

SCIENCE SPECTRUM MAGAZINE

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SCIENCE SPECTRUM

MAGAZINE



STEM

VOLUME NO. 4 • Jan

Quantum Computing

Graphene: the most famous allotrope of carbon

Introduction: The Internet revolution, which corresponds to the fourth stage of the industrial revolution, came along with the development of computers. Computers followed Moore's Law (explanation) for the past 50 years and showed an improvement in technology, but recently the size of computer parts has reached its limit as it approaches the size of an atom. There is an increasing awareness that a completely different method is needed for the development of computers instead of simply reducing the size of parts. Quantum computers, already proposed by physicist Richard Feynman in the early 1980s, are said to hold the answer to this problem. In order to handle enormous calculations, a completely new computer using quantum roles is needed.

Concept of quantum computer – simultaneous computational ability using superposition. A quantum computer can be easily described as a computer using the concept of quantum mechanics. A bit, the smallest information unit of a general computer, represents only two states, 0 and 1, according to voltage control. A qubit, a new information unit presented by quantum computers, is a new information unit using the characteristics of quantum superposition. An atom consists of a nucleus made up of protons and neutrons, and electrons. When the electron gains energy, it becomes the ground state, where the electron is excited with energy. When it loses energy again, it becomes the excited state, which is the most stable state of the electron. In quantum mechanics, when a particle receives an electromagnetic wave of a certain frequency at a temperature of absolute zero and the electrical resistance is zero, the electron gains or loses energy and goes back and forth between the ground state and the excited state.

At this time, by interpreting the ground state as 0 and the excited state as 1, it is possible to replace the bit of the computer and at the same time calculate using the characteristics of superposition. Calculation utilizing the feature of superposition simply means that multiple calculations are possible at the same time. To explain in detail, assuming that there are 4 bits, the number of cases in which these bits are arranged is 16. While a normal computer processes each of these 16 cases and finds a value in a contrasting way, qubits can process all the cases at the same time [1]. This is the reason why faster and more efficient calculations are possible in that all data can be compared at once, unlike the existing method of finding the desired value by comparing each data one by one. Therefore, it has no choice but to surpass existing computing power.

Efficiency in various calculations using quantum entanglement
The concept of quantum entanglement, in which the state of one particle determines the state of another when particles are physically entangled, is one of the reasons quantum computers excel at their capabilities. If the number of qubits overlapping 0 and 1 is increased by n , the result corresponding to the power of 2^n is obtained simultaneously and in parallel. These quantum mechanical concepts help to quickly derive results for many calculations[2]. Therefore, while it's at a disadvantage compared to a normal computer at computing one value at a time, it's far superior at trying multiple times at a time to find the optimal solution.

Advancements: Recently, a paper published in Nature in October 2019 proved that quantum computers are not just a theoretical dream. The paper is about a quantum computer developed by Google AI quantum.

Google Sycamore chip is based on a type of quantum computing called superconducting qubits, which uses electric currents flowing through superconducting materials to store and process information. It is proved that the Sycamore can perform a calculation in 200 seconds that would take a classical computer 10,000 years to complete[3]. Even though, the calculation type is more advantageous on a quantum computer, it is a significant research result as it proved the possibility of quantum computer in reality.

Conclusion:

Quantum information science, which is a top discipline of quantum computers, is a study that can be used to determine the optimal alternative considering variables that occur exponentially. In this respect, quantum computers also have the advantage of being applicable to various fields. For example, in the field of pharmacy, it is possible to drastically reduce the time and cost required for new medicine development by simultaneously interpreting the physicochemical reaction to each medicine using a quantum computer. In the field of finance, uncertainty in investment can be reduced by creating a model that can quickly and accurately identify and analyze numerous behavioral data. The advantage of reducing risk and maximizing efficiency for a given option based on quick analysis is already recognized by the world. NSC of the US selected quantum information science as one of the 20 key promising technologies, and the EU launched a quantum flagship organization for the second industrial revolution in quantum field[3]. However, there are also opinions that there are still many technical problems that need to be improved before the technology is commercialized. The fact that it is difficult to use at room temperature in terms of the operating principle of quantum computers is expected to be solved through the development of technology. Similarly, as the number of qubits increases, noise control and error correction become more difficult. It is expected that the inadequacy of the input method or algorithm to be used in a quantum computer will be resolved as research related to improving the function of a quantum computer continues.

