

# Quantum Information & Computation

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This set of notes is a work-in-progress account of the course ‘Quantum Information & Computation’, originally lectured by Prof Richard Jozsa in Lent 2020 at Cambridge. These notes are not a direct transcription of the lectures, but they do roughly follow what was lectured (in content and in structure).

These notes are likely to be more succinct than other lecture notes of mine, and I have left out various aspects of what was taught. If you spot any errors in this set of notes, I can be contacted at [ak2316@cam.ac.uk](mailto:ak2316@cam.ac.uk).

## 1 Introduction

Why bother with *quantum* computation and information? To answer this, it helps to consider the natural of computation and information in a classical sense.

Classical information is usually expressed in bits and bit strings. Formally these are strings of Boolean variables with values 0 or 1.

Computation, at a fundamental level, can be thought of as updating bit strings by prescribed sequences of steps (‘the program’). These are usually elementary Boolean operations/gates, for example AND, OR, NOT, SWAP and so on. A crucial property here is that each operation takes a ‘fixed effort’ to perform, independent of the length of the string.