



UNIVERSITY  
OF WARSAW



Doctoral School of  
Exact and Natural  
Sciences

### **Competition notice**

Project title: DeMeTeR: Interpretation of diffusion models through representation analysis

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### **Project description**

Diffusion models are the latest revolution of generative modelling in computer vision. However, we still lack an in-depth understanding of their inner workings from both an empirical and theoretical standpoint. Improving this understanding is not only crucial to their continued development. It also allows for enhancing their safety and provides opportunities to develop new methods for explainability of predictive models in computer vision.

Considering that, the **main goals** of the DeMeTeR project are:

- to broaden the practical and theoretical understanding of diffusion-specific latent representations and architecture specific internal representations of diffusion models,
- to develop novel methods of manipulating these representations that allow for enhancing safety and explainability of deep learning models.

### **Questions and hypotheses:**

We aim to address the following research questions and hypotheses. How to improve the understanding of state-of-the-art diffusion models trained on images through their latent and internal representations? What are the critical limitations of their generative process and how to overcome them? Latent and internal representations of diffusion models trained on images allow precise control of the generative process. How to transfer this understanding to improve the safety of diffusion-based foundation models? How to exploit these representations for explaining visual predictive models? Understanding the representations of diffusion models can improve the safety and explainability of other deep learning models.

### **Requirement**

- university education, preferred majors: mathematics, statistics, computer science
- experience in research work, preferred published articles in the area of explainable artificial intelligence (XAI) and/or generative models including diffusion models
- fluency in English.

**Discipline:** Computer Sciences

**Admission limit:** 1

## **Recruitment schedule**

- registration in the Internet Registration of Candidates, referred to as "IRK", submitting an application to the IRK: May 27 - June 17, 2024
- qualification procedure: June 24 – 28, 2024
- announcement of the ranking list: until July 1, 2024
- accepting documents from qualified candidates: July 2 - September 23, 2024, until 14.00
- announcement of the list of accepted candidates: until 30 September 2024

## **Recruitment fee**

200 PLN

## **Form of the qualification proceedings**

Qualification proceedings include the assessment of the following items:

- 1) the research project proposed by a candidate;
- 2) the candidate's scientific activity, based on their CV or Resume, documented by scans of materials attached to the application for admission to the School;
- 3) an interview with the candidate;
- 4) other achievements.

## **Language of the selection process, including the interview**

The interview shall be carried out in Polish or English – in accordance with the candidate's preferences presented in IRK. If the Polish language is selected, the interview may include parts in English.

## **Required documents**

The candidate shall submit a School admission application only through the IRK. The application shall include the following:

- 1) indication of the selected discipline in which the candidate plans to pursue education or in the case of applying for the Interdisciplinary Doctoral School – fields of science with the specification of the leading field (and where there is no leading field – at least two equivalent disciplines), PESEL number or passport number, nationality, contact information (residence address, e-mail address, telephone number), information whether the candidate agrees to receive administrative decisions by means of electronic communication, consent for processing of personal data for the purposes of the admissions procedure;
- 2) a scan of the graduation diploma of uniform master's degree or postgraduate studies or an equivalent diploma obtained under separate regulations. In the case of a diploma equivalent to a uniform master's degree or postgraduate studies graduation diploma, a candidate shall justify such equivalence. In case the diploma was issued in a language other than Polish or English, the candidate shall attach its certified translation;
- 3) a description of the initial research project proposal with the title, the description should not exceed 4 pages, type style: New Times Roman size min. 11, single leading, top and bottom margins min. 1,5 cm, outside margins min. 2cm;
- 4) a resume or CV outlining the candidate's scientific activity, including scholarly interests and achievements during the five calendar years preceding the application (if a candidate became a

parent during this time, as evidenced by a scan of the child's birth certificate attached to the application, this period shall be extended by two years for each child), including, but not limited to:

- publications,
  - research and organizational work at student research groups,
  - participation in scientific conferences,
  - participation in research projects,
  - awards and honorable mentions,
  - research internships,
  - research skills training programs completed,
  - activities promoting science,
  - activity in science movement representative bodies,
  - average of their university grades,
  - professional career,
  - level of proficiency in foreign languages;
- 5) scans of materials evidencing scientific activity mentioned in their CV and/or resume;
  - 6) a document confirming at least B2 proficiency level in English or a declaration of the level of proficiency in English allowing education at the School;
  - 7) the scan of a declaration by the planned supervisor, confirming their agreement to undertake the duties of a supervisor and of the number of doctoral students, for whom they perform the duties a designated supervisor, in accordance with the template constituting Appendix no.4 to the Resolution no. 17 of the Senate of the University of Warsaw of 20th January 2021 on rules of admission to doctoral schools at the University of Warsaw (the University of Warsaw Monitor of 2023, item 43), the candidate may also attach a scan of their planned supervisor's opinion and opinions of other academics about the candidate and their scientific activity and/or proposed research project;
  - 8) the photograph of a candidate's face that allows for their identification;
  - 9) a declaration confirming whether the candidate was or is a doctoral student or a participant of doctoral studies or whether they have initiated a doctoral dissertation process or whether proceedings to award them a doctoral degree have been initiated – and if yes, the title of their doctoral dissertation or the research project prepared by a candidate, including the name and last name of the candidate's tutor or supervisor;
  - 10) a declaration confirming that they have reviewed the Resolution no. 17 of the Senate of the University of Warsaw of 20th January 2021 on rules of admission to doctoral schools at the University of Warsaw (the University of Warsaw Monitor of 2023, item 43) and Articles 40 and 41 of the Code of Administrative Procedure;
  - 11) scanned transcripts of records of the graduate and postgraduate studies or the uniform Master's degree studies, or equivalent documents (e.g. diploma supplement);
  - 12) abstract of the master's thesis or master's project in English (up to 3,000 characters with spaces);

### **Evaluation criteria**

The main criterion is experience in research work in the area of machine learning (with particular emphasis on explainable machine learning and diffusion models).

The candidate should describe his/her experience by indicating research work conducted, software developed, scientific articles developed and published, and participation in conferences related to the application topic.

### **Education program**

The education lasts 4 years. It includes obligatory classes (no more than 300 hours in total during the whole period of education) and the implementation of an individual research program, carried out under the supervision of a supervisor. Beginning of education – October 1, 2024.

**Scholarships**

During the four years of study, the PhD student receives a scholarship in the amount of PLN 4266,00 gross per month before a PhD student's mid-term evaluation and PLN 5119,00 gross per month after the PhD student's mid-term evaluation.