Biomimicry Cognitive Network Design
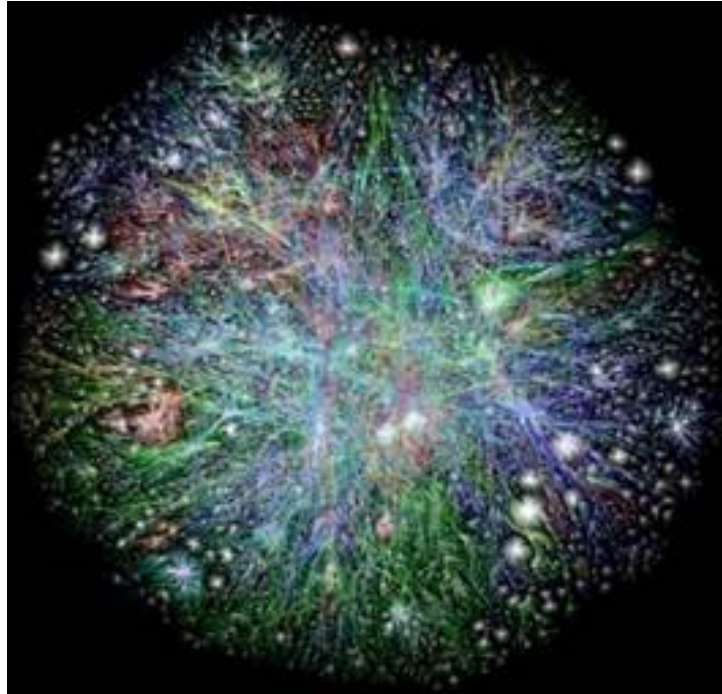

Dr. Mohsen Kavehrad (IEEE Life Fellow)
Center for Research in Knowledge Communications (CRKC) - http://crkckav.com
E-MAIL: mkavehrad1000@gmail.com

ABSTRACT

- The new technology revolution era will be characterized by automation of processes, routines, and functions in a way that is contextually aware, allowing enterprises and individuals to increase the efficiency with which they operate.

- This will be accelerated by digitization but will be driven by the connection of everything and everyone and with augmented intelligence, to help in knowledge creation.

- As such, the network will once again play an important role in the transformation, as has been the case in all recent technological revolutions.
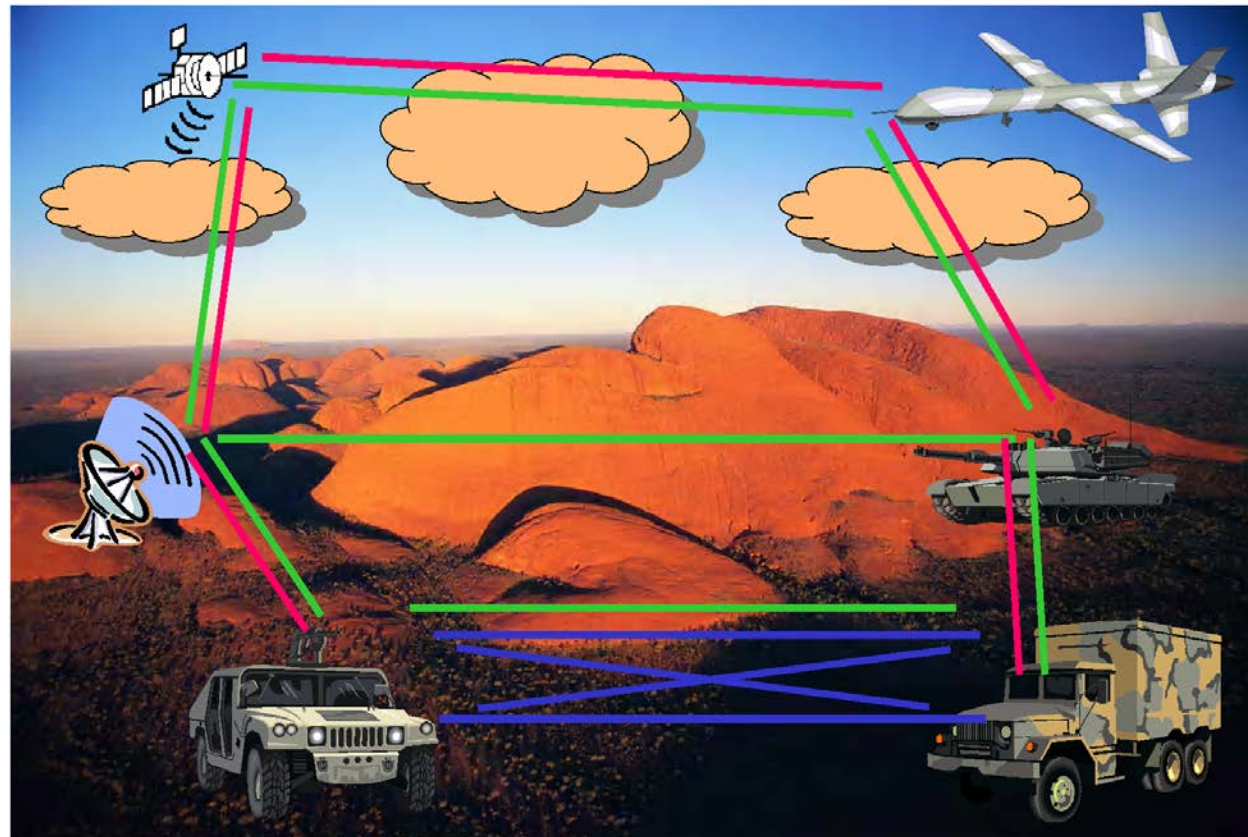
- Can biomimicry help in designing a cognitive network ?

