

Hsin-Yuan Huang (Robert)

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EDUCATION

Ph.D., California Institute of Technology

Oct. 2018 - Now

Advised by John Preskill (Physics) and Thomas Vidick (CS).

B.S., National Taiwan University

Sep. 2014 - Jun. 2018

Studied in Computer Science (major) and Physics (minor). GPA: 4.30/4.30, Rank: 1/120.

Member of the Machine Learning and Data Mining Group; Advisor: Chih-Jen Lin

RESEARCH EXPERIENCE

Research Assistant, Institute for Quantum Information and Matter, Caltech

Oct. 2018 - Now

Research Intern, AWS Center for Quantum Computing, Mentor: Steven T. Flammia

Jun. 2021 - Sep. 2021

Research Intern, Google AI Quantum, Mentor: Jarrod R. McClean

Jun. 2020 - Oct. 2020

Visitor, Centre for Quantum Technologies, Host: Patrick Rebentrost

Jul. 2019 - Aug. 2019

Research Intern, Allen Institute for Artificial Intelligence, Mentor: Wen-tau Yih

Jun. 2018 - Sep. 2018

Research Intern, Microsoft Research, Redmond, USA, Mentor: Chenguang Zhu

Jun. 2017 - Sep. 2017

Research Assistant, Dept. of Computer Science, NTU, PI: Chih-Jen Lin

Sep. 2014 - Jun. 2018

Research Assistant, Dept. of Life Science, NTU, PI: Hsueh-Fen Juan

May 2013 - Aug. 2014

Research Assistant, Institute of Earth Sciences, Academia Sinica, PI: Fong Chao

Mar. 2012 - Mar. 2013

ACADEMIC PAPERS

- [1] **H.-Y. Huang**, Learning quantum states from their classical shadows. *Nature Review Physics*, 2022.
- [2] **H.-Y. Huang**, M. Broughton, J. Cotler, S. Chen, J. Li, M. Mohseni, H. Neven, R. Babbush, R. Kueng, J. Preskill, J. R. McClean. Quantum advantage in learning from experiments. *arXiv preprint*, arxiv:2112.00778, 2021.
- [3] (**alphabetical order**) J. Cotler, **H.-Y. Huang**, J. R. McClean. Revisiting dequantization and quantum advantage in learning tasks. *arXiv preprint*, arxiv:2111:05874, 2021. Technical manuscript.
- [4] (**alphabetical order**) S. Chen, J. Cotler, **H.-Y. Huang**, J. Li. Exponential separation between learning with and without quantum memory. *arXiv preprint*, arxiv:2111:05881, 2021. In *62nd Annual IEEE Symposium on Foundations of Computer Science (FOCS-21)*, 2021. Invited to SIAM Journal of Computing Special Issue.
- [5] (**alphabetical order**) S. Chen, J. Cotler, **H.-Y. Huang**, J. Li. A hierarchy for replica quantum advantage. *arXiv preprint*, arxiv:2111:05874, 2021.
- [6] M. C. Caro, **H.-Y. Huang**, M. Cerezo, K. Sharma, A. Sornborger, L. Cincio, P. J. Coles. Generalization in quantum machine learning from few training data. *arXiv preprint*, arxiv:2111:05292, 2021.
- [7] **H.-Y. Huang**, R. Kueng, G. Torlai, V. V. Albert, J. Preskill. Provably efficient machine learning for quantum many-body problems. *arXiv preprint*, arxiv:2106.12627, 2021.

