# An overview of biological and computer virology


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The pandemic named "COVID-19" has dramatically raised the whole world about the existence of viruses that are deadly for humankind. In this article, we will explain to the reader what biological and computer viruses are and by which mechanisms they can be linked together.

## Biological Viruses

Everybody knows the term “virus” and it is often associated with computer viruses. A biological virus is a microscopic *infectious agent*. First viruses are *not* life forms. they are not 'alive' but they possess some significant characteristics that differentiate them from inert matter as well. They are referred to also as pathogens meaning that they are defined *as a disease*. That disease is their "raison d'être", their goal, and their mission.

Viruses can potentially infect *any* life form, including bacteria (which are also microscopic).

Their nature is mysterious and it’s unclear where and how they have been created during the evolutionary processes.

Viruses share several common characteristics with life but miss many fundamental points. For example, viruses do not possess *cell structures*. They are therefore at the ‘edge of life’.

Viruses are often named *replicators*, because they can duplicate themselves, like a 'self-photocopy'. Their functioning is therefore different from cells and bacteria which are using Phagocytosis, e.g. absorbing a nearby cell or bacteria.  In that respect, viruses try to duplicate while cells or bacteria try to merge.

The replication mechanism in viruses is fundamentally stranger to life. Viruses 'hack' cells to force them to duplicate the virus's genetic code. They predate the cell mechanism and use it for their purpose: self-replication.

Viruses are made of genetic material, proteins, and lipids and they cannot spread without vectors, which vary greatly: animals, water, air, blood, etc…

Once again, a virus is *not* a living organism while a bacteria *is* a living organism. Therefore the behavior of viruses is to be understood at a different biological scale than life itself. They appear to rely on information mechanisms and especially replication which is the main way they seem to achieve their goal of survival: replicating and infecting more and more hosts with copies of themselves.

Viruses are destroyed by the immune system when they infect animals (and especially us… the Humans). If the immune system cannot destroy them, this usually results in the death of the animal host because the replication mechanism of the virus can infect more and more cells of the animal and prevent vital functions from operating. Not all viruses destroy their hosts, some hosts can coexist with viruses, allowing them to be present in their bodies.

# Are Biological viruses alive?

The idea of life in viruses is a very important topic in virology. As we mentioned, viruses are not classified as living organisms, yet they have an obvious *activity*. They are inside a grey zone between 'life' and 'death' and they have been dubbed 'dead-alive organisms' by several authors. Spores, which are produced by living organisms, or some chemical crystals that can perform replications,  can also be considered to belong to that gray zone.

As we saw, viruses are considered to be *replicators*, but they are not the only ones. The class of replicators in biology involves many other entities such as chromosomes, introns, mini-inteins, organellar genomes, and plasmids. quasi-replicators. retrotransposons. transposons etc…

So, are viruses *nothing else* but replicators? As replicator agents, viruses are characterized by their huge mobility and 'selfishness", meaning their autonomy. In other terms, viruses are the replicators that seem to have the largest freedom among all the others.

Viruses are still an area of active research and their classification is a complicated and tremendous task, especially since new viruses appear all the time. … such as the SARS-COV-2 which causes COVID-19.

# Interrogations about biological viruses

Viruses are important and ubiquitous biological entities. Their mechanisms are still not clear to us. For example: where do they get produced? Where do they appear from? Viruses can be

transported and exist in animals, especially wild animals but this does not explain how they are created and why new and unknown viruses regularly appear.

Viruses are supposed to have started around 1.5 billion years ago but some theories suggest “giant’” viruses could have created life itself and in general, viruses may be responsible - at least partially - for many evolutionary processes of life.

The relationship between life and viruses and how animals (and especially humans) acquire immunity is not well understood.

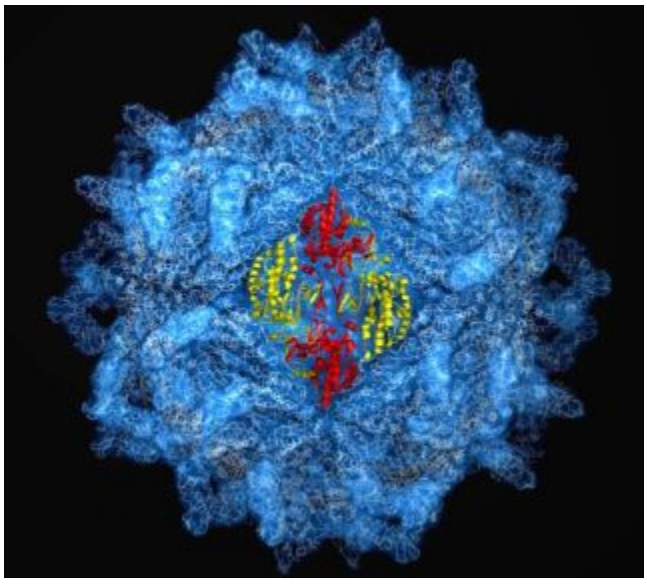
The information mechanism of viruses is also complicated to apprehend. The main 'strength' of a virus lies in its ability to 'hack' into the cell and inject its genetic material and this mechanism can often be quite complex.

