the microprocessors in conventional or classical computers are built from billions of transistors that are turned on or off to represent a value of either one or zero in turn this allows classical computers to store and process data using binary digits or bits in contrast quantum computers process information using quantum bits or qubits these can be created in many different for example using superconducting electronic circuits

classical computers encode information in bits and each bit can represent a 0 or a 1 these zeros and ones act as on-off switches that ultimately translate into compute functions to perform a simple calculation like solving a maze a classical computer would test each possible route one at a time to find the correct one just as classical computers have bits quantum computers have cubits cubits however make use of two key principles of quantum physics superposition and entanglement superposition means that each qubit can represent a zero a one or both at the same time and entanglement happens when two qubits in a superposition are correlated with one another meaning the state of one whether it's a 0 a 1 or both depends on the state of another using these two principles qubits can act as a much more sophisticated version of switches helping quantum computers solve difficult problems that are virtually impossible using classical computers to illustrate how this makes quantum computers more powerful

let's look at some numbers take a classical n bit computer with n representing the number of bits it can represent and examine only one system state at a time an N cubed computer however would have the power to represent 2 to the power of n system states and perform parallel operations on all those states at once this means that every time you add just one more qubit to a quantum computer the number of states that can represent and examine the so a 50 cubit quantum machine could examine two to the power of 50 states at once this exponential increase in power together with the entanglement of qubits is what allows quantum computers to solve certain problems so much more efficiently while a classical computer solves a problem like the maze by testing each possible route one at a time a quantum computer uses its entangled quantum state to find the correct route quicker with far fewer calculations think of it this way technologies that currently run on classical computers can expertly find patterns and insights buried in vast amounts of existing data but quantum computers will deliver solutions where patterns cannot be seen because sufficient data does not exist or the possibilities for discovering an optimal answer are too enormous to ever be processed by a classical computer

So determine the state of this two spin system, I need to give you four numbers, four coefficients,

whereas in the classical example of the two bits, I only need to give you two bits.

So this is how you understand why two qubits actually contain four bits of information.

I need to give you four numbers to tell you the state of this system, whereas here I only

need two.

Now if we make three spins, we would have eight different states and it could give you

eight different numbers to define the state of those three spins, whereas classical it

is just three bits.If you keep going, what you find is that the amount of equivalent classical information

contained by N qubits is two to the power N classical bits.And, of course, the power of exponentials tells you that once you have, let’s say,300 of those qubits in what we call the folient angle state, so you must be able to create these really crazy states where there is a super position of all three angles being one way and another way and another way and so on, then you have like two to the 300 classical bits, which is as many particles as there are in the universe.>> But there is a catch, although the qubits can exist in any combination of states, when they are measured they must fall into one of the basis states. And all the other information about the state before the measurement is lost.

>> So you don’t want generally to have as the final result of your quantum computation

something that is a very complicated super positional state, because our cannot measure a super position.