Attacking cryptosystems by means of virus machines

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Mario J. Pérez-Jiménez[1,2], Antonio Ramírez-de-Arellano[1,2]✉ & David Orellana-Martín[1,2]

The security that resides in the *public-key cryptosystems* relies on the presumed computational hardness of mathematical problems behind the systems themselves (e.g. the *semiprime factorization problem* in the RSA cryptosystem), that is because there is not known any polynomial time (classical) algorithm to solve them. The paper focuses on the computing paradigm of *virus machines* within the area of Unconventional Computing and Natural Computing. Virus machines, which incorporate concepts of virology and computer science, are considered as number computing devices with the environment. The paper designs a virus machine that solves a generalization of the semiprime factorization problem and verifies it formally.

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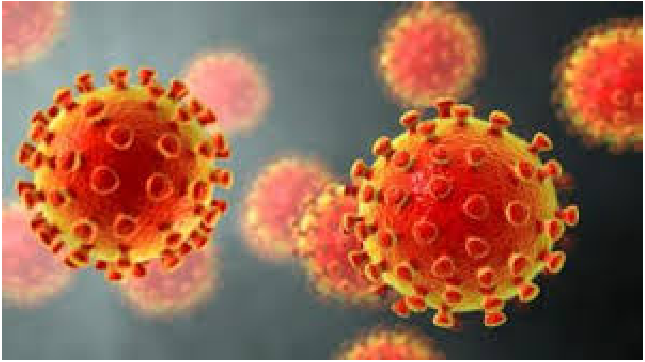
- ⋆ Execution of metabolic procceses.

Viruses



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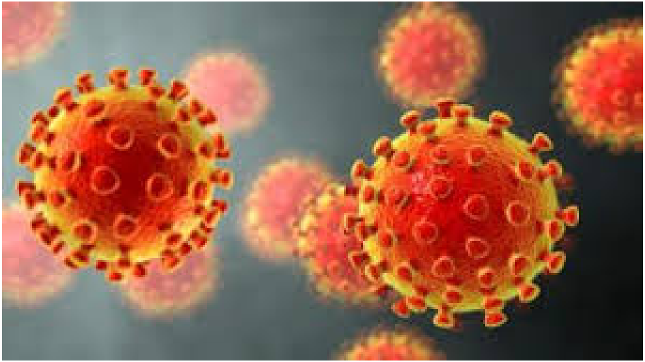

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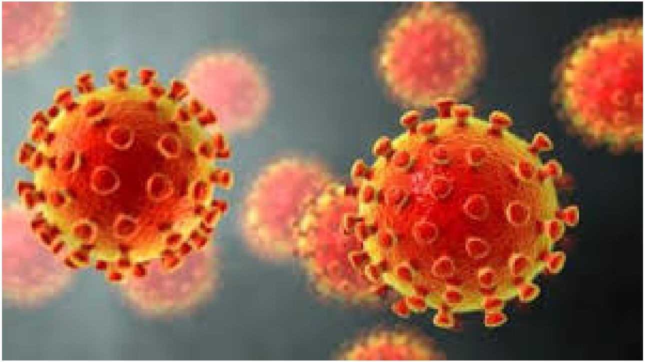

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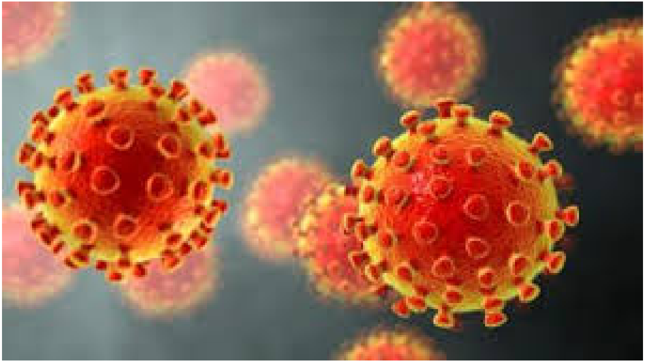

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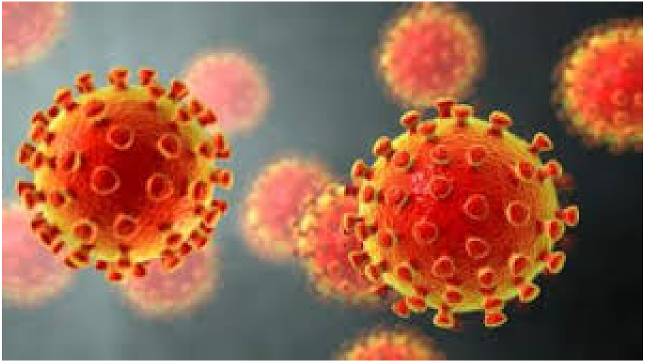

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- ⋆ Viruses are not lone "wolves".

