Notes:
Introduction - close with a discussion of math as the universal language, reduce problems to arithmatic, this is profound, a description of the physical world reduced to +/- introduce to Turing machine

2.0 Classical Computers

Church's Thesis:
Turing machine is capable of simulating all physical properties, CAD, light, visiion, flowing hair, mechanical systems leads to

Time it takes depends on the difficulty and power of machine. Machines have grown more powerful by Moor's Law, todays machines can simulate 3D environments in real time and are literally millions of times faster than when Gordon Moore proposed his law in 1965, but some problems are still hard... leads to

Problems that can be solved in Polynomial time, that is X^2, X^3, are called P problems. Problems that can not be solved in polynomial time are notP, or nP. It has not been proven in the mathematical sense that nP does not equal P. Factorization, nP problem, but multiplication is P, basis of cyptography. The time it takes to undo the math rises exponentially as 2^L where L is the key length, but the time to encrypt rises only as L (or L^2). For example factorization using a number sieve of 130 decimal digits takes 42 days at 10^12 ops per second. Merely doubling L increases the time required to 10^25 years.

3.0 Quantum Mechanics

Quantum Mechanics is a different way of looking at the universe, a big subject, but some parts are intrinsic to the discussion of Quantum computing, including:

The core difference is that, while allowed states may be discrete, observables always have some uncertainty, defined by Hiezenberg's uncertainty principle.

Schrodinger's equation expands on the theme by defining the location of an entity (observable only at the particle level) as a continuous function: WHICH TAILS OFF BUT IS NEVER ZERO. The probability of finding a particle at a location significantly outside the classical radius (or location) is exponentially asymptotic on zero.

3.2 Spin is a useful observable in quantum mechanics, as is polarization. The Pauli exclusion principle states that two electrons cannot be in the exact same state, and so spin was proposed to differentiate electrons in otherwise identical energy positions. There are two allowed projections, Up and Down, and may be in any axis (X,Y,Z) but both will always resolve to one axis.

Polarization: polarizer resolves the polarization of a photon (or any other particle), which is indeterminate before being tested by the polarizer to be in one of two allowed polarizations (up/down). A second polarizer, rotated 90 degress from the first will not pass any photons. Rotating the second polarizer allows some photons to pass, as a function of rotation. This is not because they squeek through (why some photons and not others) but because of uncertainty in the wave wave state.

3.3, Interference,
Blocking one slit produces a single slit pattern, even one photon at a time. Can you measure which slit the photon came through? Measurement collapses the wave funtion, entangled between both slits, the single photon behaves as a particle, without the collapse of the wave function, the wave function defines the propagation of the particle, and both slits effect it's "location" which is later resolved at the screen.