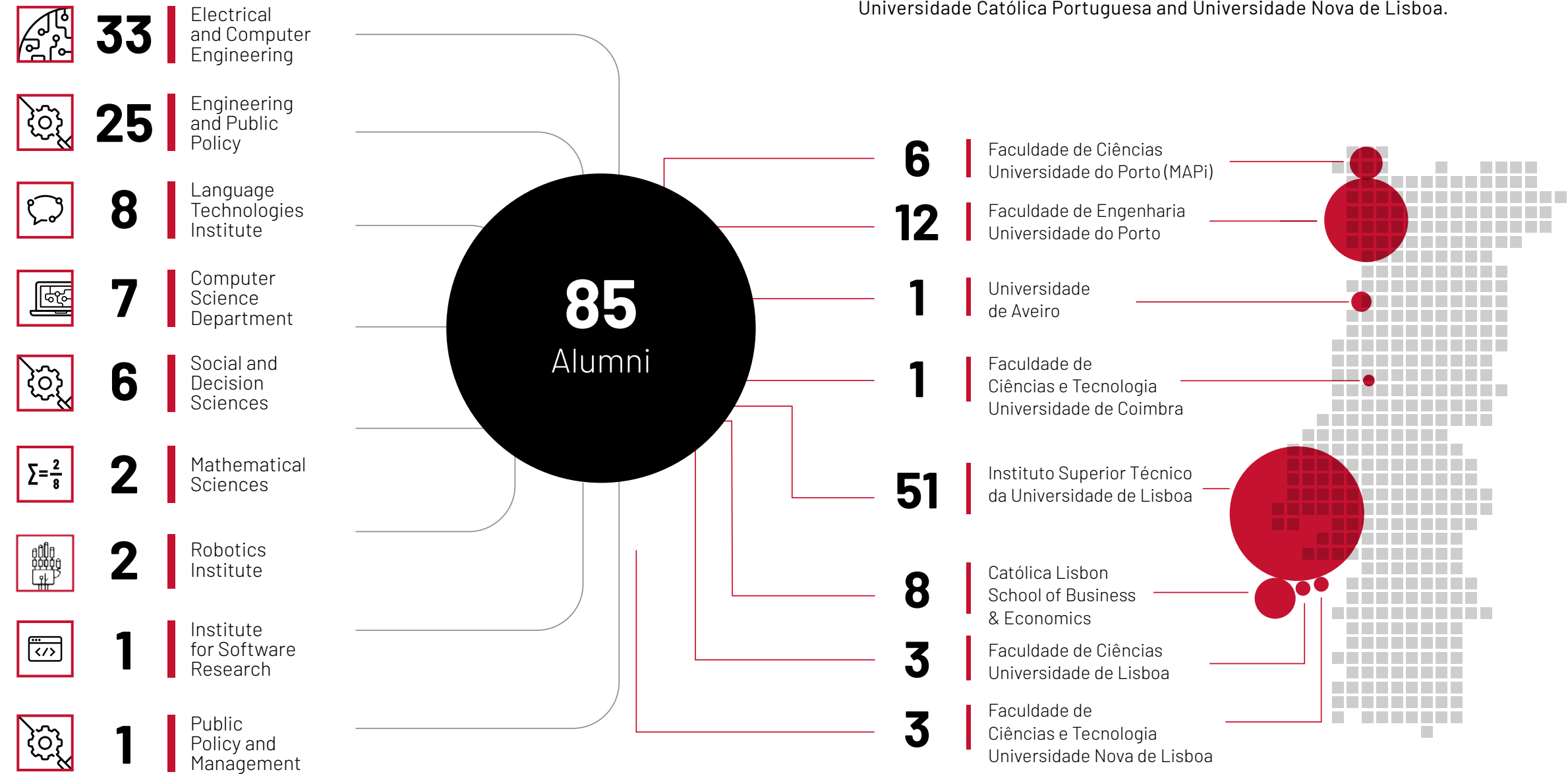


may be related to the fact that the 2nd phase of the Program had an important decrease in students. On average, 54% of the alumni finished the Ph.D. in the expected timeline of 5 years or less, 27% in 6 years, and 19% take more than 6 years to finish the Ph.D.. The majority of the alumni graduated in Electrical and Computer Engineering (39%) and in Engineering and Public Policy (30%). EPP is the Ph.D. Program with the highest completion rate (78%). All of the other Programs have completion rates above 50%. Software Engineering is currently an exception since it recently had an important share of newly enrolled students, 1 has graduated, and 6 are still active.

TCE	1	1	4	2	2	0	2	1	1		
SE			1								
Math	1			1							
LT		1	1		3			1	1	1	
EPP	1	4	2	2	2	1	3	2		1	
ECE		1	4	3	6	4	4	7	2	1	1
CS/R								1		1	
CS					4		2			1	
	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21

Dual Degree Ph.D. Programs: Alumni

Alumni by host CMU department
and Portuguese university

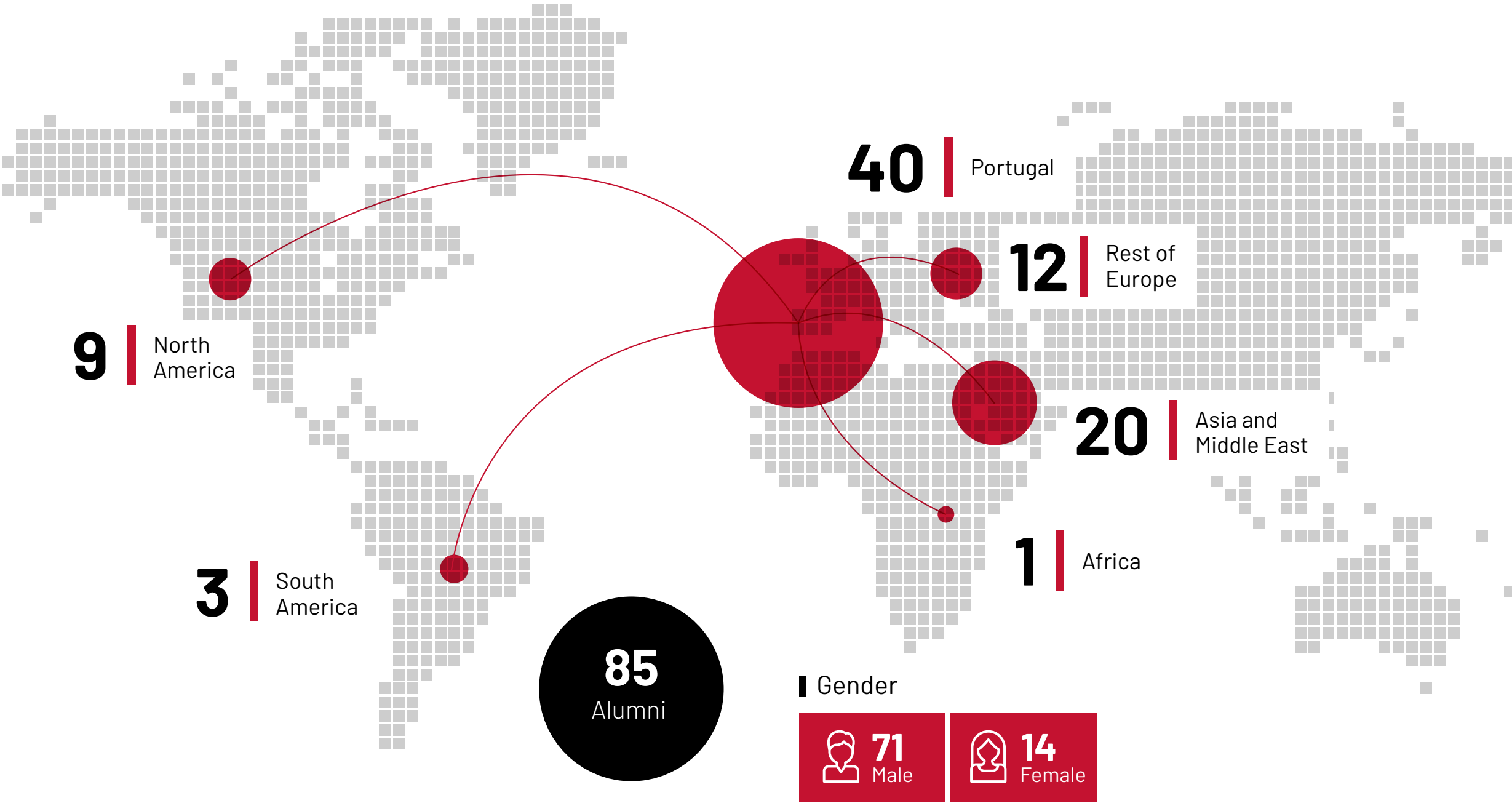


From the 78 alumni, 40% were hosted in the Department of Electrical and Computer Engineering, 22% in the Department of Engineering and Public Policy, and 10% in the Department of Computer Science. The remaining students were enrolled in the Institute for Software Research, Language Technologies Institute, Department of Mathematical Sciences, School of Public Policy & Management, Robotics Institute, and Department of Social and Decision Sciences. In Portugal 60% of the students were enrolled in the Universidade de Lisboa, 23% in the Universidade do Porto, and the remainder in the Universidade de Aveiro, Universidade de Coimbra, Universidade Católica Portuguesa and Universidade Nova de Lisboa.

Dual Degree Ph.D. Programs: Alumni

| Nationality and gender

Regarding the alumni nationality, 47% are Portuguese, 24% are from Asia and the Middle East countries, 14% are from other European countries, and 11% are from North America (all from the United States of America). The alumni community includes nationals from countries located in South America and Africa.

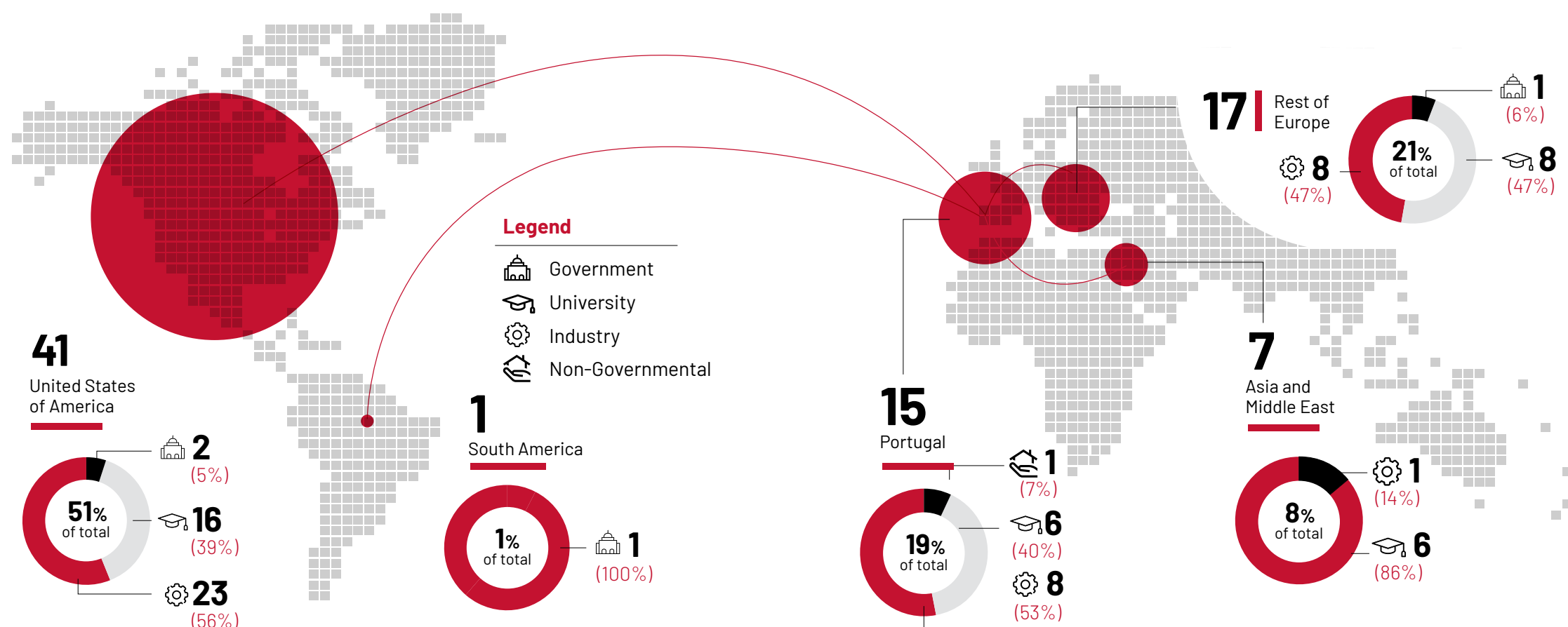


Dual Degree Ph.D. Programs: Alumni

Alumni job positions by type of employer and country of employment

Concerning alumni job positions by type of employer and country of employment, it was possible to complete the information for 81 of the 85 alumni. Of those, 41 alumni (51%) are working in the U.S., 14 are Portuguese. Many alumni in the U.S. are working in companies that are a reference in their area of activity (such as Samsung, Google, Duolingo, JP Morgan) and top-tier universities (such as Carnegie Mellon University, University of California, University of Chicago, Princeton University).

The majority of the alumni that work in the U.S. are working in industry (56%), followed by academia (39%) and governmental institutions (5%). Apart from the U.S., the most prominent job location country for the CMU Portugal alumni base is Portugal, accounting for 19% of the total alumni. **In Portugal, 40% of the alumni in Portugal are working in some of the best Portuguese Universities, and 53% are working in Portuguese ICT-related companies** such as Feedzai, Priberam, Unbabel, Synopsys, and NOS. An important share of the alumni works in other European countries (21%), with 47% of the alumni working in academia and an equal share working in the industry. In these cases, alumni job positions range from Utrecht University, Erasmus University, and Eindhoven University to Google, Amazon, and the European Commission. The majority of the alumni who work in Asia and the Middle East work in companies (86%) such as IBM, Alibaba, or Kaust University in Saudi Arabia. In South America 1 alumni is working in Peru, in a delegation of the European Commission.



Dual Degree Ph.D. Programs: Alumni

| 2020 and 2021 alumni



Hugo Rodrigues

Software Engineering at Freheit Technologies

Ph.D.: Language Technologies

Affiliation: CMU/IST

Graduation year: 2020



Kim Baraka

Assistant Professor at Vrije Universiteit Amsterdam
(VU Amsterdam)

Ph.D.: Computer Science/ Robotics

Affiliation: CMU/IST

Graduation year: 2020



Alessandro Giordano

Transport Policy Analyst at Joint Research
Centre (European Commission)

Ph.D.: Engineering and Public Policy

Affiliation: CMU/IST

Graduation year: 2020



Rui Silva

AI Research Scientist at J.P. Morgan

Ph.D.: Computer Science

Affiliation: CMU/IST

Graduation year: 2020

João Guilherme Antunes Martins

Ph.D.: Electrical and Computer Engineering

Affiliation: CMU/IST

Graduation year: 2020

Min Hun Lee

Singapore Management University

Ph.D.: Electrical and Computer Engineering

Affiliation: CMU/IST

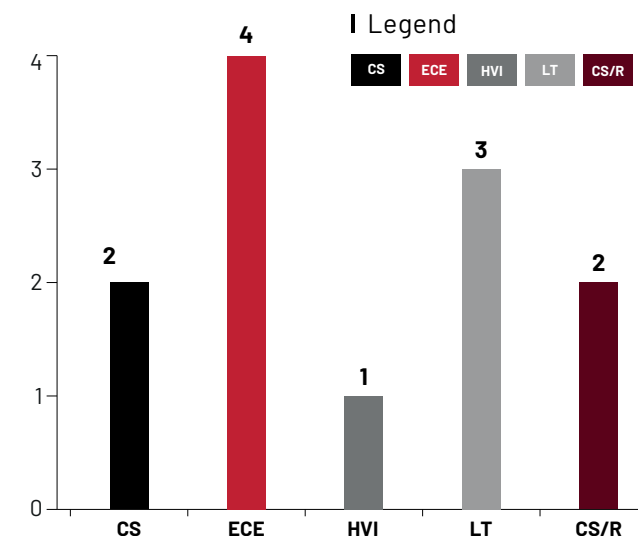
Graduation year: 2021

Affiliated Ph.D. Programs

In 2021, the Program launched a new initiative for doctoral degrees, the CMU Portugal Affiliated Ph.D. Programs. Through this new mechanism, CMU Portugal and FCT offer Ph.D. scholarships in selected cutting-edge areas of Information and Communication Technologies (ICT), related to the scope of the CMU Portugal Program. **Ph.D. students are hosted only by a Portuguese University and can spend a research period at Carnegie Mellon for up to 1 year.** Students must have a supervisor affiliated with a Portuguese higher education institution and a co-supervisor affiliated with CMU. Practically all higher education institutions in Portugal and all CMU departments are eligible for the student to be affiliated with, as long as they are aligned with the main research areas of the Program, which confers to this initiative a high level of flexibility and diversity. A key aspect of this initiative is the collaboration with Industry since candidates are encouraged to develop part of their **Ph.D. work plan in collaboration with a Portuguese ICT company.** Upon the Ph.D. conclusion, candidates will be awarded a degree by the Portuguese host University. The jury is chaired by the Program's Directors and composed of specific committees constituted for each CMU Portugal's main research areas. The committees are formed of faculty affiliated with a Portuguese higher education institution and at least 1 faculty member affiliated with CMU.

In this 1st edition of the Affiliated Ph.D. Programs, **12 students** were admitted for the academic year 2021/2022. The 12 new students are developing research across **5 research areas, 6 CMU departments,** and **4 universities** in Portugal. **8 students** are developing their thesis in **close collaboration with a Portuguese ICT company.** A new call for the 2nd edition of the Affiliated Ph.D. Programs was launched on February 15th, 2022, for the attribution of up to 12 FCT Ph.D. scholarships.

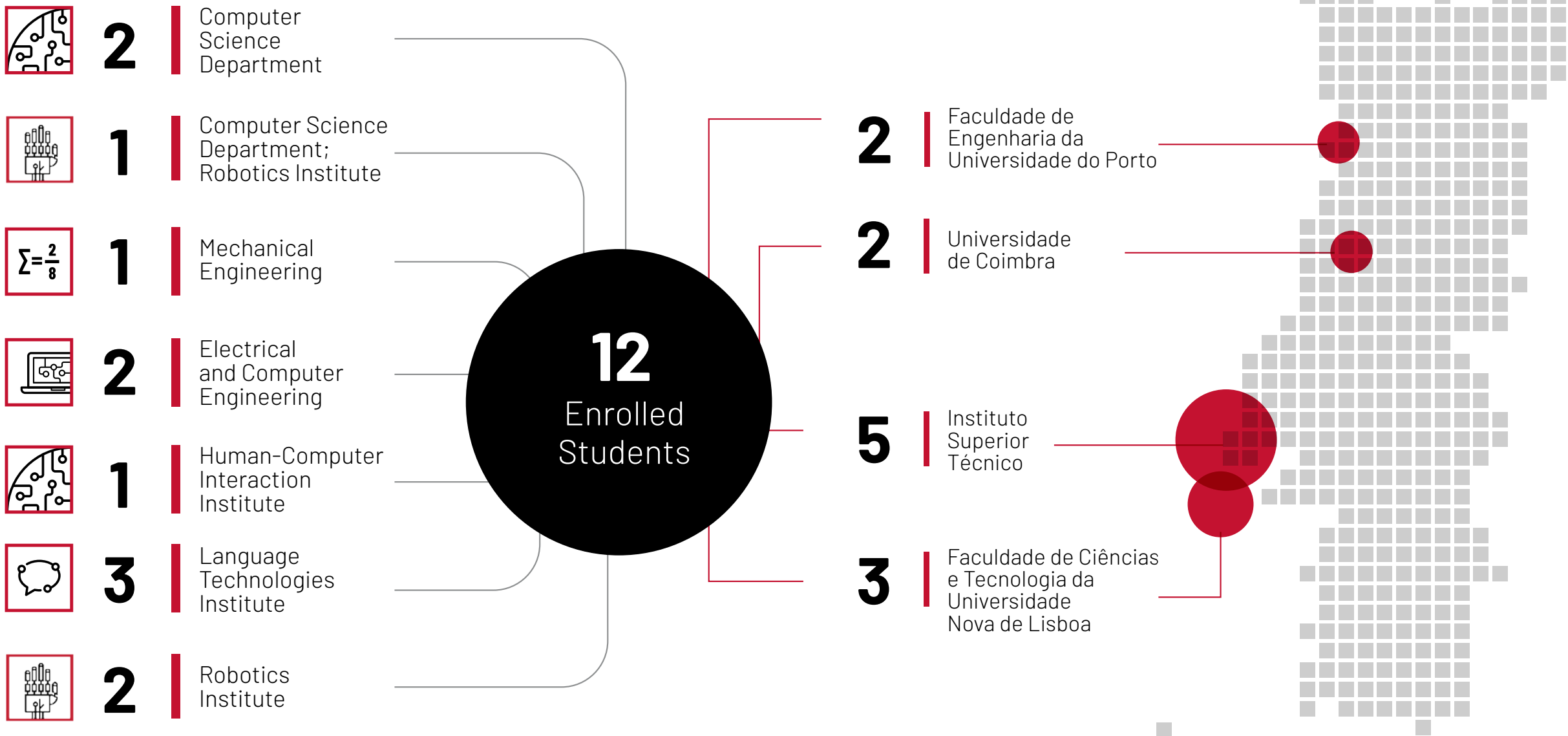
Enrolled students by research area



Affiliated Ph.D. Students:

Enrolled students by host CMU department and Portuguese university

Of the 12 enrolled students in 2021/2022, 33% are hosted in the Department of Electrical and Computer Engineering, 25% in the Language Technologies Institute, 17% in the Department of Computer Science and Robotics and 8% (1) in the Human-Computer Interaction Institute. In Portugal, 42% of the students were enrolled in the University of Lisbon, 25% in the Nova University of Lisbon, and 17% in the University of Porto and University of Coimbra.