Viruses

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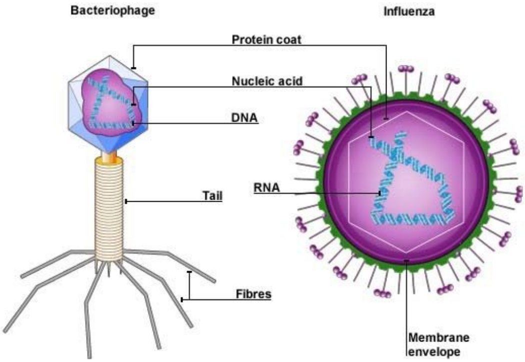

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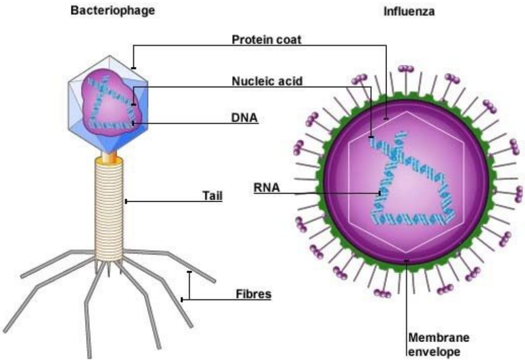

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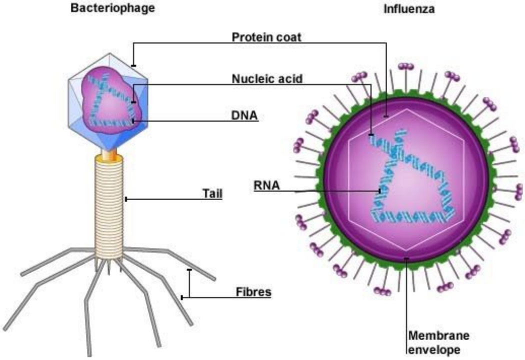
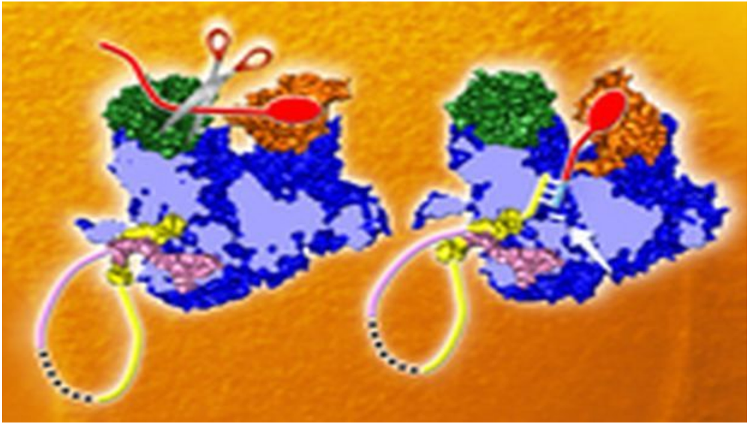


- ⋆ Genetic material: either RNA or DNA.
- ⋆ A protective protein coat.

Virus machines



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A new computing paradigm inspired by the manner in which viruses transmit from one host to another (introduced in 2015[1]).