- [8] J. R. McClean, N. C. Rubin, J. Lee, M. P. Harrigan, T. E. O’Brien, R. Babbush, W. J. Huggins, **H.-Y. Huang**. What the foundations of quantum computer science teach us about chemistry. *Perspectives, Journal of Chemical Physics*, 2021.
- [9] **H.-Y. Huang**, R. Kueng, J. Preskill. Efficient estimation of Pauli observables by derandomization. *Physical Review Letters*, 2021.
- [10] J. Cotler[†], D. Mark[†], **H.-Y. Huang[†] (co-first author)**, F. Hernandez, J. Choi, A. L. Shaw, M. Endres, S. Choi. Emergent quantum state designs from individual many-body wavefunctions. *arXiv preprint*, arxiv:2103.03536, 2021.
- [11] J. Choi, A. Shaw, I. Madjarov, X. Xie, J. Covey, J. Cotler, D. Mark, **H.-Y. Huang**, A. Kale, H. Pichler, F. Brandao, S. Choi, M. Endres. Emergent Randomness and Benchmarking from Many-Body Quantum Chaos. *arXiv preprint*, arxiv:2103.03535, 2021.
- [12] **H.-Y. Huang**, R. Kueng, J. Preskill. Information-theoretic bounds on quantum advantage in machine learning. *Physical Review Letters (Editor’s Suggestion)*, 2021. In *24th Annual Conference on Quantum Information Processing (QIP-21)*, 2021 (Talk title: Fundamental aspects of solving quantum problems with machine learning).
- [13] Y. Su, **H.-Y. Huang**, E. Campbell. Nearly-tight Trotterization of interacting electrons. *Quantum*, 2021. In *24th Annual Conference on Quantum Information Processing (QIP-21)*, 2021.
- [14] **H.-Y. Huang**, M. Broughton, M. Mohseni, R. Babbush, S. Boixo, H. Neven, J. R. McClean. Power of data in quantum machine learning. *Nature Communications*, 2021. In *24th Annual Conference on Quantum Information Processing (QIP-21)*, 2021 (Talk title: Fundamental aspects of solving quantum problems with machine learning).
- [15] C.-F. Chen[†], **H.-Y. Huang[†] (co-first author)**, R. Kueng, J. Tropp. Concentration for random product formulas. *PRX Quantum*, 2021.
- [16] **H.-Y. Huang**, K. Bharti, P. Rebentrost. Near-term quantum algorithms for linear systems of equations. *New Journal of Physics*, 2021.
- [17] M. Broughton, G. Verdon, T. McCourt, A. J. Martinez, J. H. Yoo, S. V. Isakov, P. Massey, R. Halavati, M. Y. Niu, A. Zlokapa, E. Peters, O. Lockwood, A. Skolik, S. Jerbi, V. Dunjko, M. Leib, M. Streif, D. V. Dollen, H. Chen, S. Cao, R. Wiersema, **H.-Y. Huang**, J. R. McClean, R. Babbush, S. Boixo, D. Bacon, A. K. Ho, H. Neven, M. Mohseni. TensorFlow Quantum: A Software Framework for Quantum Machine Learning *arXiv preprint*, arXiv:2003.02989, 2020.
- [18] A. Elben, R. Kueng, **H.-Y. Huang**, R. van Bijnen, C. Kokail, M. Dalmonte, P. Calabrese, B. Kraus, J. Preskill, P. Zoller, B. Vermersch. Mixed-state entanglement from local randomized measurements. *Physical Review Letters*, 2020.
- [19] **H.-Y. Huang**, R. Kueng, J. Preskill. Predicting many properties in a quantum system from very few measurements. *Nature Physics*, 2020.
- [20] **H.-Y. Huang**, R. Kueng. Predicting features of quantum systems using classical shadows. In *23rd Annual Conference on Quantum Information Processing (QIP-20)*, 2020. (single-track talk)
- [21] **H.-Y. Huang**, E. Choi, W. Yih. FlowQA: grasping flow in history for conversational machine comprehension. In *7th International Conference on Learning Representations (ICLR-19)*, 2019.
- [22] **H.-Y. Huang**, C. Zhu, Y. Shen, W. Chen. FusionNet: Fusing via Fully-aware attention with application to machine comprehension. In *6th International Conference on Learning Representations (ICLR-18)*, 2018. (top 3% in review score)

- [23] H.-F. Yu, **H.-Y. Huang**, I. S. Dhillon, C.-J. Lin. A unified algorithm for one-class structured matrix factorization with side information. In *31st AAAI Conference on Artificial Intelligence (AAAI-17)*, 2017. (acceptance rate: 24.6%)
- [24] **H.-Y. Huang**, C.-J. Lin. Linear and kernel classification: When to use which? In *SIAM International Conference on Data Mining (SDM-16)*, 2016. (acceptance rate: 25.8%)
- [25] C.-Y. Chen, A. Ho, **H.-Y. Huang**, H.-F. Juan and H.-C. Huang. Dissecting the human protein-protein interaction network via phylogenetic decomposition. In *Scientific Reports*, 4, 7153 (2014).

SELECTED AWARDS AND HONORS

Google Ph.D. Fellowship

Awards for Academic Excellence:

First Place Scholarship, Ministry of Education (awarded to Olympiad medalists ranking top 1)

2015, 2016, 2017, 2018

Presidential Award, National Taiwan University (awarded to students ranking top 5%)

Fall / Spring 2015, 2016, 2017, 2018

Awards for Competition in Algorithm and Informatics:

