ANNOUNCEMENT FOR THE AWARD OF A RESEARCH FELLOWSHIP

37/ECUM/CMAT/2023- UIDB/00013/2020 (6)

A call for applications is now open for the attribution of 6 (six) research grants within the scope of the R&D project UIDB/00013/2020-Financiamento Base of the Centre of Mathematics, School of Science, University of Minho, financed by national funds through "Fundação para a Ciência e Tecnologia", under the following conditions:

Scientific Area: Mathematics

Recipient category: Students enrolled in a MSc (2nd cycle) course in the areas of Mathematics, Computer Science or Statistics, of the University of Minho.

Requirement for granting the fellowship:

The applicants may apply without prior registration in the course for which the fellowship is open. The requirement to enrol in a degree course or non-academic degree course will be verified on the date of contracting the fellowship;

Only fellowships whose selected applicants present a valid proof of enrolment in a degree course or non-academic degree course will be contracted, according to the type of the fellowship, issued by the academic services of the Higher Education Institution, indicating, respectively, the academic year or its duration (star and term).

Candidates profile: The candidates must have a profile that fits the research activities foreseen in the research project(s) to which he/she is applying. The 10 (ten) projects in this call are listed where, in particular, the candidate profile of each project is described.

Applicants eligibility: Applicants must comply with the eligibility conditions laid down in article 9 of the Research Grants Regulation of the Portuguese Foundation for Science and Technology (2019).

Workplan and objectives to be achieved: It is intended that the fellowship researcher collaborate in the research activities of the CMAT, integrating one of the projects whose description and supervisors are indicated below, including the corresponding target audience. The candidate must mention up to 3 (three) references of projects for which he is applying, in descending order of preference, chosen from among the following 10 (ten) projects:

[Proposal BI2023-A] Automated Metadata Extraction from Geological Research Articles
Supervisor: Cecília Castro (cecilia@math.uminho.pt)
Target audience: students of the Master in Mathematics and Computation
Work plan: This project aims to design, develop, and implement an automated system for extracting metadata from scientific articles, with a focus on the field of geology. The primary goal is to identify and catalog the most frequently cited geological sites in the scientific literature. The information extraction procedure should be capable of retrieving the geolocation of each site from a variety of formats, which can range from text, such as names, to images, like maps. This implies the use of image processing techniques and pattern recognition to identify and extract the desired coordinates. Furthermore, other relevant information should also be gathered, including the authors' names,

nationalities, and institutional affiliations, as well as the publication date of the articles referencing the site. By automatically storing this type of information in a structured format, it becomes possible to gain an understanding of the variety of known and studied geological sites worldwide and their importance. Additionally, this stored data provides valuable insights into research trends, author collaborations, and the impact of individual studies on the broader scientific discourse. This project has the collaboration of Professor José Brilha, full professor of the School of Sciences, University of Minho.

[Project BI2023-B] Study of species distribution models incorporating spatial correlation
Supervisor: Raquel Menezes (rmenezes@math.uminho.pt)
Target audience: 2nd-year students of the Master in Statistics for Data Science
Work plan: Sardines and other pelagic fish are of great cultural and economic importance in Portugal. Species Distribution Models allow the learning of environmental factors that favor or hinder the occurrence and abundance of species in a region. Recently, methods have been developed that allow the estimation of their spatial distribution and evolution over time, by incorporating random effects with spatial correlation. This project proposes to study these methods, applying them to real data, in order to generate knowledge about these resources in the current context.

[Project BI2023-C] Semigroups of transformations with an invariant set
Supervisor: Suzana Mendes Gonçalves (smendes@math.uminho.pt)
Target audience: 1st -year students of the Master in Mathematics and Computation
Work plan: Given a non-empty set X, the set of all transformations $\alpha:X\to X$, under composition, is a semigroup, usually denoted by T(X). This semigroup, as well of several of its subsemigroups, has been studied by many authors, since every semigroup S is embeddable in a semigroup T(Z), for some set Z. The principal aim of this project is to study the structure of subsemigroups of T(X) whose elements are transformations that leave invariant a certain set: for example, the semigroup of all transformations $\alpha:X\to X$ such that $Y\alpha\subseteq Y$, where Y is a fixed subset of X.

