Project guideline

Each student is required to select a paper related to the course, write a report on it, and deliver a 30-minute presentation. The report should include a summary of the paper that addresses the following questions:

1. What problem does the paper address?
2. Why is this problem relevant?
3. What is the paper's main contribution?
4. What techniques are used to support their findings?

Additionally, the report should identify at least one unresolved question from the paper and propose a potential approach to address it (though you do not need to solve the question). The report should be no longer than two pages.

Timeline Please select your paper by September 30. Presentations will be held at the end of the semester, with two students presenting per session. The deadline for submitting your report is November 15.

Recommended papers

1. H. Bennett, P. W. Shor, J. A. Smolin and A. V. Thapliyal, "Entanglement-assisted capacity of a quantum channel and the reverse Shannon theorem," in IEEE Transactions on Information Theory, vol. 48, no. 10, pp. 2637-2655, Oct. 2002
2. I. Devetak, "The private classical capacity and quantum capacity of a quantum channel," in IEEE Transactions on Information Theory, vol. 51, no. 1, pp. 44-55, Jan. 2005
3. Hayden, P., Leung, D. and Winter, A. "Aspects of Generic Entanglement." Commun. Math. Phys. 265, 95–117 (2006).
4. Hayden, P., Leung, D., Shor, P. et al. "Randomizing Quantum States: Constructions and Applications" Commun. Math. Phys. 250, 371–391 (2004)
5. Patrick Hayden, Michal Horodecki, Andreas Winter, and Jon Yard "A Decoupling Approach to the Quantum Capacity" Open Systems & Information Dynamics Vol. 15, No. 01, pp. 7-19 (2008)

6. C. H. Bennett, P. Hayden, D. W. Leung, P. W. Shor and A. Winter, "Remote preparation of quantum states," in IEEE Transactions on Information Theory, vol. 51, no. 1, pp. 56-74, Jan. 2005

7. Abeyesinghe Anura, Devetak Igor, Hayden Patrick and Winter Andreas "The mother of all protocols: restructuring quantum information's family tree" Proc. R. Soc. A.4652537–2563

8. Masato Koashi and Andreas Winter "Monogamy of quantum entanglement and other correlations" Phys. Rev. A 69, 022309

9. Zi-Wen Liu and Andreas Winter "Many-Body Quantum Magic" PRX Quantum 3, 020333

10. Irit Dinur, Min-Hsiu Hsieh, Ting-Chun Lin, and Thomas Vidick. 2023. Good Quantum LDPC Codes with Linear Time Decoders. In Proceedings of the 55th Annual ACM Symposium on Theory of Computing (STOC 2023).

11. Anurag Anshu, Nikolas P. Breuckmann, and Chinmay Nirkhe. 2023. NLTS Hamiltonians from Good Quantum Codes. In Proceedings of the 55th Annual ACM Symposium on Theory of Computing (STOC 2023).

12. Elben, A., Flammia, S.T., Huang, HY. et al. The randomized measurement toolbox. Nat Rev Phys 5, 9–24 (2023).

13. Marco Tomamichel and Renato Renner "Uncertainty Relation for Smooth Entropies" Phys. Rev. Lett. 106, 110506

14. M. Tomamichel, R. Colbeck and R. Renner, "A Fully Quantum Asymptotic Equipartition Property," in IEEE Transactions on Information Theory, vol. 55, no. 12, pp. 5840-5847, Dec. 2009

15. M. Tomamichel, R. Colbeck and R. Renner, "Duality Between Smooth Min- and Max-Entropies," in IEEE Transactions on Information Theory, vol. 56, no. 9, pp. 4674-4681, Sept. 2010

16. Lami, L., Regula, B. "No second law of entanglement manipulation after all." Nat. Phys. 19

17. Ambainis, A. et al. "Quantum Strategies Are Better Than Classical in Almost Any XOR Game."

18. Berta, M., Christandl, M., Colbeck, R. et al. "The uncertainty principle in the presence of quantum memory." Nature Phys 6, 659–662 (2010)

19. Winter, A. "Weak Locking Capacity of Quantum Channels Can be Much Larger Than Private Capacity." J Cryptol 30, 1–21 (2017)

20. Brandão, F.G.S.L., Harrow, A.W. & Horodecki, M. "Local Random Quantum Circuits are Approximate Polynomial-Designs." Commun. Math. Phys. 346, 397–434 (2016).

21. F. G. S. L. Brandão, A. W. Harrow, J. R. Lee and Y. Peres, "Adversarial Hypothesis Testing and a Quantum Stein's Lemma for Restricted Measurements," in IEEE Transactions on Information Theory, vol. 66, no. 8, pp. 5037-5054, Aug. 2020

22. Marco Tomamichel et al "A monogamy-of-entanglement game with applications to device-independent quantum cryptography" 2013 New J. Phys. 15 103002

23. Thomas Schuster, Jonas Haferkamp, Hsin-Yuan Huang "Random unitaries in extremely low depth" arXiv:2407.07754

24. Anne Broadbent, Sébastien Lord "Uncloneable Quantum Encryption via Oracles" arXiv:1903.00130

25. Prabhanjan Ananth, Fatih Kaleoglu, Henry Yuen "Simultaneous Haar Indistinguishability with Applications to Unclonable Cryptography" arXiv:2405.10274