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DAFTAR PUSTAKA

AbuGhanem, M. 2025. Characterizing grover search algorithm on large-scale superconducting quantum computers. *Scientific Reports*, 15(1):1281.

Babbush, R., Huggins, W. J., Berry, D. W., Ung, S. F., Zhao, A., Reichman, D. R., Neven, H., Baczewski, A. D., and Lee, J. 2023. Quantum simulation of exact electron dynamics can be more efficient than classical mean-field methods. *Nature Communications*, 14(1):4058.

Beauregard, S. 2003. Circuit for shor's algorithm using 2n+3 qubits. *Quantum Info. Comput.*, 3(2):175–185.

Berezutskii, A., Luchnikov, I., and Fedorov, A. 2025. Simulating quantum circuits using the multi-scale entanglement renormalization ansatz. *Physical Review Research*, 7(1):013063.

Bergholm, V., Izaac, J., Schuld, M., Gogolin, C., Ahmed, S., Ajith, V., Alam, M. S., Alonso-Linaje, G., AkashNarayanan, B., Asadi, A., et al. 2018. Pennylane: Automatic differentiation of hybrid quantum-classical computations. *arXiv preprint arXiv:1811.04968*.

Bernardi, M. 2023. Efficient mean-field simulation of quantum circuits inspired by density functional theory. *Journal of Chemical Theory and Computation*, 19(22):8066–8075.

Brandao, F. G. and Harrow, A. W. 2016. Product-state approximations to quantum states. *Communications in Mathematical Physics*, 342:47–80.

Burnett, J. J., Bengtsson, A., Scigliuzzo, M., Niepce, D., Kudra, M., Delsing, P., and Bylander, J. 2019. Decoherence benchmarking of superconducting qubits. *npj Quantum Information*.

Casagrande, H. P., Xing, B., Munro, W. J., Guo, C., and Poletti, D. 2024. Tensor-networks-based learning of probabilistic cellular automata dynamics. *Physical Review Research*, 6(4):043202.

Cerezo, M., Arrasmith, A., Babbush, R., Benjamin, S. C., Endo, S., Fujii, K., McClean, J. R., Mitarai, K., Yuan, X., Cincio, L., et al. 2021. Variational quantum algorithms. *Nature Reviews Physics*, 3(9):625–644.

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Das, S., Tariq, A., Santos, T., Kantareddy, S. S., and Banerjee, I. 2023. Recurrent neural networks (rnns): architectures, training tricks, and introduction to influential research. *Machine learning for Brain disorders*, pages 117–138.

Farhi, E., Goldstone, J., and Gutmann, S. 2014. A quantum approximate optimization algorithm. *arXiv preprint arXiv:1411.4028*.

Goodfellow, I., Bengio, Y., Courville, A., and Bengio, Y. 2016. *Deep learning*, volume 1. MIT press Cambridge.

Gourianov, N., Givi, P., Jaksch, D., and Pope, S. B. 2025. Tensor networks enable the calculation of turbulence probability distributions. *Science Advances*, 11(5):eads5990.

Grover, L. K. 1996. A fast quantum mechanical algorithm for database search. In *Proceedings of the twenty-eighth annual ACM symposium on Theory of computing*, pages 212–219.

Harris, C. R., Millman, K. J., van der Walt, S. J., Gommers, R., Virtanen, P., Cournapeau, D., Wieser, E., Taylor, J., Berg, S., Smith, N. J., Kern, R., Picus, M., Hoyer, S., van Kerkwijk, M. H., Brett, M., Haldane, A., del Río, J. F., Wiebe, M., Peterson, P., Gérard-Marchant, P., Sheppard, K., Reddy, T., Weckesser, W., Abbasi, H., Gohlke, C., and Oliphant, T. E. 2020. Array programming with NumPy. *Nature*, 585(7825):357–362.

Horodecki, R., Horodecki, P., Horodecki, M., and Horodecki, K. 2009. Quantum entanglement. *Reviews of modern physics*, 81(2):865–942.

Jahromi, S. S. and Orús, R. 2024. Variational tensor neural networks for deep learning. *Scientific Reports*, 14(1):19017.

Javadi-Abhari, A., Treinish, M., Krsulich, K., Wood, C. J., Lishman, J., Gacon, J., Martiel, S., Nation, P. D., Bishop, L. S., Cross, A. W., Johnson, B. R., and Gambetta, J. M. 2024. Quantum computing with Qiskit.