I want to know God's thoughts... the rest are details.

Albert Einstein

DARPA ORCLE (2004) - **O**ptical & **R**f **C**ombined **L**ink **E**xperiment

- RSTA (Reconnaissance, surveillance, and target recognition) system
- Hybrid RF and Free-space optical communication links

FSO link ——— RF SISO link ——— RF MIMO link

Dolphin Echolocation Emission System

Dolphins are known to use about 20% capacity of their brain as opposed to human beings using 10% on average. This myth appears to be from the early neuroscience finding that much of the cerebral cortex consists of "silent areas" not activated by sensory activity. However, it is now known that these silent areas mediate higher cognitive functions.
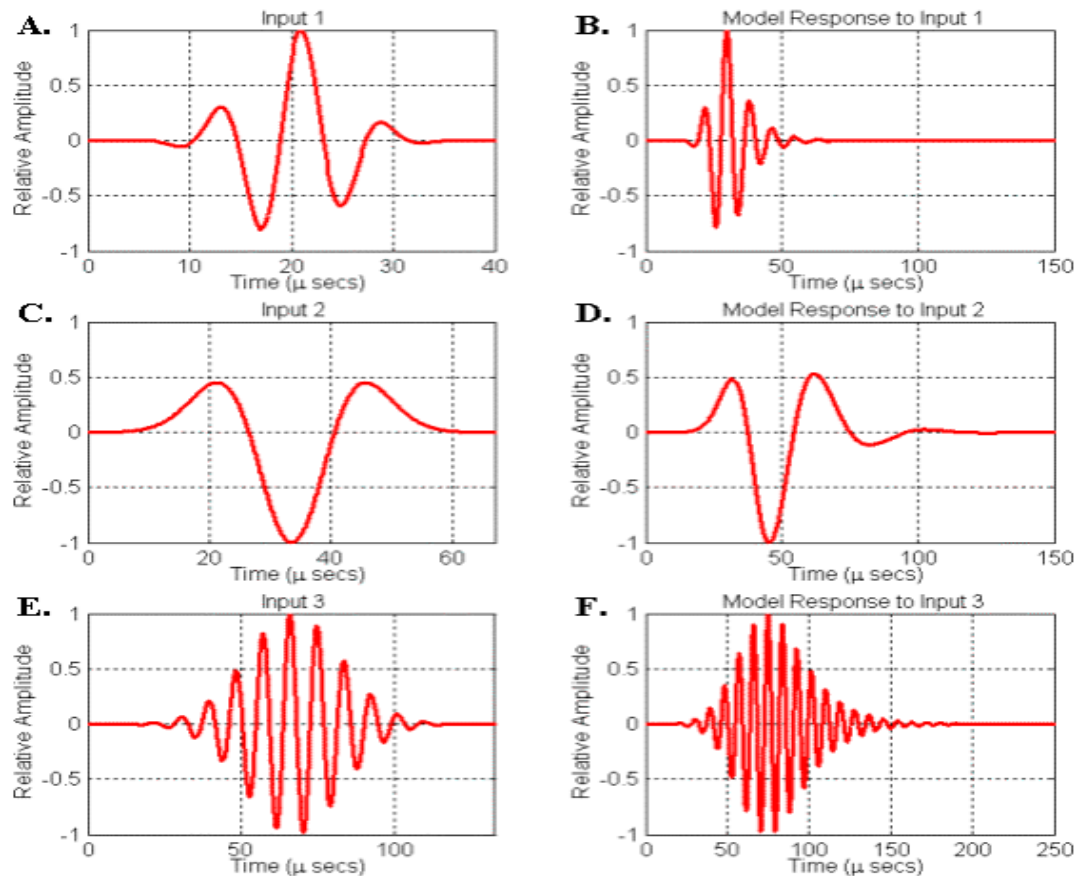
Dolphin Chirps