25th International Olympiad in Informatics, Bronze Medal

Jul. 2013

2013 Asia-Pacific Informatics Olympiad, Silver Medal

May 2013

National Informatics Olympiad in Taiwan, First Place

Dec. 2012

ORAL AND POSTER PRESENTATIONS

- [1] "Provably efficient machine learning for quantum many-body problems". Invited Talk at Math Picture Language Seminar, Mar. 22nd, 2022.
- [2] "Making predictions in a quantum world". Invited Talk at APS March Meeting, Mar. 18th, 2022.
- [3] "Foundations for learning from noisy quantum experiments". Contributed talk, 25th Annual Conference on Quantum Information Processing (QIP-22), Mar. 7th, 2022.
- [4] "Provably efficient machine learning for quantum many-body problems". Plenary talk, 25th Annual Conference on Quantum Information Processing (QIP-22), Mar. 7th, 2022.
- [5] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at PsiQuantum, Mar. 1st, 2022.
- [6] "Predicting many properties of quantum systems from very few measurements". Invited Talk at Graeme Smith's group at CU Boulder / JILA. Feb. 22th, 2022.
- [7] "Making predictions in a quantum world". Invited Talk at CTQM Seminar, CU Boulder / JILA. Feb. 18th, 2022.
- [8] "Quantum advantage in learning from experiments". Invited Talk at Los Alamos National Laboratory, Jan. 20th, 2022.
- [9] "Making predictions in a quantum world". Invited Talk at Quantum Colloquium, Simons Institute for the Theory of Computing. Nov. 30th, 2021.
- [10] "Provably efficient machine learning for quantum many-body problems". Invited Talk at Shivaji Sondhi's group at Oxford University. Nov. 19th, 2021.
- [11] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at the International Conference on Quantum Techniques in Machine Learning (QTML), Nov. 9th, 2021.

- [12] "Provably efficient machine learning for quantum many-body problems". Invited Talk at Perimeter Institute. Oct. 20th, 2021.
- [13] "Provably efficient machine learning for quantum many-body problems". Quantum Creators Prize Symposium. Sep. 29th, 2021.
- [14] "Provably efficient machine learning for quantum many-body problems". Invited Talk at QuSoft. Sep. 17th, 2021.
- [15] "Provably efficient machine learning for quantum many-body problems". Invited Talk at MIT/Harvard QML Journal Club. Sep. 2nd, 2021.
- [16] "Power of data in quantum machine learning". Invited Talk at QML Meetup. Aug. 26th, 2021.
- [17] "Provably efficient machine learning for quantum many-body problems". Invited Talk at Technical University of Munich. Jul. 26th, 2021.
- [18] "Experimental advantage in learning with noisy quantum memory". Invited Talk at Google Quantum Summer Symposium. Jul. 22nd, 2021.
- [19] "Provably efficient machine learning for quantum many-body problems". Invited Talk at Simons Institute for the Theory of Computing. Jul. 15th, 2021.
- [20] "How can we estimate properties of many-body quantum states in a Rydberg-atom system?". Theory Talk at Quantum Systems Accelerator meetings. Jul. 14th, 2021.
- [21] "Experimental advantage in learning with noisy quantum memory". Invited Talk at Google Quantum AI Theory Meeting. Jul. 13th, 2021.
- [22] "Provably efficient machine learning for quantum many-body problems". Invited Talk at Max Planck Institute of Quantum Optics. Jul. 13th, 2021.
- [23] "Predicting many properties of quantum systems from very few measurements". Invited Talk at Cornell University. May 20th, 2021.
- [24] "Recent advances on predicting properties of quantum many-body systems". Invited Talk at Peking University. May 12th, 2021.
- [25] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at IBM Research, May 5th, 2021.
- [26] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at Microsoft Research, Apr. 26th, 2021.
- [27] "Making predictions in the quantum world". Invited talk at Quantum Information Processing Seminar, Massachusetts Institute of Technology, Apr. 23rd, 2021.
- [28] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at Duke University, Apr. 16th, 2021.
- [29] "Characterizing quantum advantage in machine learning". Invited Talk at Scientific Machine Learning Series, Carnegie Mellon University. Apr. 15th, 2021.
- [30] "Power of data in quantum machine learning". Invited Talk at Rigetti Computing. Apr. 14th, 2021.
- [31] "Recent advances on predicting properties of quantum many-body systems". Invited Talk at the 6th International Conference for Young Quantum Information Scientists. Apr. 12th, 2021.
- [32] "Fundamental aspects of solving quantum problems with machine learning". Los Alamos National Laboratory, Mar. 25th, 2021.

