2015

HARMONY SYSTEMS®

INDEPTH PRESENTATION

OVERVIEW

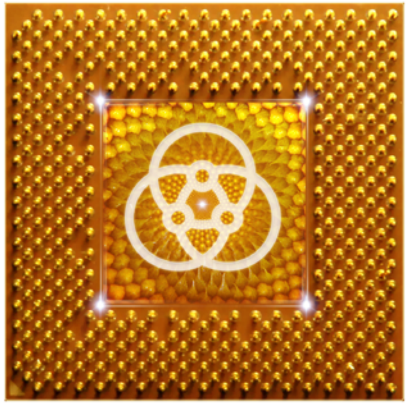
Harmony Systems is a project created to evolve and harmonise the the world of digital microelectronics using Nature's mathematics of harmony.

It was all born out of a very simple but powerful idea:

The Universe and Nature have underlying harmonic mathematical laws that govern structure, growth and relationships of all things and fundamentally make it all work.

This universal "technology" is the result of billions of years of R&D and is a proven winner, we and the world around us are the living proof of that.

There is no point to reinvent the wheel or compete with Nature. Rather with great appreciation and respect borrow from Nature its mathematical inner essence to create new Harmonic technology.



By doing so we know our technology will have the winning charecteristics of nature, it will be harmonious with us and the world around us and we get all this without spending billions of years in trial and error.

THE HARMONIC CODE

Did you know that the binary code the language off all computing since the 1960's has a big hidden problem...

For all its simplicity it has a major weakness, it considers all code combinations as error free, and if for some reason an error in the code does occur due to: overheating, ageing, cosmic radiation, noise, manufacturing defects or human error, then it simply has no way of knowing and will allow this wrong command or information to go through.

We all have experienced this when using digital devices, while it is an inconvenience at the small scale it can be catastrophic at the big industrial scale.

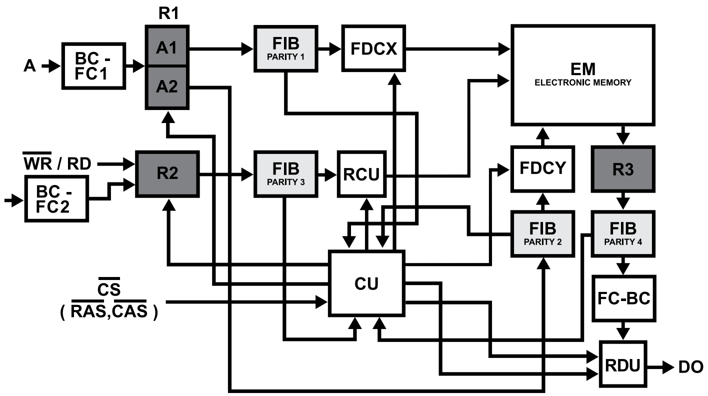
This is where Harmony systems comes in. By using natures laws of harmonic mathematics to evolve the binary code into the"Harmonic" code we get a digital system that can detect up to 99.98% of all kinds of errors in its code and arithmetic operations without additional equipment, has the potential to be much more energy efficient and is also self synchronising.

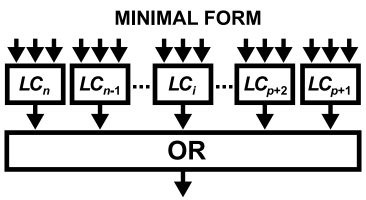
This is a total quantum leap for the binary code. It opens up new horizons of mission critical digital technology, for the global multi-billion dollar industries such as :

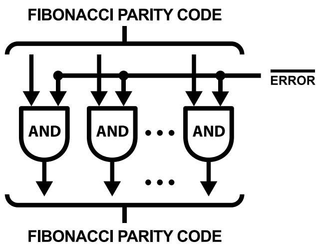
space, energy, transportation, manufacturing, medical, communication, science, media, finance, robotics, personal computing and devices and as the basis for future nano computers, robotics and A.I.