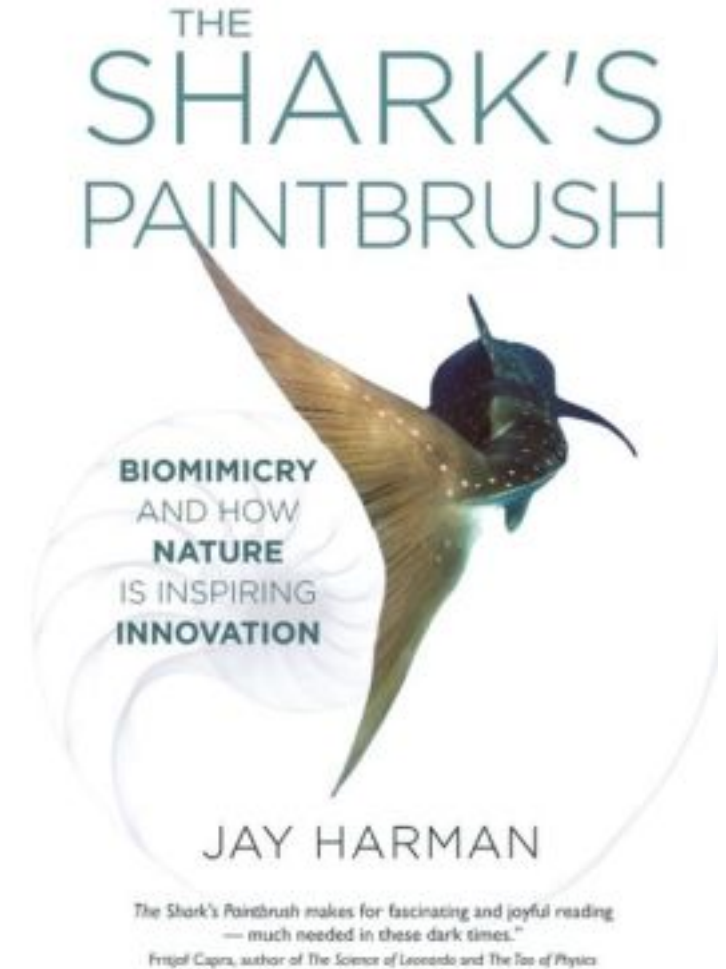# Fractal Meyer's Wavelets Transmitted
