ANNOUNCEMENT FOR THE AWARD OF SIX RESEARCH INITIATION FELLOWSHIPS

Research Initiation Fellowship (6 vacancies)

17/ECUM/CMAT/2024 – 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 the BSc course of Computer Science, or in the BSc course of Data Science, or in the BSc course of Applied Statistics, or in the BSc course of Mathematics, or in the BSc course of Applied Mathematics and Data Science.

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 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 7 (seven) projects:

[Project BII2024-A] Machine Learning and Navier-Stokes Equations in Modeling Blood Flow in Arteries

Supervisors: Luís Ferrás (lferras@fe.up.pt), Cecília Coelho

Target audience: Students of the degrees in Computer Science, Data Science and Mathematics

Work plan:

The Navier-Stokes equations are applied in aircraft and car design, the study of blood flow, analysis of dispersion of pollutant gases, etc. Recently, the use of Machine Learning for solving and discovering parameters of differential equations has grown, through Physics-Informed Neural Networks (PINNs). This project proposes to use PINNs to find the parameters of the Navier-Stokes equation that describe the velocity and pressure of blood in an artery. This project aims to apply optimization methods and PINNs to find the parameters of the Navier-Stokes equation. The student will have the opportunity to engage with numerical methods, optimization, and Machine Learning for differential equations and their application to real-world problems.

[Project BII2024-B] Artificial Intelligence in Ethical Optimization of Hydropower Plant Management

Supervisors: Fernanda Costa (mfc@math.uminho.pt), Cecília Coelho

Target audience: Students of the degrees in Computer Science, Data Science and Mathematics

Work plan:

Recently, the use of artificial intelligence (AI) in the management of hydropower plants (HP) has been increasing. However, current approaches only focus on maximizing energy generation without considering minimum ecological discharge limits to preserve the ecosystem and water allocation for agricultural irrigation. This project proposes to explicitly incorporate these constraints into a neural network (NN) model for HP management, resulting in more transparent and ethical AI models.

This project aims to develop an AI model for the transparent and ethical optimization of HP management. The model will incorporate constraints on minimum ecological discharge limits and irrigation explicitly, ensuring the satisfaction of these constraints and promoting AI for sustainability. In this work, the student will have the opportunity to understand the mathematical tools involved in an AI model, program and train an AI model, and validate it for optimal HP management.

[Project BII2024-C] RSA Code - Discretisation of the Logarithm

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

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

Work plan:

This research project aims to deepen some of the topics studied by Euler, namely the logarithm of negative numbers; Fermat's little theorem and its generalisation by Euler.

It will show how these functions and mathematical results make it possible to construct the RSA code (one of the first asymmetric key systems widely used for secure data transmission).

[Project BII2024-D] Exploration of mathematical approaches in the study of tumors

Supervisors: Regina de Almeida (rameida@utad.pt), Ana Paula Teixeira (ateixeir@utad.pt)

Target audience:

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

Work plan:

Cancer continues to represent a significant global health challenge. Mathematical modeling has become increasingly valuable to improve understanding of this problem, particularly in prevention, prediction of tumor behavior and their reaction to therapies. The objective of this project is to explore the fundamental concepts for the construction and investigation of mathematical models applied to the study of tumors and their resolution methods.

[Project BII2024-E] Change-points in time series - an approach via linear regression models

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

Target-audience: 2nd-year students of the Degrees in Applied Statistic or in Data Science

Work plan:

Change-points analysis is an important process in time series analysis, allowing identifying and studying change-points in the observation series. Linear regression is a classic statistical modelling process that allows us to model and predict time series by establishing decomposition models that incorporate the components present in the series. Thus, the main objective of this project is to analyse change-points in time series, namely the various types of change-points that can be observed and to establish methods of analysis and detection in the context of linear regression models.

[Project BII2024-F] Variable selection in Linear Models

Supervisor: Susana Faria (sfaria@math.uminho.pt)

Target-audience: Students of the Degrees in Applied Statistic or in Data Science

Work plan:

Given the emergence of databases with a large number of variables, variable selection plays a crucial role in model development. In this study, within the context of linear regression models, the aim is to investigate methods for selecting explanatory variables. To compare the performance of different selection methods, simulation studies will be conducted and applied to a real dataset. Both the simulation study and the application to real data will be developed using the R/Python programming language.

[Project BII2024-G] Regularity on semigroups

Supervisor: Suzana Mendes Gonçalves (smendes@math.uminho.pt)

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

Work plan:

A semigroup is a non-empty set S with an associative binary operation *, that is to say, for all a,b,c in S, a*(b*c)=(a*b)*c.

We say that a in S is regular if a=a*x*a for some x in S. The semigroup S is said to be regular if all elements in S are regular. Regular semigroups play a significant role in the semigroup theory and they have been studied from various aspects.

If S is non-regular, it is important to describe its regular elements. Also, there are other types of regularity that may be studied. Within this project, we aim to explore notions such as regular element, left or right regular element, corregular element and intra-regular element, and study properties and relations between them.

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 July of 2024.

Amount of the research grant: The value stipend (Monthly Maintenance Allowance) is **601,12 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 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: Irene Vitória Ribeiro de Brito, Professora Associada do Departamento de Matemática da Escola de Ciências da Universidade do Minho

First effective member: Marta Susana Ribeiro Ferreira, Professora Auxiliar do Departamento de Matemática da Escola de Ciências da Universidade do Minho

Second effective member: Eva Virgínia Araújo Morais, Professora Auxiliar do Departamento de Matemática da Escola de Ciências e Tecnologia da Universidade de Trás-os-Montes e Alto Douro

First substitute member: Maria Piedade Machado Ramos, Professora Associada do Departamento de Matemática da Escola de Ciências da Universidade do Minho

Second substitute member: Wolfram Erlhagen, Professor Associado do Departamento de Matemática da Escola de Ciências da Universidade do 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%):

   A1: Academic path (considering the marks obtained in the Curricular Units of the degree in which the applicant is enrolled), with a weighting of 50%;

   A2: Personal curriculum (considering academic merit and skills), with a weighting of 30%

   A3: Motivation letter, with a weighting of 20%.

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

$$AM=(A1×0,5) + (A2×0,3) + (A3×0,2)$$

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 (*alphabetically, by final grade obtained*), 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, 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 jury the corresponding claim. Interested parties may also submit an optional hierarchical appeal, addressed to the Pro-Rector for Research and Projects, Professor Sandra Cristina Almeida 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 31/10/2024.

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

Applications must be formalized by sending an application letter with the following documents: **curriculum vitae; certificate of the marks obtained in the Curricular Units of the degree in which the applicant is enrolled; motivation letter**.

Applications must be sent by email to **bolsas@ecum.uminho.pt**, indicating the reference **17/ECUM/CMAT/2024 – 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.