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Quantum Programming for the Computer Science Sophomore

Abstract: Quantum computers exist, access to them via the cloud is affordable, university and industry-developed education is increasing, and government funding was approved to further research and focus on needed workforce development. As the field continues to grow, so too has the computer science sophomore's interest in learning about, and testing, some of the publicly available quantum computers. I will present a plan for a series of lessons aimed to teach the basics of quantum algorithms to those who may have little to no background in quantum physics and/or minimal knowledge of coding in Python. Each lesson covers select physics and coding topics eventually building up a toolset for tackling more and more challenging quantum algorithms. The sequence of topics and activities is designed with the following two learning outcomes in mind: (a) build a concise and thorough understanding of some of the most popular and/or academically important quantum algorithms, and (b) obtain a fluent understanding of how to write code for quantum algorithms, using IBM's publicly available Quantum Information Software Kit (QISKit). Topics include: single and multiple qubit systems; entanglement; teleportation; quantum states, quantum gates and measurement; evolving quantum states with quantum gates; quantum circuits; primitives for a quantum processing unit; reversible computation; quantum algorithms.

Biography: Adrian German is a Senior Lecturer in Computer Science. At Indiana University Bloomington he is the recipient of several teaching awards at the departmental and university level. His interests include learner-sighted teaching practices and maker-centered learning. He is the organizer of several successful symposia and conference workshops and has had presentations at various national and international conferences (SIGCSE, SIGITE, ITICSE, ISSOTL, FIE, ECEL, and others). His most recent presentations include: *Decoding Self-Regulated Learning* (The Learner Conference, Queen's University Belfast, Northern Ireland, July 2019) and *Promoting and Maintaining Student Agency in the Era of Interactive Textbooks* (18th European Conference on e-Learning, Aalborg University, Copenhagen, Denmark, November 2019). In the past his work was partially supported by various local (university) grants. He is now a co-primary investigator on an NSF grant proposal (joint submission between Indiana University, the University of Kansas and Ithaca College) entitled "Improving Undergraduate STEM Education: Computing in Undergraduate Education"