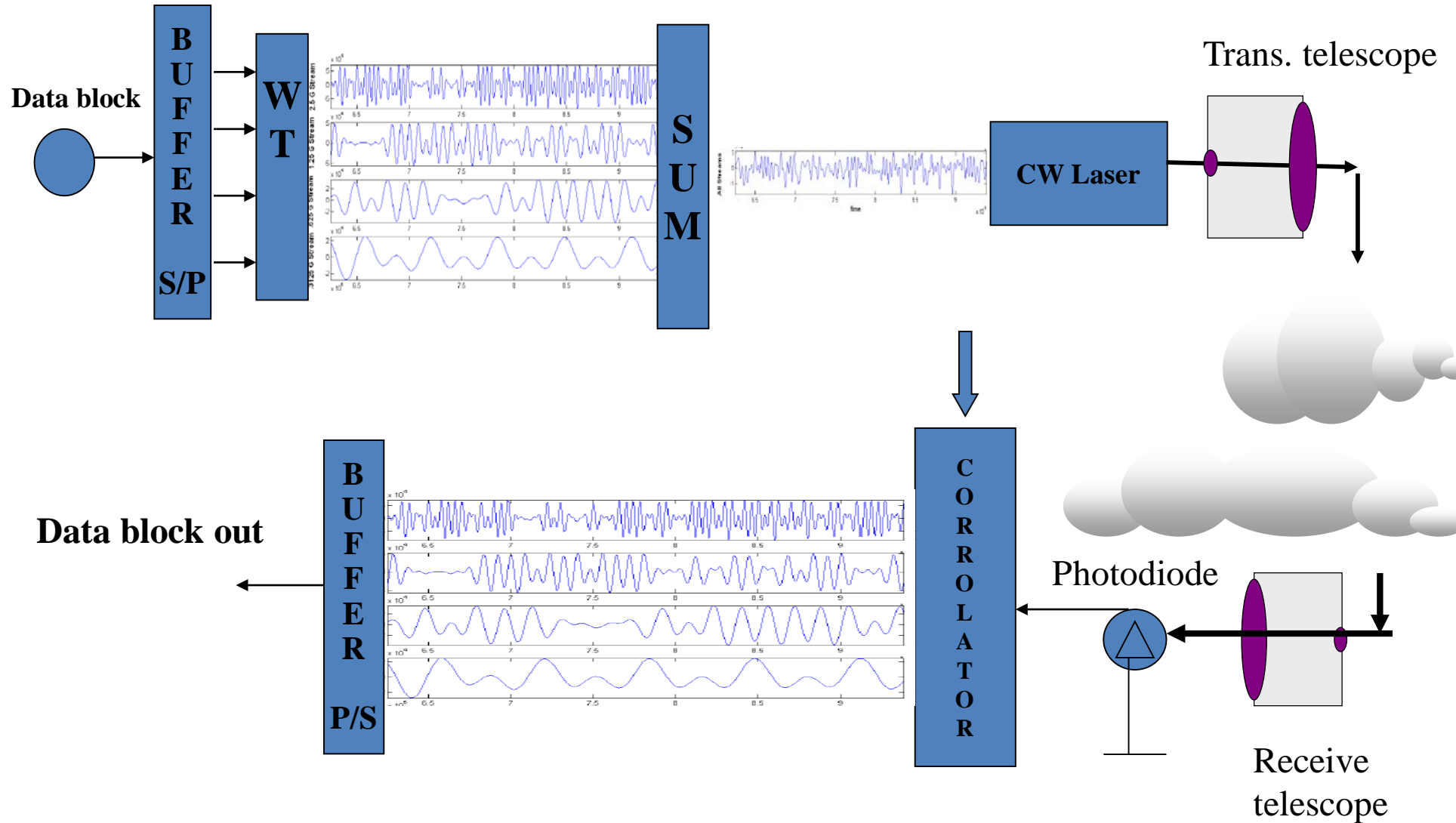
Biomimicry and How Nature is Inspiring Innovation

