



Elies Gil-Fuster

ELLIS PHD STUDENT · QUANTUM MACHINE LEARNING

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about

I am an ELLIS PhD student in quantum machine learning. I am based in in Jens Eisert's research group at FU Berlin, my secondary supervisors are Thomas Wiegand from HHI Berlin, and Vedran Dunjko from Leiden University. My goal is to contribute to the mathematical foundation of quantum machine learning theory, especially for parametrized quantum circuits.

education

Freie Universität Berlin, Fraunhofer HHI Berlin, Leiden University, ELLIS

Berlin, Germany, and Leiden, Netherlands

PH.D. IN THEORETICAL PHYSICS

Oct. 2021 - present

• Research in theoretical quantum machine learning.

Supervisors: Prof. Jens Eisert, Prof. Thomas Wiegand, Prof. Vedran Dunjko

Freie Universität Berlin

Berlin, Germany

M.Sc. IN PHYSICS

Apr. 2019 - Oct. 2021

• Master's thesis in theoretical quantum machine learning with Prof. Jens Eisert.

Universitat de Barcelona

Barcelona, Spain

B.Sc. IN MATHEMATICS

Sep. 2013 - Mar. 2019

• Bachelor's thesis in differential geometry for physical systems with Prof. Ignasi Mundet and Prof. Chris Wendl.

Universitat de Barcelona

Barcelona, Spain

B.Sc. IN PHYSICS

Sep. 2013 - Mar. 2019

• Bachelor's thesis in quantum machine learning with Prof. José Ignacio Latorre.

Humboldt-Universität zu Berlin

Berlin, Germany

MATHEMATICS, PHYSICS

Sep. 2017 - Jul. 2018

• Erasmus exchange program

publications

Up-to-date list of publications,

Google scholar

PEER-REVIEWED

- 2021 **Training Quantum Embedding Kernels on Near-Term Quantum Computers:** PRA, arXiv
Hubregtzen T., Wierichs D., [Gil-Fuster E.](#), Derks P.J.H.S., Faehrmann P.K., and Meyer J. J., *PRA* **106**, 042431
- 2021 **Encoding-dependent generalization bounds for parametrized quantum circuits:** Quantum, arXiv
Caro M.C., [Gil-Fuster E.](#), Meyer J.J., Eisert J., and Sweke R., *Quantum* **5** p. 582.
- 2020 **Data re-uploading for a universal quantum classifier:** Quantum, arXiv
Pérez-Salinas A., Cervera-Lierta A., [Gil-Fuster E.](#), and Latorre, J. I., *Quantum* **4** p. 226.

PRE-PRINTS

- 2022 **Exploiting symmetry in variational quantum machine learning:** arXiv
Meyer J.J., Mularski M., [Gil-Fuster E.](#), Mele A.A., Arzani F., Wilms A., and Eisert J., *arXiv:2205.06217*

work experience

Institut für Theoretische Physik, Freie Universität Berlin

Berlin, Germany

RESEARCH ASSISTANT

Oct. 2021 - present

- Leads the quantum machine learning seminar.
- Conducts research in quantum machine learning.
- Reviewed papers for: Physical Review Letters, Quantum journal, npj Quantum Information.

Xanadu Inc.

Toronto, Canada (remote)

RESEARCH SUMMER RESIDENT

May 2021 - August 2021

- Conducted research in quantum machine learning under the supervision of Dr. Maria Schuld.
- Wrote documentation for the **PennyLane** python package: authored a **how-to blogpost**, co-authored an **optimization demo**, and authored a **QML demo**.

QUANTIC, Barcelona Supercomputing Center

Barcelona, Spain

RESEARCH ASSISTANT

Sep. 2018 - Mar. 2019

- Conducted research in quantum machine learning under the supervision of Dr. Alba Cervera-Lierta and Prof. José Ignacio Latorre.

IFAE: Institut de Física d'Altes Energies

Barcelona, Spain

UNDERGRADUATE SUMMER FELLOW

Jul. 2017

- Conducted research in data analysis for particle physics under the supervision of Prof. Martine Bosman.

Col·legi Major Penyafort-Montserrat

Barcelona, Spain

MANAGER OF MUSIC ACTIVITIES

Sep. 2014 - Jun. 2015

- Organized music seminars, recitals, and contest with professional musicians.
- Coordinated two student-run rock concerts.

skills

(Quantum) programming, Pennylane, Qiskit, Python, C/C++, R.

Computer skills, L^AT_EX, git, MS Office, web, image, and video editing.