Enrolled Students (2021)



**Fernanda
Famá**

Research topics: Edge Computing and AI applied to healthcare

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: Universidade de Coimbra

CMU Department: Mechanical Engineering

PT Supervisor: David Portugal

CMU Supervisor: Carmel Majidi



**Shuhao
Ma**

Research topics: Human Computer Interaction

Enrollment year: 2021

Ph.D. Program: Human-Computer Interaction

Institution in Portugal: Técnico

CMU Department: Human-computer interaction Institute

PT Supervisor: Nuno Nunes

CMU Supervisor: John Zimmerman



**Maria Eduarda
Andrada**

Research topics: Supervised learning; Scene understanding;
Knowledge representation and reasoning

Enrollment year: 2021

Ph.D. Program: Robotics

Institution in Portugal: Universidade de Coimbra

CMU Department: Robotics Institute

PT Supervisor: David Portugal

CMU Supervisor: George Kantor



**Tamás
Karácsony**

Research topics: Electrical and Computer Engineering

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: FEUP

CMU Department: Computer Science Department

PT Supervisor: João Paulo Cunha

CMU Supervisor: Fernando De la Torre

Enrolled Students (2021)



**Diogo
Pereira**

Research topics: Machine learning; Network performance evaluation; Modeling and simulation

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: FCT - UNL

CMU Department: Electrical and Computer Engineering

PT Supervisor: Rodolfo Oliveira

CMU Supervisor: Hyong Kim



**Diogo
Tavares**

Research topics: Dialogue State Tracking

Enrollment year: 2021

Ph.D. Program: Language Technologies

Institution in Portugal: FCT - UNL

CMU Department: Language Technologies Institute

PT Supervisor: João Magalhães

CMU Supervisor: Alexander Rudnicky



**Diogo
Silva**

Research topics: Language Generation

Enrollment year: 2021

Ph.D. Program: Language Technologies

Institution in Portugal: FCT - UNL

CMU Department: Language Technologies Institute

PT Supervisor: David Semedo

CMU Supervisor: Alexander G. Hauptmann



**Eduard
Pinconschi**

Research topics: Software Security, Automated Program Repair, Program Analysis

Enrollment year: 2021

Ph.D. Program: Electrical and Computer Engineering

Institution in Portugal: FEUP

CMU Department: Electrical and Computer Engineering

PT Supervisor: Rui Maranhão, Pedro Adão

CMU Supervisor: Corina Pasareanu, Hakan Erdogan

Enrolled Students (2021)



**Francisco
Pereira**

Research topics: Network Function Virtualization

Enrollment year: 2021

Ph.D. Program: Computer Science

Institution in Portugal: Técnico

CMU Department: Computer Science Department

PT Supervisor: Luís Pedrosa

CMU Supervisor: Justine Sherry



**Ricardo
Brancas**

Research topics: Program Synthesis

Enrollment year: 2021

Ph.D. Program: Computer Science

Institution in Portugal: Técnico

CMU Department: Computer Science Department

PT Supervisor: Vasco Manquinho

CMU Supervisor: Ruben Martins



**John
Mendonça**

Research topics: NLP, Dialogue, Conversational Agents

Enrollment year: 2021

Ph.D. Program: Language Technologies

Institution in Portugal: Técnico

CMU Department: Language Technologies Institute

PT Supervisor: Isabel Trancoso

CMU Supervisor: Alon Lavie



Mobility Programs

The **Visiting Faculty and Researchers Program** and the **Visiting Students Program** have, and continue to be, key educational initiatives of the CMU Portugal Program. They contribute to strengthening the research networks that exist between the Portuguese Universities and CMU.

Since 2007, 79 faculty affiliated with Portuguese higher education institutions have participated in the Visiting Faculty and Researchers Program, and 40 students under the Visiting Students Program.

In regard to the Visiting Faculty and Researchers Program, **of the 79 participants, 28 went on to participate in a CMU Portugal research project as PI's or researchers and/or have supervised Dual Degree Ph.D. students.** As for the Visiting Students Program, only 2 students who have visited CMU enrolled in the Dual Degree Ph.D., which is why the Program's strategy for its 3rd phase is to target master's students, preferably in the 2nd year of the master's, to establish a coherent transition between the master and the Ph.D., should the student decide to continue their education.

Each year on average, from 2007 to 2019, 10 faculty and/or students visited CMU. The average length of the visits is 3 months for the Visiting Faculty and Researchers and 4 months for the Visiting Students Program. Since the beginning of the 3rd phase of the Program, there have been two calls for the Visiting Faculty and Researchers Program (in 2018 and 2019). The 2018 call admitted 11 faculty that visited CMU during 2019. The 2019 call resulted in 7 faculty accepted with visits scheduled for 2020. As for the Visiting Students Program, a call was open in 2019 being that 9 students were selected to visit CMU in 2020. However, the mobility visits were suspended due to travel and health constraints caused by the COVID-19 pandemic. The initiatives will resume in 2022 with 5 visits for the faculty who have applied to the 2019 call and were still able to visit the CMU campus in 2022.

Regarding the Visiting Students Program, no visit could be resumed in 2022 since the candidates were no longer eligible (they have finished their masters and therefore did not comply with the requirement of being a master's student). A new call will be launched in 2022.

Mobility Programs

Participants by initiative and year

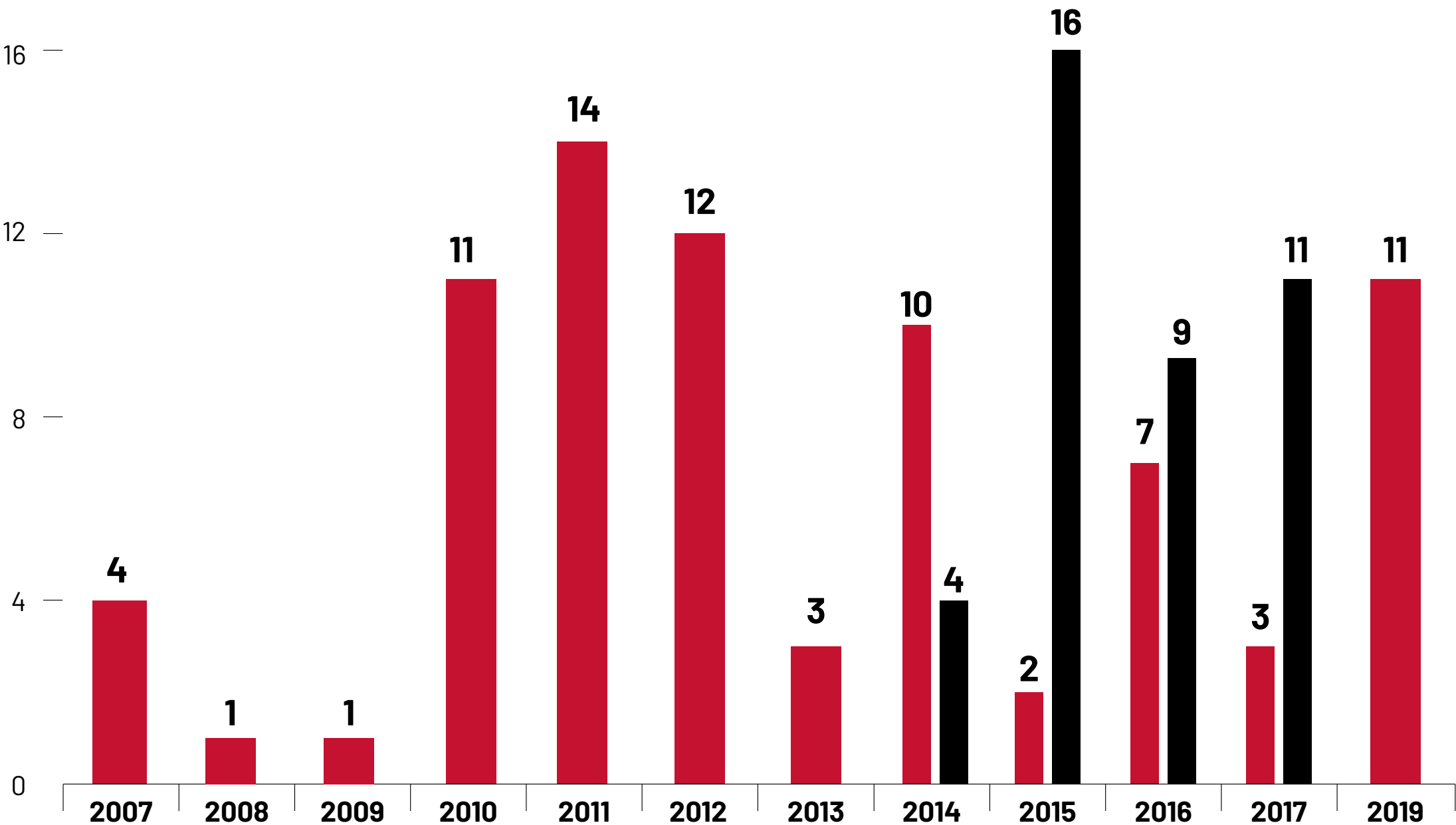
Gender

 **87**
Male

 **32**
Female

 Visiting Faculty and Researchers Program

 Visiting Students Program



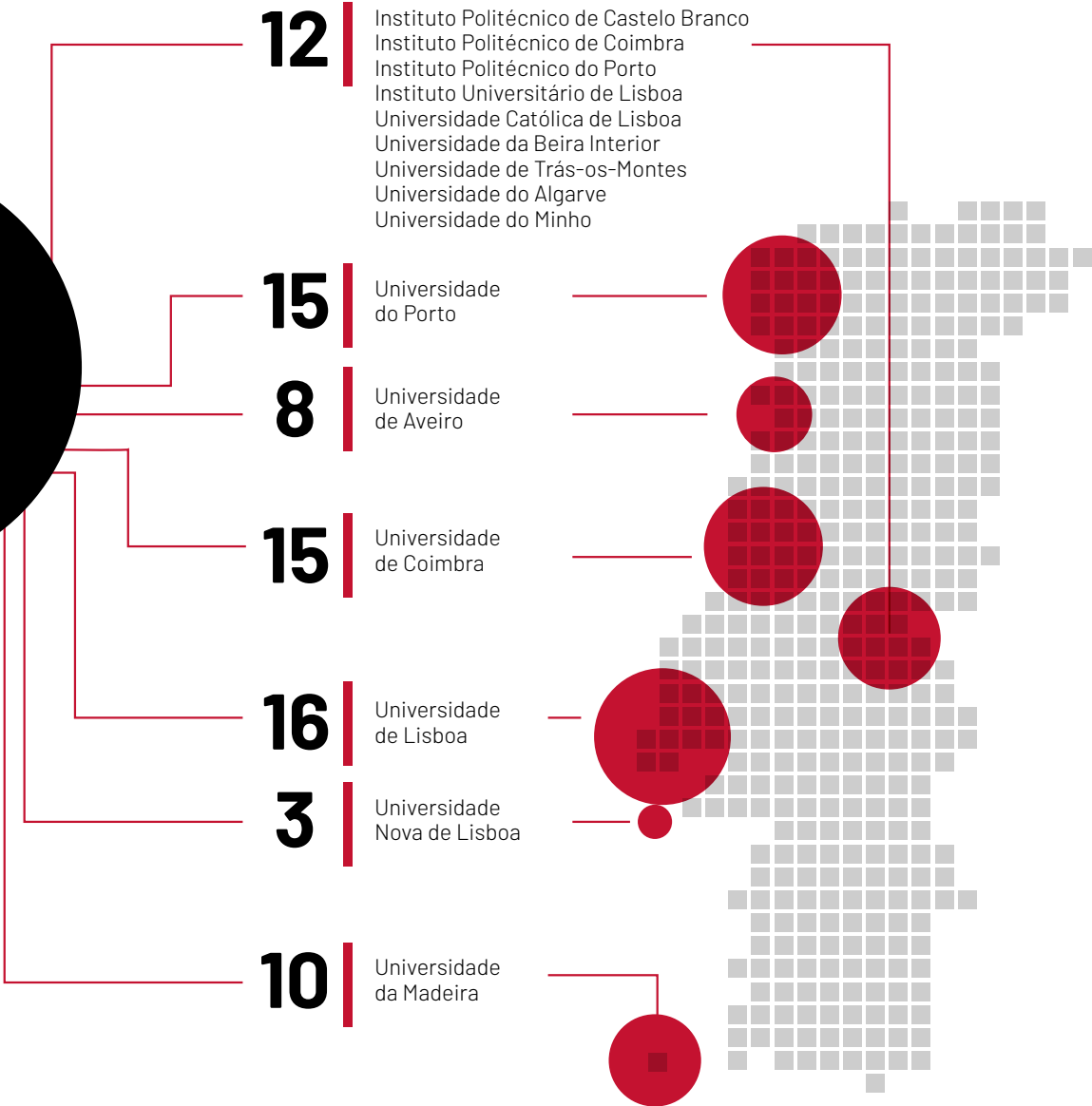
Faculty and Researchers Program

By host CMU Departments and Portuguese Universities

21	Electrical and Computer Engineering	2	Civil and Environmental Engineering
14	Institute for Software Research	2	Machine Learning
11	Computer Science	1	Entertainment Technology Center
10	Human-Computer Interaction Institute	1	Chemistry
4	Engineering and Public Policy	1	Psychology
3	Chemical Engineering	1	Mechanical Engineering
3	Robotics Institute	1	Information Systems & Management
3	Tepper School of Business	1	Software Engineering Institute

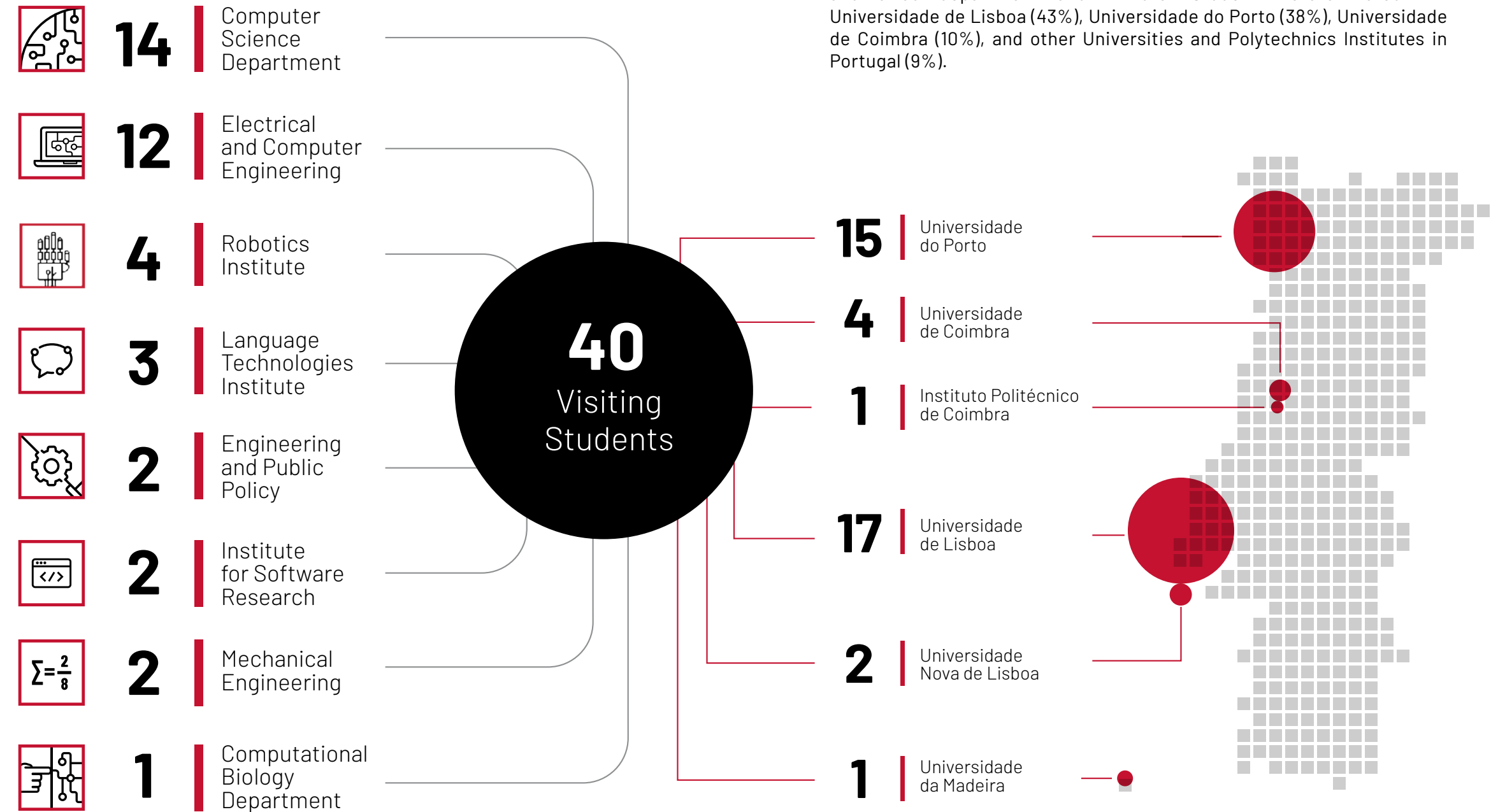
79
Visiting Faculty

Since the beginning of this initiative, 16 CMU departments have hosted 79 Portuguese faculty members. Visiting faculty have the opportunity to collaborate with a CMU counterpart in research, co-teaching, and other academic activities. Of those, 27% were hosted in the Department of Electrical and Computer Engineering, 18% in the Institute for Software Research, 14% in the Department of Computer Science, 13% in the Human-Computer Interaction Institute, and the remaining in various departments and institutes. Participants are from a wide range of Portuguese higher education institutions, 20% were affiliated with Universidade de Lisboa, 19% with the Universidade de Coimbra, 19% with the Universidade do Porto, 13% with the Universidade da Madeira, 10% to the Universidade de Aveiro, and other Universities and Polytechnics Institutes in Portugal.



Visiting Students Program

| By host CMU Departments and Portuguese Universities



About the Visiting Students, and considering the number of visits until 2019, **40 visiting students hosted by 8 CMU departments** had the opportunity to participate in research projects and immerse themselves in the Carnegie Mellon community. Of those, 35% were hosted in the Department of Computer Science, 30% were hosted in the Department of Electrical and Computer Engineering, and 10% were hosted in the Robotics Institute and various departments and institutes. Students were affiliated with Universidade de Lisboa (43%), Universidade do Porto (38%), Universidade de Coimbra (10%), and other Universities and Polytechnics Institutes in Portugal (9%).

Advanced Training Programs

The CMU Portugal Program has been designing two Advanced Training Programs: **Data Science and Machine Learning**; and **Human-Computer Interaction**. These initiatives will be offered by CMU in partnership with Universidade de Lisboa (Instituto Superior Técnico through Técnico+ and Faculdade de Ciências da Universidade de Lisboa) and Universidade Nova de Lisboa (NOVA School of Science and Technology).

The Advanced Training Programs were designed in close collaboration with CMU, in terms of the structure of the Programs, the modules that will be offered, and their content. The objective of the training programs will be to provide professionals who work in ICT-related areas with a short and intensive educational Program through which they will have close contact with the latest developments in their field of work and cutting-edge methods and tools. The Programs will attract participants with a wide range of professional backgrounds and skills. There will be an opportunity to share experiences with people from different areas: software engineers, data scientists, and product managers. The faculty involved in the Programs will be composed of high-profile faculty from the participating universities and experts from the industry. During 2020 and 2021, several meetings were held between the partners to define the Program's structure, content, and budget. The CMU Portugal Industry Affiliates and other companies related to the areas of the Programs, and their inputs, were crucial to defining the structure of the Programs.

The CMU Portugal Program also organized a series of talks named "User Experience Design Talks @ CMU Portugal" and "Data Science Talks @ CMU Portugal". In 2021, CMU Portugal organized 6 talks, 3 for each series. The talks were given by distinguished CMU faculty or industry leaders in an online format, with 1 hour of duration, and attracted hundreds of virtual participants.

An agreement was signed between all the parties involved for the 1st edition of the User Experience Design Program in 2021, and the applications period opened in the end of the same year. However, in 2022, the Program has not managed to attract the necessary applications. Currently, the coordination of the Program is reviewing the required changes to be applied to the Program to attract more candidates.

Data Science Talks @ CMU Portugal



User Experience Talks @CMUPortugal



Publications

The scientific output assessment of the CMU Portugal Program is of critical importance to understand the **quality and impact of the research that its Ph.D. students, researchers, and faculty are producing.**

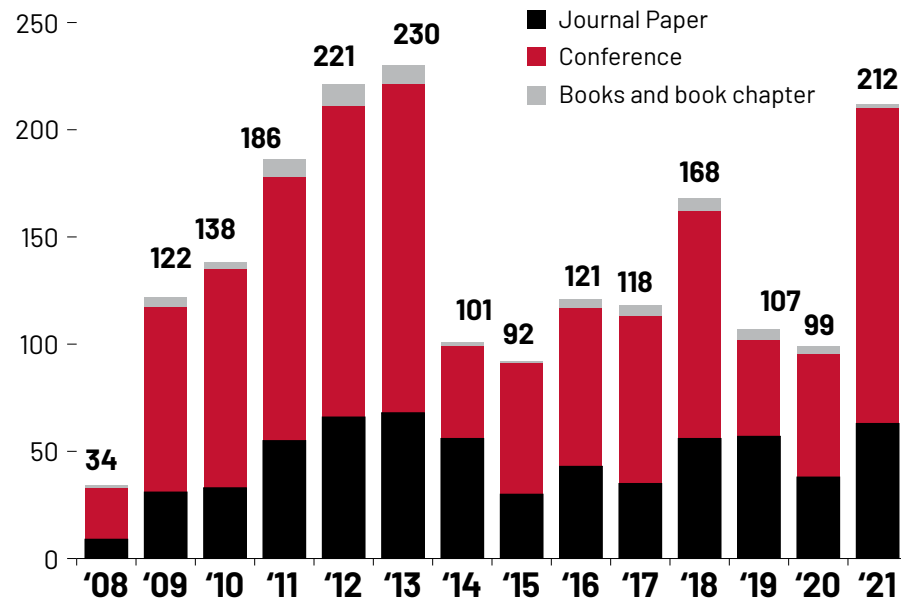
For the current report, a new method of information extraction was used which enabled the update of all the publications authored and co-authored by CMU Portugal Ph.D. students. The data now imported to the Program's database, includes all publications of the Dual Degree Ph.D. students, with a Google Scholar profile between 2008 and 2021. The second source of information used to monitor publications published within the scope of the projects was the CMU Portugal research projects annual reports.

Looking into the nearly **2,000 publications published since 2008** under the scope of the CMU Portugal Program, it is possible to identify two main tendencies. First, a steady growth in the total number of publications until 2013, followed by a decrease in the number of publications from 2014 onwards. The numbers have remained with a relatively constant growth pattern, although registering a significant increase in 2021. It is important to underline that the biggest differences in the number of publications produced per year were registered in years that followed the transition from one CMU Portugal's phase to another: from 230 publications to 101 between 1st phase (2013) and 2nd phase (2014), and from 168 to 107 between 2nd phase (2018) to 3rd phase (2019). The decrease in the number of active students until 2018 also explains this tendency, which will be discussed further in this chapter.

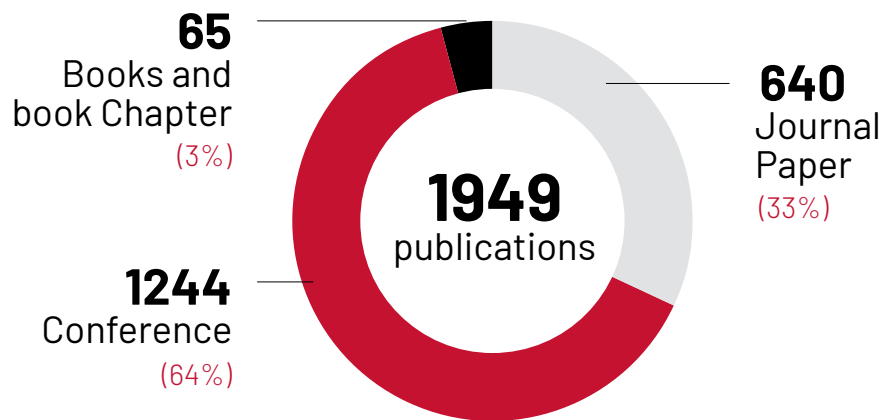
Since 2015, there has been an increase in the number of journal papers (except for 2017 and 2020), with **2021 being one of the years with a highest number of papers published** since the 1st phase of the Program. Looking into the Conference Papers, the publication pattern is more irregular, contrary to the book/book chapters publications, which present a constant pattern since 2016. If we average the number of publications by phase of the Program, the 3rd phase, despite not having ended yet, is the one with the highest average of journal papers published (54), followed by the 2nd phase (46) and 1st phase (38). Looking into the average number of Conference Papers, the 1st phase has the highest average (96), followed by 3rd phase (89), and 2nd phase (82). Finally, when analyzing publications from book and book chapters, the 1st phase presented the highest average value (5,4) followed by the 3rd phase (4,25) and 2nd phase (4,2).