Keen, T., Maier, T., Johnston, S., and Lougovski, P. 2020. Quantum-classical simulation of two-site dynamical mean-field theory on noisy quantum hardware. *Quantum Science and Technology*, 5(3):035001.

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GADJAH MADA
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Kingma, D. P. and Ba, J. 2014. Adam: A method for stochastic optimization. *arXiv preprint arXiv:1412.6980*.

Kissinger, A., van de Wetering, J., and Vilmart, R. 2022. Classical simulation of quantum circuits with partial and graphical stabiliser decompositions. *arXiv preprint arXiv:2202.09202*.

Krantz, P., Kjaergaard, M., Yan, F., Orlando, T. P., Gustavsson, S., and Oliver, W. D. 2019. A quantum engineer's guide to superconducting qubits. *Applied physics reviews*, 6(2).

Krizhevsky, A., Sutskever, I., and Hinton, G. E. 2012. Imagenet classification with deep convolutional neural networks. *Advances in neural information processing systems*, 25.

LeCun, Y., Bengio, Y., and Hinton, G. 2015. Deep learning. *nature*, 521(7553):436–444.

Leng, J., Yang, F., and Wang, X.-B. 2025. Noise-tolerant grover's algorithm via success-probability prediction. *Physical Review Research*, 7(1):L012017.

Lu, Y., Bengtsson, A., Burnett, J. J., Wiegand, E., Suri, B., Krantz, P., Roudsari, A. F., Kockum, A. F., Gasparinetti, S., Johansson, G., et al. 2021. Characterizing decoherence rates of a superconducting qubit by direct microwave scattering. *npj Quantum Information*, 7(1):35.

Mehmandoost, M. and Dobrovitski, V. 2024. Decoherence induced by a sparse bath of two-level fluctuators: Peculiar features of 1/f noise in high-quality qubits. *Physical Review Research*, 6(3):033175.

Mermin, N. D. 2007. *Quantum Computer Science: An Introduction*. Cambridge University Press.

Napp, J. C., La Placa, R. L., Dalzell, A. M., Brandao, F. G., and Harrow, A. W. 2022. Efficient classical simulation of random shallow 2d quantum circuits. *Physical Review X*, 12(2):021021.

Nielsen, M. A. and Chuang, I. L. 2010. *Quantum computation and quantum information*. Cambridge university press.

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GADJAH MADA
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Oonishi, K. and Kunihiro, N. 2023. Shor's algorithm using efficient approximate quantum fourier transform. *IEEE Transactions on Quantum Engineering*, 4:1–16.

Orús, R. 2014. A practical introduction to tensor networks: Matrix product states and projected entangled pair states. *Annals of physics*, 349:117–158.

Orús, R. 2019. Tensor networks for complex quantum systems. *Nature Reviews Physics*, 1(9):538–550.

Paszke, A. 2019. Pytorch: An imperative style, high-performance deep learning library. *arXiv preprint arXiv:1912.01703*.

Perez-Garcia, D., Verstraete, F., Wolf, M. M., and Cirac, J. I. 2006. Matrix product state representations. *arXiv preprint quant-ph/0608197*.

Peruzzo, A., McClean, J., Shadbolt, P., Yung, M.-H., Zhou, X.-Q., Love, P. J., Aspuru-Guzik, A., and O'brien, J. L. 2014. A variational eigenvalue solver on a photonic quantum processor. *Nature communications*, 5(1):4213.

Polla, S., Anselmetti, G.-L. R., and O'Brien, T. E. 2023. Optimizing the information extracted by a single qubit measurement. *Physical Review A*, 108(1):012403.

Portugal, R. 2022. Basic quantum algorithms. *arXiv preprint arXiv:2201.10574*.

Pradata, S. Y., Amrizal, M. A., Suryanto, W., Nugraha, A. R. T., and Takizawa, H. 2026. Deep learning-integrated pairwise-qubit subsystems for highly efficient quantum circuit simulation. In *Proceedings of the Supercomputing Asia and International Conference on High Performance Computing in Asia Pacific Region*, SCA-/HPCAsia '26, page 130–141, New York, NY, USA. Association for Computing Machinery.

Pradata, S. Y., Azhiim, M. N., Lim, H. M., and Nugraha, A. R. T. 2024. Efficient classical computation of single-qubit marginal measurement probabilities to simulate certain classes of quantum algorithms. *arXiv preprint arXiv:2411.06822*.