Resources:

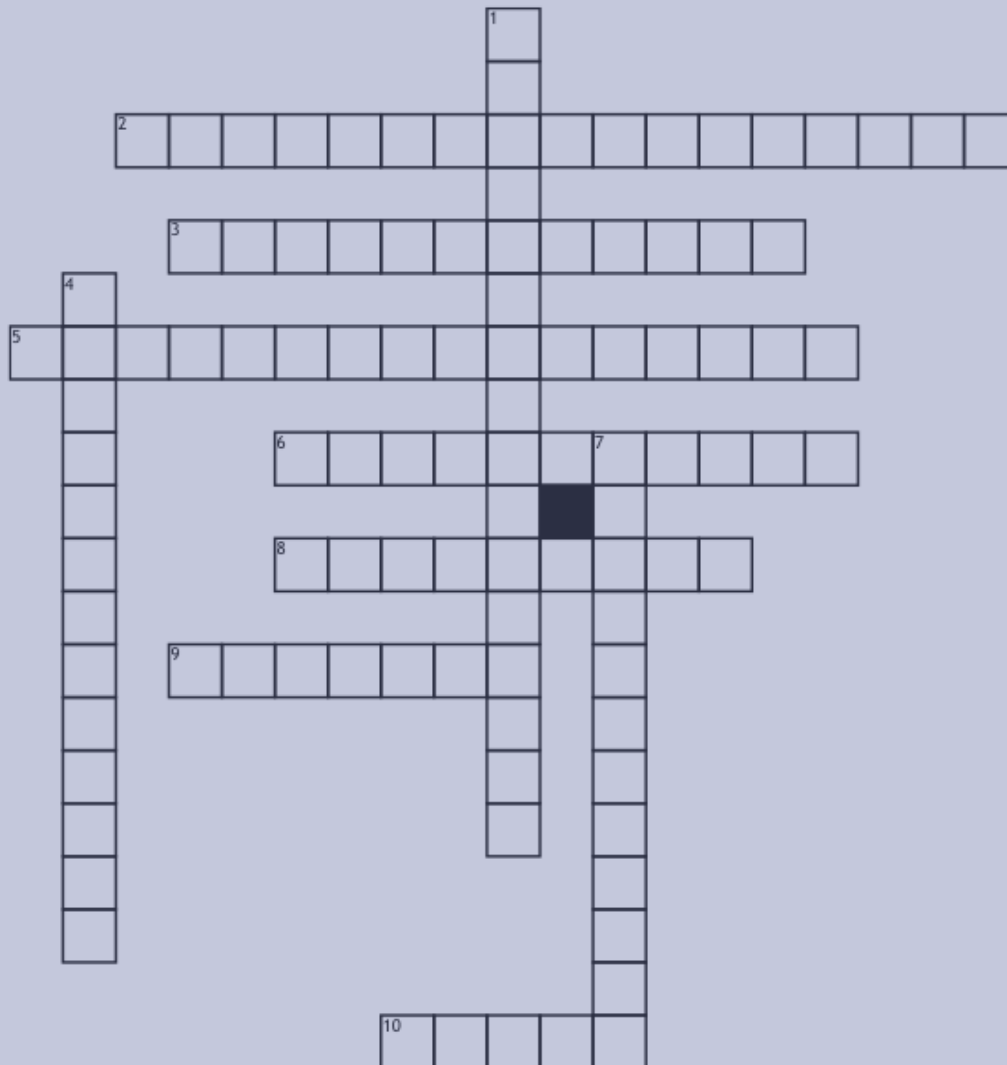
[1] <https://matmatch.com/learn/material/graphene>

[2] <https://www.graphenea.com/pages/graphene-properties#.Y6B8KnbMLIW>

[3] <https://www.differencebetween.com/difference-between-graphene-and-carbon-fiber/>