In 2020, 38 papers were published and 63 were published in 2021. Of those 74 were related to projects, and 28 were related with Ph.D. thesis. Also, within this period **57 (in 2020) and 147 (in 2021) Conference Papers** were published, of which 162 were related to projects and 42 to Ph.D. thesis. Regarding the books and book chapters published in this period there were 4 (in 2020) and 2 (in 2021), 3 were related to projects and 3 to Ph.D. thesis.

Publications authored or co-authored by CMU Portugal students, alumni, faculty and researchers per year and type of publication.



Publications authored or co-authored by CMU Portugal students, alumni, faculty and researchers by type of publication



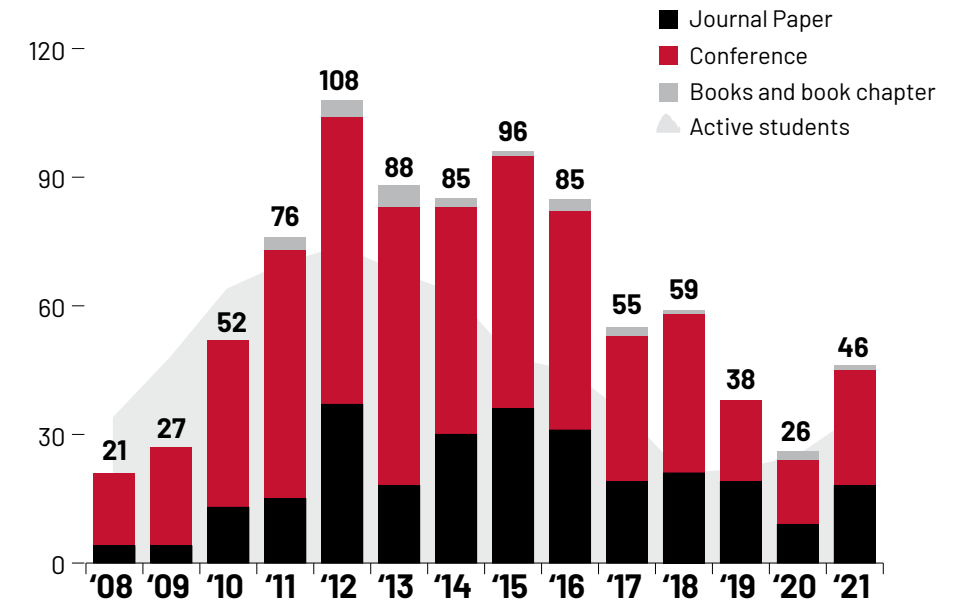
When analyzing solely the publications authored or co-authored by Ph.D. students, one of the main factors contributing to the drop in the global number of publications was the decrease in the number of active students. This has led to a quite constant reduction of the number of publications since 2014, as shown in more detail in the figure below.

This tendency appears to have a rebound in 2021, increasing with the number of active students. To note, the significant discrepancies are primarily visible in the Conference Papers.

In 2020-2021, 15 and 27 conference papers were produced, respectively, in pair with the average of 25 conference publications/year for phase 3 of the Program, but distant from the average of phase 1 (41) or phase 2 (52).

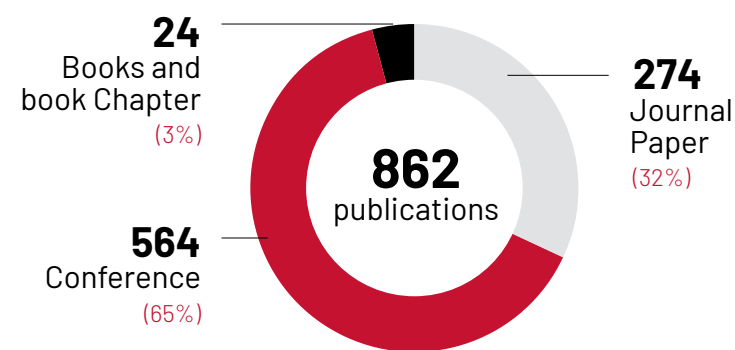
Regarding the books and book chapters, from 2020-2021, 2 books or book chapters were published in 2020 and 1 in 2021, which is in line with the average of phase 3 (1) and phase 1 (1,4) but below phase 2 (2,6). Regarding the journal papers, 9 journal papers were published in 2020 and 18 in 2021, while the average for phase 3 was (17), which was higher than phase 1 (15) but below phase 2 (27).

Publications authored or co-authored by CMU Portugal students by type of publication, year and number of active students



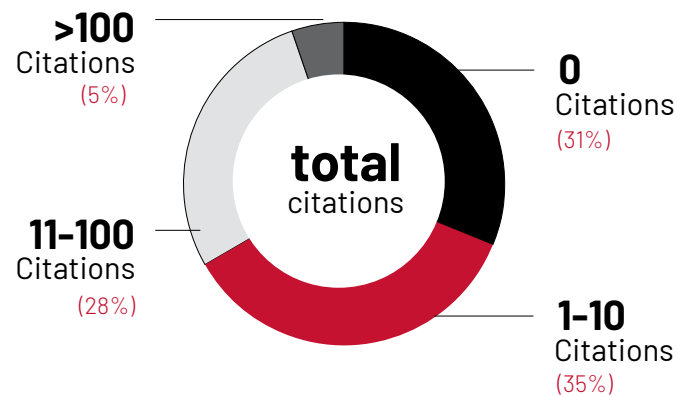
Publications authored or co-authored by CMU Portugal Ph.D. students per year and type of publication

Considering the distribution of the publications Ph.D. students, which account for 862 publications, most of the publications (65%) were conference papers, followed by journal papers (32%) and books/book chapters (3%).



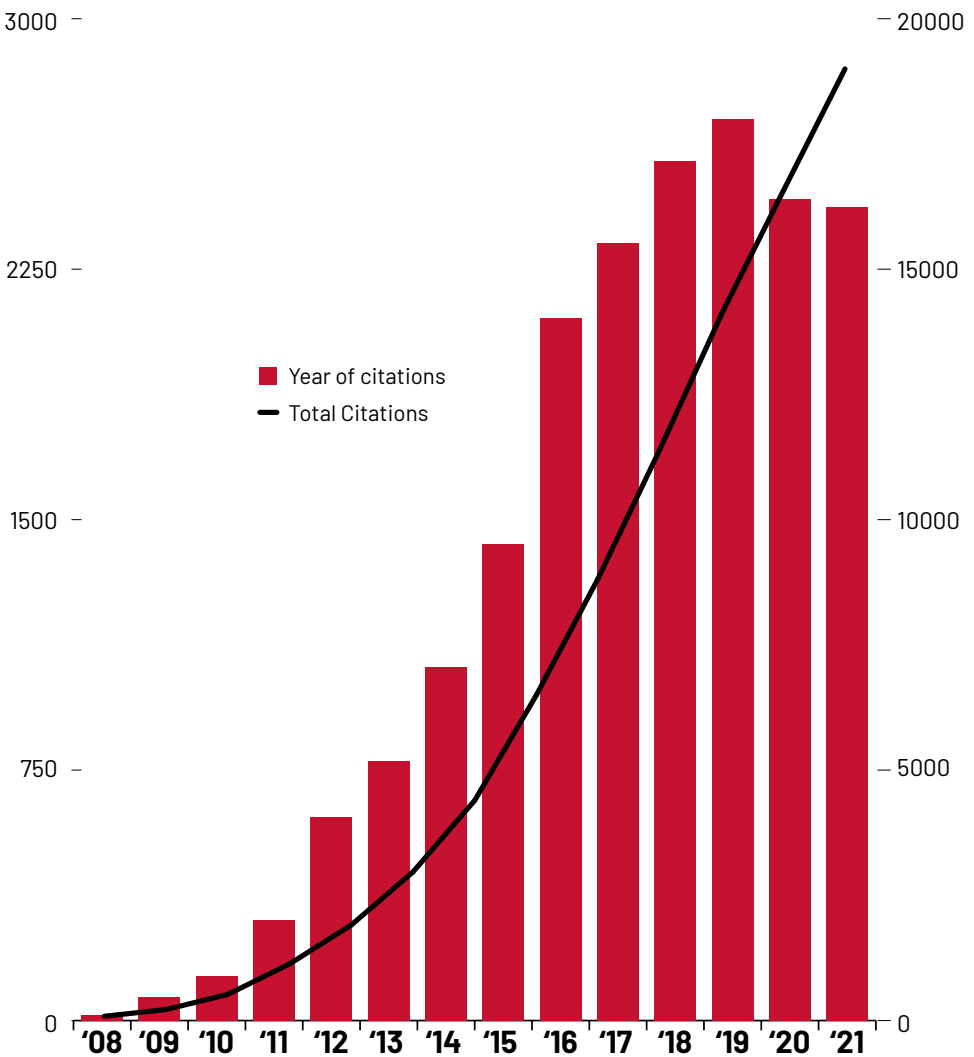
Publications authored or co-authored by CMU Portugal students by type of publication

According to the Google Scholar website, used to analyze the impact of the publications: 31% of the publications had 0 citations, 35% had from 1-10 citations, 28% had 11-100 citations and 5% had more than 100 citations.

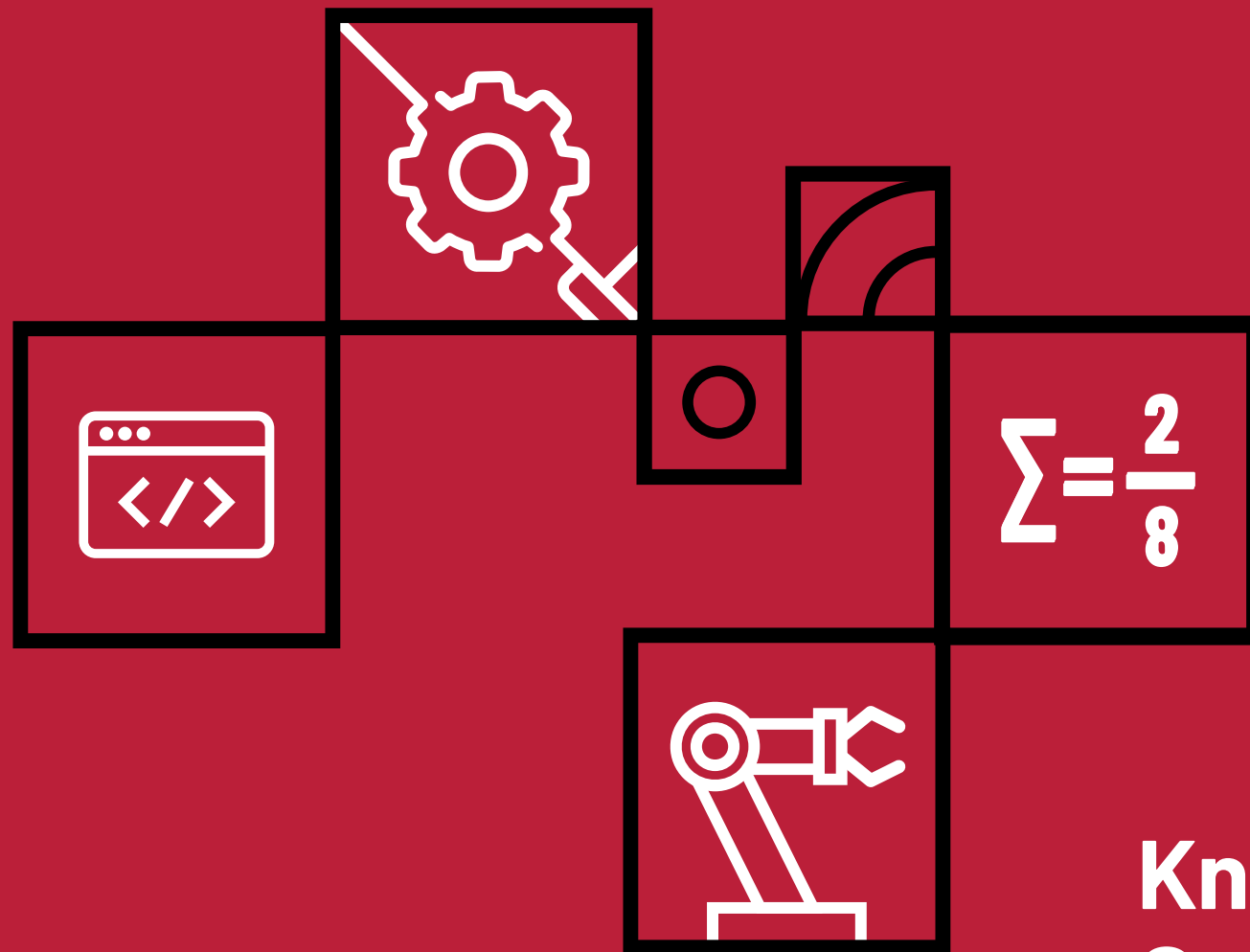


Publications authored or co-authored by CMU Portugal students by number of citations

The number of citations per year registered robust growth until 2019, which stabilized between 2020 and 2021. **However, the number of citations along the years was kept well above the 2000's**, even considering the decrease of the number of active students registered in the 2nd phase and previously mentioned in this chapter.



Publications authored or co-authored by CMU Portugal students by number of citations and year.



**Knowledge
Creation**



Strategic Areas and Research

CMU Portugal creates **new opportunities to develop world-class research and innovation networks**, stimulate a highly qualified entrepreneurship culture in Portuguese universities, and foster an ecosystem of support for R&D activities between companies in close articulation with academic institutions.

CMU Portugal supports research projects in the broad area of Information and Communication Technologies (ICT), fostering interdisciplinary collaboration between Industry and academia across different levels. This includes research topics spanning from **data science and engineering for large-scale data sets to artificial intelligence, robotics, and machine learning** that extract value from data or the sociotechnical systems and applications catalyzed through these technologies.

In 2020 and 2021, 25 CMU Portugal projects were supported across multiple Portuguese research institutions and CMU departments, strengthening an international collaborative effort across institutions and in close collaboration with industry partners. These projects correspond to **12 Large-Scale Collaborative Research Projects (LSCRPs)**, **7 Exploratory Research Projects (ERPs)**, and **6 Entrepreneurial Research Initiatives (ERIs)**. CMU Portugal's commitment to knowledge creation was further enhanced by launching **a new call for Exploratory Research Projects in 2021**.

In 2020, 12 new projects were initiated under the CMU Portugal Program partnership. The **Large-Scale Collaborative Research Projects (LSCRPs)** are led by major IT Portuguese companies and carried out in collaboration between companies and non-corporate entities of the R&D System and research groups at Carnegie Mellon. Overall, the Call represented a commitment of **25M€** from public funding (PT2020 and FCT) and a **4,2M€** investment by companies in ICT R&D, the most significant public and private financial commitment to date under the scope of the CMU Portugal Program.

For the first time, top IT companies in Portugal assumed the project's leadership. They now have the role of dynamizing networks and collaborative projects, reinforcing the innovation ecosystem, relying on Portuguese R&D institutions, and taking advantage of the experience of research teams at Carnegie Mellon. Some of these companies, such as **Feedzai** and **Unbabel**, have benefited from the Program's ecosystem and are now giving back by investing in the CMU Portugal R&D initiatives. The promoters also include **Capgemini Engineering**, **Compta**, **DST Solar**, **Farfetch**, **First Solutions**, **Glintt**, **GLSMED Learning Health**, **Ingeniarius**, **Mobileum**, and **Outsystems**. In addition, the projects bring together 27 other Portuguese Institutions - from Universities to Research Labs, Hospitals, and Companies - and 8 CMU Departments.

Carnegie
Mellon
Portugal

Exploring new research
frontiers in ICT towards a
global innovation ecosystem

These 12 new projects allowed CMU Portugal to reinforce previous partnerships with Industry and engage with new companies that have a strong presence in new lines of business and research from online privacy to health, energy, and environment sectors.

In parallel, CMU Portugal continues to support **Exploratory Research Projects (ERPs)** designed to assist teams of researchers from Portuguese institutions, Carnegie Mellon University, and industry partners in bootstrapping high-impact potential research activities of strategic relevance. The evaluation committee of the **2019 Call for ERPs** recommended **7 new projects** for funding in areas as diverse as **robotics, artificial intelligence, intelligent transport systems, and language processing**. The projects will run at **12 Portuguese research units** from all over the country in collaboration with **4 different Departments at Carnegie Mellon University**. They will benefit from overall funding of 821k€. Of these, three projects began in 2020, and four projects started in early 2021.

In **2021**, FCT and CMU Portugal launched a new competitive **Call for Exploratory Research Projects**, which resulted in the selection of 6 new ERPs. The new projects will focus on a diverse set of research areas such as data science applied to healthcare, the creation of satellites (PocketQube), human-robot interaction, traffic supervision for Cybercrime Investigation, applied artificial intelligence for customizable robotic exoskins, and the detection of injection vulnerabilities in node applications. The six new projects, representing an investment of **656K€**, will start in 2022 across **9 Portuguese research institutions** and **6 CMU Departments**.

In 2020 and 2021, **6 Entrepreneurial Research Initiatives (ERIs)** ended, bringing to a close the research initiatives that began in the 2nd phase of CMU Portugal but were executed during the 3rd phase. The 12 grants awarded under this Call were funded with 10.8M€ of public funding and 2.6M€ through private companies' investment. ERIs have established collaborations extending to **26 Portuguese research institutions, 46 companies**, and **11 CMU Departments**.

In summary, since 2006, the CMU Portugal Program has launched **11 calls for Projects** and has supported **80 research projects**. The 25 projects in 2020 and 2021 further support CMU Portugal's mission to place Portugal at the forefront of research and technological development in ICT. Throughout 2022, a new call for Exploratory Projects will fund up to eight projects in ICT, focusing on the data economy's opportunities as a driver of growth and change. All projects are selected through competitive research calls and independently evaluated by an international panel.



1st Phase (2006 – 2012)

2008 Call for Projects

Broad ICT and Computer Science area

-  10 Lead Projects approved
-  Concluded in 2012-2013

2009 Call for Projects

Broad ICT and Computer Science area

-  12 Lead Projects approved
-  Concluded in 2013-2014

2009 Joint Call for Projects with UT Austin

Partnership with UT Austin Portugal in Applied Mathematics

-  3 Projects approved
-  Concluded in 2012-2013

2nd Phase (2013 – 2017)

2013 Call for Early Bird Projects

Jumpstart new high-impact initiatives with na emphasis on exploratory research

-  10 Projects approved
-  1 year
-  Concluded in 2015

2013 and 2014 Entrepreneurial Research Initiatives(ERIs)

Integrated activities in R&I and advanced education, with Industry collaboration

-  12 projects approved
-  Integrated activities in R&I and advanced education, with Industry collaboration
-  4 years
-  7 Concluded in 2018-19
-  3 Concluded in 2020-2021

3rd Phase (2018 – 2020)

2019 Call for Large-Scale Collaborative Research Projects

Projects in co-promotion projects led by national companies

-  12 projects approved
-  3 years (started in 2020)
-  25M € (Public and private PT and CMU Budget)

2019 Call for Exploratory Research Projects

Jumpstart new high-impact initiatives

-  7 projects approved
-  Started in 2020- Concluded 2022
-  820K € (PT and CMU Budget)

2021 Call for Exploratory Research Projects

Jumpstart new high-impact initiatives

-  6 projects approved
-  1 year
-  654K € (PT + CMU Budget)
-  Started in 2022- Concluded 2023

Large-Scale Collaborative Research Projects



The 12 CMU Portugal Large-Scale Collaborative Research Projects (LSCRP) are the result of the most ambitious Call for projects launched in the context of the Program. In 2019, Compete 2020, **ANI**, and **FCT** launched a **Call for Large-Scale Collaborative Research Projects under the scope of the “Go Portugal – Global Science and Technology Partnerships Portugal,”** an initiative sponsored by the Ministry of Science, Technology, and Higher Education, which included other international partnerships.

Through previous research calls, CMU Portugal has created new opportunities for developing world-class research and innovation networks, stimulating a culture of highly qualified entrepreneurship in Portuguese universities, and creating an ecosystem of support for R&D activities by companies in close articulation with academic institutions. The Call for LSCRP aimed to build from this previous experience, maintaining the path to strengthen the entrepreneurship competencies and R&D capacities of Portuguese companies and research institutions and promoting the internationalization of their R&D activities by exposing them to new dynamics through the CMU Portugal partnership. **National companies now hold the projects’ leadership and take the role of dynamizing networks and collaborative projects**, relying on Portuguese R&D institutions and taking advantage of the experience and knowledge of Carnegie Mellon. Thus, it seeks to complete the transition process of International Partnerships, from an initial model based on the dynamism of Portuguese universities to a model that gives Portuguese companies the leadership of modernizing the national economic fabric, reinforcing the innovation ecosystem. Therefore, the projects are led by a Portuguese company, carried out in partnership between companies and non-corporate entities of the R&D System, and with the participation of a CMU research team. The projects involve industrial research and experimental development activities, leading to the creation of new products, services, processes, and systems. This may also include introducing significant improvements in existing products, services, processes, or systems.

The initial total funding available for the CMU Portugal Program was 5M€, with an indicative budget of 1,25 M€ per project. However, an independent international committee organized by ANI, evaluated the 41 proposals and, due to their high quality, recommended funding 12 projects under the scope of the CMU Portugal Program. Therefore, twelve new projects started in 2020 led by top national ICT companies. **The awarded projects cover the areas of Data Science and Engineering, Artificial Intelligence and Machine Learning, Design and Engineering applied to social problems, addressing problems in the health sector, forest fire-prevention, data management, mobility, energy, and language technologies.**

AIDA : Adaptive, Intelligent and Distributed Assurance Platform

Leading company in Portugal: MOBILEUM

Partner Institutions:

- INESC TEC – Instituto De Engenharia De Sistemas E Computadores, Tecnologia E Ciência
- Universidade de Coimbra
- Computer Science Department at Carnegie Mellon University

BEE2WasteCrypto

Leading company in Portugal: FUTURE COMPTA

Partner Institutions:

- 3 DRIVERS – Engenharia, Inovação e Ambiente
- Instituto Superior Técnico
- Universidade NOVA de Lisboa
- Civil and Environmental Engineering at Carnegie Mellon University

Building Hope

Leading company in Portugal: DST SOLAR, S.A.

Partner Institutions:

- Instituto Superior Técnico
- Universidade de Coimbra
- Electrical Engineering Department
- WATT-IS, S.A
- InnovationPoint, S.A.