Language, Catalan (*mother tongue*), Spanish (*native*), English (*proficient*), German (*advanced*).

honors & awards

Mar. 2021 **First prize and sponsor prize**, QHACK2021, the Xanadu quantum machine learning hackathon

Global (remote)

Oct. 2020 **Second prize**, Qiskit Hackathon Global, the IBM quantum hackathon

Global (remote)

Oct. 2019 **Team leader**, Quantum futures hackathon 2019, the CERN cooperative quantum hackathon

CERN, Switzerland

May 2014 **University access grade award**, Fundació Pedrera Catalunya Caixa

Barcelona, Spain

talks & conferences

Jan. 2023 **Invited: Exploiting symmetry in variational quantum machine learning:**

Barcelona, Spain

QUANTIC group seminar at Barcelona Supercomputing Center

Nov. 2022 **Poster: Non-Embedding Quantum Kernels, do they exist?:**

Naples, Italy

QTML2022: Quantum Technologies in Machine Learning

Dec. 2021 **Invited: Training quantum embedding kernels on near-term quantum computers:**

Leiden, Netherlands and
Berlin, Germany (remote)

One-day workshop: "Theory of Quantum Machine Learning"

Nov. 2021 **Contributed: Encoding-dependent generalization bounds for parametrized quantum circuits:**

Osaka, Japan (remote)

QTML2021: Quantum Technologies in Machine Learning

Nov. 2021 **Invited: Encoding-dependent generalization bounds for parametrized quantum circuits:**

Singapore (remote)

Marco Tomamichel's group seminar at Centre for Quantum Technologies

Sep. 2021 **Poster: Generalization bounds in the quantum realm:**

Tübingen, Germany

EDS2021: ELLIS Doctoral Symposium

May. 2020 **Participated: Hands-on Quantum Computing Summer School:**

Benasque, Spain (remote)

Centro de Ciencias de Benasque Pedro Pascual, and Technology Innovation Institute Abu Dhabi

Mar. 2020 **Poster: Data re-uploading for a universal quantum classifier:**

Cambridge, UK (remote)

QCTIP 2020: Quantum Computing Theory in Practice

teaching

Analytical geometry

Freie Universität Berlin, Germany

TEACHING ASSISTANT

Apr. 2020 - Sep. 2020

- Teaching assistant of Prof. Alexander Schmitt for the course "Geometrie" (in German) in the Mathematics institute.

Informatics

Freie Universität Berlin, Germany

TEACHING ASSISTANT

Oct. 2019 - Mar. 2020

- Teaching assistant of Prof. Carsten Gräser for the course "Computerorientierte Mathematik I" (in German) in the Mathematics institute.

The mathematics of Cryptography

Berlin, Germany

SUMMER TUTOR AT SOMMERUNI, FREIE UNIVERSITÄT BERLIN

Jul. 2020

- Teaching assistant for the two-day course “Die Mathematik hinter Codes, Chiffrierung, und verschlüsselten Nachrichten” (in German) for high-schoolers.

Web design and video game development

Barcelona, Spain

SUMMER TUTOR AT CAMPTECNOLÓGICO

Jul. 2016

- Summer camp teacher for primary school students.

Mathematics and Physics

Barcelona, Spain

PRIVATE TUTOR

Jul. 2013 - Jun. 2017

- Private teacher for high-schoolers.

extracurricular activity

insideQuantum podcast

Berlin, Germany

VOLUNTEER ORGANIZATION ASSISTANT

Jun. 2022 - present

- Manage communication and logistics with the podcast guests.
- Curate the list of invited podcast guests.

Les Vinyes del Convent

Horta de Sant Joan, Spain

FAMILY-BUSINESS ASSISTANT

Aug. 2007 - Sep. 2019

- 2018, 2019: Performed chemical analyses and sampling of ripening grapes, fermenting must, and wine. Advised in harvest and conservation decisions.
- 2017, 2018: Lead winery tours, guided wine tastings, and attended the wine shop.
- 2007 - 2016: Worked in the vineyards and winery.

Talents of Barcelona

Barcelona, Spain

VOLUNTEER ORGANIZATION ASSISTANT

Feb. 2017 - May 2017

- Co-organized entrepreneurship events.
- Managed communication and maintained the webpage.

17th National Meeting of Mathematics Students

Barcelona, Spain

VOLUNTEER ORGANIZATION ASSISTANT

Jun. 2016

- Managed participants and organized events.

Artistic Legends

Offenbach, Germany

VOLUNTEER

Jul. 2014

- Took part in cultural week with German youths in risk of social exclusion.

World youth day

Madrid, Spain

VOLUNTEER

Aug. 2011

- Worked in event organization and logistics.