Author Jay Harman interviewed Kavehrad on a paper he published through the DARPA/Air Force Research project.

"We had discovered the dolphin chirps look like a wavelet waveform we used to transmit optical pulses through clouds," Kavehrad said.

"The book is meant to encourage people to get inspirations from nature to imagine and invent."

THE SHARK'S PAINTBRUSH

BIOMIMICRY AND HOW NATURE IS INSPIRING INNOVATION

JAY HARMAN

The Shark's Paintbrush makes for fascinating and joyful reading
— much needed in these dark times."
Fritjof Capra, author of The Science of Leonardo and The Tao of Physics

Jay Harman, "The Shark's Paintbrush: Biomimicry and How Nature is Inspiring Innovation," White Cloud Press, ISBN: 978-1-935952-84-8, 2013.

Shannon Capacity

- C = Maximum bits/second without error
- B_w = Available transmission bandwidth in Hertz
- S/N = Signal to noise power ratio

$$C = B_w \, log_2(1+S/N)$$

(Bits per second) per Hz

But S/N is also a function of the bit rate and bandwidth:

$$\frac{S}{N} = \frac{(E_b = Energy/bit)*C}{(N_o = Noise\,Power\,per\,Hz)*B_w)} = \left(\frac{E_b}{N_o}\right)\left(\frac{C}{B_w}\right)$$

So E_b/N_o is a more fundamental characterization of the channel use which is independent of the actual bit rate. So we can solve for E_b/N_o as a function of C/B_w.

Human Communications – Five Senses

Kavehrad's Human Brain Capacity

http://crkckav.com/research/bioinf/index.html

November 2006

C = Human Brain Capacity

$$C = IQ.Log_2 (1 + A)$$

- Intelligence Quotient (IQ) is what a human being is born with and is a matter of heredity (Genetic) for diversity reasons.   Brain Capacity grows linearly as a function of IQ.

$$A = \frac{\text{Rational "Mind} + \text{emotion"}}{\text{Irrational "Mind} + \text{emotion"}}$$

Base 2 of Logarithm refers to "Freedom" and "Lack There of"

- Parameter "A" is the ratio of (Rational Mind and Emotion) to (Irrational Mind and Emotion) related to Emotional Intelligence (EQ). We call this "Wisdom". Wisdom is Epigenetic and modifiable in time; e.g., it grows with experience, association with wise people.
- The mind capacity can grow with "A" logarithmically. Thus, when "A" is very small, C is nearly zero (babies at birth).
- Base 2 of the logarithm refers to "Freedom" of mind growth or a "Lack There of" within the society that human brain functions. Meaning, an open-door society provides a more suitable environment for human mind to grow in comparison to a closed-door society.

Human Brain

- It is not that we use 10 percent of our brains, merely that we only understand about 10 percent of how it functions.
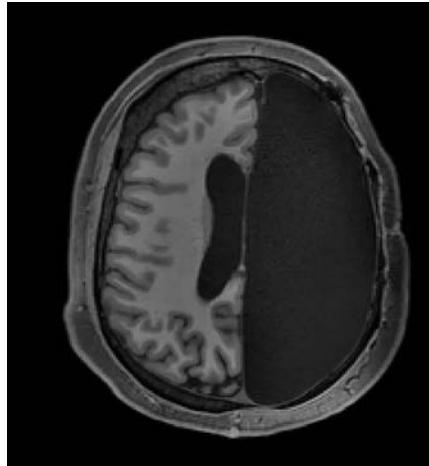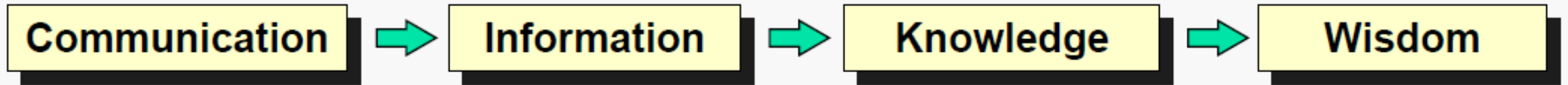

How the Brain Still Works When Half of It Is Missing
Live Science Magazine, November 2019

- **Sounds like Survivable Networking - Datagram Routing & Packet Networking – INTERNET (1970s).**

Application Evolution

Communication → **Information** → **Knowledge** → **Wisdom**

- voice
  - fax
    - email
      - file transfer
        - World Wide Web
          - video services