CAMELOT: autonomiC plAtform for MachinE Learning using anOnymized data

Leading company in Portugal: FEEDZAI

Partner Institutions:

- Universidade de Coimbra
- Faculdade de Ciências da Universidade de Lisboa
- Instituto Superior Técnico
- Computer Science Department at Carnegie Mellon University

FLOYD: 5G/SDN Intelligent Systems For LOW latencY V2X communications in cross-Domain mobility applications

Leading company in Portugal: Capgemini Engineering

Partner Institutions:

- ALTICE LABS
- Instituto Superior De Engenharia Do Porto
- Instituto De Telecomunicações
- Vortex
- Computer Science Department

GOLEM: Automated Programming to Revolutionize App Development

Leading company in Portugal: OUTSYSTEMS

Partner Institutions:

- INESC ID – Instituto De Engenharia De Sistemas E Computadores, Investigação E Desenvolvimento Em Lisboa
- FCT NOVA
- Computer Science Department at Carnegie Mellon University

ifetch: Multimodal conversational agents for the online fashion marketplace

Leading company in Portugal: FARFETCH

Partner Institutions:

- FCT NOVA
- Instituto Superior Técnico
- The Language Technologies Institute at Carnegie Mellon University

IntelligentCare: Intelligent Multimorbidity Management System

Leading company in Portugal: GLSMED LEARNING HEALTH

Partner Institutions:

- Priberam
- INESC ID – Instituto De Engenharia De Sistemas E Computadores, Investigação E Desenvolvimento Em Lisboa
- Instituto Superior Técnico
- IST-ID, Associação Do Instituto Superior Técnico Para A Investigação e o Desenvolvimento
- Hospital da Luz
- Heinz College of Information Systems and Public Policy at Carnegie Mellon University

MAIA: Multilingual Virtual Agents for Customer Service

Leading company in Portugal: UNBABEL

Partner Institutions:

- Instituto de Telecomunicações
- INESC ID – Instituto De Engenharia De Sistemas E Computadores, Investigação E Desenvolvimento Em Lisboa
- The Language Technologies Institute at Carnegie Mellon University

SAFEFOREST: Semi-Autonomous Robotic System for Forest Cleaning and Fire Prevention

Leading company in Portugal: INGENIARIUS

Partner Institutions:

- Instituto de Sistemas e Robótica – ISR Coimbra
- Associação para o desenvolvimento da aerodinâmica industrial
- SILVAPOR, Ambiente e Inovação
- The Robotics Institute at Carnegie Mellon University

TAMI: Transparent Artificial Medical Intelligence

Leading company in Portugal: FIRST SOLUTIONS

Partner Institutions:

- FRAUNHOFER Portugal
- INESC TEC – Instituto De Engenharia De Sistemas E Computadores, Tecnologia e Ciência
- Administração Regional de Saúde Do Norte
- Electrical and Computer Engineering Department at Carnegie Mellon University

Wow: Wireless biOmonitoring stickers and smart bed architecture: toWards Untethered Patients

Leading company in Portugal: GLINTT – HEALTHCARE SOLUTIONS

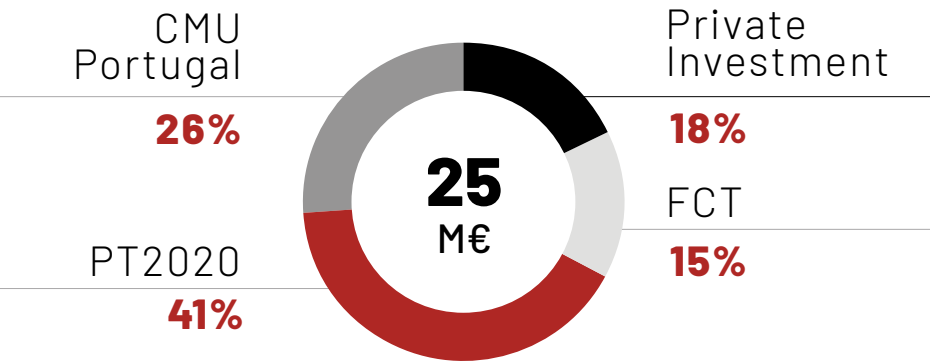
Partner Institutions:

- Instituto de Sistemas e Robótica –ISR Coimbra
- Universidade de Coimbra
- Centro Hospitalar e Universitário de Coimbra
- Mechanical Engineering at Carnegie Mellon University

The 12 LSCRPs reinforce partnerships previously established with the industry and engage with new companies that have a strong presence in new lines of business and research, ranging from online privacy to health, energy, and environment sectors. Through these projects, CMU Portugal was able to strengthen research connections with companies from its start-ups and innovation ecosystem (**Feedzai** and **Unbabel**), increase the commitment of industrial affiliates in R&D (**Farfetch**, **Outsystems**, both Unicorn companies) and establish new partnerships with companies (**Altran Portugal - now Capgemini Engineering**, **Compta**, **DST Solar**, **First Solutions**, **Glintt**, **Ingeniarius**, **Hospital da Luz Learning Health**, **Mobileum**).

In addition to these 12 companies, the projects involve **27 other Portuguese Institutions**, from Universities to Research Labs, Hospitals, and Companies, plus **8 different CMU Departments** (Civil and Environmental Engineering, Computer Science, Engineering Research Accelerator, Heinz College of Information Systems, and Public Policy, Institute for Software Research, Language Technologies Institute, Mechanical Engineering, Robotics Institute).

Overall, the Call represented a commitment of 25M€ from public funding (PT2020 and FCT) and a 4,2M€ investment by companies in ICT R&D, the most significant public and private financial commitment to date under the scope of the CMU Portugal Program.



Large-scale Collaborative Research Projects

By CMU Departments and Portuguese institutions
(proponent or participant)

8 CMU Departments



Civil and Environmental Engineering



Computer Science, Engineering Research Accelerator



Heinz College of Information Systems and Public Policy



Institute for Software Research, Language Technologies



Institute, Mechanical Engineering, Robotics Institute

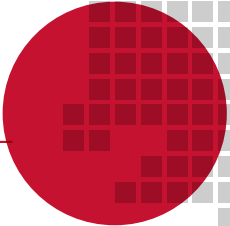


20 Academic Co- Promoters

Porto | Administração Regional De Saúde Do Norte, I.P.
FRAUNHOFER PORTUGAL
INESC TEC
ISEP
IT Porto

Coimbra | Associação para o Desenvolvimento da Aerodinâmica Industrial
Centro Hospitalar e Universitário de Coimbra
CISUC
FCTUC
ISR Coimbra

Lisboa | FCUL
FCT NOVA
INESC ID
IN +, Centre for Innovation, Tech. and Policy Research, IST
ISR Lisboa
IT - Instituto de Telecomunicações
IST
LASIGE
NOVA Cidade - Urban Analytics Lab
NOVA IMS



A critical component of these projects concerns human resources recruitment and the projects' contributions to the employment of highly skilled human resources, including, but not limited to Ph.D. and MScs, and strengthening scientific employment in scientific institutions in international cooperation. Overall, more than 366 multidisciplinary collaborators participate in the LCSRP, with 269 directly funded, partially or totally, under the scope of the projects, the majority at levels 7 and 8 of the European Qualifications Framework.

The collaborative projects can also be translated into their scientific achievements, with 21 publications in international peer-review journals, 91 peer-review conference papers, 44 Ph.D. and 72 Master thesis are being developed or concluded within the context of the LCSRP. In the area of innovation, there are four provisional applications submitted.

 Publications

4
Patents

44
Ph.D. Thesis

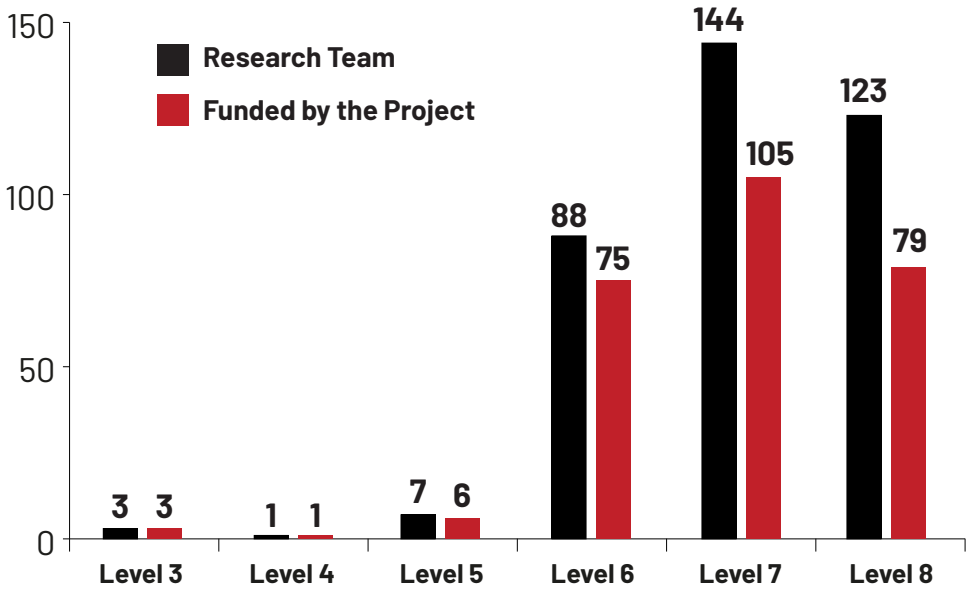
91
Peer-review conference papers

21
Peer review papers

72
Master Thesis



**Research Team & Researchers
Funded by the Project**



Level 3	Upper-secondary education geared towards further studies in higher education
Level 4	Upper-secondary education obtained via dual certification or upper-secondary education geared towards further studies in higher education with vocational internship – minimum 6 months
Level 5	Non-higher, post-secondary qualification with credits to continue to higher education-level studies
Level 6	Licentiate Degree (Licenciatura)
Level 7	Master Degree
Level 8	Doctorate

AIDA

Adaptative, Intelligent and Distributed Assurance Platform

AIDA aims at improving a platform used by Mobileum for integrated risk management in companies. This platform ensures revenue, corporate conditions, and fraud control for companies. Thanks to this newest version of the platform, companies will be able to collect and monitor data in an extremely flexible way, with real-time guarantees, security and reliability by leveraging the increasing edge computing capacity made available by the IoT and the imminent large-scale deployment of 5G cellular technology. A complete prototype of AIDA will be deployed and demoed by the end of the project in a realistic scenario in telecommunication services.

Keywords: Risk Management, Fraud control, Revenue Assurance, 5G, Edge Computing, Data Privacy.



**Leading company
in Portugal**
MOBILEUM

Project Start Date
12/05/2020

Project End Date
08/11/2022



**Meet the
partners**

Promoter:

Mobileum – Carlos Martins

Academic Co-promoters:

INESC TEC – José Pereira

Universidade de Coimbra – Marco Vieira

CMU:

Computer Science Department at Carnegie Mellon University – Christos Faloutsos

AIDA, Improving the RAID Platform

RAID is a Mobileum (previously named WE DO Technologies) flagship end-to-end real-time data management platform developed to collect data across business applications and platforms to provide detailed monitoring of business activity and improve corporate performance. RAID handles the entire risk management lifecycle of enterprises and is currently applied worldwide to address, among others, revenue assurance, business assurance, and fraud management.

The AIDA project's overarching goal is to conceive a new version of the RAID platform by moving some of the pipeline phases to the edge of the system and taking advantage of 5G. Today, the platform is fully deployed in physically collocated servers, either on-premises or in the cloud. With AIDA, data collection, monitoring, and even actuation phases should be prepared to run in diverse hardware architectures outside the platform's owner's physical or even administrative control.



What to expect

AIDA will enable data collection, monitoring, and even actuation phases of the RAID platform to run at the edge of the network, considering diverse hardware architectures, such as end-user devices, intermediaries such as routers and gateways, telcos base stations, and cloudified microservices. AIDA should still provide highly configurable and rich data collection and monitoring while preserving the current real-time, security, and dependability guarantees of the RAID platform.



Goals

The main technological goals of the project are:

- Distribution of the RAID platform components leveraging edge computing and 5G
To delegate processing to the edge or use central servers, according to the computation nature and the type and localization of monitoring and reference data;
- Exploration of emergent federated machine learning techniques
To learn from local data and push incremental model updates to coordinator nodes that maintain global models based on the contribution of edge nodes and other relevant data sources;
- Resilience to intrusion or tampering
To require the research and application of intrusion detection techniques at multiple architecture levels to enable system-wide intrusion tolerance;
- Data privacy and confidentiality
To maintain the confidentiality of the operational data being monitored and analyzed and protecting the privacy of the entities to whom the data refers to are fundamental concerns in the platform's design.

BEE2WasteCrypto

This project is intended to develop a new and innovative IT tool that may contribute to empower Regional Waste Management Utilities (RWMU) in their dual role of designers and managers of decentralized and customized solutions and as promoters of new citizen behavior in terms of waste generation and handling. The Bee2WasteCrypto project will focus on data science and Blockchain technologies to maximize value and contribute to a sustainable waste management strategy at a local level, with a global scope.

Keywords: Waste · PAYT · Blockchain · SmartCities · IOT · Industry 4.0 · Artificial Intelligence



Leading company in Portugal
FUTURE COMPTA

Project Start Date
01/05/2020

Project End Date
30/04/2023

Meet the partners

Promoter:
FUTURE COMPTA – Paulo Fernandes

Industrial Co-Promoter:
3 DRIVERS – António Lorena

Academic Co-promoters:
Nova IMS – Miguel de Castro Neto
Instituto Superior Técnico – Paulo Ferrão

CMU:
Civil and Environmental Engineering at
Carnegie Mellon University – Mitch Small

BEE2WasteCrypto, contributing to a sustainable waste management strategy

The RWMUs will choose the best set of technologies to help in their operation, namely in terms of the quality and quantity of waste generated and materials to be produced from waste processing, under environmental and economic criteria. This IT tool will facilitate Pay As You Throw (PAYT) schemes, by using blockchain technologies to produce liable information and establish recycling rate credits based on the performance of each RWMU in the national recycling scenario (an analogue of carbon credits in the energy sector).

What to expect

In short, the Bee2WasteCrypto Consortium will focus on data science to deliver the best combination of technologies that maximizes value and contributes to a sustainable waste management strategy at a local level with a global scope.

Goals

- Provide the RWMUs with the capacity to design the best set of technologies to be used in the context of their operation, namely in terms of the quality and quantity of waste generated and also of the materials to be produced from waste processing, under environmental and economic criteria;
- Develop an IT system to facilitate Pay As You Throw (PAYT) schemes together with blockchain technologies to produce credible information. This might allow establishing recycling rate credits based on the performance of each RWMU about national recycling rate targets for each material stream (an analog of carbon credits in the energy sector) and the subsequent purchase of credits from low to high performers making use of recycling rate credits;
- Create a Token, eventually based on a cryptocurrency, intended to make use of Blockchain technologies that remunerate individual sustainable behavior in returning waste for recycling or reuse and promote pay as you throw solutions.

Building Hope

Building Holistic Optimization of Prosumed Energy

The **Building HOPE** project led by **DST SOLAR**, will develop a tool to redefine buildings energy management practices in the context of smart urban environments. The HOPE platform will be tested in relevant contexts: industrial, office and retail buildings, demonstrating the novelty of its features and its impact in the energy management, in order to become a unique energy management platform for buildings in the next decade.

Keywords: AI, ML, Electric Systems, Energy efficiency of buildings



Leading company in Portugal
DST SOLAR

Project Start Date
01/07/2020

Project End Date
30/06/2023



Promoter:
DST SOLAR, S.A. – Ana Luísa Pereira

Industrial Co-Promoter:
WATT-IS, S.A. – Miguel Carvalho
InnovationPoint, S.A. – Ricardo Lopes

Academic Co-promoters:
Instituto Superior Técnico – Carlos Silva
Universidade de Coimbra – Manuel Gameiro

CMU Department:
Electrical Engineering Department – Soumya Kar



This project’s resulting technology will add new dimensions to energy management concept and extend the capabilities of state-of-the-art energy management systems by:

- Characterizing in detail energy services consumption;
- Perform asset management;
- Optimizing the operation across multiple energy systems (generation, storage and service demand) and multiple buildings;
- Aiding building owners with contracts management.

iFetch

Multimodal conversational agents for the online fashion marketplace

Conversational systems have seen a significant rise in demand due to modern commercial applications using these types of methods such as Amazon’s Alexa, Apple’s Siri and Google Assistant. Multimodal chatbots is a growing area of research, where users and the conversational agent communicate by natural language and visual data.

The **iFetch** project proposes to deliver a new generation of task-oriented conversational agents that interact and support users seamlessly using verbal and visual information. This innovative project will allow interaction with consumers through a multimodal interface, providing an experience close to the one you have in a physical store.

Keywords: Conversational Agents, Machine Learning, E-Commerce



Leading company in Portugal
Farfetch

Project Start Date
01/04/2020

Project End Date
30/06/2023



Meet the partners

Promoter:
FARFETCH – Ricardo G. Sousa

Academic Co-promoters:
FCT NOVA – João Magalhães
Instituto Superior Técnico – João Paulo Costeira

CMU:
The Language Technologies Institute at Carnegie Mellon University – Alexander Hauptmann

ifetch, developing a new generation of task-oriented conversational agents

iFetch aims to mimic the fashion concierge that understands the customer needs and provide the correct answers leveraging the vast textual and visual data and knowledge coded in training, descriptions, and accumulated sequences of past experiences with a massive number of users. Soon, most of the interaction between large organizations and their users will be mediated by AI agents. This perception is becoming undisputed as online shopping dominates entire market segments, and the new “digitally-native” generations become consumers.

iFetch proposes research and delivers a new generation of task-oriented conversational agents that interact with users seamlessly using verbal and visual information. iFetch must provide targeted advice and a “physical store-like” experience through the conversation while maintaining user engagement.

What to expect

The iFetch project expects to revolutionize the whole online shopping experience by changing how customers access information and make shopping decisions.

Goals

- The project ambition is to develop research on technology that will make an impact on the future. To fulfil this ambition, this project will address two critical research challenges:
- Tracking the evolution of the information needed in the conversation with neural memory networks;
 - Visual data analysis can relate product categories and characteristics to the conversation, thus leading to a better user engagement in the shopping experience.

IntelligentCare

Intelligent Multimorbidity Management System

The growing population aging with multimorbidity (MM) is a problem to the sustainability of the healthcare sector. MM is typically associated with high healthcare usage and costs, which do not always translate into better outcomes for patients. Consequently, there is a need to develop new tools to manage this condition.

The **IntelligentCare** project, promoted by **GLSMED LEARNING HEALTH S.A.**, aims at developing a patient centric solution to help manage MM condition using analytical methods to explore data from the electronic health records (EHR) and the measures reported remotely by the patients, related to outcomes (PROMs) and to life events/ quality of life/physical activity, named as additional value variables (AVVs), using smart sensors and mobile solutions.

Keywords: Health Data Science, Value-based healthcare, Multimorbidity



Leading company in Portugal
GLSMED LEARNING HEALTH S.A.

Project Start Date
01/04/2020

Project End Date
01/04/2023

Meet the partners

Promoter:
GLSMED – Nuno André da Silva

Industrial Co-Promoter:
Priberam – Carlos Amaral
Hospital da Luz Lisboa – João Sequeira Carlos

Academic Co-promoters:
INESC ID – Mário Gaspar Silva
Instituto Superior Técnico – José Santos-Victor
IST ID – Alexandre Bernardino

CMU Department:
Heinz College – Pedro Ferreira

IntelligentCare, improving patient-centric medicine

The IntelligentCare project offers an innovative approach to manage the MM condition by introducing the concept of value to the patient (patient centric) in the process of characterization and prediction of patient interactions with the hospital.

Patient-centric medicine hopes to improve health outcomes of individual patients in everyday clinical practice, taking into account the patient's objectives, preferences, values as well as the available economic resources.

What to expect

The IntelligentCare project will add value by working on advanced analytical methodologies to improve patient outcomes with MM, evaluating the healthcare delivery and contribute to hospital resources optimization, moving towards value-based healthcare.

Goals

Under the value-based healthcare framework, the project will develop methods to achieve three main goals:

- Early signaling and characterization of patients with MM using the EHR and PROMs/AVVs (Multimorbidity phenotypes)
- Identification of personalized clinical pathways for each cluster based on granular evidence (approach “patients like me” and not “one size fits all”)
- Development of tools for monitoring and predicting hospital interactions combining EHR data with PROMs/AVVs reported systematically.

To achieve these goals research will be conducted in advanced analytical algorithms, particularly deep learning methods, in order to fully explore EHR data (structured and unstructured), PROMs and AVVs recorded via smart sensors.

MAIA

Adaptative, Intelligent and Multilingual Virtual Agents for Customer Service

Online conversational support – chat – is the fastest-growing customer service channel, being the preferred way for millennials to obtain customer service. Today, supporting international customers in this channel is mostly done using human agents that speak different languages – a scarce and costly resource.

The project **MAIA** will develop a multilingual conversational platform, supported by machine translation and dialogue systems, where AI agents assist human agents. This approach will overcome the limitations of existing customer service.

Keywords: AI, Machine Translation, Conversational support



Leading company in Portugal
UNBABEL, LDA

Project Start Date
01/04/2020

Project End Date
01/04/2023

Meet the partners

Promoter:
AI . Machine Translation . Conversational support

Academic Co-promoters:
Instituto de Telecomunicações – André Martins
INESC-ID – Helena Moniz

CMU:
Language Technologies Institute – Graham Neubig

MAIA, enabling chats to develop multilingual conversations

MAIA project will focus on improving chats [message applications] to develop multilingual conversations by expanding customer service professionals’ skills, using artificial intelligence, and making this support process more efficient. To do so, the MAIA consortium will develop a set of machine learning technologies that will allow automatic translation and responses. Among the main challenges is the need to consider the conversational context to ensure accurate, correct, and culturally appropriate translations.

What to expect

The ultimate goal of MAIA will be to develop multilingual chats using AI, allowing companies to chat with their customers in 30 different languages.

Goals

MAIA will target the following scientific and technological goals:

- New memory-efficient neural models for context-aware machine translation
- New answer generation techniques to support the decisions of human agents
- New techniques for conversational quality estimation and sentiment analysis
- Integration of the scientific advances above into a full end- to-end product

Two demonstrators will be built to cover concrete use cases in the Travel and Tourism Industries.

CAMELOT

autonomiC platform for Machine Learning using anonymized data

The **CAMELOT** project expects to revolutionize the detection of financial fraud through Machine Learning techniques. The project aims to develop an innovative machine learning platform, which will tackle three key issues that hinder the efficiency and accuracy of modern AI applications such as machine learning models, cloud resources, anonymized data, privacy issues, and integrating information from different, independent, and heterogeneous data platforms.

Keywords: Fraud detection, Machine Learning, Anonymization



Leading company in Portugal
FEEDZAI, S.A.

Project Start Date
07/01/2020

Project End Date
07/01/2022



Meet the partners

Promoter:

FEEDZAI – Pedro Bizarro

Academic Co-promoters:

Universidade de Coimbra – Bruno Cabral
Faculdade de Ciências da Universidade de Lisboa – Alcides Fonseca
Instituto Superior Técnico – Paolo Romano

CMU:

Computer Science Department – David Garlan

Using AI to improve the detection of financial fraud

Feedzai uses AI to detect and prevent financial fraud such as card fraud, money laundering, or account opening fraud for all types of financial institutions and large merchants. To support its clients, Feedzai manages about 2000 machines and spends about 500,000 eur/month in cloud computing resources.

The goals of the CAMELOT project are to improve the efficiency, accuracy, or quality of the machine learning platform and associated stack using efficient cloud resources.



What to expect

Feedzai expects to be able to sustain its aggressive company growth goals. Among the desired potential impacts of the project are to reduce by 50% the cost for tuning the platform's configuration; 50% reduction in of the operational costs at steady state and 50% faster deployment times for new models when reusing models.



