ANNOUNCEMENT FOR THE AWARD OF SIX RESEARCH INITIATION FELLOWSHIPS

Research Initiation Fellowship - 6 vacancies

30/ECUM/CMAT/2023- UIDB/00013/2020

A call for applications is now open for the attribution of 6 (six) research initiation fellowships, in the area of Mathematics, within the scope of the R&D project UIDB/00013/2020 of the Center of Mathematics of the University of Minho (CMAT), financed by Fundação para a Ciência e Tecnologia (FCT/MCTES), through national funds (PIDDAC), under the following conditions:

Scientific Area: Mathematics

Recipient category: Students enrolled in a BSc course ("1º ciclo") in the area of Mathematics, Computer Science, Data Science, or Statistics, of the University of Minho or the University of Trás-os-Montes e Alto Douro.

Requirement for granting the fellowship:

- Candidates may apply without prior registration in the course for which the scholarship is open. The requirement to enroll in a degree course or non-granting course will be verified on the date of contracting the fellowship.
- For contractualization purposes, only be accepted selected candidates who present valid proof of enrollment in the degree course or non-degree course, according to the type of scholarship in the call for application, issued by the academic services of the Higher Education Institution, respectively with the indication of the current academic year or its duration (beginning and end).

Applicant's 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).

Work plan:

Clarifying: Each project can only be implemented by a single student. The priority in choosing the project by each student will be defined by the final ordered list.

Proposal BII2023-A: Coloring algorithm for planar graphs without loops or triangles

Supervisor: Assis Azevedo (assis@math.uminho.pt)

Target audience: 3rd-year students of the Degree in Computer Science

Work plan: According to Grötzsch's Theorem, every triangle-free planar graph is 3-colorable, which distinguishes them from the NP-hard problem of deciding whether any graph admits such coloring. From the proof of this Theorem presented by Dvořák, Kawarabayashi and Thomas, it is intended to implement the colouring algorithm, in linear time, which departs from it, through an "open source" module of graphs of Python language, such as NetworkX, thus contributing for its development.

Proposal BII2023-B: Web scraping of geological sites.

Supervisor: Cecília Castro (cecilia@math.uminho.pt)

Target audience: 3rd-year students of the Degree in Computer Science

Work plan: Develop scripts for collecting and storing information on geological sites, such as geolocation, whose research has been published in scientific geology journals to be selected. Analysis of the structure of articles and choice of suitable tools, for example PyPDF2, Textract, BeautifulSoup or Scrapy, Pandas, Geopy, OpenCV. Collect, store, clean and organize data for later analysis. Elaboration of a report with methodology, results and conclusions.

Collaboration of José Brilha, Full Professor at the School of Sciences at the University of Minho.

Proposal BII2023-C: Analysis of mathematical models applied to cancer

Supervisors: Ana Paula Teixeira(ateixeir@utad.pt) e Regina de Almeida (ralmeida@utad.pt)

Target audience: Undergraduate students in the areas of Mathematics, Applied Mathematics and Data Science, Computer Science, or Statistics

Work plan: Cancer remains a major health problem worldwide. Since the beginning of the 20th century, mathematical modelling has been fundamental to improve our understanding of this issue and to predict the behaviour of tumours and their reaction to therapies. The aim of this project is to carry out a survey and characterize the different mathematical models applied to the study of tumors, in order to understand what has already been done and, thus, gain a better insight on the future research of this topic.

Proposal BII2023-D: Linear regression models in the analysis of change-points in time series

Supervisor: Arminda Manuela Andrade Pereira Gonçalves (mneves@math.uminho.pt)

Target audience: 2nd-year students of the Degree in Applied Statistic

Work plan: Change-points analysis in time series allows identifying and studying behavior change-points in the succeeding observations. Linear regression is a classical statistical modeling process that allows modeling and forecasting time series by establishing decomposition models that incorporate the components present in the series. Thus, the main objective of this project is to analyze change-points in time series, namely the various types of change-points that can be observed, and establish analysis and detection methods in the context of linear regression models.

Proposal BII2023-E: Real functions with unexpected properties

Supervisor: Lisa Santos (lisa@math.uminho.pt)

Target audience: Mathematics Degree Students

Work plan: Description: It is known that the majority (in a sense that can be made precise) of real functions of a real variable are strange functions, meaning that they have unexpected properties. In this project we intend to address some of the following topics on: discontinuous additive functions; discontinuous functions that send compact sets into compact sets; unusual periodic functions; extremely surjective functions; continuous functions not differentiable at any point; functions differentiable but not monotonic at any point; Conway's function in base 13.

Proposal BII2023-F: Regression models applied to marine species abundance indicators

Supervisor: Raquel Menezes (rmenezes@math.uminho.pt)

Target audience: 3rd-year or 2nd-year students of Degree in Applied Statistics or 3rd-year students of Degree in Mathematics

Work plan: The aim of this work is to study regression models, having as a variable of interest the egg count for a given volume of water in a given location, defined as an indicator of the abundance of a species. It is intended to relate the spatial distribution of the species with environmental variables, such as sea surface temperature, salinity and chlorophyll. The work will be carried out within the scope of a collaboration with the Division of Modeling and Management of Fishing Resources, of the Portuguese Institute of the Sea and Atmosphere (IPMA).