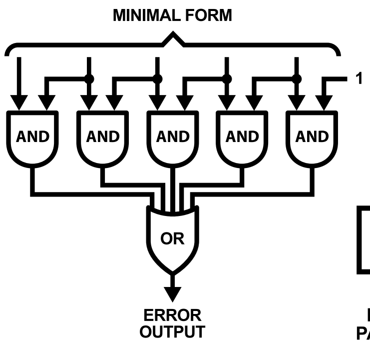
APPLICATION NUMBER: 61825001
PRIORITY DATE: 18.05.2013

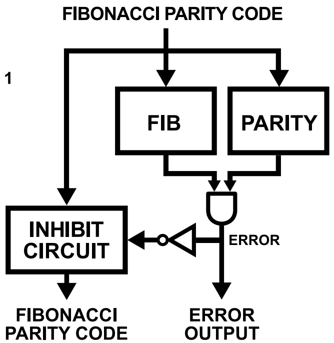
PROVISIONAL PATENT PENDING











HARMONY SYSTEM Digital functional data converter with error detection and regeneration based on electronic memory (ROM, RAM, FLASH, etc.) and the "HARMONIC" number systems (Fibonacci p-codes and codes of the golden p-proportions)

This invention lays down the fundamental principals for the creation of microelectronics with built-in error detection and regeneration abilities based on the **Mathematics of Harmony**.

Based upon Harmonic number systems, it is **designed to detect up to 99.98% of all errors in digital devices.**

The built-in system of error detection has the following advantages:

- Continuous error detection process at all stages of the transfer, processing and storage of information in the microchip.
- Detection of errors at the moment of their occurrence and their subsequent correction by means of repeating the micro operation (regeneration).
- Blocking the passage of the distorted information for future information processing, preventing the execution of false commands in the control system.
- Providing fast error detection in the parallel code .
- The system for error detection is simple for technical implementation and does not significantly affect the speed of information processing in the microchip.
- It also **provides greater energy efficienc**.

This invention is the principal subject of this presentation.

