Quantum, Nano, Neuromorphic, Photonic, DNA

Computer Tech is Changing

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Agenda

1. Why Computing Needs to Change

2. Exploring the New Technologies
   - What they are and how far away they are
     - Quantum
     - Nano
     - Neuromorphic
     - Photonic
     - DNA

3. Summary

1 Why Computing Needs To Change

Moore's Law implies: Number of transistors on an integrated chip doubles but the price halves

MEANS: Cheaper, Faster, Smaller Computing Devices
Observation not law of physics

Come a long way from room sized computers 1950's…But

May be approaching capacity of conventional processors, how small and powerful can be built

But humans have grown to expect faster, great capacity
Need new ways to Process and Store Data

2 Exploring the New Technologies

What they are and How far away they are

Quantum
More than 10 years away

Nano
Many parts already on Gartner plateau and in use for everyday life
Nano Computing
2- - 5 years

Neuromorphic
5 to 10 Years

Photonic: Decades
Unknown Distant future

DNA, Binary Code Already exists

But not yet DNA computers - Decades away

2 Exploring the New Technologies

What they are and How far away they are

QUANTUM

Schrödinger's Cat

Binary Logic 1 and 0

Base 2 Number System - sequential

Human Choice: easier binary than decimal at that time
Especially for electrical signals: True(1) and False(0) states

Bits and Bytes

64 Bit processor, 16 Gigabytes RAM

Binary digi**T**

Bits string together form larger number. Groups of 8 called bytes

Qubit – Computer memory AND processor

Quantum Replace Silicon Chips

Transistor replaced Vacuum Tube

2 Exploring the New Technologies

What they are and How far away they are

NANO

Nano: 10 to minus 9th power – one billionth

Thickness of human hair 50,000 nanometers

Manipulating atoms and molecules
IBM Man

Richard Feynman (1959)

Smart Materials eg. self-tinting automotive glass that darkens with light intensity

Sensors e.g. designed to fit only the molecules of interest, similar to "Cinderella" in that only she could wear the shoe

2 Exploring the New Technologies

What they are and How far away they are

NANO

Medieval Stain Glass Makers

Trapped gold nano particles in glass mix – create Ruby Red

Silver nano particles for Deep Yellow

Medical Applications

Bacteria and Virus – Drug Delivery

Cancer – Drug Delivery

Computers with **Carbon Nanotubes**

Swop Silicon Chips for Nanotubes

Instead of multi computers linked to be a Supercomputer with Nanotubes move to parallel processing

2 Exploring the New Technologies

What they are and How far away they are

NEUROMORPHIC

Model Computer after Human Brain and Nervous System

Both Hardware and Software

This is done by **creating networks of electronic neurons**, which are **like the biological neurons in our brains**

Advantage over traditional AI algorithms that need to consume content then learn. Instead **learn and adapt on the fly**

Good advantage for driverless cars respond to their surroundings, even more so if no internet is available

2 Exploring the New Technologies

What they are and How far away they are

PHOTONIC Photons instead of electrons

This technology is based on the idea **that light can be used to perform many of the same functions as an electrical current** in a computer, such as:

- performing calculations
- storing and retrieving data, and
- communicating with other devices

Replace computer electrical wires with optical: 1,000 times faster

DNA

Storage Capacity

Concept re code strand to binary