Press, W. H. 2007. *Numerical recipes 3rd edition: The art of scientific computing*. Cambridge university press.

Rasmussen, S. E., Christensen, K. S., Pedersen, S. P., Kristensen, L. B., Bækkegaard, T., Loft, N. J. S., and Zinner, N. T. 2021. Superconducting circuit companion—an introduction with worked examples. *PRX Quantum*, 2(4):040204.

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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Regev, O. 2025. An efficient quantum factoring algorithm. *Journal of the ACM*, 72(1):1–13.

Resch, S. and Karpuzcu, U. R. 2021. Benchmarking quantum computers and the impact of quantum noise. *ACM Computing Surveys (CSUR)*, 54(7):1–35.

Rivest, R. L., Shamir, A., and Adleman, L. 1978. A method for obtaining digital signatures and public-key cryptosystems. *Communications of the ACM*, 21(2):120–126.

Sak, H., Senior, A. W., Beaufays, F., et al. 2014. Long short-term memory recurrent neural network architectures for large scale acoustic modeling. In *Interspeech*, volume 2014, pages 338–342.

Schuld, M., Sinayskiy, I., and Petruccione, F. 2015. An introduction to quantum machine learning. *Contemporary Physics*, 56(2):172–185.

Shiri, F. M., Perumal, T., Mustapha, N., and Mohamed, R. 2023. A comprehensive overview and comparative analysis on deep learning models: Cnn, rnn, lstm, gru. *arXiv preprint arXiv:2305.17473*.

Shor, P. W. 1994. Algorithms for quantum computation: discrete logarithms and factoring. In *Proceedings 35th annual symposium on foundations of computer science*, pages 124–134. Ieee.

Suppes, P. 1961. Probability concepts in quantum mechanics. *Philosophy of Science*, 28(4):378–389.

R. Acharya et al. (Google Quantum AI) 2023. Suppressing quantum errors by scaling a surface code logical qubit. *Nature*, 614(7949):676–681.

Van Rossum, G. and Drake, F. L. 2009. *Python 3 Reference Manual*. CreateSpace, Scotts Valley, CA.

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., Kaiser, Ł., and Polosukhin, I. 2017. Attention is all you need. *Advances in neural information processing systems*, 30.

Vathsan, R. 2015. *Introduction to Quantum Physics and Information Processing*. CRC Press.

UNIVERSITAS
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Virtanen, P., Gommers, R., Oliphant, T. E., Haberland, M., Reddy, T., Cournapeau, D., Burovski, E., Peterson, P., Weckesser, W., Bright, J., van der Walt, S. J., Brett, M., Wilson, J., Millman, K. J., Mayorov, N., Nelson, A. R. J., Jones, E., Kern, R., Larson, E., Carey, C. J., Polat, İ., Feng, Y., Moore, E. W., VanderPlas, J., Laxalde, D., Perktold, J., Cimrman, R., Henriksen, I., Quintero, E. A., Harris, C. R., Archibald, A. M., Ribeiro, A. H., Pedregosa, F., van Mulbregt, P., and SciPy 1.0 Contributors 2020. SciPy 1.0: Fundamental Algorithms for Scientific Computing in Python. *Nature Methods*, 17:261–272.

Wang, C., Li, X., Xu, H., Li, Z., Wang, J., Yang, Z., Mi, Z., Liang, X., Su, T., Yang, C., et al. 2022. Towards practical quantum computers: Transmon qubit with a lifetime approaching 0.5 milliseconds. *npj Quantum Information*, 8(1):3.

Weinstein, Y. S., Pravia, M. A., Fortunato, E. M., Lloyd, S., and Cory, D. G. 2001. Implementation of the quantum fourier transform. *Phys. Rev. Lett.*, 86:1889–1891.

Willsch, D., Willsch, M., Jin, F., De Raedt, H., and Michielsen, K. 2023. Large-scale simulation of shor's quantum factoring algorithm. *Mathematics*, 11(19).

Wu, X.-C., Di, S., Dasgupta, E. M., Cappello, F., Finkel, H., Alexeev, Y., and Chong, F. T. 2019. Full-state quantum circuit simulation by using data compression. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, SC '19, New York, NY, USA. Association for Computing Machinery.

Xu, M., Yan, Y., Shi, Q., Ankerhold, J., and Stockburger, J. 2022. Taming quantum noise for efficient low temperature simulations of open quantum systems. *Physical Review Letters*, 129(23):230601.