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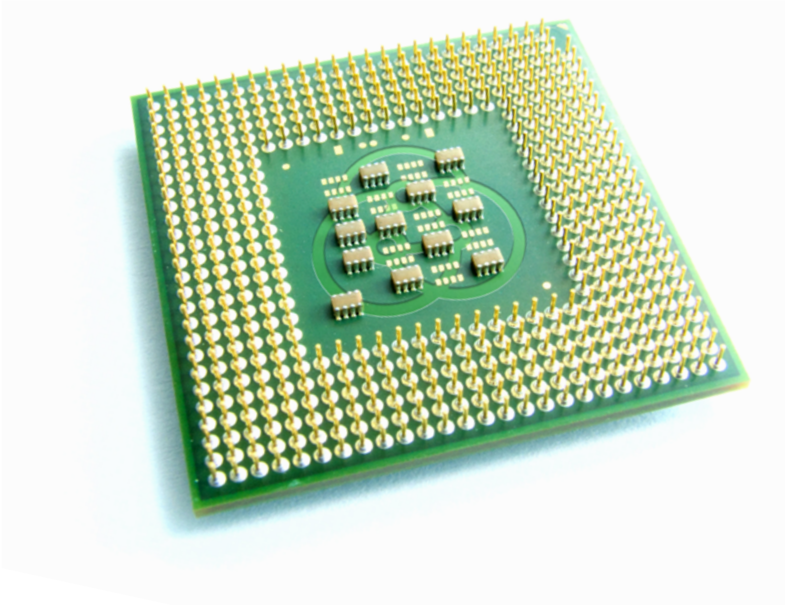
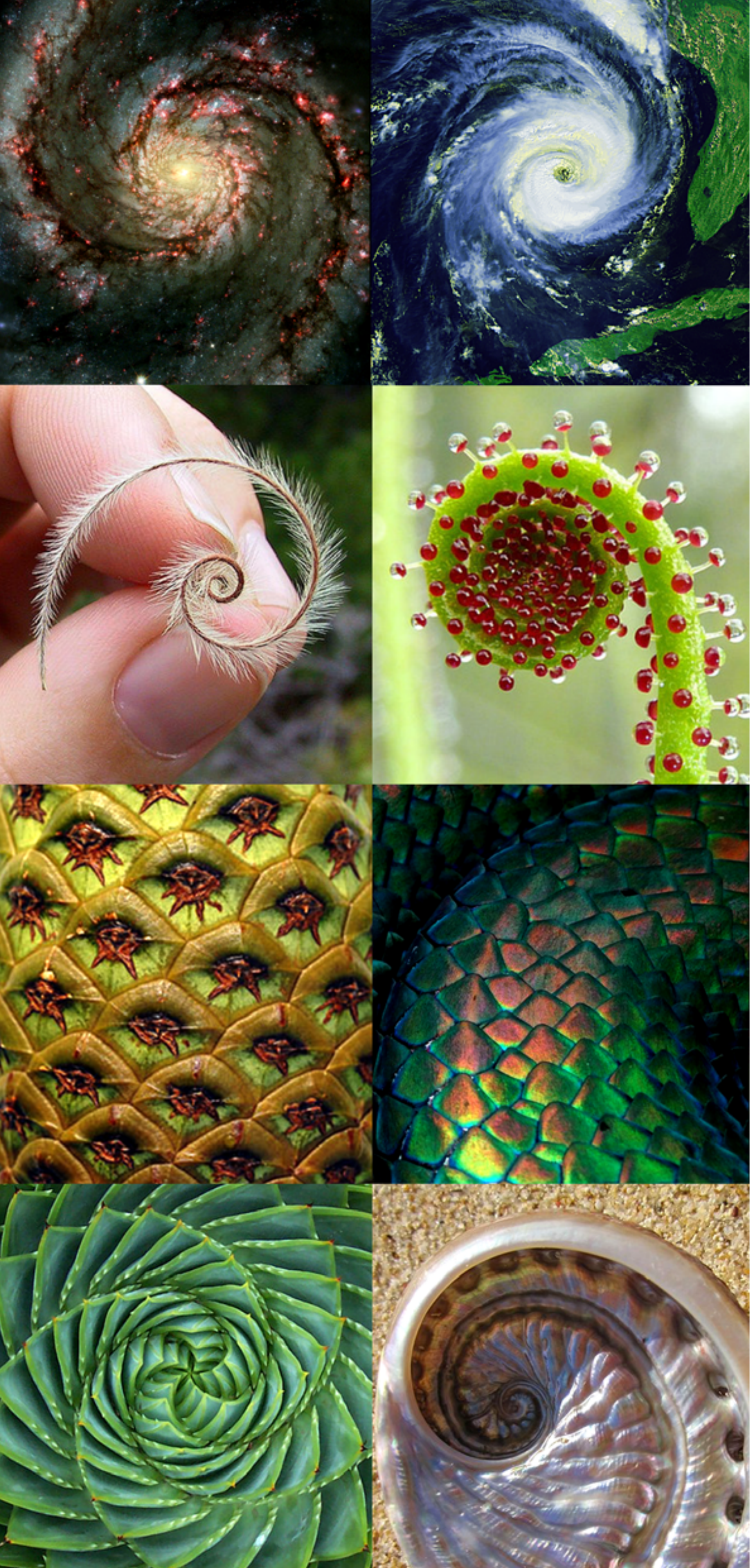