Proposal BII2023-G: Aplicações entre Grassmannianas

Supervisors: Lucile Vandembroucq (lucile@math.uminho.pt) and Ana Cristina Ferreira (anaferreira@math.uminho.pt)

Target audience: 3rd-year students of Degree in Mathematics

Work plan: For positive integers k≤n, the Grassmannian Gr(k, n) is the manifold of linear subspaces of dimension k in euclidean space $\mathbb{R}$^n. In particular, Gr(2,n) is the manifold of linear planes in $\mathbb{R}$^n and Gr(1,n) is the projective space of dimension n-1. These manifolds are of great importance in geometry and in algebraic topology. In this project, the student is to construct examples of homotopically non-trivial maps from Gr(2,n) to Gr(1,m), where m in less than the dimension of Gr(2,n), that is, less than 2(n-2).

Proposal BII2023-H: Appell Polynomials and Applications

Supervisors: Maria Irene Falcão (mif@math.uminho.pt) and Fernando Miranda (fmiranda@math.uminho.pt)

Target audience: Students of Degree in Mathematics or Computer Science

Work plan: In 1880, Appell introduced and studied sequences of polynomials with the following property: the nth term of the sequence is a polynomial of degree n whose derivative is equal to n times the (n-1)th term of the sequence, with the 0th term being a nonzero constant polynomial. These polynomials, currently known as Appell polynomials, have interesting properties and various important applications in mathematics, physics, and engineering. Classic examples of Appell polynomials are the Bernoulli polynomials, the Hermite polynomials, and the Euler polynomials. The goal of this project is to study properties that characterize Appell polynomials and consider applications of these polynomials in concrete problems.

Proposal BII2023-I: To infinity and beyond

Supervisors: Eurica Henriques (eurica@utad.pt) and Luís Roçadas (rocadas@utad.pt)

Target audience: Undergraduate students in the areas of Mathematics, Applied Mathematics and Data Science, Computer Science, or Statistics

Work plan: In this research project we propose to study the size of infinite sets (numerable and non-numerable) and to analyze how the "small" question: Is every set formed by an infinite number of elements of the same size? Relates to the axiom of choice and the continuum hypothesis. The works of Cantor, Zermelo and Godel will be analyzed.

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 work plan will be carried out in the Centro de Matemática da Universidade do Minho, located in the Campus de Gualtar, Braga, or Campus de Azurém, Guimarães, or Quinta dos Prados, Vila Real, under the scientific supervision of the member(s) of CMAT who proposed the work.

Fellowship duration: The grant will take place for a period of 2(two) months, with a provisional starting date in the July of 2023.

Amount of the research grant: The value stipend (Monthly Maintenance Allowance) is 541,12 euros, 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 og UMinho's Regulation of Scientific Research Fellowships (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 rules.

Payment is made until the 23rd of each month, through bank transfer to the fellowship holder's NIB indicated in the contracting 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: José Joaquim Martins Oliveira, Auxiliary Professor, Department of Mathematics of School of Sciences, University of Minho;

First effective member: José Luís dos Santos Cardoso, Associate Professor, Department of Mathematics, University of Trás-os-Montes e Alto Douro;

Second effective member: Maria de Lurdes Azevedo Teixeira, Auxiliary Professor, Department of Mathematics of School of Sciences, University of Minho;

First substitute member: Maria Fernanda Pires da Costa, Auxiliary Professor, Department of Mathematics of School Sciences, University of Minho;

Second substitute member: Ana Jacinta Pereira da Costa Soares, Associate Professor, Department of Mathematics of School of Sciences, University of Minho.

In case of impediment of the President, he will be substituted by the first effective member, or the second effective member in case of impediment of the first effective member, being the effective members substituted by the substitute members.

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%):

a) Academic path (considering the marks obtained in the Curricular Units of the degree in which the applicant is enrolled), with a weighting of 50%;
b) Personal curriculum (considering academic merit and skills), with a weighting of 30%
c) Motivation letter, with a weighting of 20%.

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

$$AM=(a\times0,5) + (b\times0,3) + (c\times0,2)$$

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

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.

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 by final grade obtained, posted in CMAT's web portal, as well as by email to all applicants, enclosing for that purpose, the minutes of the jury deliberations.

The selected candidate(s) must inform its willingness to accept the grant, in writing. In case of rejection, the fellowship will be awarded to the next candidate in the ordered list of applicants.

The final decision can be contested within 15 working days, by sending to the President of the selection panel the corresponding claim. Interested parties may also submit an optional hierarchical appeal, addressed to the Pro-Rector for Research and Projects, Professor Filipe Vaz.

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 31/10/2023.

Application deadline and submission: The call for applications is open during 10 working days from its publication in the Euroaxess's portal.

Applications must be formalized by sending an application letter with the following documents: curriculum vitae; certificate of the Curricular Unit's marks; motivation letter.

Applications must be sent by email to bolsas@ecum.uminho.pt, indicating the reference 30/ECUM/CMAT/2023-UIDB/00013/2020 of the call for applications in Subject. 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, according 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.