Crossword

Quantum Computing



Across

2. A computer that operates from binary code
3. The temperature required for a quantum computer to perform algorithms
5. Use of entanglement and superposition to perform computations
6. The act of measuring a quantum state
8. A collection of instructions that allows you to complete a function

9. Minimum amount of physical entity involved in an interaction

10. The basic unit of information in quantum computing

Down

1. A quantum computer out performing a classical computer
4. Allows two states to exist at the same time
7. the physical phenomenon that occurs when a pair or group of particles come together in a quantum state and cannot be differed from each other

WORD SEARCH

K L U H J R G U S T E X C E L D Y E E M S O O F
C F K W P O O A I J O E U L J W E Z W O W S G S
U A K H G T C A M X I Y R I U I A R U D Y C U S
Q O F C E A P Q D E V N U A S X T S Q E G R K M
F G F X P R U E K B S J B M B F H N I M I G O W
O H G V J T L D N C H A T E V O E S K V Q T D H
L U Z E R S R I W T J V Q M R D R P C B H Z Y G
D B C G D I E T A K L A S A H A N X O E N O X F
E S S E F N M N C A M O E P M T E B R T D E K A
R C D I G I T A L T K J D S T A T B U S P R C V
N R U Q E M J A W O E M O E M J O N W Y D A O P
O E G D R D W X R P D X C Q A A E O K N C V L W
I E H E A A T E L B A C T P R T D S E H R W X Q
T N F S W C P A K I W S K D W N J V I Q O Z E T
A W I K D C R S D K Z I K O I C N P T X T L D P
C V N T R E G G O R K M R W B D R E N G I S E D
I F T O A S G P M U I K A E L G O O G P N T P D
L U E P H S N S A N E V I R D C S I D I O Q D I
P R R S P E A K E R S H U S E R P C I Y M W N I
P L N L C S U M O H Y F T M T U P T U O O P Y M
A O E P U U U R C J R E N N A C S G D M V F T A
Y F T E E O V G M B M Y T N I O P R E W O P E G
F Q B I B M P T K M E G A B Y T E B K H I O W E
D R A O B Y E K P R V E V A S Y P E N I L N O E

data	designer	digital	power point	access	word	excel
eathernet	windows	motherboard	codes	modem	cable	java
administrator	user	desktop	laptop	keyboard	mouse	games
disc drive	usb	spam email	pc	mac	network	skype
speakers	scanner	cpu	screen	monitor	image	internet
application	hardware	url	edit	save	megabyte	folder
output	virus	chip	text	google	jpeg	online
run						

RIDDLES

1. What did the computer eat on the moon?
2. Why is a computer so smart?
3. What do you call a computer hero?
4. What did the computer do at lunchtime?
5. What do computers eat when they get hungry?
6. What do you get if you cross a computer with a hamburger?

RIDDLE

ANSWERS

1. Space Bars
2. Because it listens to its motherboard
3. A screen saver
4. It had a byte!
5. Chips
6. A big mac

Cool Things to Check Out

COMPETITIONS:

- [HTTPS://WWW.IMMERSE.EDUCATION/ESSAY-COMPETITION/](https://www.immerse.education/essay-competition/)
-

WEBSITES:

- [HTTPS://WWW.GI-DE.COM/EN/SPOTLIGHT/DIGITAL-INFRASTRUCTURES/QUANTUM-COMPUTING-TECHNOLOGY-FUTURE?GCLID=CJWKCAIA76-DBHBYEIWAA0_S9ZSG1L8E8Y13LZR9QNYEIDNSIPN_OBHCSUWTDJ2NCMGI2K32T5WDLHOCEZIQAVD_BWE](https://www.gi-de.com/en/spotlight/digital-infrastructures/quantum-computing-technology-future?Gclid=CJWKCAIA76-DBHBYEIWAA0_S9ZSG1L8E8Y13LZR9QNYEIDNSIPN_OBHCSUWTDJ2NCMGI2K32T5WDLHOCEZIQAVD_BWE)

COURSES:

- [HTTPS://WWW.COURSERA.ORG/LEARN/INTRODUCTION-TO-QUANTUM-INFORMATION](https://www.coursera.org/learn/introduction-to-quantum-information)