Goals

The project will tackle three key issues that hinder the efficiency and accuracy of modern AI applications:

- Ensuring real-time constraints during both the training and inference phases of machine learning models while minimizing operational costs deriving from cloud resources.
- Enabling learning over anonymized data, thus circumventing the privacy issues that currently prevent the reuse of information across models trained on datasets belonging to various entities (e.g., different financial institutions).
- Integrating information from different, independent, and heterogeneous data platforms (e.g., key-value stores, relational and graph databases) in an automatic approach that maximizes machine learning applications' performance.

FLOYD

5G/SDN Intelligent Systems For Low latency V2X communications in cross-Domain mobility applications

Connected vehicles are set to become a pervasive reality in the upcoming years. Despite the emergence of this trend, providing seamless connectivity and computing services to vehicles reveals a challenging task, requiring coordinated work between numerous players and the integration of the respective technologies.

FLOYD, a Research & Innovation (R&I) project led by **Capgemini Engineering**, has the main purpose of building such a technological stack for offering high-performance network/computation services to vehicular users. Through the collaboration between complementary R&I industrial and academic entities, FLOYD will enable the development, validation, and exploitation of a variety of components and technologies, addressing multiple unanswered interrogations between vehicular and network communications.



Leading company in Portugal
MOBILEUM

Project Start Date
02/01/2021

Project End Date
30/06/2023



Meet the partners

Promoter:
Capgemini Engineering – Raquel Pinho

Industrial Co-Promoter:
ALTICE LABS, S.A. – Rui Calé

Academic Co-promoters:
Instituto Superior de Engenharia do Porto – Eduardo Tovar
Instituto de Telecomunicações – Ana Aguiar
Vortex – Joana Maria

CMU Department:
Computer Science Department – Peter Steenkiste

FLOYD: combining AI, edge computing and 5G to support platooning applications

FLOYD innovation potential is leveraged by the comprehensive technological approach of this project, where novel developments in the area of Artificial Intelligence are combined with breakthrough technologies in the area of edge computing and 5G, which will allow developing a framework of tools for networking and communications to support platooning applications.

It is relevant to highlight the following innovative characteristics:

- AI-supported Performance Characterization for 5G Physical and MAC layer
- Link and Connection Status Monitoring and AI-enhanced Prediction
- Edge Computing & Offloading Tools for Cooperative Vehicles
- Closed-Loop Orchestration
- Cooperative Platooning Applications with Network-in-the-Loop
- Non-Public Network Support and Integration with V2X Services
- Security, Trust and Safety for V2X Applications

What to expect

This project aims to improve mobility services and accelerate the integration of autonomous driving in society, by advancing the networking and computation technological basis on which complex mobility and autonomy services and functionalities can be built.

Goals

FLOYD aims to build an integrated demonstrator able to showcase the coordinated operation between all these components and technologies in a real-world use-case scenario.

The technological research and development lines are based on **two main driving forces**: Artificial Intelligence and Platooning Applications. In this project, the entities will explore the potential of Artificial Intelligence in multiple technological domains, by identifying processes in mobility, autonomous driving, or network operation that follow complex behaviors and require an intelligent learning approach. Underlying all the tech development, a down-to-earth, use-case of vehicular platooning motivates the developed applications, testbed, and demonstrator.

GOLEM

Automated Programming to Revolutionize App Development

Businesses need to become digital to survive, but there's a shortage of talent for programming enterprise applications. The GOLEM project **led by OutSystems** expects to enable everyone to create enterprise applications with no code through Artificial Intelligence (AI) and a rich set of language abstractions. GOLEM is aiming to automate programming and revolutionize the software development experience, ultimately allowing citizens or non-expert business professionals to develop their own apps. The project will advance the state-of-the-art AI applied to code, program synthesis, and automated programming techniques.

Keywords: Automation. Programming. AppDevelopment.



Leading company in Portugal

OUTSYSTEMS - SOFTWARE EM REDE, S.A.

Project Start Date
01/05/2020

Project End Date
30/04/2022



Meet the partners

Promoter:

OutSystems - João Abril de Abreu

Academic Co-promoters:

INESC ID - Inês Lynce

FCT NOVA - João Costa Seco

CMU:

Computer Science Department - Ruben Martins

GOLEM, revolutionizing the low-code and no-code development market.

The GOLEM's ultimate goal is to find a sustainable solution for the increasing need for complex enterprise digital systems and the lack of people with enough technical skills for creating them. Since those systems are, at their core, complex software, the most realistic long-term solution is to automate insofar as possible the creation of such systems.

In doing so, not only the design of enterprise software is speeded up, but more importantly, more people with non-programming backgrounds are granted the opportunity to contribute to the digitization effort.



What to expect

The project will try to set a new benchmark for easy-to-use enterprise application development platforms and revolutionize the low-code and no-code development market.



Goals

The GOLEM project will enable non-programmers to develop enterprise grade applications by evolving the OutSystems low-code development model to a new fully integrated and interactive development experience in which programming is automated, based on natural language specifications, examples given by the developer, point and click demonstrations or sketches.

The output of that automation is not only code but also a live preview of the application's behavior that allows the developer to understand his actions' effects.

SAFEFOREST

Semi-Autonomous Robotic System for Forest Cleaning and Fire Prevention

The world has been affected by an alarming number of wildfires every year, ravaging millions of hectares of forestry areas and resulting in an unacceptable amount of human losses. The **SafeForest** project deals with developing an advanced robotic system for the prevention of wildland and wildland-urban interface (WWUI) fires. Vegetation cleaning in corridors along high voltage electric lines will be central to avoiding forest fires that recently led to massive destruction in countries like the USA and Portugal.

Keywords: Forestryrobotics · Sustainableforestmanagement · Wildfireprevention



Leading company in Portugal
INGENIARIUS, LDA

Project Start Date
01/03/2020

Project End Date
01/03/2023

Meet the partners

Promoter:
INGENIARIUS – Micael Santos Couceiro

Industrial Co-Promoter:
SILVAPOR – José Gameiro

Academic Co-promoters:
ISR Coimbra – Anibal Traça de Almeida
Associação para o Desenvolvimento da Aerodinâmica Industrial – Domingos Xavier Viegas

CMU Department:
The Robotics Institute – George Kantor

SafeForest, a way to control and reduce large forest fires

The project intends to drastically reduce the costs associated with the maintenance of private or public forests, namely near houses, as well as the protection of wide corridors used as fuel breaks and corridors near critical infrastructures (roads, railways, telecommunication lines, and antennas, electric utility lines) to control and reduce the propagation of large forest fires.

SafeForest will develop an advanced monitoring and robotic system to improve the maintenance of forests and contribute to reducing the wildfire hazard potential while conserving natural resources and creating ecosystems that are resilient to climate change.

What to expect

The main goal of the project is to develop semi-autonomous mobile platforms that can execute a land clearing mission, based on a preliminary mapping of the area carried out with the support of advanced drone terrain/vegetation monitoring, and manage to remove the redundant vegetation to achieve the necessary fuel breaks cleaning. This objective will be achieved by integrating different sensors on a semi-autonomous all-terrain platform for land clearing in fuel breaks and in WWUI areas, able to perform in most types of terrains.

Goals

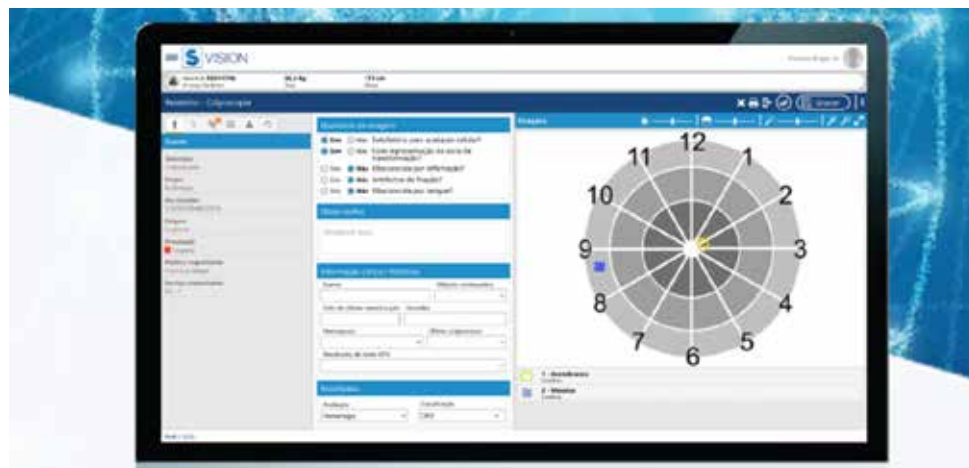
- To develop an advanced mapping and characterization system, called the Forest Management Information System (FMIS), for the terrain and its detailed vegetation cover.
- To develop semi-autonomous robot systems to clean vegetation in different types of terrain, namely rough and sloppy areas, in order to clean fuel breaks to create opportunities of controlling fire propagation and to prevent the possibility of larger forest fire events.

TAMI

Transparent Artificial Medical Intelligence

The project will develop a set of tools to support medical decision, based on artificial intelligence algorithms. The project will work on a platform for commercial, scientific and academic use that will provide “consumers” access to results and explanations of diagnostic orders, filtered data sets access for investigators or scientists, and a knowledge base for academic purposes.

Keywords: Artificial intelligence · Computer-aided decision · Healthcare ethically in their context.



Leading company in Portugal

FIRST SOLUTIONS – SISTEMAS DE INFORMAÇÃO S.A.

Project Start Date
01/04/2020

Project End Date
01/03/2023



Meet the partners

Promoter:

FIRST SOLUTIONS – Tiago Oliveira

Academic Co-promoters:

FRAUNHOFER PORTUGAL – Luís Rosado
INESC TEC – Ana Maria Mendonça and Jaime Cardoso
ADMINISTRAÇÃO REGIONAL DE SAÚDE DO NORTE, I.P. – Pedro Sousa

CMU Department:

Electrical and Computer Engineering Department – Asim Smailagic

TAMI, explaining medical diagnosis through AI tools

The Project’s main mission is to help make medical diagnosis clearer and more reliable, supported by artificial intelligence. TAMI will develop a set of tools to support medical decision based on AI algorithms, that will explain to both clinician and researchers the diagnosis of a specific disease and its causes, focusing on cervical cancer, lung diseases and eye diseases.

The system will explain the information visually through images or text, by presenting information through a concept or sentence that makes sense to the user.



What to expect

The tools developed in this project will potentially help to detect possible flaws and introduce improvements in the diagnosis support systems while helping to determine disease patterns and offering new sources of knowledge.



Goals

The project will be based on the following specific objectives involving the development of research in the following areas:

- Quantitative methods to objectively assess and compare different explanations of the automatic decisions;
- Methods to generate better explanations, providing variety in the explanations, adapting it to who will consume them and explaining multimodal decisions;
- Novel visualization solutions for interpretations of decisions based on imagiological data.

In order to accomplish that, TAMI will use clinical data, including textual and image data, in order to design and validate interpretable machine learning models. During the project, different multimodal settings will be tested to enable a better understanding of the AI-based decisions. Moreover, the algorithms will be designed to generate self-explanatory AI-based decisions, minimize bias, and act ethically in their context.

WoW

Wireless biOmonitoring stickers and smart bed architecture: toWards Untethered Patients

Electronic skin (e-skin) patches with biomonitoring sensors that adhere to the human epidermis are highly transformative in patient monitoring. These devices can collect and classify physiological and behavioral data, including heart, muscle, brain activities, respiration rate, body temperature, and blood oxygen. **WoW** proposes a novel architecture focused on untethered, simple, and low-cost printed biomonitoring stickers, not only to be used in patients but also in patients' beds, that are equipped with a smart IoT unit. The bed-sticker connection allows for data acquisition and transmission and enables energy transmission to the stickers.

Keywords: Electronic skin (e-skin) patches · Wireless patient monitoring · IoT infrastructure



Leading company in Portugal

GLINTT - HEALTHCARE SOLUTIONS, S.A.

Project Start Date
01/04/2020

Project End Date
30/04/2023



Meet the partners

Promoter:
GLINTT - Filipa Fixe

Academic Co-promoters:

ISR Coimbra - Mahmoud Tavakoli
Universidade de Coimbra - Jorge Coelho
Centro Hospitalar e Universitário de Coimbra - Alexandre Lourenço

CMU Department:

Mechanical Engineering Department - Carmel Majidi

WoW, developing a wireless patient monitoring solution

The WoW project will develop IoT solutions to monitor patients that will have a strong impact for all the involved stakeholders:

- For patients, this option is above all a guarantee of comfort since users will be able to be untethered from machines, will have freedom of movement and instead of being at the Hospital will in alternative be in Home hospitalization;
- For the Healthcare System this solution will have an influence on the reduction of costs related to treatments and hospitalizations;
- For everyone involved (Patient, Hospital, Doctors, Insurance, Health and AI Scientists) this solution will allow a invaluable centralized data collection.



What to expect

These solutions will contribute to placing Portugal as one of the first countries to demonstrate continuous wireless patient monitoring through patches with excellent signal quality. In the long term, it is expected to use these devices in-home care scenarios and pharmacies, giving an alternative to hospital stays, enabling patients to stay home while fully monitored.



Goals

The project will focus on developing two mains components that will allow the untethered monitorization of patients:

Wireless Biomonitoring Sensor Patches for detection of:

- Vital signals: heart rate, temperature, respiration, ECG, pulse, oximeter,
- Motion: digital identity tracking, accelerometers, magnetometer, gyroscope
- Emotion: galvanic skin response for emotional computing

IoT nodes for beds - Smart Box

- Single board computer
- Energy transmission
- Data acquisition module
- Bluetooth, WiFi, RFID

The bed-sticker connection allows not only for data acquisition and transmission, but also enables energy transmission to the stickers. Each bed is an IoT node that communicates with Globalcare, a proprietary Hospital Information System developed by the project promoter - Glintt.

Exploratory Research Projects



CMU Portugal Exploratory Research Projects (ERPs) are designed to assist teams of researchers from Portuguese institutions, Carnegie Mellon University, and industry partners in bootstrapping high-impact potential research activities of strategic relevance to Carnegie Mellon Portugal Program. ERPs are selected through Exploratory Research Project Calls, funded by the Fundação para a Ciência e a Tecnologia (FCT). This typology of projects has an exploratory basis and is planned for 12 months, granting the scientific community the opportunity to identify and explore new ideas bottom-up. In 2014, the Early Bird Projects Call awarded the first 10 exploratory projects. This initial call was followed by three new calls for ERPs in 2017, 2019, and 2021.

The calls, opened under the scope of CMU Portugal's 3rd phase, are open to high-risk/high-reward ICT projects that showed promise and strategy for significant future expansion of the project's goals. ERPs under this call should aim at formulating and launching longer-term projects, i.e., they will not be required to achieve, within their scope, the fully developed and ambitious final results that are typical of longer-term projects. However, the proposals must be very concrete on the activities and outcomes that the consortium has proposed to carry out and achieve in the scope of the ERP and link them to its longer-term objectives.

ERPs 2019

During 2020-21, CMU Portugal Program executed 7 ERPs resulting from the 2019 call. The call for proposals featured a total of 38 projects, 7 of which were recommended for funding by Fundação para a Ciência e a Tecnologia under the scope of CMU Portugal and benefited from overall funding of 820 000 €. **The projects focus on areas as diverse as robotics, artificial intelligence, intelligent transport systems, and language processing.**

Agents: Automatic generation of humor for social robots

Principal Investigator in Portugal: Ana Paiva

Principal Investigator at CMU: Louis-Philippe Morency

Partner Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; ISCTE – Instituto Universitário de Lisboa; Language Technologies Institute – Carnegie Mellon University

CRUAV: Cooperative Trajectory Planning for Real-Time Surveillance in UAV-assisted Intelligent Transportation Systems

Principal Investigator in Portugal: Kai Li

Principal Investigator at CMU: Pei Zhang

Partner Institutions: Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto; Faculdade de Engenharia da Universidade do Porto; Department of Electrical and Computer Engineering – Carnegie Mellon University

AI-Beam: Intelligent Beamforming Metasurfaces for Future Telecommunications

Principal Investigator in Portugal: Stanislav Maslovski

Principal Investigator at CMU: Sheng Shen

Partner Institutions: Universidade de Aveiro (UA); Instituto de Telecomunicações (IT) Aveiro; Department of Mechanical Engineering Carnegie Mellon University.

PassCert: Exploring the Impact of Formal Verification on the Adoption of Password Security Software

Principal Investigator in Portugal: João Fernando Ferreira

Principal Investigator at CMU: Nicolas Christin

Partner Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Inesc Tec – Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência; Department of Computer Science– Carnegie Mellon University

PRIVADIA: Privacy in speaker diarization: Detecting “who spoke when” privately

Principal Investigator in Portugal: Isabel Trancoso

Principal Investigator at CMU: Bhiksha Raj

Partner Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Language Technologies Institute – Carnegie Mellon University

SecurityAware: Fine-grained approach to detect and patch vulnerabilities

Principal Investigator in Portugal: Rui Maranhão

Principal Investigator at CMU: Hakan Erdogmus

Partner Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; Department of Electrical and Computer Engineering – Carnegie Mellon University

SyNAPSE: Synthesizing Network Accelerators using Programmable Switching Equipment

Principal Investigator in Portugal: Luís Pedrosa

Principal Investigator at CMU: Justine Sherry

Partner Institutions: Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa, Instituto Superior Técnico, Universidade de Lisboa; FCiências.ID – Associação para a Investigação e Desenvolvimento de Ciências; Department of Computer Science– Carnegie Mellon University

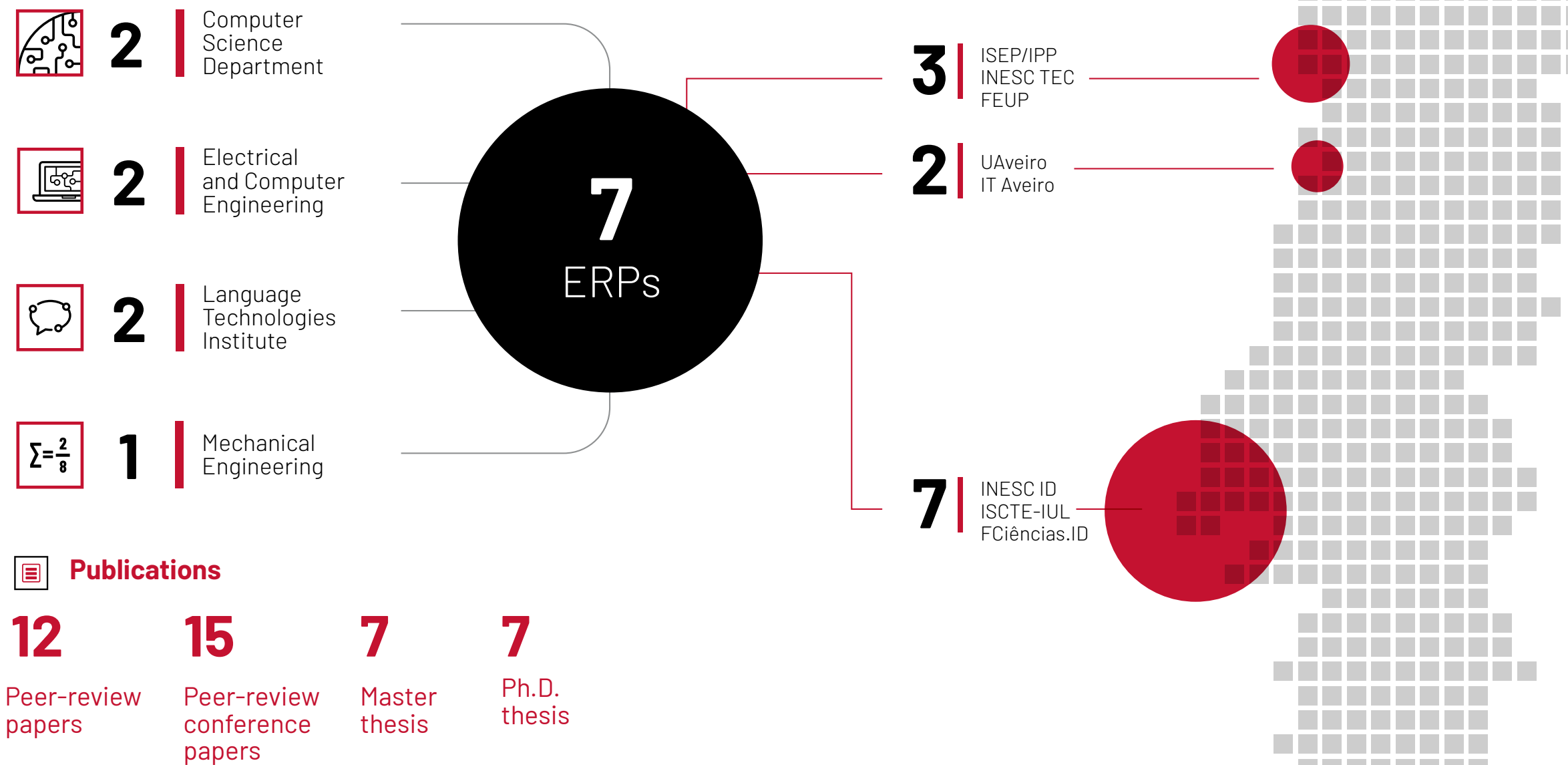


Exploratory Research Projects 2019

By CMU Departments and Portuguese institutions
(proponent or participant)

The ERPs promoted research networks across **8 Portuguese institutions** across the country, and **4 CMU Departments** (Computer Science; Electrical and Computer Engineering; Language Technologies Institute; and Mechanical Engineering). The 7 ERPs offered financial support to 30

researchers: 1 postdoctoral fellow, 9 Ph.D. students, 14 master students, and 6 other researchers during this period. Although their outputs were expected to go beyond the publication of articles and other metrics, the researchers published 12 articles in international peer-review publications, 15 peer-review conference papers, 7 Master theses and contributed to the development of 7 Ph.D thesis. The restrictions imposed by the COVID-19 pandemic impacted the start and execution of the 7 ERPs. CMU Portugal and FCT approved the PIs request to extend the projects' deadline. In early 2022, the 7 projects were all still active.



AI Beam

Intelligent Beamforming Metasurfaces for Future Telecommunications

Start: 01/10/2020

End: 31/03/2022

Metasurfaces are versatile tools for controlling wave fronts and performing nearly-instantaneous operations on the angular spectrum of propagating electromagnetic waves. In this project, we investigate the previously unexplored possibility of realizing hybrid intelligent beamforming systems comprising the programmable metasurfaces (the quasi-optical hardware) and the algorithmic (the silicon/software) layers. In order to allow for fully flexible and dynamic control over the antenna radiation pattern, this new architecture borrows a few key ideas from the areas of AI and neural networks, such as the AI network training methods. This architecture has a potential to realize real-time dynamic channel propagation estimations and adaptive beamforming using a trained AI network that incorporates the programmable metasurfaces as an integral part of such network. As a novel and exploratory concept, this project is centered on the feasibility studies and numerical simulations associated with the proposed architecture and its possible applications under various beamforming scenarios. We aim to identify the potential of this new technology for future telecommunication systems, estimate the performance gains, and make recommendations on the use of the programmable metasurfaces for the mentioned applications.