[Project BI2023-D] Machine Learning Approach for Combinatorial Optimization of Time-Series Analysis
Supervisors: Fernanda Costa (mfc@math.uminho.pt), Flora Ferreira (fjferreira@math.uminho.pt)
Target audience: 1st -year students of the Master in Mathematics and Computation
Work plan: Abstract: When analyzing time-series data, multiple categorical dimensions can be present. These dimensions offer the option to either split the data or aggregate it without considering these dimensions. However, exhaustive splitting across all dimensions becomes impractical due to the exponential increase in the number of time-series to analyze. Conversely, fully aggregating the data into a single time-series diminishes valuable information and yields suboptimal analysis results. This project proposes the development of an optimization algorithm, utilizing machine learning techniques, to determine the optimal approach for aggregating or splitting a time-series dataset along various dimensions. The aim is to enhance unsupervised anomaly detection in time-series analysis.

[Project BI2023-E] The chaotic dynamics of Smale's horseshoe application
Supervisor: Davide Azevedo (davidemsa@math.uminho.pt)
Target audience: students of the Master in Mathematics and Computation
Work plan: The horseshoe application is defined from a region S of the plane, consisting of a square and two semicircles connected to it on the left and on the right. It is a diffeomorphism of S, which contracts the domain in the vertical direction, stretches it in the horizontal direction and then folds it

into a horseshoe shape contained in S. The aim is to study the dynamics of this map, which has a rich structure. For this, another dynamical system that is easier to study will be used as support. This project is accessible to students from both specialization areas and does not require prior knowledge of dynamical systems.

[Project BI2023-F] Stability of discrete neural network models
Supervisor: José Joaquim Martins Oliveira (jjoliveira@math.uminho.pt)
Target audience: students of the Master in Mathematics and Computation (specialization area in Mathematics, Pure Mathematics Profile)
Work plan: In this project, in the first moment, it is intended to study the main types of discrete-time neural network models with delays and describe the main known stability criteria. In a second moment, it is intended that the scholarship holder study the existing techniques for obtaining the global stability of Hopfield-type models and try to find out to what extent new stability criteria can be obtained for other types of discrete neural networks models, such as BAM (bidirectional associative memory) models, Cohen-Grossberg models, and/or higher order Hopfield models.

[Project BI2023-G] Modeling HIV test utilization in the Lisbon cohort of men who have sex with men and associated factors
Supervisors: Carla Moreira (d8434@math.uminho.pt), Luís Machado (lmachado@math.uminho.pt)
Target audience: students of the Master in Statistics for Data Science
Work plan: In 2019, the HIV incidence was 7.6 cases per 100,000 people, with the majority in men. Of the cases diagnosed in individuals under 30 years of age, 65.2% were diagnosed in MSM. In Portugal, laboratory screening for HIV infection is recommended annually for MSM, or more frequently if they present a clinical picture compatible with primary infection or if they remain at high risk of exposure to HIV. This study aims to identify the frequency of HIV testing in HIV-negative men who have sex with men.

[Project BI2023-H] Inverse function theorem
Supervisor: José Manuel Ribeiro Oliveira (jmo@math.uminho.pt)
Target audience: 1st or 2nd-year students of the Master in Mathematics and Computation
Work plan: It is well known that the inverse function theorem states that a smooth mapping, in which its derivative at a point of its domain is a linear isomorphism, admits a restriction which is a diffeomorphism. When the derivative of the mapping is not necessarily bijective, it is also possible to characterize properties of the mapping under lighter hypotheses such as surjective derivative or injective derivative. This work embraces the study of some properties of smooth mappings between two smooth manifolds in which its derivatives are injective mappings or surjective mappings, enhancing the construction of submanifolds as inverse images of regular values of smooth mappings.

[Project BI2023-I] Inductive Logic Programming: logical foundations and computational systems
Supervisors: José Carlos Espírito Santo (jes@math.uminho.pt), Luís Pinto (luis@math.uminho.pt)
Target audience: 1st -year students of the Master in Mathematics and Computation
Work plan: Inductive logic programming (ILP) offers an alternative machine learning paradigm, based on logic and inductive reasoning, where the goal is to induce a hypothesis (a logic program), capable of generalizing prior knowledge and a collection of training examples. In this project, it is intended, on the one hand, to study the logical foundations of ILP and inductive reasoning, including techniques

such as abduction, subsumption or inverse resolution, and, on the other hand, to get acquainted with computational systems based on ILP, such as, for example, ILASP or Popper.

[Project BI2023-J] Generalized Linear Mixed Models
Supervisor: Susana Faria (sfaria@math.uminho.pt)
Target audience: 1st -year students of the Master in Statistics for Data Science
Work plan: Generalized Linear Mixed Models (GLMMs) are particularly useful for describing the relationship between a response variable and one or more explanatory variables in grouped data according to one or more factors, such as longitudinal data, repeated measurements, and data with a hierarchical structure. This study aims to address the problem of parameter estimation and variable selection in GLMMs. Additionally, we intend to apply these models to a real dataset.