The ‘hacking’ of the cell is the main intelligence of the virus. Viruses ‘hijack’ cellular processes to create virally encoded proteins that will replicate inside the cell the virus’s genetic material. Even more puzzling is that viruses can mutate themselves to avoid being detected.

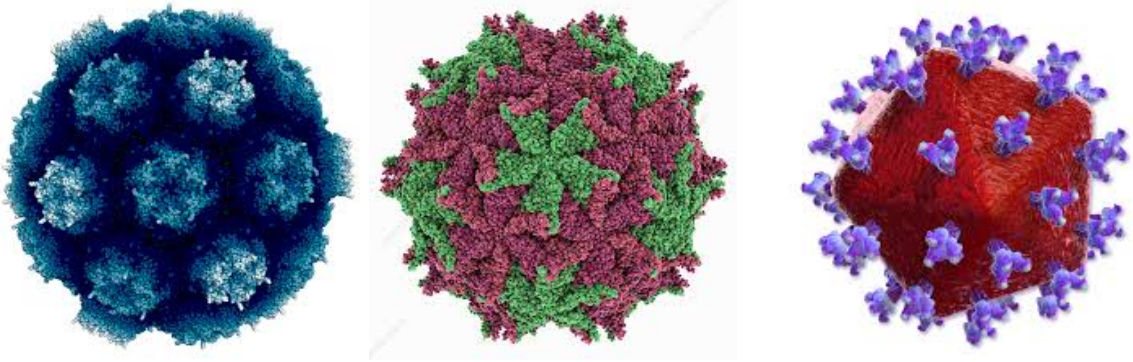
The virus hosts and shields its genome using a coat, the *capsid*. What is represented in the spherical-like images of viruses is that protective shield.

Same as a 'dark star', the virus protects its core with an impenetrable shell. This is what is usually depicted by 'artist' representation images of viruses.

The following picture represents the precise location of some 5 million atoms in a spherical type of capsid that many viruses use to shield their genomes. It was generated in 2009 by Rice University after three years of computations.



We also represent below three typical examples of the capsid (protective shield) of viruses.



The reader can already understand how deadly and dangerous viruses are because of their perfection: they are *weapons*.

# Biological viruses vs bacteria

Many pandemics that tragically reduced the world populations such as the great pestilence, the black plague, and others have been caused by bacteria - not viruses. Bacteria are responsible for cholera or typhus for example but bacteria are different from viruses because they do not act as autonomous infectious agents, they are a part of life.

Viruses are much more dangerous than bacteria and that's the reason why viruses are not encountered so frequently: a pandemic of an unknown virus could wipe out almost the whole of humanity in a few years.

Such a hypothesis was only an anticipation and science-fiction nightmare… until COVID-19 appeared.

Breaking the genetic code behind COVID-19, and understanding how it hacks the cell mechanisms of its hosts involves complex work. Technology can help us do so.

# An analogy between biological viruses and computer viruses

We have seen biological viruses and how they operate. Now let us look at another type of virus: computer viruses.

Computer viruses infect computers. They Hijack the defense mechanism of computers to enter into it and spread it over all the other computers. The way they do it can be various:

A computer virus will use the computer hardware to duplicate itself by injecting its code into the stack of the host computer. Once duplicated, it will seek to spread by using a *vector*. That vector can be emailed, copy over the network, using the infected hosts to scan the internet to find other new hosts, etc…

We all know how antiviruses work, they play the role of the biological immune system. They possess a copy of virus signatures and search for it. When they detect it they eradicate it by removing any copy of it.

Computer viruses, same as computers, are of course the product of mankind therefore to stop a virus it is often enough to stop the programmers who wrote it.

## Computer virology

Computer Virology is a new discipline dedicated to the study of viral and antiviral computer technologies, and it often encompasses both theoretical and experimental aspects of the topic, including mathematical aspects and theoretical fundamentals of computer virology.

Computer virology relates to algorithmic and computer virology; computer immunology and biological models for computers, steganography techniques and tools in computer virology, etc…

Computer virology is an interesting area where research could potentially bring answers to Biological virology. For example: cryptography. Do *biological* viruses use some sort of cryptographic techniques to hide themselves? Etc…

The gap between biological and computer viruses becomes thinner and thinner, especially with the rise of nanotechnologies and there are also some fears that computer engineer viruses could be created from mathematical and computer models.

Both viruses: computers and biological, share the same characteristic of some sort of *'intelligence'.* In the case of computer viruses, that intelligence is the reflection of the intelligence of the programmer.  In the case of biological viruses, it is less obvious where that presupposed intelligence comes from.

# Conclusion

We have seen in that article how viruses work, both on the biological and computer side. The topic is huge, and we invite the readers to document themselves about the topics that we raised.

Our comprehension of the fundamental mechanisms behind viruses and evolution may be strengthened by the study of computer viruses. This is a very interesting path that some researchers may want to consider.