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CCS Concepts

- Hardware~Emerging technologies~Analysis and design of emerging devices and systems~Emerging tools and methodologies
- Computing methodologies~Machine learning
- Computing methodologies~Modeling and simulation~Model development and analysis

AGENTS

Automatic generation of humor for social robots

Start: 01/01/2021

End: 30/06/2022

Humor has been linked to numerous positive outcomes and laughter is thought to decrease anxiety. From a psychological standpoint, the employment of humor can lead to strategies that help individuals deal with stressful or traumatic situations. Humor has also been used in therapy, as it has been linked to positive outcomes. The AGENTS project is leveraging on the power of humor to create more naturalistic and lifelike interactions with social embodied agents, in particular, social robots. To achieve this goal, a top-down approach of humor will be employed that can be modeled to match each user's preferences.

The project uses a 2x2 conceptualization of humor that involves its social function (humor used to enhance oneself or used to enhance others) and the valence of the humoristic content (positive, negative). By using such conceptualization, the goal is to create a dataset of humorous jokes or stories and through the application of supervised machine learning techniques, to extract and automatize multimodal humor delivery.

The end-goal of this process will be the implementation of user personalized humoristic interactions in the context of a group card game involving more than one human and more than one social agent. This is expected to lead to better interaction outcomes and increase the value perception of the agent, by contributing to greater task enjoyment, improved perception of the agent and greater intention to interact again with these social agents in the future.

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CCS Concepts

- Human-centered computing
- Collaborative and social computing
- User studies

**Website:**

<https://www.agents-humor.com>

CRUAV

Cooperative Trajectory Planning for Real-Time Surveillance in UAV-assisted Intelligent Transportation Systems

Start: 01/01/2021

End: 30/06/2022

The CRUAV project investigates cooperative Unmanned Aerial Vehicles (UAVs) for real-time surveillance of traffic violations, accidents, or other road emergencies in intelligent transportation systems. Specifically, many Internet-of-Things (IoT) nodes (e.g., lightweight cameras and portable tachymeters) are deployed on roadside to take videos or images and collect environmental data. Every IoT node is equipped with solar panels or wind power generators to harvest energy to power its operations. In particular, the battery energy of the IoT nodes can be drastically different from each other, depending on the ambient environmental conditions of the individual nodes. Each IoT node generates its data at an application-specific sampling rate and buffers the data awaiting transmission. The UAV equipped with a wireless transceiver and an onboard processor is instructed to fly over an unpopulated area with little to no 5G service but a need for bursty transmissions of high-bandwidth data, e.g., high-resolution images or videos.

The real-time and secure data aggregation achieved by the proposed frameworks in this project enables a variety of innovative applications spanning both the commercial and official sectors: providing road users with the latest information on traffic and monitoring possible traffic violations, for example. The outcome of the project will be systematically evaluated for airborne surveillance of intelligent transportation.

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CCS Concepts

- Networks~Network types~Cyber-physical networks~Sensor networks
- Computing methodologies~Machine learning~Machine learning algorithms

PASSCERT

Exploring the Impact of Formal Verification on the Adoption of Password Security Software

Start: 01/02/2021

End: 30/06/2022

PassCert's short-term vision is to build an open-source, proof-of-concept password manager that through the use of formal verification, is guaranteed to satisfy properties related to data storage and password generation, since these were identified as barriers to adoption and effective use of PMs. While text passwords are one of the most used security mechanisms, users fail to use them effectively and safely. To combat this, experts recommend the use of Password Managers (PMs) to help users generate and manage their passwords. However, their adoption is low as users do not trust PMs. Formal verification can provide strong assurances, making software more reliable. Therefore, the expectation is that a PM with formally verified features will increase users' trust and, consequently, their adoption of PMs. This can help address many of the existing security problems regarding password authentication.

 **Principal
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INESC TEC and Universidade do Minho

CCS Concepts

- Security and privacy
- Formal methods and theory of security
- Usability in security and privacy



Website:

<https://passcert-project.github.io>

PRIVADIA

Privacy-Preserving Speaker Diarization

Start: 01/01/2021

End: 30/06/2022

The growing number of Machine Learning as a Service applications has caused an increasing awareness of their potential to compromise users' privacy, as shown by the intense debate around the GDPR. Among other data types, a large amount of information may be extracted from speech going far beyond linguistic contents. This extra information includes demographic traits like gender, age range, level of education, emotional status, personality traits, levels of stress, intoxication, sleepiness, etc. and even cues about diseases that affect speech. This implies that one should regard speech as "Personally Identifiable Information".

Current machine learning models can remotely transcribe speech recordings, identify speakers, and perform "diarization", often referred to as the problem of determining "who spoke when" in a conversation. Privacy in speech processing is the overarching topic of the PRIVADIA project, with a particular focus in diarization. The main challenges are in combining state-of-the-art speaker representations or embeddings with cryptographic techniques. The project also explores alternative approaches to privacy based on deep learning speech manipulation techniques.

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CCS Concepts

- Networks~Network components~Middle boxes / network appliances
- Networks~Network services~Programmable networks
- Software and its engineering~Software creation and management~Search-based software engineering



Website:

<https://privadia.hlt.inesc-id.pt>

SECURITY AWARE

Fine-grained approach to detect and patch vulnerabilities

Start: 01/11/2020

End: 31/01/2022

Software vulnerabilities lead to massive financial losses for software companies because of business disruption, loss of privacy, reputational damage, legal implications, and life-threatening situations. For instance, in 2014, an Apple bug ('goto fail') in a widely used SSL implementation caused applications to accept invalid certificates. Although several success stories exist, there are also several concerning limitations hindering wide adoption: viz. high number of false positives and warnings that are innocuous and difficult to act upon. Continuous Integration (CI) is an increasingly popular practice among modern development teams however, due to the overwhelming amount of information generated by all of these phases and tools, software engineers feel that some of the production phases are frustrating and tend to ignore valuable output. Following the CodeAware [1] vision (CodeAware is sensor-based fine-grained monitoring and management of software that can easily be integrated into the CI pipeline), the project proposes the development of a novel framework for automatically and efficiently detecting security issues that can be integrated with confidence on the CI pipelines through the implementation of more fine-grained, more unified and faster approaches to CI static analysis.

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CCS Concepts

- Software and its engineering
- Software verification
- Software safety
- Automated static Analysis

SyNAPSE

Synthesizing Network Accelerators using Programmable Switching Equipment

Start: 01/11/2020

End: 30/04/2022

When implementing network functions (NFs), developers are often confronted with a choice: implement the NF in software and face the challenge of performance or use one of a wide variety of programmable networking devices, such as programmable switches and SmartNICs, to trade-off some flexibility for the ability to process packets at full line rate. With SyNAPSE we ask the question “Why not have both?”. The project offers a synthesis based approach to automatically generate accelerated implementations of Software NFs, using smart network devices whenever possible to increase performance. The SyNAPSE project aim is to advance the state of the art in building programmable networks using synthesis. Towards this end, a prototype synthesis engine will be built that takes as input an NF implementation mapped onto a network and synthesizes a network controller and any requisite switch programs that combined produce equivalent behavior. The project will further build the infrastructure needed to design, develop, and evaluate the prototype, while also laying the groundwork for longer-term collaboration.

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CCS Concepts

- Networks~Network components~Middle boxes / network appliances
- Networks~Network services~Programmable networks
- Software and its engineering~Software creation and management~Search-based software engineering



Website:

<https://pedrosa.2y.net/Projects/SyNAPSE>

ERPs 2021

In partnership with Fundação para a Ciência e a Tecnologia (FCT), a new Call was opened from May 19th and June 30th, 2021, to support the development of new CMU Portugal ERPs in strategic emerging areas of ICT. This was the **second Call for ERPs projects launched under the Program's third phase**.

The proposals included one or more Portuguese research institutions from different entities and one partner CMU faculty team. The call for proposals featured a total of **33 submissions, 6 of which were recommended for funding** by Fundação para a Ciência e a Tecnologia (FCT) under the scope of the CMU Portugal Program. The projects were evaluated by an international panel of evaluators met by Zoom on November 16 and 18th, 2021.

The 6 new ERPs will focus on research areas and subjects as diverse as **data science applied to healthcare, the creation of satellites (PocketQube), human-robot interaction, traffic supervision for Cybercrime Investigation, applied artificial intelligence for customizable robotic exoskins, and the detection of injection vulnerabilities in node applications**. The projects will run at **10 Portuguese research units** from Universities of Coimbra, Lisbon, Minho, and Porto, in collaboration with **5 different departments at Carnegie Mellon University** (Electrical and Computer Engineering, Human-Computer Interaction Institute, Institute for Software Research, Engineering & Public Policy and The Robotics Institute). Overall, the research teams will benefit from **655K€**.

MD2TRUST: Trustworthy data science for improving health-care efficiency: the case of the medical referral process

Principal Investigator in Portugal: Cláudia Soares
Principal Investigator at CMU: Haiyi Zhu; Yuejie Chi
Partner Institutions: Human-Computer Interaction Institute (CMU), NOVA.ID.FCT, Nova SBE (FE/UNL), IST-ID

PROMETHEUS – PocketQube Framework Designed for Research and Educational access to Space

Principal Investigator in Portugal: Alexandre Ferreira da Silva
Principal Investigator at CMU: Zachary Manchester
CMU Department: Robotics Institute
Partner Institutions: Robotics Institute (CMU) Universidade do Minho (UM), Instituto Superior Técnico (IST/ULisboa)

shiftHRI: Exploring the Transfer of Agency to Older Adults in HRI

Principal Investigator in Portugal: Tiago Guerreiro
Principal Investigator at CMU: Jodi Forlizzi
Partner Institutions: Human-Computer Interaction Institute (CMU), FCIências.ID, IST-ID

DAnon: Supervised Deanonymization of Dark Web Traffic for Cybercrime Investigation

Principal Investigator in Portugal: Nuno Santos
Principal Investigator at CMU: Nicolas Christin
Partner Institutions: Institute for Software Research, Engineering & Public Policy (CMU), INESC-ID/INESC/IST/ULisboa, INESC TEC; NOVA.ID.FCT; FCIências.ID

Exoskins : AI Codesign of Robotic and Personalized Compliant Exoskins for Physical Exercises, Prosthesis and Rehabilitation

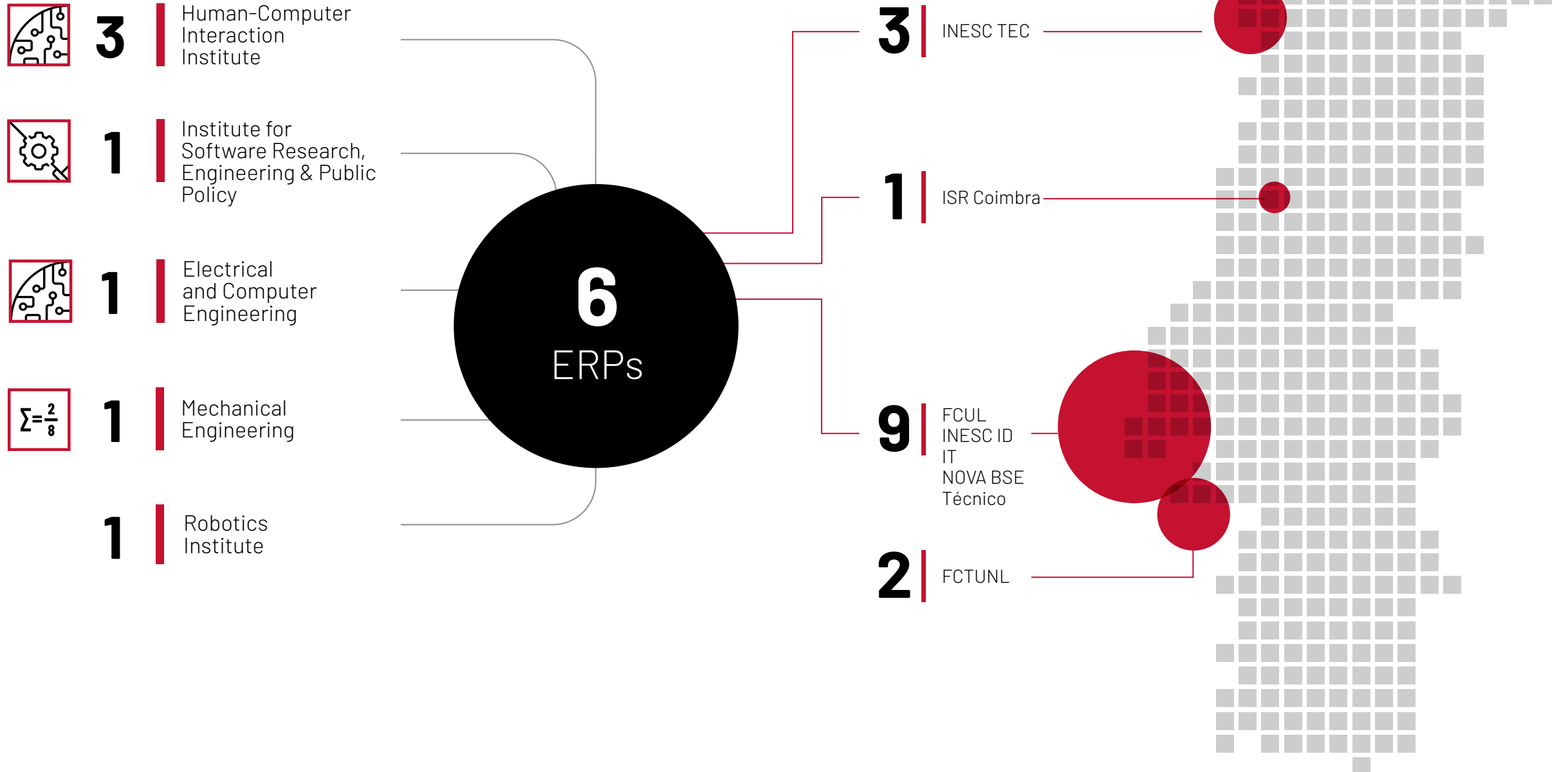
Principal Investigator in Portugal: Mahmoud Tavakoli
Principal Investigator at CMU: Lining Yao; Carmel Majid
Partner Institutions: Human-Computer Interaction Institute (CMU), Mechanical Engineering (CMU), Instituto de Sistemas e Robótica (ISR) Coimbra

DIVINA: Detecting Injection Vulnerabilities In Node.js Applications

Principal Investigator in Portugal: José dos Santos
Principal Investigator at CMU: Limin Jia
Partner Institutions: Electrical and Computer Engineering (CMU), INESC-ID/INESC/IST/ULisboa, Instituto de Telecomunicações (IT)

Exploratory Research Projects 2021

By CMU department and Portuguese Institutions
(proponente or participant)



DAnon

Supervised Deanonymization of Dark Web Traffic for Cybercrime Investigation

Start: 01/02/2022

End: 31/01/2023

Cybercrime is escalating to unprecedented levels. Perpetrators often communicate on the Internet using highly sophisticated anonymization systems that allow them to thrive without being tracked by Law Enforcement Agencies (LEAs). Tor is by far the most popular of such systems. What makes Tor communications so hard to trace is that it relies on a large-scale network of servers – called relays – that employ advanced encryption and complex traffic obfuscation techniques. For this reason, although anonymous networks play a vital role on the Web for protecting user privacy and allowing for censorship-free access to information, they have also been used as the backbone of the so-called Dark Web, providing a key technological pillar sustaining the flourishing ecosystem of cybercrime.

Driven by our ultimate goal of building a practical cybercrime investigation tool for analyzing Dark Web traffic, this work will advance the state of the art on cutting-edge topics in privacy-preserving computation, machine learning, and “ethical-by-design” systems. By extending our early work, we will deliver a new prototype of our tool that will be able to efficiently process deanonymization queries in a privacy-preserving manner.

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CCS Concepts

- Security and privacy -> Security services -> Pseudonymity, anonymity, and untraceability
- Security and privacy -> Security services -> Privacy-preserving protocols
- Security and privacy -> Human and societal aspects of security and privacy

DIVINA

Detecting Injection Vulnerabilities In Node.js Application

Start: 27/03/2022

End: 26/03/2023

JavaScript is the de facto language for client-side programming and, with the advent of Node.js, has rapidly become one of the most popular languages for implementing server-side applications. Node.js code is not sandboxed, making it open to a broad range of security attacks. Among them, one of the most serious is injection attacks, which allows attackers to run arbitrary code on the targeted execution platform. Node.js has been used to build high-profile applications, such as Skype, Slack and WhatsApp, and thus, injection attacks on Node.js code can have serious consequences as they can lead to breaches of user data or be used as building blocks for more sophisticated attacks on a company's network and servers. In this project, we plan to develop DIVINA: a new analysis tool for detecting injection vulnerabilities in Node.js applications. Our goal is for DIVINA to be both effective—with low false negative and false positive rates—and efficient—with low overheads—so that it can be integrated in standard code review pipelines. We will leverage the combination of dynamic taint tracking and dynamic symbolic execution. We aim to deliver a prototype implementation of the analysis tool and results on applying our tool to a set of curated Node.js packages.



Principal Investigators



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CCS Concepts

- Web Application Security
- Software Testing and Debugging
- Formal Software Verification

Exoskins

Human-AI Codesign of Robotic and Personalized Compliant Exoskins for Physical Exercises, Prosthesis and Rehabilitation

Start: 15/01/2022

End: 14/01/2023

Exoskins – broadly defined as exoskeletons, exosuits, orthotics, and assistive wearable technologies – have already been proposed for medical treatments and healthcare, helping patients experiencing motor disorders to receive treatments or rehabilitate. However, since each wearer's health condition and body shape are different, it is challenging to custom fit to each patient. To this end, a novel medical exoskin solution is needed: one ideal medical exoskin may provide a light-weight actuation system, and on-demand tunable stiffnesses to meet the patients' evolving medical and comfort requirements while being compact and affordable.

We propose to develop an AI-enabled computational design framework to develop patient-specific exoskins with variable stiffness robotic material in compliant mechanisms. Such exoskins will have tunable resistance (for physical rehabilitation or exercise), reconfigurable degree-of-freedom and active actuation (for prosthesis). We plan to leverage data-driven methods to develop the material simulator and integrate it into an AI-enabled computational platform to guide the design and manufacturing of such devices. Such efforts will advance the social and economic impact of such functional systems in healthcare and medical devices and foster industry-science-engineering relationship.

 **Principal
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CCS Concepts

- Human-centered computing
- Human computer interaction (HCI)
- Interactive systems and tools

MD2TRUST

Trustworthy data science for improving healthcare efficiency: The case of the medical referral process

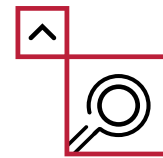
Start: 01/02/2022

End: 31/01/2023

MD2TRUST aims to develop a recommender system for referral of specialist care doctors to be used by primary care doctors, that is compatible with current referral practice, and that can transparently encourage organizational change, towards a more effective patient-centric healthcare management.

Typically, for a given patient with clinical needs, the primary care physicians can make a choice of several specialists to whom they may refer. As such, primary-specialty referral may affect many aspects of patient care, such as quality of care, patient satisfaction and healthcare costs, etc. Researchers recently leveraged the patient consultation history extracted from insurance claims data to construct the patient sharing network between physicians based on the shared patients. Essentially, the patient sharing network operationalizes an informal information-sharing network in which physicians provide care to shared patients. These current metrics derived from network science can serve as informative features to boost predictive model performance and optimize the health system for improved medical outcomes.

This project will analyze the current state of medical referral in CUF Health and compare it with another reality in the USA by implementing novel recommendation systems that are: 1) trustworthy, 2) advised by policy, 3) not disruptive of the usual referral process used today, 4) fostering online communities.



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CCS Concepts

- Neural Networks
- Recommender Systems
- Medical Technologies

PROMETHEUS

PocketQube Framework Designed for Research and Educational Access to Space

Start: 01/06/2022

End: 31/05/2022

The PROMETHEUS project aims at providing easy access to space for the research and education (R&E) community. Learning or researching about space can be more fruitful via hands-on projects. However, Space can seem like a pitfall environment with high risks and therefore high costs to develop projects at the student level. This barrier is critical and hinders R&E opportunities given the lack of experience in this environment. The team has identified that there is no current tool that enables easy and low-cost access to such space experiences of learning or manufacturing a simple satellite device.

The PROMETHEUS project aims at being a contributor for this momentum, by serving as an open-source PocketQube platform, which is a small satellite in a 5 cm cube form factor, an ideal size for R&E. From the foundation, this proposed platform has all the minimum required conditions to be easily integrated as a tool that facilitates hands-on activities and access to space. However, the PROMETHEUS goes beyond that and shares the entire pipeline for the satellite deployment as it will be licensed, certified, and launched. PROMETHEUS aims at giving access to space for everyone.

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CCS Concepts

- Neural Networks
- Recommender Systems
- Medical Technologies

shiftHRI

Exploring the Transfer of Agency to Older Adults in Human-Robot Interaction

Start: 01/01/2022

End: 31/12/2022

Aging of the population carries several concerns and challenges. There will be fewer young people to take care of the elder and waiting lists for nursing homes and other care facilities will grow. Most importantly, their wellbeing and sense of self-worth is at risk.

Previous work has looked at assistive robots as a way to allow people to live more independently at home, or keep active in a care home. However, they do not support people in achieving their own goals. This project wants to empower them by transferring agency to older adults in human-robot interaction. One speculative example would be to place a robot in a grandson's home controlled by his grandmother while sitting in her chair in a care home: she would look at the toddler, have a chat about school, and offer milk and cookies through this skillful proxy. How can robots support older people in achieving their wishes and how can they control or program a robot to perform tasks? The project's vision is to advance research on human-robot interaction to facilitate a new type of relationship between elders and assistive robots.

However, shifting agency to older adults brings several challenges to the control of those robots. The project will combine collaborative research & design with elders and caregivers, iterative system development, and iterative evaluation through controlled field studies by leveraging existing relationships with Portuguese elder care facilities.

