



Elies Gil-Fuster

GOOGLE PHD FELLOW · 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 Jens Eisert's research group at FU Berlin, I also work with Vedran Dunjko's group in Leiden University. My goal is to contribute to the mathematical foundations of quantum machine learning theory, especially for parametrized quantum circuits.

education

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

Berlin, Germany

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.

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: American Physical Society, Quantum journal, Nature Publishing Group, IOP Publishing, QIP, QTML, TQC.

Xanadu Quantum Technologies

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](#).

honors & awards

Oct. 2023 **Google PhD Fellowship**, Quantum Computing

Google AI

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


skills

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

Computer skills, \LaTeX , git, MS Office, web, image, and video editing.

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

publications & pre-prints

Up-to-date list of publications can be found in my  [Google scholar](#) profile.

PEER-REVIEWED

- 2024 **On the expressivity of embedding quantum kernels:** *Mach Learn Sci Tech, arXiv*
[Gil-Fuster E.](#), Eisert J., and Dunjko V., *Mach. Learn.: Sci. Technol.* **5** 025003
- 2024 **Understanding quantum machine learning also requires rethinking generalization:** *Nat. Comms., arXiv*
[Gil-Fuster E.](#), Eisert J., and Bravo-Prieto C., *Nat. Comms.* **15**, 2277
- 2023 **Exploiting symmetry in variational quantum machine learning:** *PRX Quantum, arXiv*
Meyer J.J., Mularski M., [Gil-Fuster E.](#), Mele A.A., Arzani F., Wilms A., and Eisert J., *PRX Quantum* **4**, 010328
- 2022 **Training Quantum Embedding Kernels on Near-Term Quantum Computers:** *PRA, arXiv*
Hubregtsen 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**, 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**, 226

PREPRINTS

- 2023 **Potential and limitations of random Fourier features for dequantizing quantum machine learning:** *arXiv*
Sweke R., Recio E., Jerbi S., [Gil-Fuster E.](#), Fuller B., Eisert J., and Meyer J. J., *arXiv:2309.11647*

talks & conferences

Apr. 2024	Invited: On the expressivity of embedding quantum kernels: GIQ Seminar at UAB	Barcelona, Spain
Mar. 2024	Contributed: On the expressivity of embedding quantum kernels: DPG March Meeting 2024	Berlin, Germany
Mar. 2024	Contributed: Understanding quantum machine learning also requires rethinking generalization: DPG March Meeting 2024	Berlin, Germany
Feb. 2024	Invited: On the expressivity of embedding quantum kernels: IBM Q UK seminar	United Kingdom (remote)
Jan. 2024	Invited: On the expressivity of embedding quantum kernels: QAISG QML seminar	Singapore
Jan. 2024	Poster: Understanding quantum machine learning also requires rethinking generalization: QIP2024: Quantum Information Processing	Taipei, Taiwan
Dec. 2023	Invited: On the expressivity of embedding quantum kernels: aQa seminar at Leiden University	Leiden, Netherlands
Nov. 2023	Invited: On the expressivity of embedding quantum kernels: QIC seminar at EPFL	Lausanne, Switzerland
Nov. 2023	Contributed: Understanding quantum machine learning also requires rethinking generalization: QTM2023: Quantum Techniques in Machine Learning	CERN, Switzerland
Nov. 2023	Invited: Understanding quantum machine learning also requires rethinking generalization: Einstein Research Unit update meeting	Berlin, Germany
Oct. 2023	Invited: Understanding quantum machine learning also requires rethinking generalization: Google Quantum AI QML meeting	California, USA (remote)
Oct. 2023	Invited: Understanding quantum machine learning also requires rethinking generalization: QAISG QML seminar	Singapore (remote)
Sep. 2023	Invited: Understanding quantum machine learning also requires rethinking generalization: QUANTIC group seminar at Barcelona Supercomputing Center	Barcelona, Spain
Jun. 2023	Participated: Quantum Information Workshop: Centro de Ciencias de Benasque Pedro Pascual	Benasque, Spain
Apr. 2023	Contributed: Exploiting symmetry in variational quantum machine learning: Machine Learning and (Quantum) Physics workshop	Obergurgl, Austria
Jan. 2023	Invited: Exploiting symmetry in variational quantum machine learning: QUANTIC group seminar at Barcelona Supercomputing Center	Barcelona, Spain
Nov. 2022	Poster: Non-Embedding Quantum Kernels, do they exist?: QTM2022: Quantum Techniques in Machine Learning	Naples, Italy
Dec. 2021	Invited: Training quantum embedding kernels on near-term quantum computers: One-day workshop: "Theory of Quantum Machine Learning"	Leiden, Netherlands and Berlin, Germany (remote)
Nov. 2021	Contributed: Encoding-dependent generalization bounds for parametrized quantum circuits: QTM2021: Quantum Techniques in Machine Learning	Osaka, Japan (remote)
Nov. 2021	Invited: Encoding-dependent generalization bounds for parametrized quantum circuits: Marco Tomamichel's group seminar at Centre for Quantum Technologies	Singapore (remote)
Sep. 2021	Poster: Generalization bounds in the quantum realm: EDS2021: ELLIS Doctoral Symposium	Tübingen, Germany
May. 2020	Participated: Hands-on Quantum Computing Summer School: Centro de Ciencias de Benasque Pedro Pascual, and Technology Innovation Institute Abu Dhabi	Benasque, Spain (remote)
Mar. 2020	Poster: Data re-uploading for a universal quantum classifier: QCTIP 2020: Quantum Computing Theory in Practice	Cambdridge, UK (remote)

teaching

Quantum Information Theory

TEACHING ASSISTANT

- Teaching assistant of Prof. Jens Eisert for the master's course "Quantum Information Theory".

Freie Universität Berlin, Germany

Oct. 2023 - Mar. 2024

Analytical geometry

TEACHING ASSISTANT

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

Freie Universität Berlin, Germany

Apr. 2020 - Sep. 2020

Informatics

TEACHING ASSISTANT

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

Freie Universität Berlin, Germany

Oct. 2019 - Mar. 2020

The mathematics of Cryptography

SUMMER TUTOR AT "SOMMERUNI"

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

Freie Universität Berlin, Germany

Jul. 2020

Web design and video game development

SUMMER TUTOR AT CAMPTECNOLÓGICO

- Summer camp teacher for primary school students.

Barcelona, Spain

Jul. 2016

Mathematics and Physics

PRIVATE TUTOR

- Private teacher for high-schoolers.

Barcelona, Spain

Jul. 2013 - Jun. 2017

extracurricular activity

insideQuantum podcast

VOLUNTEER ORGANIZATION ASSISTANT

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

Berlin, Germany

Jun. 2022 - present

Les Vinyes del Convent

FAMILY-BUSINESS ASSISTANT

- 2018, 2019: Performed chemical analysis 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.

Horta de Sant Joan, Spain

Aug. 2007 - Sep. 2019

Talents of Barcelona

VOLUNTEER ORGANIZATION ASSISTANT

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

Barcelona, Spain

Feb. 2017 - May 2017

17th National Meeting of Mathematics Students

VOLUNTEER ORGANIZATION ASSISTANT

- Managed participants and organized events.

Barcelona, Spain

Jun. 2016

Artistic Legends

VOLUNTEER

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

Offenbach, Germany

Jul. 2014

World youth day

VOLUNTEER

- Worked in event organization and logistics.

Madrid, Spain

Aug. 2011