- [33] "Power of data in quantum machine learning". APS March Meeting, Mar. 18th, 2021.
- [34] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at IST seminar series on Mathematics, Physics & Machine Learning, Mar. 17th, 2021.
- [35] "Power of data in quantum machine learning". Invited talk at SIAM Conference on Computational Science and Engineering, Mar. 3rd, 2021.
- [36] "Fundamental aspects of solving quantum problems with machine learning". Caltech Institute for Quantum Information and Matter (IQIM) Seminar, Feb. 26th, 2021.
- [37] "Fundamental aspects of solving quantum problems with machine learning". QuICS Seminar, University of Maryland, Feb. 17th, 2021.
- [38] "Fundamental aspects of solving quantum problems with machine learning". Contributed talk, 24rd Annual Conference on Quantum Information Processing (QIP-21), Jan. 30-31, 2021.
- [39] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at National Tsing Hua University, Jan. 12th, 2021.
- [40] "Information-theoretic bounds on quantum advantage in machine learning". Invited talk at Academia Sinica, Jan. 8th, 2021.
- [41] "Predicting Many Properties of a Quantum System from Very Few Measurements", National Taiwan University, Center for Quantum Science and Engineering, Dec. 18th, 2020.
- [42] "Predicting Many Properties of a Quantum System from Very Few Measurements", University College London, Quantum Information Seminar, Nov. 27th, 2020.
- [43] "Power of data in quantum machine learning", Centre for Quantum Technologies, Quantum Machine Learning Seminar, Nov. 26th, 2020.
- [44] "Predicting Many Properties of a Quantum System from Very Few Measurements", Caltech Institute for Quantum Information and Matter (IQIM) Seminar, Apr. 17th, 2020.
- [45] "Predicting Features of Quantum Systems using Classical Shadows", Single-track talk, 23rd Annual Conference on Quantum Information Processing (QIP-20), Jan. 6-10, 2020.
- [46] "Understanding Machine Reading Comprehension", Invited Talk, Academia Sinica, Oct 16, 2017.
- [47] "A Unified Algorithm for One-class Structured Matrix Factorization with Side Information", 31st AAAI Conference on Artificial Intelligence (AAAI-17), Feb. 4-9, 2017.
- [48] "Linear and Kernel Classification: When to Use Which?", SIAM International Conference on Data Mining (SDM16), May 5-8, 2016.
- [49] "Linear and Kernel Classifier: When to Use Which?", Spotlight presentation (acceptance rate: 11%), Machine Learning Summer School (MLSS'15), Kyoto University, August 23-September 4, 2015.
- [50] "Brief Introduction to Automatic Machine Learning", Science Exploration Forum, National Taiwan University, August 11, 2015.
- [51] "Dissecting Human Protein-Protein Interaction Network via Phylogenetic Decomposition." 14th International Conference on Systems Biology (ICSB2013), August 30-September 3, 2013.

SYNERGISTIC ACTIVITY

Conference review: NeurIPS, QIP, ICML, STOC, SODA, Asia Pacific Bioinformatics Conference.

Journal review: Nature, Physical Review Letters, npj Quantum Information, npj Quantum Materials, Quantum, Physical Review A, Quantum Machine Intelligence, Data Mining and Knowledge Discovery.

Teaching Assistant: Introduction to the Theory of Computation (2017).

Conference volunteer: QIP 2022, AAAI 2017.

OTHER AWARDS AND HONORS

<i>MediaTek Research Young Scholarship</i>	<i>Dec. 2021</i>
<i>Quantum Creators Prize</i>	<i>Sep. 2021</i>
<i>J. Yang Scholarship</i>	<i>Oct. 2020</i>
<i>Kortschak Scholarship</i>	<i>Oct. 2018</i>
<i>Taiwan Government Scholarship to Study Abroad</i>	<i>Sep. 2019</i>
<i>The Phi Tau Phi Scholastic Honor Society of the Republic of China</i>	<i>Jun. 2018</i>
<i>Undergraduate Research Project Exhibition, First Place</i>	<i>Jun. 2017</i>
<i>Appier Scholarship</i>	<i>Apr. 2016, Feb. 2017</i>
<i>AAAI Conference on Artificial Intelligence 2017 Scholarship</i>	<i>Feb. 2017</i>
<i>Shih-Liang Chien Memorial Award</i>	<i>May. 2016</i>
<i>SIAM International Conference on Data Mining 2016 Travel Award</i>	<i>Apr. 2016</i>
<i>Machine Learning Summer School 2015 Travel Award</i>	<i>Oct. 2015</i>
<i>Wang Da Gang Natural Science Scholarship</i>	<i>May 2013</i>
<i>Taiwan International Science Fair, Third Prize</i>	<i>Nov. 2012</i>
<i>Science Research Grant for High School Student, First Prize</i>	<i>Nov. 2012</i>
<i>Taipei High School Informatics Competition, First Place</i>	<i>Oct. 2012</i>
<i>Taipei High School Informatics Competition, Third Place</i>	<i>Oct. 2011</i>