 **Principal
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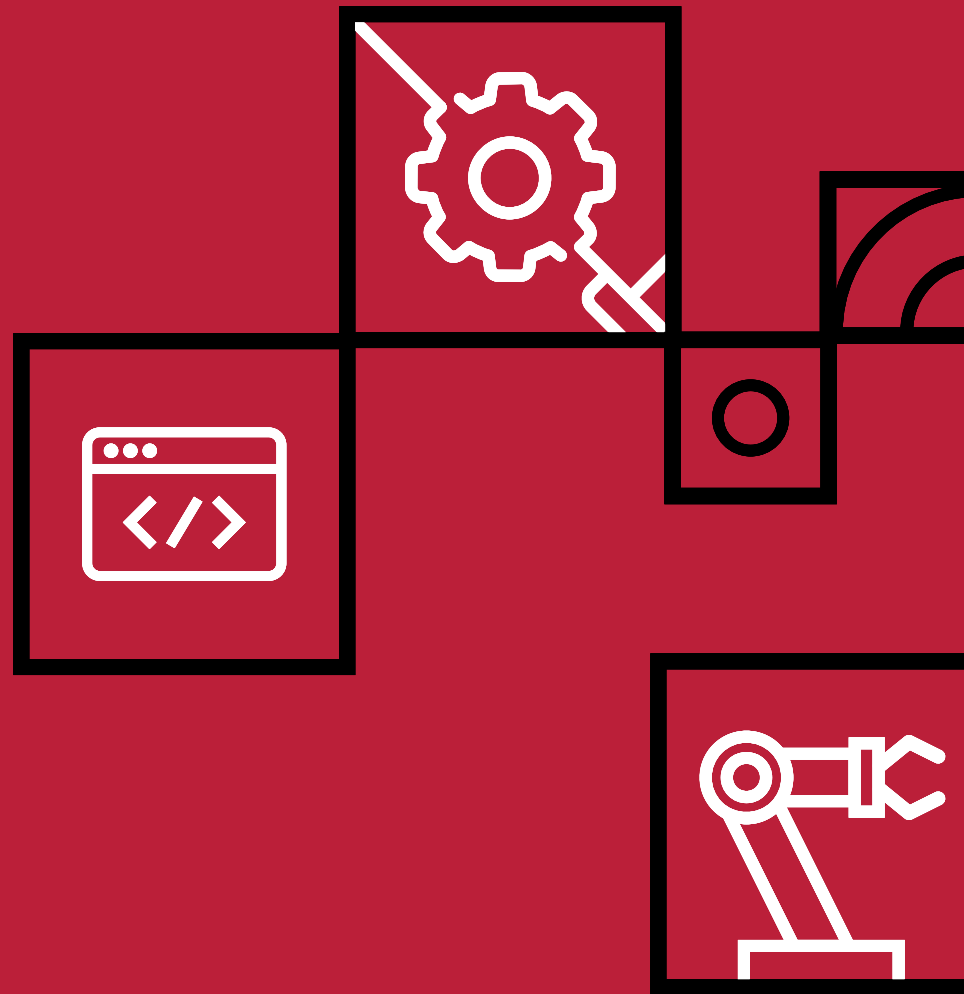


Jodi Forlizzi

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CCS Concepts

- Human-Centered Computing
- Social and Professional Topics->User Characteristics->Age->Seniors
- Computer Systems Organization -> Embedded and Cyber-Physical Systems-> Robotics



Innovation and Entrepreneurship

Portugal as a hub for I&E

The third phase of the CMU Portugal Program continues to strengthen the relationship between academia and industry, promoting an ecosystem of innovation in Portugal and benefitting from Carnegie Mellon's experience as a dynamic economic engine. The industry alignment that permeates the activities of this third phase comprises the ideal setting for the consolidation of Portugal as a global innovation and technology hub.

Industrial Affiliates

The CMU Portugal Program has been working to establish a very close relationship with the Portuguese Industry, namely through the companies of its Industrial Affiliates Program. Since 2018, 16 CMU Portugal Industrial Affiliates have committed to actively contributing to the Partnership's advanced education and research programs, increasing their competitiveness by investing in R&D, advanced training of human resources, and building a highly-skilled workforce dedicated to innovation activities. CMU Portugal Industry Affiliates include **five Portuguese unicorn companies (Farfetch, Feedzai, Outsystems, Remote, and Talkdesk) and ICT leaders (Accenture, Altice, CEiiA, NOS, Priberam, REN, Tekever, Thales, Unbabel, Uniplaces, and Veniam)**. Furthermore, Farfetch, Feedzai, Outsystems, and Unbabel have reinforced their commitment to the Program by leading four out of the twelve CMU Portugal Large-Scale Collaborative Research Projects that started in 2020.

Together, the 16 CMU Portugal Industrial Affiliates support the strategic governance of the Program and promote their affirmation as technology-based companies, intending to strengthen their R&D and qualified employment by 2030 significantly. Within the scope of the data economy, the industrial affiliates cover a wide range of sectors enriching the Program's ecosystems and network.

Industry Involvement in Education

The 1st edition of the CMU Portugal Affiliated Ph.D. Programs reinforced the industry involvement with CMU Portugal's educational initiatives. One of the main goals of this initiative is to promote collaboration between academia and industry through Ph.D. research. Candidates for this initiative were encouraged to present a Ph.D. work plan involving the close cooperation of a Portuguese ICT company, the advisor in Portugal, and the co-advisor at CMU.

In the first edition of the Program, which started in 2021, **7 of the 11 enrolled candidates presented a collaboration with industry**, involving companies such as Outsystems, Farfetch, Unbabel, NOS Comunicações, Ingeniarius, Codacy, and Sundance.

Industry Involvement in Projects

Projects developed under the scope of the CMU Portugal Program combine research, innovation, and advanced training initiatives while establishing collaborations between academia - in Portugal and at Carnegie Mellon - and industry. Since 2006, over 150 companies from different sectors of activities have been partners in projects promoted by CMU Portugal. Technological companies have had their R&D activities successfully integrated with the activities of the academic partners and have developed corresponding plans to improve their solutions or collaboratively formulate new solutions. User companies have provided access to test-bed infrastructures, critical for the success of these projects. The potential impact of these collaborations is overall assessed as high. It features a multi-level nature, ranging from benefits to end-users (such as patients, tourists, or businesses), benefits to established companies (through improved, new, or complementary solutions to be commercialized), to contributions to the definition of enhanced industrial policies and practices. These synergies also led to significant outputs, emphasizing the development and commercialization of new technology with economic and societal impact. For instance, the **12 Entrepreneurial Research Initiatives**, of which the last projects ended in 2021, reported the construction of **92 prototypes and the submission of 11 new patents**.

The CMU Portugal Call for flagship Large-Scale Collaborative Research Projects has created a new strategy for Industry engagement with companies as the leading project promoters and investors, with nearly 4.2

M€ of private funding. **Companies are now responsible for dynamizing networks, relying on Portuguese R&D institutions and Carnegie Mellon teams, therefore taking the lead in modernizing the national economic fabric and reinforcing the innovation ecosystem.** The Large-Scale projects also allowed the Program to strengthen research connections with companies from its startup and innovation ecosystem (**Feedzai and Unbabel**), increase the commitment of industrial affiliates in R&D (**Farfetch, Outsystems**), and establish new partnerships with partners that have a strong presence in new lines of business and research from online privacy to health, energy, and environment sectors (**Altran Portugal- now Capgemini Engineering, Compta, DST Solar, First Solutions, Glinnt, Ingeniaris, Hospital da Luz Learning Health, Mobileum**). In addition to the 12 Promoters, 7 other companies joined the consortiums as co-promoters including 2 CMU Portugal Industry Affiliates (**Priberam Informática, S.A and Altice labs**), and **Hospital Da Luz S.A., Silvapor, Ambiente & Inovação Lda, 3 Drivers - Engenharia, Inovação E Ambiente, Lda. and Watt-Is**. Overall, 6 out of the 16 CMU Industry Affiliates – Altice labs, Farfetch, Feedzai, Outsystems, Priberam, and Unbabel – are involved in the Large-Scale Collaborative Research Projects.

Startups and entrepreneurial initiatives

CMU Portugal has also been a hub for faculty members, students, and alumni to launch their entrepreneurial initiatives. The Partnership has 12 startups that have been found or facilitated by activities of the CMU Portugal Program: **Dognaedis, Feedzai, Geolink, Mambu, Orange Bird, Prisma, Red Light, Sentilant, Streambolico, Veniam, and Unbabel**. Together these companies have attracted more than \$200 million in venture capital investment, created over 1,000 highly skilled jobs, and are already a reference in their activity sector, such as Feedzai and Unbabel – who are also part of the CMU Portugal Industry Affiliates – and Veniam. Furthermore, the non-profit **Patient Innovation**, born within CMU Portugal as an Entrepreneurial Research Initiative, continues to grow its reach to patients and caregivers worldwide with +1500 health solutions from over 80 countries.



Dognaedis

Dognaedis focus in three major activity areas within Information Security: Security Audit and Consultancy, Software Assurance and Business Continuity Support. Dognædis became part of the worldwide leader in the Security Services sector Prosegur in March 2016. By the end of 2018, the Group made another major acquisition with Cipher, a global cybersecurity company with offices located in North America, Europe and Latin America and in 2019 all companies within the Prosegur Cybersecurity Division including Dognaedis, transitioned towards the global brand Cipher, a Prosegur Company. Mário Zenha-Rela was a visiting faculty at CMU under the CMU Portugal Program and benefited from the CMU Portugal Entrepreneurship in Residence, a business acceleration program for entrepreneurial teams in the area of ICT. He was one of the professors involved in the Dual Degree professional master in Software Engineering (MSE), taught at FCTUC and Carnegie Mellon University.



Sentilant

Sentilant develops innovative and secure software solutions that use sensorial data collected from mobile devices to provide users and clients with disruptive applications and unparalleled real-time decision support information for vehicle road telematics and field service optimization businesses. The startup benefited from the results achieved during the CMU Portugal research project **Æminium – Freeing Programmers from the Shackles of Sequentiality**, co-lead by Bruno Cabral. The know-how and technology developed with **Æminium** were essential to plan, design and develop Sentilant's infrastructure.



Feedzai

Feedzai is the market leader in fighting financial crime, providing today's most advanced cloud-based risk management platform powered by artificial intelligence and big data. Founded and developed by data scientists and aerospace engineers, Feedzai has one critical mission: make commerce safe. The world's largest banks, payment providers and retailers use Feedzai's machine learning technology to manage risks associated with banking and shopping, whether it's in person, online or via mobile devices. The company is now valued at well above \$1billion that is a clear acknowledgment of the Program's outcomes and a proof of the impact that the partnership has in supporting strong and innovative ICT initiatives.

The partnership with Carnegie Mellon University was very important in the company's early days. Both Paulo Marques and Pedro Bizarro were Visiting Faculty at CMU under the scope of CMU Portugal and adjunct professors at Carnegie Mellon University, which granted the company a high degree of credibility. Since then, they have been engaged in a series of initiatives promoted by the Program in the US which opened Feedzai to new markets.



Geolink has specialized in the optimization of the operation of automotive fleets, involving mobile computing devices that communicate in real-time with central servers that permanently monitor and optimize the operation of vehicles. Call center solutions that tightly integrate with the fleet management services are also a fundamental component of the technological architectures developed by Geolink. They partner with major telecommunication operators for setting up our advanced solutions in terms of fixed and mobile communications and with NDrive to power the GPS navigation installed in the mobile terminals. Geolink was heavily involved with the CMU Portugal research project DRIVE-IN (Distributed Routing and Infotainment through VEhicular Inter-Networking), deploying 500 nodes vehicular network in the city of Porto, in the north of Portugal.



Mambu

Mambu is a startup company established by three alumni of the Master in Human Computer Interaction that is now worth over €1.7 billion. The three company founders met while attending the CMU Portugal Master's program in HCI at Madeira. They developed the company's idea as their Master Project – a year-long microfinance research project with a focus on Mozambique – which was their first step towards creating Mambu, a company operating in the microfinance sector that developed the banking platform "SaaS" (Software as a Service) that is today the leader market share. Mambu's platform is used by traditional banks, fintech startups, financial institutions, nonprofits and other businesses to power their financial products and services. Their customer list includes fintech start-ups, telcos and top tier banks, operate on six continents and help customers constantly change the way financial institutions operate and innovate, service more than 180 customers with over 33M end users.



Orange Bird

Orange Bird promotes crowdsourcing in Portugal and abroad through its several initiatives, including PPL, the main reward-based crowdsourcing platform in Portugal. The goal of this startup is to promote the concept of crowdfunding (collective finance) in Portugal and to boost entrepreneurship and social development within the country. Unprecedented forms of cooperation and communication were made possible by technological advances. Virtual networks can capture a collective knowledge and experience that surpasses those of an individual. The same applies to the collective effort and creativity of the masses. Another promising potential is the ability to collectively choose the best for a community, and ultimately donate or invest in meaningful and impactful ideas, projects and institutions. One of the co-founders, Pedro Oliveira, was conducting research on the role of users in developing innovative financial services, including crowdfunding and director of the dual degree doctoral program in Technology Change and Entrepreneurship offered by Católica-Lisbon, Técnico and CMU in the scope of the Carnegie Mellon Portugal Program.



Prsma

Prsma is a company created by a M-ITI team associated with an entrepreneur from the electronics industry, to commercialize EnergySpectrum. The sensing system is capable of disaggregating home energy consumption using a low-cost and effective non-intrusive approach. The sensing system is coupled with a middleware web system that supports novel eco-feedback strategies that are meaningful and compelling for families and households. EnergySpectrum is one of the outcomes of the research project, Sustainable Interaction with social Networks, context Awareness and Innovative Services (SINAIS), carried out in the scope of the CMU Portugal Program. This project allowed testing of cost-effective solutions for disaggregation of electrical signals in a partnership with Empresa de Electricidade da Madeira (EEM).



RedLight

RedLight Software is a process-driven software company providing solutions for the health sector in Europe, from product specification and early design concepts to product launch and maintenance. It is a technological startup originated from the Carnegie Mellon Portugal initiative as a direct outcome of the multidisciplinary partnership in software engineering, quality processes (CMMI) and human-computer interaction.



Streambolico

Streambolico technologies offer enhanced quality of experience for real-time data streaming over wireless networks. The Company solutions combine wireless multicasting, interactive apps and the power of network coding, to deliver the right data packets to the right customer at the right time. The key challenge, which its technology is able to overcome, is caused by the typically poor quality of the wireless link, which causes loss of critical data packets and strong deterioration of the perceived video quality. The Company technology allows all users to recover lost packets with very limited delay. Streambolico's team has a large experience in developing and prototyping multimedia platforms for wireless communications, including communication software, communication protocols, security mechanisms and coding algorithms. The company was founded by João Barros, former national director of the CMU Portugal Program, and Paulo Oliveira, a Ph.D student that spent several periods at Carnegie Mellon University. Streambolico was acquired by Codavel in 2018.



Virtual Traffic Lights

VTL patented a disruptive technology that provides for the advancement in Traffic Management. This advancement substantially improves traffic efficiency and safety by using V2V and V2I communications whereby vehicles communicate with each other and traffic infrastructure. Helping to reduce traffic accidents and fatalities, reduce commute times, and improve the overall safety of drivers. Virtual Traffic Lights (VTL), was founded based on technology developed under the CMU Portugal Project: DRIVE-IN - Distributed Routing and Infotainment through Vehicular Inter-Networking.



Veniam

Veniam is a tech startup accelerating the future of mobility by delivering the Internet of Moving Things. With an IP portfolio of 150+ patents, Veniam's Intelligent Networking platform enables connected cars and autonomous vehicles to move massive amounts of data between vehicles and the cloud, at a fraction of the cost, using advanced simulation software. This startup is able to deliver detailed studies on the expected quality of service, bandwidth, latency and coverage for different cities, vehicle densities and traffic scenarios. VeniamWorks is a spin-off company of the Instituto de Telecomunicações and the Universities of Aveiro and Porto based on technology developed under the CMU Portugal Project: DRIVE-IN - Distributed Routing and Infotainment through Vehicular Inter-Networking. The company was founded by pioneering technology researchers including João Barros, former CMU Portugal National Director and Susana Sargento, CMU Portugal Scientific Director and faculty member. Veniam is a global company with its headquarters in Mountain View, California, an Engineering Center in Porto (Portugal) and sales offices in Detroit, Munich and Tokyo.



Patient Innovation

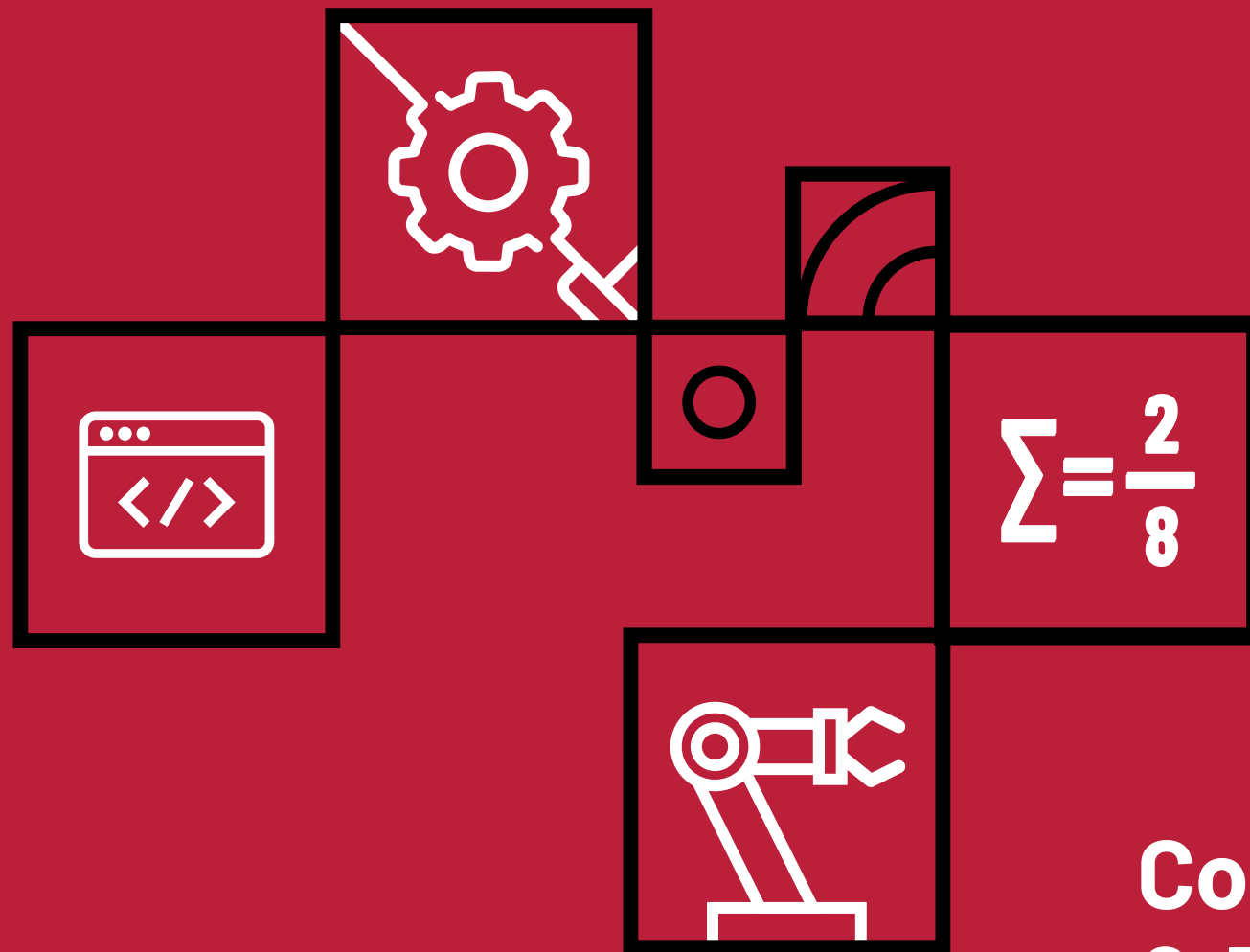
Patient Innovation is an online platform where patients and caregivers around the world connect to share and create solutions they developed themselves or had the help from collaborators to cope with a health-related problem. The Patient Innovation project investigates the role of patients of chronic rare diseases in the development of new treatments, therapies, or medical devices. It features over 1500 solutions developed by patients, caregivers and collaborators, from 80 countries, and approved by its medical team. In 2018 Patient Innovation expanded its operations to Scandinavia, and more specifically created a new hub in Copenhagen (Denmark). The Patient Innovation project "Offer your hand" was one of the winners of the Santa Casa Challenge and the Fidelidade Comunidade

prizes that reward social inclusion and healthcare promotion projects. Patient Innovation results from the CMU Portugal project "Technology, Entrepreneurship, and Innovation Policy Lab" and was founded by Helena Canhão and Pedro Oliveira, Principal Investigators of the project.



Unbabel

Unbabel's Customer Service Solution allows modern enterprises to understand and be understood by their customers in dozens of languages by combining human expertise and artificial intelligence (AI). Powered by AI and refined by a global community of translators, Unbabel combines the speed and scale of machine translation with the authenticity that can come only from a native speaker. Based in San Francisco, California, Unbabel works with leading customer support teams at brands such as Facebook, Microsoft, Booking.com, and Uber, to communicate effortlessly with customers around the world, no matter what language they speak. Unbabel was founded by Vasco Pedro, a graduate from CMU's Language Technology Institute (LTI) and CMU Portugal project post-doctoral fellow. André Martins, CMU Portugal alumni, is the VP of Artificial Intelligence Research



**Communication
& Events**



Strategy & Communication Overview

For the 2020-21 period, the **CMU Portugal Program's communication strategy continued to support its mission and objectives** through the promotion of its achievements, initiatives, and events while strengthening a network collaboration involving the Program community and main stakeholders.

The **key communication objectives** for the CMU Portugal Program in 2020-21 included:

- Enhancing the Program's visibility, particularly on online platforms;
- Disclosing the Program's initiatives and activities;
- Building a strong communications network to share common initiatives and increase the Program's outreach.

To fulfill these objectives, the program oversees a **very wide spectrum of communication activities** as listed below:

- Online activities
- Media related activities
- Events (as a promoter and supporter)
- Outreach & networking activities



Communication in Numbers

Online Platforms

| Website (2020 - 2021)



76
CMU Portugal
News articles

28
Events Shared

+60
CMU Portugal
Mailings

11
Newsletters

| Social Media (2020 - 2021)



Facebook


36k
Global Reach


784
Nº of followers



Instagram


3.8k
Global Reach


422
Nº of followers



Twitter


894K
Impressions


422
Nº of followers



LinkedIn


113K
Impressions


1 126
Nº of followers

Online Activities

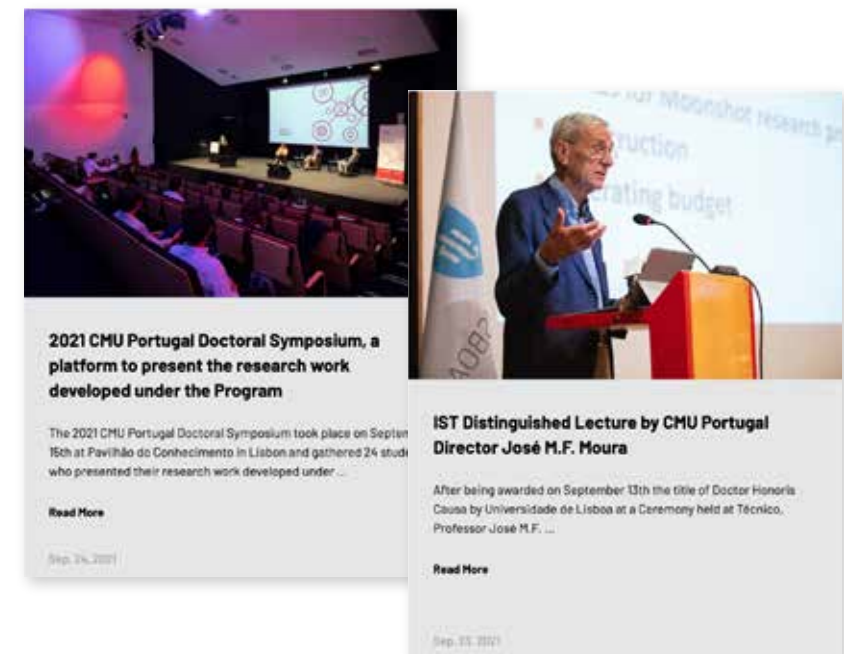
Web-based platforms are essential tools to promote and release the results achieved within the Program.