VISION

UNIVERSAL HARMONY
VISION OF THE FUTURE
EVOLUTION OF ELECTRONICS



UNIVERSAL HARMONY

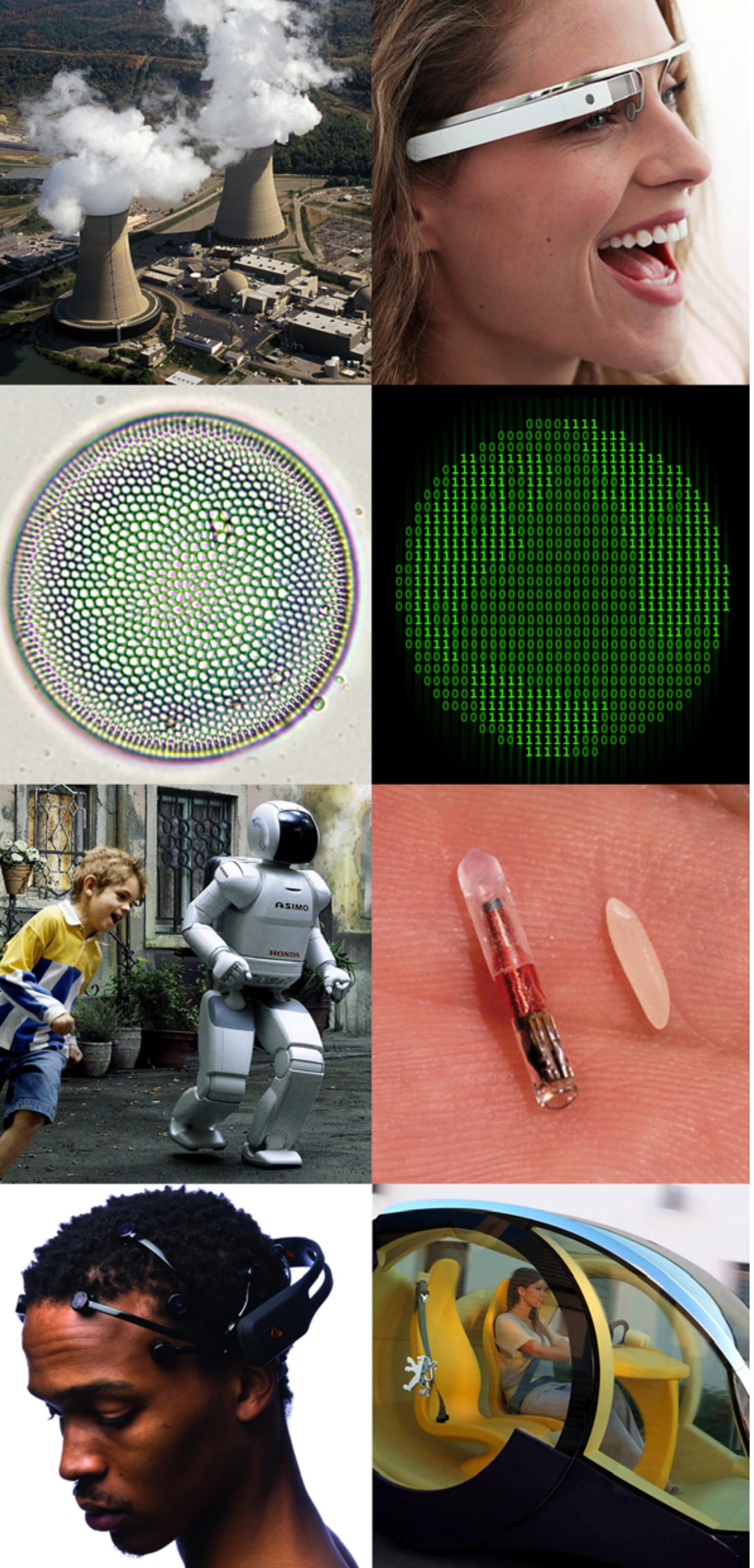
The Universe has taken **13.7 billion years** of evolution to create the world as we know it today.

Nature, the ultimate living system which we are a product of, is the pinnacle of this titanic creative process.

After **3.5 billion years** of evolution here on Earth, it holds the answers to all harmonious, clean and sustainable technologies we could ever dream of.

Humanities great minds understood, that by learning from Natures universal wisdom and by adapting its technologies we will attain Harmony.

Natural sciences and especially mathematics have given man an insight into the secrets of the Universe and Nature as well as tools to use this knowledge in our daily lives and technologies.



VISION OF THE FUTURE

We are collectively beginning to understand that our survival depends on finding balance with the planet, through developing clean, sustainable and harmonious technologies and systems.

