

ALMA MATER STUDIORUM | AREA UNIVERSITÀ DI BOLOGNA | FORMAZIONE E DOTTORATO

# PHD PROGRAMME TABLE

# Call for applications for the admission to the PhD programmes (41<sup>st</sup> cycle) - A.Y. 2025/2026 Second round

## Section "Research Fields" modified on 05/06/2025

PROGRAMME'S NAME	COMPUTER SCIENCE AND ENGINEERING
DURATION	3 years
PROGRAMME START DATE	01/11/2025 (DD/MM/YYYY)
LANGUAGES	English
COORDINATOR	Prof. Ilaria Bartolini ( <u>ilaria.bartolini@unibo.it</u> )
PhD POSITIONS	8
ADMISSION PROCEDURE	Qualifications and research proposal evaluation Oral examination

# Available Positions and Scholarships

Pos. n.	Financial Support	Description	Positions linked to a specific research topic
1	PhD Scholarship	Totally funded by the University of Bologna general budget	
2	PhD Scholarship	Totally funded by the University of Bologna general budget	
3	PhD Scholarship	Totally funded by the University of Bologna general budget	
4	PhD Scholarship	Totally funded by the University of Bologna general budget	
5	PhD Scholarship	Totally funded by the University of Bologna general budget	
6	PhD Scholarship	Funded by the University of Bologna general budget and by the Department of Computer Science and Engineering	
7	PhD Scholarship	Funded by Luna Rossa Challenge S.r.l.	AI Techniques for AC 75 Class Competition
8	PhD Scholarship	Funded by TGen - The Translational Genomics Research Institute, in memory of Renzo Tomasetti. The position requires research activities to be carried out at least in part at the funding body's headquarters in the USA.	Models, techniques, and algorithms for cancer early detection and assessment of cancer risk and biological age

The yearly gross amount of the scholarships awarded for the PhD Programme in "Computer Science and Engineering" is €17,805.

All winners of PhD positions must fulfil the study and research obligations decided by the Academic Board, as well as the obligations set out in the relevant regulations, in the call for applications, in the funding schemes and in any agreements relating to specific positions.

# Admission Exams

	DATE AND TIME	RESULTS
Qualifications and research proposal evaluation	Applicants' participation is not required	Available from <b>16/07/2025</b>
Oral examination	Date: starting from 24/07/2025 – 10.15 a.m. CEST Place: In presence, Aula Nadia Busi, Department of Computer Science and Engineering, Mura Anteo Zamboni 7, Bologna. Remotely, using Microsoft Teams	Available from <b>31/07/2025</b>

The results of the qualifications and research proposal evaluation, as well as the oral examination detailed schedule, shall be available on the webpage <u>Studenti Online</u> (select "requests in progress" > "see detail" and open the .pdf file at the bottom of the page). No personal written communication will be sent to applicants concerning the examinations results.

During the oral examination, applicants may express their interest in one or more PhD positions linked to specific research topics.

# Required and Supporting Documents to be attached to the application

Only documents in Italian or English will be considered valid and will be assessed by the Admission Board. Identity documents and diplomas/degree certificates issued in a language other than Italian or English must be accompanied by an official translation. The translation must be carried out by an authorized body or by the awarding university. Only qualifications obtained in the last 5 years will be taken into account, with the exception of university degrees. The Admission Board will assess the relevance of the supporting documents to the PhD programme.

REQUIRED DOCUMENTS		
Identity document	Valid identity document with photo (i.e. identity card, passport)	
Curriculum Vitae	The Curriculum Vitae shall contain <b>on the first page the</b> <u>CV Summary</u> , duly filled, downloadable in .docx from the <u>University website</u> (select the PhD Programme → " <i>More</i> <i>information</i> ", then check " <i>Notices</i> " at the bottom of the page). Versions of the Summary modified in content and/or in the order in which they are presented will not be accepted: therefore, it is mandatory to use only and exclusively the form provided by the University. If the uploaded Curriculum does not contain such a Summary as per the instructions above, the Admission Board will not proceed to the evaluation of any title provided by the applicant and he/she will be automatically excluded from the oral examination.	
Degrees	Documents attesting the awarding of the first and second cycle degrees, the exams taken and the marks obtained (see Art. 3 of the Call for Applications)	
Research proposal	<ul> <li>Multi-annual research proposal (drawn up in Italian or in English), with special emphasis on the activities to be completed during the first-year course. The proposal must meet the following requirements:</li> <li>it must be written following the <u>Research Proposal Template</u>, downloadable in .docx from the <u>University website</u> (select the PhD Programme → "More information", then check "Notices" at the bottom of the page). Versions of the research proposal modified in content and/or in the order in which they are presented will not be accepted, therefore it is mandatory to use only and exclusively the form provided by the University. Should the research proposal not be drawn up as per the instructions above, the Admission Board will not proceed to assess any of the qualifications provided by the candidate and he/she will be automatically excluded from the oral examination;</li> <li>it cannot exceed 20,000 characters, including spaces and formula possibly used. This figure does not include: the title of proposal, the outline, references and images (such as graphs, diagrams, tables, etc if present);</li> </ul>	

