

# Cohort Project update

Cohort 4

Quantum Engineering CDT  
University of Bristol

May 22, 2018



Figure: Roadmap

<sup>1</sup>Away-day presentation

# Survey results

Cohort  
Project  
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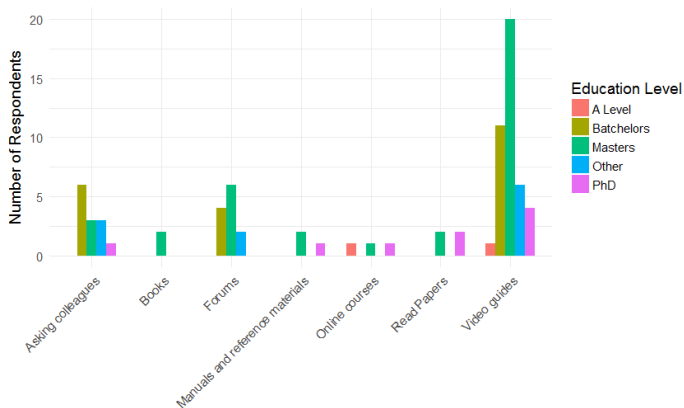


Figure: Results from onedrive <sup>1</sup>

# Survey results

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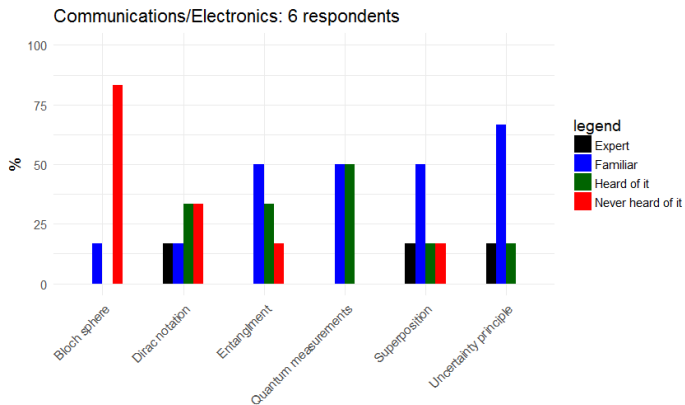


Figure: Results from onedrive <sup>2</sup>

# Sections we plan to include

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## Quantum Meta-Programming for Dummies

Cohort 4  
Quantum Engineering CDT  
University of Bristol  
May 11, 2018

### 1 Preface

This is where the preface will be

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Figure: Document at <sup>3</sup>

# Current work

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25 Apr 2018

## Quantum machine learning for data scientists

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This text aims to present and explain quantum machine learning algorithms to a data scientist in an accessible and consistent way. The algorithms and equations presented are not written in rigorous mathematical notation, instead, the procedure is put on examples and step by step explanation of different topics. This contribution gives an overview of selected quantum machine learning algorithms, however there is also a method of feature extraction for quantum PCA algorithm proposed as well as a new cost function in feed-forward quantum neural networks is introduced. The text is divided into four parts: the first part explains the basic quantum theory, then quantum computation and quantum computer architectures are explained in section two. The third part presents quantum algorithms which will be used as subroutines in quantum machine learning algorithms. Finally, the fourth section describes quantum machine learning algorithms with the use of knowledge accumulated in previous parts.

Contents

I. Introduction

10 Apr 2018

## Quantum Algorithm Implementations for Beginners

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As quantum computers have become available to the general public, the need has arisen to train a cohort of quantum programmers, many of whom have been developing classic computer programs for most of their career. While currently available quantum computers have less than 100 qubits, quantum computer hardware is widely expected to grow in terms of qubit counts, quality, and connectivity. Our article aims to explain the principles of quantum programming, which are quite different from classical programming, with straight-forward algebra that makes understanding the underlying quantum mechanics optional (but still fascinating). We give an introduction to quantum computing algorithms and their implementation on real quantum hardware. We survey 20 different quantum algorithms, attempting to describe each in a concise and self-contained fashion; we show how they are implemented on IBM's quantum computer and in each case we discuss the results of the implementation with respect to differences of the simulator and the actual hardware runs. This article introduces computer scientists and engineers to quantum algorithms and provides a blueprint for their implementation.

## Strawberry Fields:

### A Software Platform for Photonic Quantum Computing

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We introduce Strawberry Fields, an open-source quantum programming architecture for light-based quantum computers. Built in Python, Strawberry Fields is a full-stack library for design, simulation, optimization, and quantum machine learning of continuous-variable circuits. The platform consists of three main components: (i) an API for quantum programming based on an easy-to-use language named `Blackbird`; (ii) a suite of three virtual quantum computer backends, built in `Numpy` and `Tensorflow`, each targeting specialized uses; and (iii) an engine which can compile `Blackbird` programs on various backends, including the three built-in simulators, and – in the near future – photonic quantum information processors. The library also contains examples of several paradigmatic algorithms, including teleportation, `Gaussian` boson sampling, instantaneous quantum polynomial, Hamiltonian simulation, and variational quantum circuit optimization.

h] 9 Apr 2018