Applicable legislation and regulations: Research Fellowship Holder Statutes, approved by Law no. 40/2004 of August 18, in its current version published by Decree-Law no. 123/2019 of august 28; Regulation of Scientific Research Fellowships of the University of Minho (RBIC), published in "Diário da República", 2nd serie, no. 119, through dispatch no. 6524/2020 of 22-06-2020, ratified by ratification declaration no. 447/2021 of 22-06-2021 and Regulation of Research Studentships and Fellowships (RBI) of the Foundation for Science and Technology, I.P. - in force.

Host/Contracting institution and scientific supervision: The workplan will be carried out in Centre of Mathematics of University of Minho, located in Campus de Gualtar or Campus de Azurém, under the scientific supervision of the member(s) of CMAT who proposed the research plan chosen by the candidate.

Fellowship duration: The grants will have an initial duration of 3 months, starting in October 2023 and ending on December 31, 2023. The eventual renewal of scholarships, for a period of up to 3 months, is subject to approval by CMAT.

Amount of the research grant: The value stipend (Monthly Maintenance Allowance) is **930,98 euros** per month, in accordance with the stipends values published by the Foundation for Science and Technology (FCT I.P.) in the country (Annex I – Monthly Stipends Values for the maintenance allowances of the FCT Regulation for Research Studentships and Fellowships) and Annex II of the Regulation of Scientific Research Fellowships of the University of Minho (RBIC), published in "Diário da República", 2nd serie, no. 119, through dispatch no. 6524/2020 of 22-06-2020, ratified by ratification declaration no. 447/2021 of 22-06-2021, according to the applicable regulation.

Payment is made on the 23st of each month, through bank transfer to the Bank Identification Number of the fellow identified in the contractualization process.

Exclusivity regime: The grantee will perform the activities under exclusivity, as foreseen in article 5º of the Research Fellow Statutes and applicable regulations.

Selection panel:

President: Marta Susana Ribeiro Ferreira, Assistant Professor at the Department of Mathematics, member of CMAT, University of Minho

Effective member: Irene Vitória Ribeiro de Brito, Assistant Professor at the Department of Mathematics, member of CMAT, University of Minho

Effective member: Eurica Manuela Novo Lopes Henriques, Assistant Professor at the Department of Mathematics, member of CMAT, University of Trás-os-Montes e Alto Douro

Substitute member: Maria Cláudia Freitas Sousa Mendes Araújo, Assistant Professor at the Department of Mathematics, member of CMAT, University of Minho

Substitute member: Carolina Paula Baptista Ribeiro, Assistant Professor at the Department of Mathematics, member of CMAT, University of Minho

The first effective member will substitute the President of the selection panel in case of impediment, being nominate the first substitute member in the place of the first effective member.

Criteria and procedures for applications assessment and selection: The applications assessment will focus on the candidate's Merit, following evaluation criteria, valued on a scale of 1 to 5 values:

Applicant Merit - AM (100%):

A1. Academic path (considering the classifications of academic degrees), with a weighting of 50%;
A2. Personal curriculum (considering professional and scientific background), with a weighting of 30%;
A3. Motivation letter, with a weighting of 20%.

The final classification of the applicant's merit with the achieved through the following formula:

$$\mathbf{AM = (A1 \times 0{,}5) + (A2 \times 0{,}3) + (A3 \times 0{,}2)}$$

An applicant with an AM score of less than 3,5 will not be eligible for a research grant.

If the jury considers it is convenient, candidates with a minimum classification of 3,5 in the AM, will be admitted to the Interview stage, with the Jury proceeding to assess the following sub-criteria:

Interview - INT (30%)

B1. Communication, with a weighting of 50%;
B2. Attitude, with a weighting of 50%.

The Interview classification (INT) will be obtained by applying the following formula:

$$\mathbf{INT = (0{,}50 \times B1) + (0{,}50 \times B2)}$$

If an interview takes place, the final classification (CF) of the Applicant Merit (AM) and Interview (INT) will be obtained by applying the following formula:

$$\mathbf{CF = (AM \times 0{,}7) + (INT \times 0{,}3)}$$

If there is no interview, the final classification (CF) will coincide with the Applicant Merit (AM):

$$\mathbf{CF = AM}$$

The academic degrees and diplomas documents, or their respective recognition when awarded by foreign higher education institutions are not mandatory in the application phase, being replaced by a declaration of honor of the candidate with the contents of academic results. The documents of academic qualification or respective recognition will be required in the contracting phase and must

attest facts that occurred on a date prior to the application. In situations of divergence between the information contained in the declaration and the documentation submitted for contracting the grant, only the information contained in the latter will be consider. If the documents proving the ownership of the academic degree and diploma, or the respective recognition under the terms of Decree-Law No. 66/2018, of August 16, do not correspond to the classifications awarded in the evaluation of the academic path, which can change the candidate's ranking, the fellowship won't be contracted.