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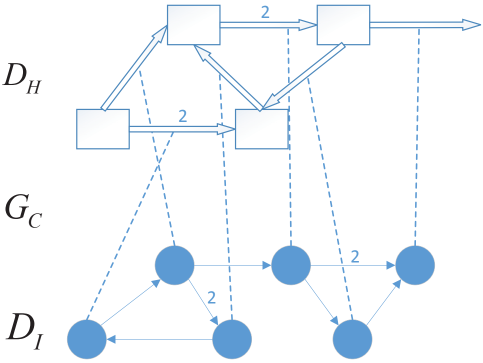

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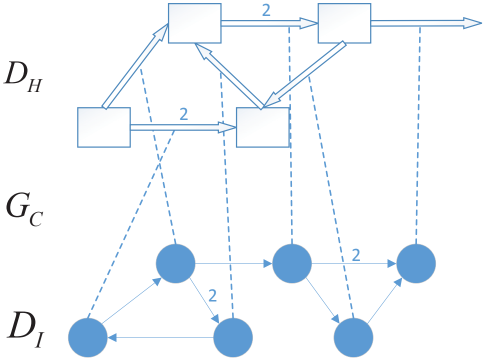
A VM of degree (p, q), $p \geq 1, q \geq 1$: $(\Gamma, H, I, D_H, D_I, G_C, n_1, \ldots, n_p, i_1)$

- ⋆ $\Gamma = \{v\}$ is the singleton alphabet (v is called *virus*).
- ⋆ $H = \{h_1, \ldots, h_p\}$, $I = \{i_1, \ldots, i_q\}$ such that $v \notin H \cup I$ and $H \cap I = \emptyset$.
- ⋆ $D_H = (H \cup \{h_0\}, E_H, w_H)$ is a weighted directed graph: $E_H \subseteq H \times (H \cup \{h_0\})$, and w_H is a mapping from E_H onto $\mathrm{N} \setminus \{0\}$.
- ⋆ $D_I = (I, E_I, w_I)$ is a weighted directed graph, where $E_I \subseteq I \times I$, w_I is a mapping from E_I onto $\mathrm{N} \setminus \{0\}$, and for each vertex $i_j \in I$ the out-degree of i_j is ≤ 2.
- ⋆ $G_C = (V_C, E_C)$ is an undirected bipartite graph, where $V_C = I \cup E_H$ being $\{I, E_H\}$ the partition associated with it. In addition, for each vertex $i_j \in I$, the degree of i_j is less than or equal to 1.
- ⋆ $n_j \in \mathrm{N}$ $(1 \leq j \leq p)$ and $i_1 \in I$.

A Virus Machine of degree $(4, 6)$



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The virus machines are equivalent in power to Turing machines[2].

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The security of the cryptosystems relies on the presumed computational hardness of a mathematical problem associated with them.

The RSA cryptosystem

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RSA cryptosystem: the first public-key cryptosystem verifying the Diffie-Hellman conditions.

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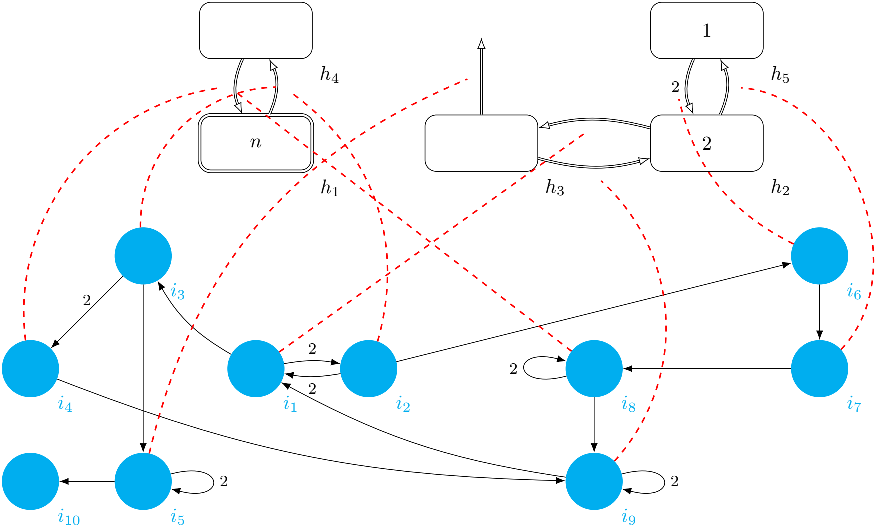
Any "large" semiprime input n for **RSA** can be used as the *modulus* for both public and private keys.

A VM computing the partial function FACT



THANK YOU

FOR YOUR ATTENTION!