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	<ul> <li>it must include: the state of the art; description of the proposal; expected results; articulation of the proposal and implementation times; references.</li> <li>The research proposals that successful applicants shall carry out during their PhD career may possibly differ from the one proposed at the application stage. This shall be defined together with the supervisor and approved by the Academic Board. The name of the possible PhD thesis supervisor should not be given, as this will only be identified by the PhD Academic Board after enrolment.</li> </ul>	
SUPPORTING DOCUMENTS		
Thesis abstract	Abstract of the <b>second cycle degree thesis (drawn up in Italian or in English)</b> . Graduands applicants may submit an abstract of the thesis about to be defended. Abstracts cannot exceed 5,000 characters, including spaces and formula possibly used. The above figure does not include: the title of the thesis, the outline, references, and images such as graphs, diagrams, tables etc.	
Reference letter/s	<b>No more than 3 reference letters</b> signed by Italian and international academics and professionals in the research field, which do not form part of the Admission Board, attesting the suitability of the applicant and his/her interest in the scientific research. Letters shall be uploaded following the procedure on <u>Studenti Online</u> , detailed in the Call for Applications (Art. 3.2).	
Publications	Lists of publications (i.e. monographs, articles on scientific journals) and minor publications (conference papers, etc.), in <b>Italian or in English</b>	
Other documents	<ul> <li>Postgraduate vocational programmes and/or specialisation programmes relevant to the PhD Programme</li> <li>Teaching activity carried out at university level</li> <li>Research activity of any kind - whether basic, applied, translational, etc carried out in any capacity, including when covered by research grants, and as a staff member of research projects</li> <li>Documents attesting the knowledge of foreign languages</li> <li>Study periods completed by applicants outside their countries of origin (e.g. Erasmus programme or other similar mobility programmes)</li> <li>Other qualifications attesting the suitability of the applicants (scholarships, prizes, etc.)</li> </ul>	

# Evaluation criteria\*

Scores will be expressed in points out of 100, as follows.

#### 1. Qualifications and research proposal evaluation

Minimum score for admission to the oral examination: 30 points, Maximum score: 50 points

Second cycle degree (Master's) final mark. Graduands shall be evaluated according to the Weighted Average Mark (WAM)	10 points max
Consistency of the Second cycle degree final thesis with the main topics of the PhD programme	10 points max
Publications	5 points max
Curriculum Vitae, reference letters, other qualifications	10 points max
Research proposal (scientific value, structure and feasibility of the proposal)	15 points max

#### 2. Oral examination

Minimum score for eligibility: 30 points, Maximum score 50 points

English language proficiency	10 points max
Research proposal presentation and general knowledge of the PhD programme's main research	40 points max
topics and of the research topics linked to the available PhD positions	

Oral examination aims to assess the suitability of the applicant for scientific research as well as the general knowledge of the PhD programme's main research topics and of the research topics linked to the available PhD positions. **During the oral examination, the applicant's English proficiency shall be assessed**.

The oral examination is carried out in Italian or English.

\* Possible further evaluation criteria will be available on the <u>University website</u>, selecting the relevant PhD Programme > "More information".

## SETTORE DOTTORATO DI RICERCA

# **Research Fields**

Pos. no. 8 with a scholarship funded by TGen - The Translational Genomics Research Institute, in memory of Renzo Tomasetti, with research topic "Models, techniques, and algorithms for cancer early detection and assessment of cancer risk and biological age"

The student will work with Prof. Cristian Tomasetti (City of Hope and TGen) as main advisor, in coordination with a coadvisor at University of Bologna, as well as with Assistant Professor Kamel Lahouel in Dr. Tomasetti's Lab on projects with a focus on mathematical modeling in cancer biology. Three proposed directions are described here and several more may arise during the program.

A first direction is in the development of methods, algorithms, assays for cancer early detection, by studying changes in fragmentation patterns, aneuploidy, methylation patterns and mutation in cell-free DNA. This involves, e.g., the development of a bioinformatics pipeline able to classify cancer vs healthy while handling batch effect normalization, on either whole genome sequencing data or amplicon-based approaches.

A second line of investigation aims at the development of methods, algorithms, assays for assessing cancer risk and biological age, particularly the quantification of multicancer risk based on the accumulation of DNA mutations and its refinements through multi-omic and clinical data integration. This involves both theoretical and algorithm development with data-driven analyses, from pilot studies to population-scale datasets. Methods may include stochastic processes, latent variable models, stochastic differential equations and statistical methods.

A third line of investigation focuses on learning the dynamics of key parameters in cancer from noisy and sparse data using machine learning and AI. This requires the development of statistical and machine learning methods to learn ordinary differential equations, stochastic differential equations, or partial differential equations from noisy and/or sparse data, using, e.g., diffusion models, kernel methods and neural ODEs.