Quantum Universality and Turing Completeness

Cristian S. Calude

November 21, 2019

Universality is a property discussed in many articles regarding quantum computing; in particular for the D-Wave machines [2].

Universality in quantum computing [6, 3, 4, 5] is different from universality in classical computability theory [7, 8]; furthermore, universality is different from Turing completeness [1].

This project goal is to study and contrast these the properties of universality and Turing completeness for various models of quantum computing.

References

[1] E. H. Allen, C. S. Calude. Quassical computing, *International Journal of Unconventional Computing*, 14 (2018),43–57.

[2] C. S. Calude, E. Calude, M. J. Dinneen. Adiabatic quantum computing challenges, *ACM SIGACT News* 1(2015), 40–61.

[3] D. Deutsch. Quantum theory, the Church-Turing principle, and the universal quantum computer, *Proceedings of the Royal Society of London* Series A400 (1985), 97–117.

[4] J. Gruska. *Quantum Computing*, McGraw-Hill, London, 1999.

[5] D. Mermin. *Quantum Computer Science*, Cambridge University Press, Cambridge, 2007.

[6] M. A. Nielsen, I. L. Chuang. Programmable quantum gate arrays, *Physical Review Letters* 79 (1997), 321–324.

[7] M. Sipser. *Introduction to the Theory of Computation*, International Thomson Publishing, 2013, 3rd ed.

[8] H. Vollmer. *Introduction to Circuit Complexity*, Springer, Berlin, 1999.