TRANSLATION OF THE DIRECTOR'S DECREE NR. 144 DATED 26.02.2025

Selection for the conferment of two PhD fellowships in Theoretical and Scientific Data Science financed by Human Technopole Foundation- Academic year 2025/26

In the framework of the agreement signed with **Human Technopole Foundation**, the International School for Advanced Studies (SISSA) announces a selection based on academic qualifications and written and oral exams for the conferment of two PhD fellowships in **Theoretical and Scientific Data Science** starting from the academic year 2025/26

Amount of the fellowship: € 29.234,74 gross per year (approx. € 1.700 monthly net)
Financing Body: **Human Technopole Foundation**
Duration of the programme: 4 years

Project "Artificial Intelligence methods for spatial cancer biology"

A new generation of biotechnologies is unveiling the spatial patterns of proteins and nucleic acids in human tissues at unprecedented resolution. This has tremendous potential for understanding how cancers develop. However, the current computational methods to analyse and interpret those data are underdeveloped, limiting the information that can be extracted from these data. In this project the student will develop new Artificial Intelligence methods to extract biological mechanisms from spatial biology data, with particular focus on spatial transcriptomics and proteomics. The class of algorithms that will be employed will include physics informed neural networks and dynamical systems including neural ODEs. The student will learn how to design Machine Learning algorithms to be used in cancer research, with the ultimate goal of providing cutting-edge tools to clinicians that will improve patient outcomes.

Project "Decoding Oncogenic Shock: Advanced Unsupervised Learning for Causal Pathway Reconstruction in Cancer"

This project aims to develop advanced unsupervised machine learning methods and apply them to longitudinal transcriptomic data collected after the suppression of key oncogenes in highly oncogene-addicted cancer models. By dissecting the molecular signals triggered during this "oncogenic shock" [1], the research will reconstruct the biological pathways driving tumour cell death. The ultimate goal is to establish a comprehensive catalogue of cancer dependency pathways, tailored to specific genomic contexts, to inform precision medicine strategies and optimize combinatorial cancer therapies [2,3]. On the methodological side, we plan to adapt to the specific problem approaches which allow inferring causal relationships in high-dimensional data [4] and automatically select the most informative and "causative" features in a large set of candidates [5].

[1] Sharma SV & Settleman J. Oncogenic shock: turning an activated kinase against the tumor cell. Cell Cycle. 2006 Dec;5(24):2878-80.
[2] Boehm JS, Garnett MJ, et al. Cancer research needs a better map. Nature. 2021 Jan;589(7843):514-516.
[3] Behan FM, Iorio F, et al. Prioritization of cancer therapeutic targets using CRISPR-Cas9 screens. Nature. 2019 Apr;568(7753):511-516.
[4] Del Tatto V, Fortunato G, et al. Robust inference of causality in high-dimensional dynamical processes from the Information Imbalance of distance ranks. Proc Natl Acad Sci U S A. 2024 May 7;121(19):e2317256121.
[5] Wild R, Wodaczek F, et al. Automatic feature selection and weighting in molecular systems using Differentiable Information Imbalance. Nat Commun. 2025 Jan 2;16(1):270. doi: 10.1038/s41467-024-55449-7.

● Requirements:

SISSA welcomes applications from young candidates who have completed, or are going to complete, their undergraduate studies, with a strong interest in research.

To apply, candidates, without limitations of age and nationality, must be in possession of one of the following degrees **by 31st October, 2025**:

- Italian **laurea magistrale**
- A University degree obtained abroad and considered equivalent to the aforementioned Italian degree by the evaluation Committee.

● Online application:

An online application must be filled and sent using the procedure available at the page https://pica.cineca.it/sissa/ **by 13.00 hrs. of 23rd May 2025 (Italian time).**

Candidates should upload the following documents in pdf format:

- *curriculum vitae*;
- a certificate of University examinations taken (with marks);
- a final degree certificate;
- If, at the time of application, candidates should not be yet in possession of a degree certificate, they can submit it at the time of the examination.
  European Union candidates can submit a personal declaration instead of the aforementioned certificates.
- a copy of the diploma thesis (if any), or its abstract.
- A motivation letter (2 pages max.)
- Identity document.

At the end of the procedure, candidates will have to indicate the names and email addresses of two professors that will receive an email requesting to send a recommendation letter through the same online procedure **by 13.00 hrs. of 25th May 2025 (Italian time).**

The candidate will then have to print out the admission request form, sign it and send it through the same online procedure.

Candidates with disabilities certified according to the law n. 104/1992 and subsequent modifications, and those diagnosed with Specific Learning Disorder certified according to the law n. 170/2010 and to the D.M. n. 5669 dated 12/07/2011, can report their needs together with the submission of the admission application, within the deadline set by this announcement.

● Selection Procedure:

After the deadline of the announcement, the Selection Committee, which will be composed of two Faculty Members of SISSA, two Human Technopole Members, and one external, will evaluate the documentation produced by the candidates (*curriculum vitae*, letters of recommendation, etc.). Candidates who have obtained a minimum score of 7/10 will be invited to take the written test via zoom on **3rd June 2025**. Those who will obtain a minimum mark of 28/40 in the written test will be admitted to the interview which will be held between **4th and 6th June 2025** via zoom, with scheduled times that will be communicated later on.

For the interview, the candidate should be reachable at the address indicated in the application, at the time communicated by SISSA through email.

Candidates should show an ID document for identification at the beginning of the interview. The absence of a contact email in the application or of a valid ID during the interview, imply the exclusion from the competition.

● **Admission:**

The admitted candidates will be notified by email and will be asked to be present at SISSA on 1st October 2025.

Failure to do so without a valid reason will result in the loss of the fellowship awarded.

In order to be enrolled and to be awarded the fellowship, admitted candidates must pay a "Regional Tax" of the amount of € 120,00 - € 160,00 per year. Information can be retrieved at http://www.ardiss.fvg.it/.

For information about rights and duties of the doctoral students please consult the SISSA PhD Courses Regulations.

As per Legislative Decree 30.06.2003 n.196, and of the European Regulation 2016/679 (General Data Protection Regulation), we inform that all data given to this Administration will be processed only for purposes related to and instrumental to the existing contract, in compliance with the provisions in force.

The Director
Prof. Andrea Romanino
(digitally signed)