- collaborations
  - business processes
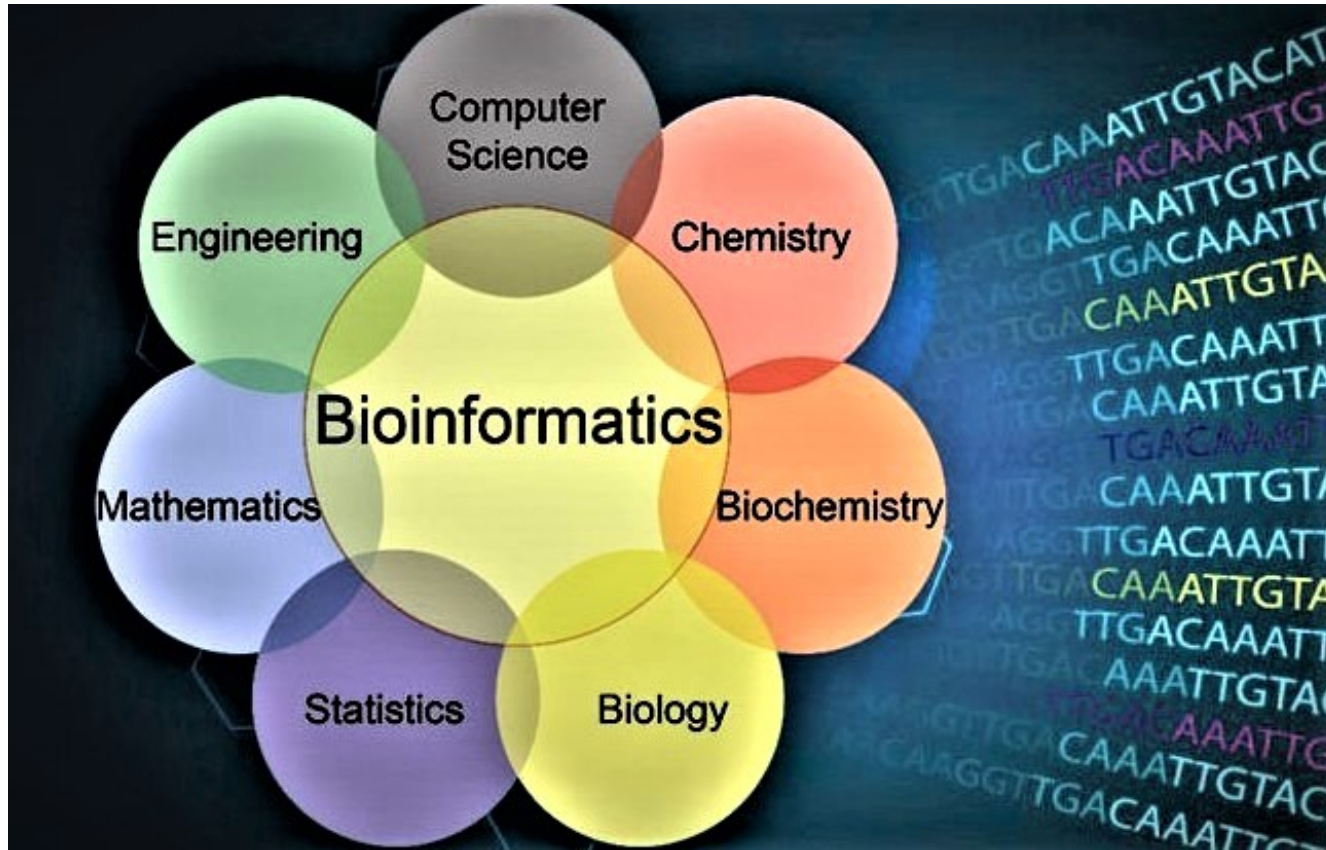   - information retailing

- personal / business assistance
  - intelligent personal agent

Bandwidth, Latency, QOS, Reliability, Connectivity, Intelligence

Conclusions: We Need a New Field

Bioinformatics is an interdisciplinary field that develops methods for understanding biological data, in particular when the data sets are large and complex: http://crkckav.com/research/bioinf/index.html