Notes: *Applicants with degrees obtained abroad must present proof of recognition of qualifications in Portugal and conversion of the final classification obtained in them to the Portuguese classification scale or declaration under the terms indicated in the previous point. Candidates who do not comply with one of these provisions, the selection panel will assign "0" in the grade of the graduation and/or master course. Candidates will be evaluated on the remaining parameters.*

Disclosure of results: The provisional results of applications, based in the selection panel minutes, will be send to the applicants by email until 90 working days from the applications deadline.

The provisional results of applications will contain information about the classification obtained by each candidate, as well as the project associated to the scholarship (in case of favourable result).

If case of unfavourable results, the candidates have a period of 10 working days to comment, if desired, in a prior hearing to interested parties, pursuant to articles 121 and 122 of the Code of Administrative Procedure (DL no. 4 / 2015 of January 7th).

Complaint and appeal procedures: The final results of the evaluation will be published through an ordered list (*alphabetically*), posted in a visible and public place of the host unit, as well as by email to all applicants, enclosing for that purpose, the minutes of the jury deliberations.

The selected candidate must inform its willingness to accept the grant, in writing. In case of rejection, a new distribution of projects/scholarships will be made among the non-excluded candidates. [1]

The final decision can be contested within 15 working days, by sending to the President of the jury the corresponding claim. Interested parties may also submit an optional hierarchical appeal, addressed to the Pro-Rector for Scientific Projects and Research Management, Professor Doctor Sandra Paiva.

Constitution of a selection reserve list: The applicants ranked in the next positions on the ordered list will be included in a selection reserve list, which can be used until 31/03/2024.

Application deadline and submission: The call for applications is open for a period of **10 working days** from the date of publication on the Euraxess portal.

Applications must be formalized by sending an application letter with the following documents: curriculum vitae; qualifications certificate or declaration of the applicant; motivation letter; statement proving that meets the conditions for the grant typology, according to the application requirements; other documents important to the evaluation process.

[1] A candidate with an awarded scholarship may exchange the associated project for another with a higher preference in the manifested choice.

Applications must be sent by email to **bolsas@ecum.uminho.pt**, indicating the reference of the call for applications in Subject: **37/ECUM/CMAT/2023 – UIDB/00013/2020**. Applications submitted by other means will not be accepted.

Fellowship contractualization: The fellowship will be attributed by signing a fellowship contract between the University of Minho and the fellow, accordingly with the contract minute (annex IV of the Regulation of Research Fellowships of the University of Minho (RBIC), published in *Diário da República, 2nd Série, no. 119*, through dispatch no. 6524/2020 of 22-06-2020, ratified by ratification declaration no. 447/2021 of 22-06-2021, as indicated in 2.4 of the FCT document: "Rules for Granting and Management of Grants within the scope of R&D projects, including infrastructure projects, the multi-annual financing program for R&D units and other FCT financing instruments (Version 2021)".

The contract may only be concluded after all the documentation required is collected, which must take place within a maximum period of 6 months.

Once all the documentation has been received, the contracting entity has a period of 60 working days to conclude the scholarship contract. Once received, the fellow must return the contract duly signed within 15 working days.

The activities under the fellowship contract can only began after proper authorization by the contracting entity.

Term and cancellation of fellowship contracts: Without prejudice to the other causes provided the fellowship regulations (FCT and UMinho) and in the Statute of the Research Fellow, the fellowship ends with the completion of the work plan, as well as with the expiration date for which it was granted or renewed.

At the end of the fellowship, the grantee is obliged to present a Final Report of the work carried out, in accordance with the objectives and evaluation criteria defined with the scientific advisor, within 30 days after the end of the scholarship.

The **final report** must be prepared in accordance with Annex I of the Scientific Research Fellowships Regulation of the University of Minho (RBIC), published in *Diário da República, 2nd Série, no. 119*, through dispatch no. 6524/2020 of 22-06-2020, ratified by ratification declaration no. 447/2021 of 22-06-2021.