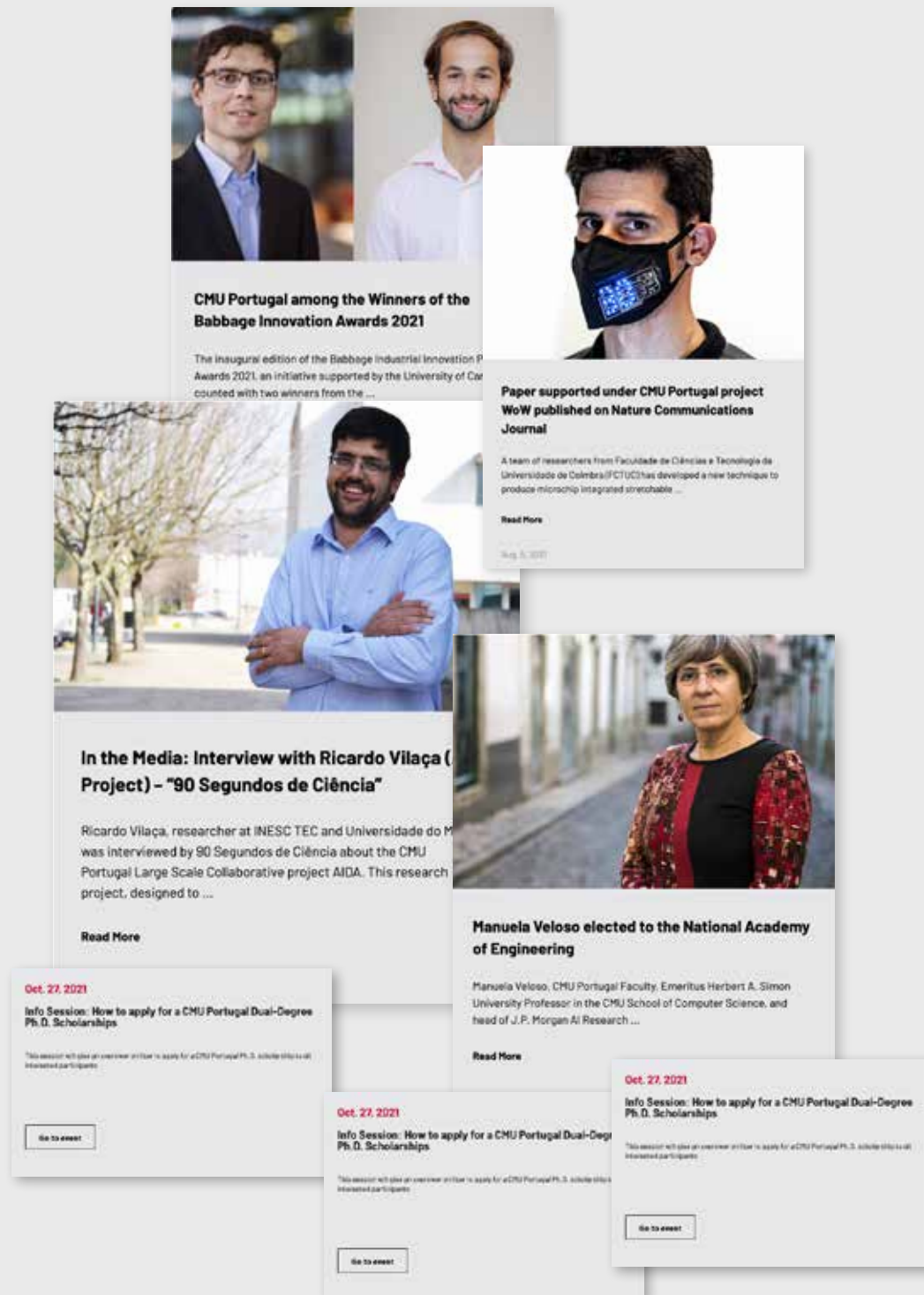
Website

The website is used to disclose news about Education, Research, and Innovation, as well as events, news in the media, and other partner-related content, namely:

- **News articles** - With all the information about our latest activities and initiatives;
- **Inside stories** - Monthly features with interviews and articles with members of our community (industry partners, students, and faculty) but also online articles to follow up relevant achievements (awards, papers, etc.);
- **Events** - Disclosure of all events related to the Program (Portugal and Pittsburgh);
- **Publications** - Regular updates of all publications related to the CMU Portugal Program, including those supported under CMU Portugal projects, authored by CMU Portugal Faculty, students, and researchers.

Between 2020 and 2021, 76 CMU Portugal news articles were published, and 28 events were announced on the website.





CMU Portugal Videos

In 2020 and 2021, CMU Portugal developed a set of **14 institutional videos**. These were instrumental in disclosing CMU Portugal's main mission and goals and promoting the research work being developed under the Program's scope to a broader audience.

The first video was launched in 2020 with an **overview of the Program's outcomes and achievements** focusing on the education, research and innovation activities implemented during the third phase.

Later in 2021, counting with the contribution of all the companies and institutions involved in the CMU Portugal Large Scale Collaborative Projects (2019 Call), the Program launched **an overview video of all the projects and 12 individual videos to present each project**. The videos are public on CMU Portugal's website and YouTube Channel.



Social Media

Social media platforms are increasingly widespread amongst individuals and organizations and provide an opportunity to establish potentially, build relationships and engage with our audience.

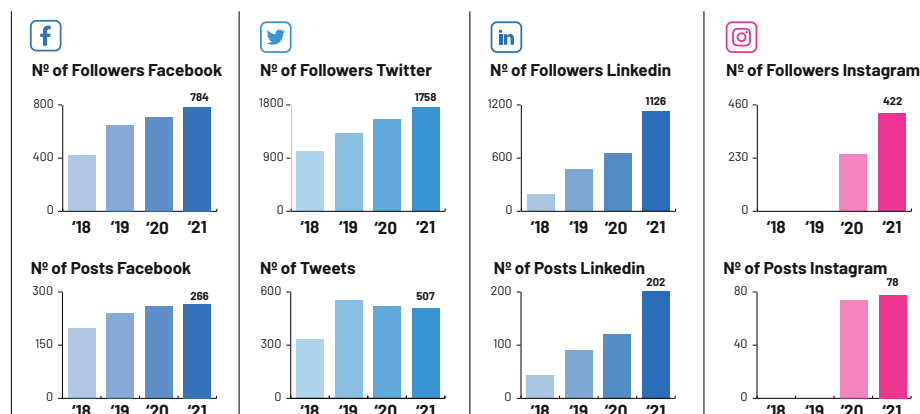


The content shared on CMU Portugal Program web platforms, namely Facebook, Twitter, Instagram, LinkedIn, and YouTube are mainly focused on:

- CMU Portugal initiatives (activities, events & CMU Portugal publications);
- Carnegie Mellon University initiatives and activities;
- Relevant information from partner Universities and companies involved with the Program;
- News and trends on ICT or other relevant topics to the community;
- Other general information that might be of relevance to CMU Portugal audience.

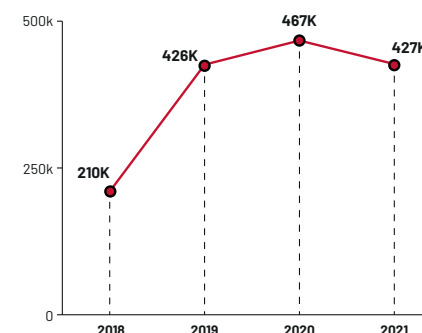
For the last two years, the Program has been firmly committed to building a robust online network involving Partner Institutions such as universities, research institutions, laboratories, and companies.

Between January 2020 and December 2021, the number of publications on social media outlets increased, especially on LinkedIn, where the total number of posts nearly doubled, directly impacting the growth of the number of followers. Overall, the efforts to regularly produce and share relevant content throughout all social media channels contributed to a positive evolution of social media followers in these last years.

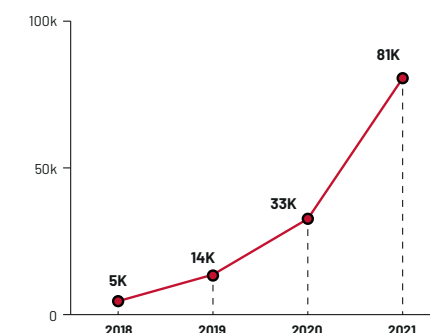


The LinkedIn account was the one with the most relevant growth between 2020 and 2021, not only in terms of followers but also in impressions.

Twitter Impressions

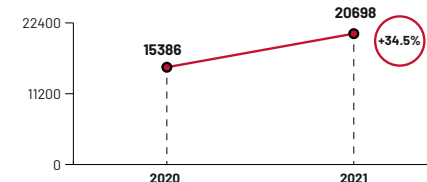


LinkedIn Impressions

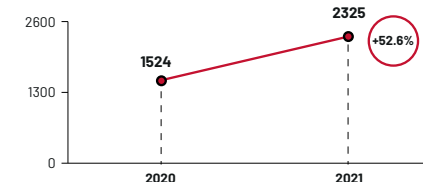


On Facebook and Instagram, the page reach increased significantly (+34.5% and +52.8%, respectively) even though a decrease was noticed in the number of page visits on Facebook. On Instagram, the number of page visits had substantial growth (+118%), showing that the presence on this platform, launched in 2020, still has the potential to expand.

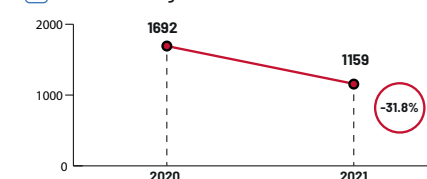
Facebook Page Reach



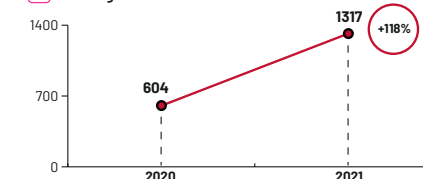
Instagram Page Reach



Facebook Page Visits



Instagram Profile Visits



Regarding Social Media activities, the CMU Portugal Program has been, since July 2021, collaborating and contributing to Carnegie Mellon's monthly report "CMU Social Media Wins" which presents the University's activity on social media also featuring CMU's international partnerships.

Newsletter



Between 2020 and 2021, the Program released 11 Newsletters.

In 2018, the Program launched its first **bi-monthly digital newsletter** named “News from the Fence” to promote its initiatives, including news, events, and CMU Portugal papers, which are distributed through an online mailing platform. The newsletter is available on the CMU Portugal website and is shared on our social media networks. The name chosen refers to the Carnegie Mellon Campus Fence, an unofficial billboard that students use to paint with poignant messages, to advertise upcoming events or recent accomplishments.

Direct-targeted mailing campaigns



E-mail messages for specific audiences are used for announcements, invitations to events, recruitment for graduate programs, and other important information in between newsletters. Myemma is also the mailing platform used for this end.

Between 2020 - 2021 a total of 41 mailings were sent to CMU Portugal audiences.



Press and Media Activities

Adding to the online communication, CMU Portugal also coordinates media communication activities. These cover content with potential interest to the media, through press releases to highlight the Program's initiatives and other achievements, or by negotiating news coverage directly with journalists to promote interviews, opinion articles or other journalistic content to disclose CMU Portugal to a broader audience.

Press releases

CMU Portugal Press releases are aimed at highlighting the Program's initiatives and other achievements.

Between 2020 and 2021, **the CMU Portugal Program launched 10 Press Releases (PRs)** to the Portuguese Media, 3 in 2020 and 7 in 2021.

2020

April

21 million euros for new R&D Projects under the CMU Portugal Program

May

CMU Portugal supports the development of 7 new projects in the ICT area

October

CMU Portugal has up to 12 Dual Degree Ph.D. Scholarships for the 2021/22 the Academic year

2021

January

CMU Portugal Startup MAMBU Becomes a Unicorn Company

January

Inês Lynce is the new co-director of the Carnegie Mellon Portugal Program

February

Call is open for up to 12 Ph.D. Scholarships at Portuguese Universities under the CMU Portugal Program

May

Open Call for 2021 Exploratory Research projects

June

Innovative Ink Allows to Print Flexible, Stretchable and Multi-Layer Circuits

November

Open Call for up to 10 Dual Degree Ph.D. Scholarships to study in Portugal and at CMU

December

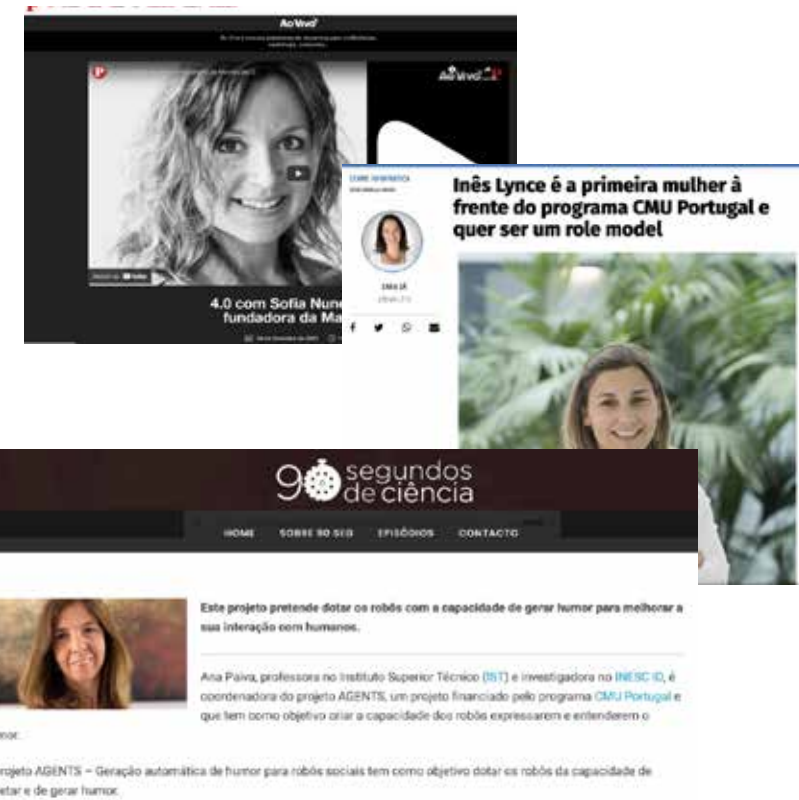
CMU Portugal adds 6 new exploratory projects in ICT to its research portfolio



One-to-one negotiations

CMU Portugal assesses, whenever relevant, potential topics of interest to the Media regarding the Program and establishes strategic contacts with journalists to promote interviews, opinion articles, and other media news.

In 2020-21, the Program proactively promoted 10 pieces, including news articles, podcasts, and radio interviews, to ensure more detailed coverage of some CMU Portugal outcomes.



Overall, the Program media activities resulted in **more than 187 references in articles published in the Portuguese media** between January 2020 and December 2021. The Internet was the primary medium with 173 online articles, followed by 6 Radio & Podcasts, 5 TV & 4 printed articles.

Summary of CMU Portugal presence in the media (2020 - 2021)

187 CMU Portugal related Articles in the Media

173
Online

5
TV pieces

6
Radio and
Podcasts

4
Printed
Articles

Events and Outreach



From January 2020 to December 2021, the CMU Portugal Program organized several **events to reach academic and industry communities** and raise awareness about its initiatives among new stakeholders and audiences. The Program held an Orientation Day in 2020, gathering new students and Faculty in a mixed-format event at the Luso-American Development Foundation (FLAD). In 2021, a similar reception event for new students entitled “CMU Portugal Doctoral Symposium” took place in Lisbon with meaningful onsite participation.

During this period, the Program has also organized **outreach and engagement events online**, namely two annual Online Info Sessions addressed to Dual Degree Ph.D. Programs and Affiliated Ph.D. Programs potential candidates.

Furthermore, to disclose and promote the Program’s new initiative, “Advanced Training Programs”, two Series of Webinars, “Data Science Talks @CMUPortugal” and “User Experience Design Talks @CMU Portugal” were organized with three sessions each, having CMU Faculty as speakers.

CMU Portugal also participated in larger outreach events such as the leading annual Portuguese Science Summit “Encontro Ciência” hosting a CMU Portugal Session in 2020 and 2021. In May 2021, the Program joined the Bauhaus of the Seas Conference as a partner of this initiative at the Lisbon Museum of Art, Architecture, and Technology (MAAT) gathering distinguished speakers from all over the globe involved in the New European Bauhaus (NEB) Initiative.

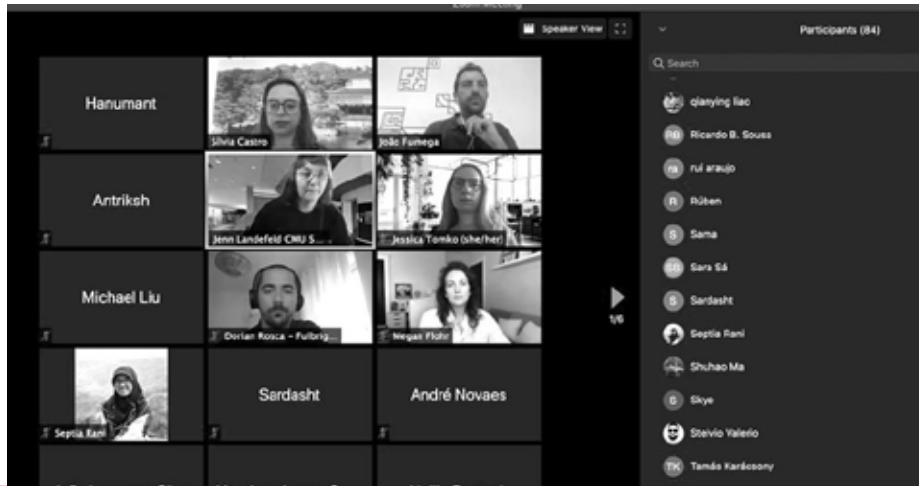
The Program was also one of the partner institutions of the 11th edition of the Lisbon Machine Learning Summer School (LxMLS 2021) that took place on July 7- 15th, 2021, with a record number of 774 applications, 245 registered attendees (39% female) from 24 countries, 17 speakers, and 23 monitors. This virtual school results from a partnership between Técnico, Instituto de Telecomunicações, INESC ID, Lisbon Unit for Learning and Intelligent Systems, Unbabel, Priberam, Carnegie Mellon Portugal, and sponsored by Google and Cleverly.

Finally, by the end of 2021, the Program organized a **visit from the Portuguese Minister of Science, Technology and Higher Education to Carnegie Mellon University**, focused on strengthening the cooperation between Portugal, Carnegie Mellon University, and Industry through the Carnegie Mellon Portugal Program. The visit included Individual meetings with CMU leadership and Faculty; a Network-lunch with 17 CMU Portugal Dual Degree Ph.D. students and Advisors; the Presentation of CMU Portugal Exploratory Projects and three thematic workshops addressing the themes of the Program’s Large-Scale Collaborative Research Projects:

- Understanding Conversations to Improve Productivity
- Vehicular Technologies, Waste Management, and Safer Forests
- Improving Machine Learning and Applications in Healthcare

Next are highlighted all the events that occurred in 2020 and 2021.

Outreach and Public Events



February

2020

FLAD Sessions in Porto and Minho, to promote training initiatives in the USA.

June

2020

Annual Board of Directors (BoD) Meeting.

March

2020

Announcement of the Visiting Students Program results

November

2020

Encontro Ciência 2020: Session "CMU Portugal – defining new frontiers in Technology within the health sector"

Career development Session with company Chaperone, for CMU Portugal Dual Degree students.



Online Info Session "How to apply for a CMU Portugal Dual-Degree Ph.D. Scholarship" (+200 attendees.)

Webinar at "ISTJob Shop" to promote the Program's Education activities.

CMU Portugal 2020 Orientation Day

October

2020



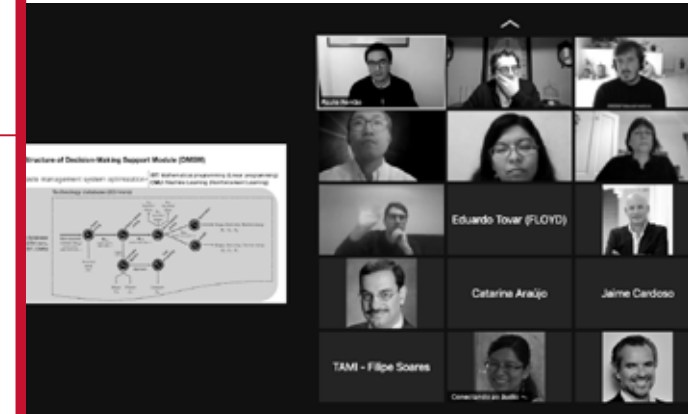
Outreach and Public Events

January

2021

External Review
Committee Meeting (ERC)

"Data Science Talks @
CMUPortugal" I Session 1:
"Conversational Assistants
for Complex Search Tasks"
by Jamie Callan (CMU)



April

2021

"User Experience
Design Talks @CMU
Portugal" I Session 1:
"Designing Systems
that Blend Human and
Machine Intelligence" by
John Zimmerman (CMU)

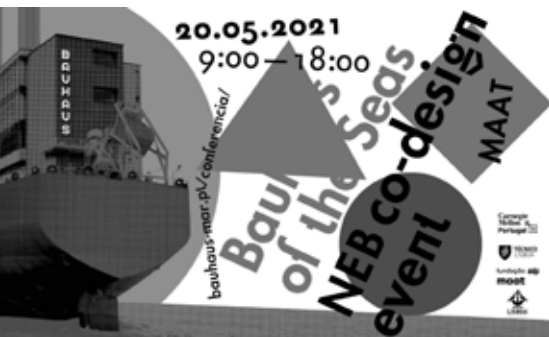


May

2021

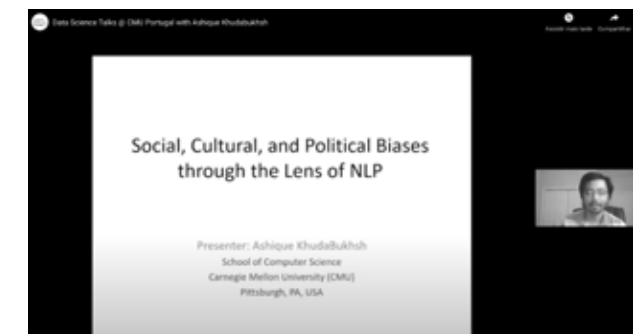
Bauhaus of the Seas International
Conference with CMU Portugal
partnership

"User Experience Design Talks @CMU
Portugal" I Session 2: "Making Active
Materials Green: Morphing Matter for
Sustainability"



Online Info Session "How to
apply for a CMU Portugal Dual-
Degree Ph.D. Scholarship"
(+200 attendees.)

"Data Science Talks
@CMUPortugal" I Session 2
"AI Learns to Race: Machine
Learning for Autonomous
Driving" by Eric Nyberg
(CMU) and Session 3 I "Social,
Cultural and Political Biases
through the Lens of NLP" by
Ashique Khudabukhsh (CMU)



February

2021

Outreach and Public Events

November

2021

Portuguese Minister of Science, Technology and Higher Education visits CMU



June

2021

CMU Portugal Session at Encontro Ciência 2021 Summit "The contribution of the CMU Portugal international partnership for the high-tech ecosystem in Portugal"

"User Experience Design Talks @CMU Portugal" I Session 3: "Context-Driven Implicit Interactions" by Gierad Laput from Apple

December

2021

Webinar #1 of the AIDA Webinar Series



2021 Fall Welcome Back Lunch for CMU Portugal Ph.D. students at CMU

Online Info session "How to apply for a CMU Portugal Dual-Degree Ph.D. Scholarship"

October

2021

2021 CMU Portugal Doctoral Symposium

September

2021





#CMUPortugal



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