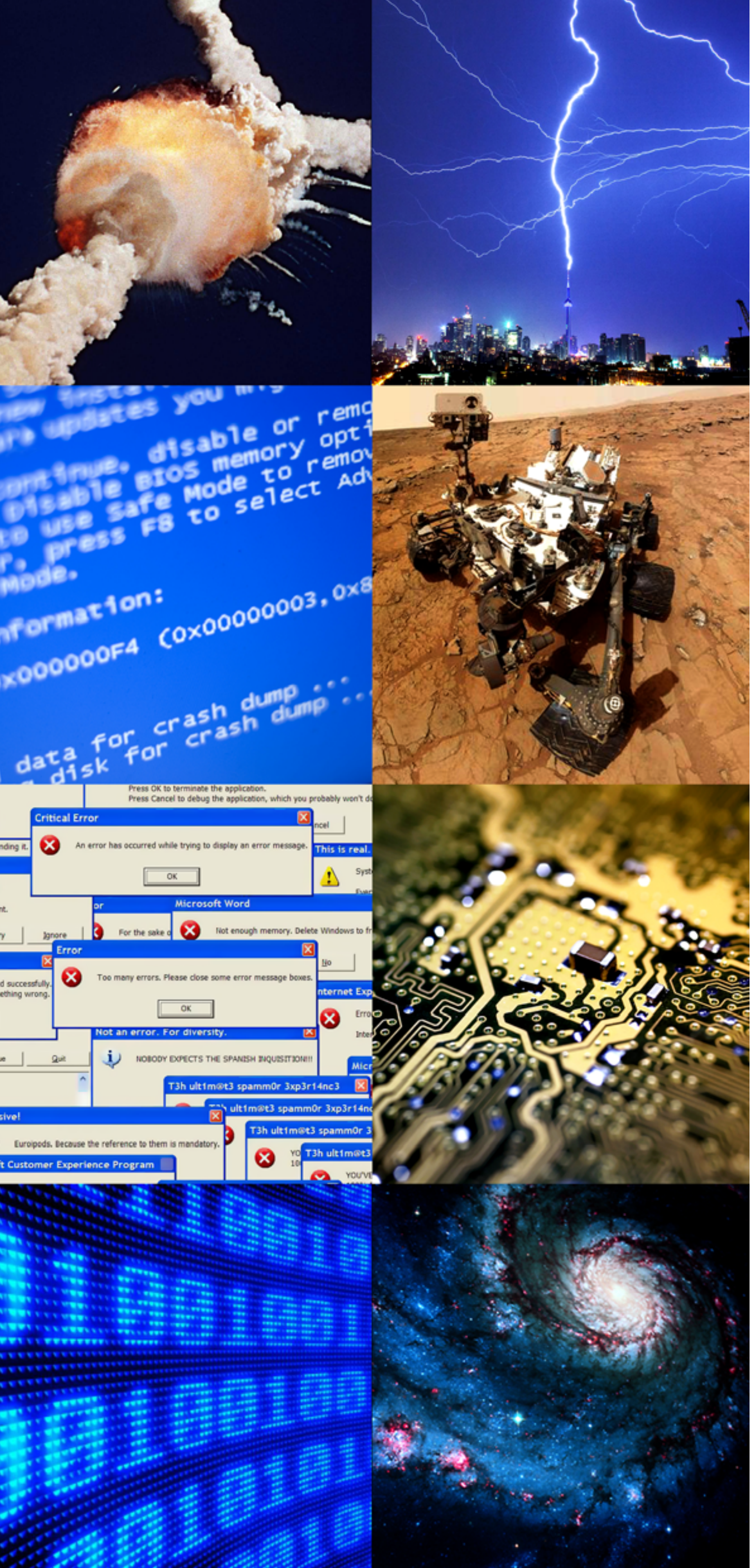
Electronics right now is humanities most rapidly developing technology.
We have found a use for it in every aspect of our lives, it is everywhere you look.

It controls our energy production, our water supply our food and transport systems, its crucial to medicine, communications, banking, entertainment, and of course all the personal computers and digital devices that we have gotten so attached to in the last 25 years.

If we look further into the future and try and predict the evolution of electronics we can see it spreading even deeper into advanced robotics, artificial intelligence, digital body enhancements, nano and DNA computing and all this within the next century...

Electronics are here to stay, their evolution is part of our survival strategy.

We need them to find harmony with the planet and the world around us.



EVOLUTION OF ELECTRONICS

Today, more and more industries are looking at Nature for answers, inspiration and innovation.

Electronics needs to also undergo a natural evolution in order to attain Harmony with Nature.

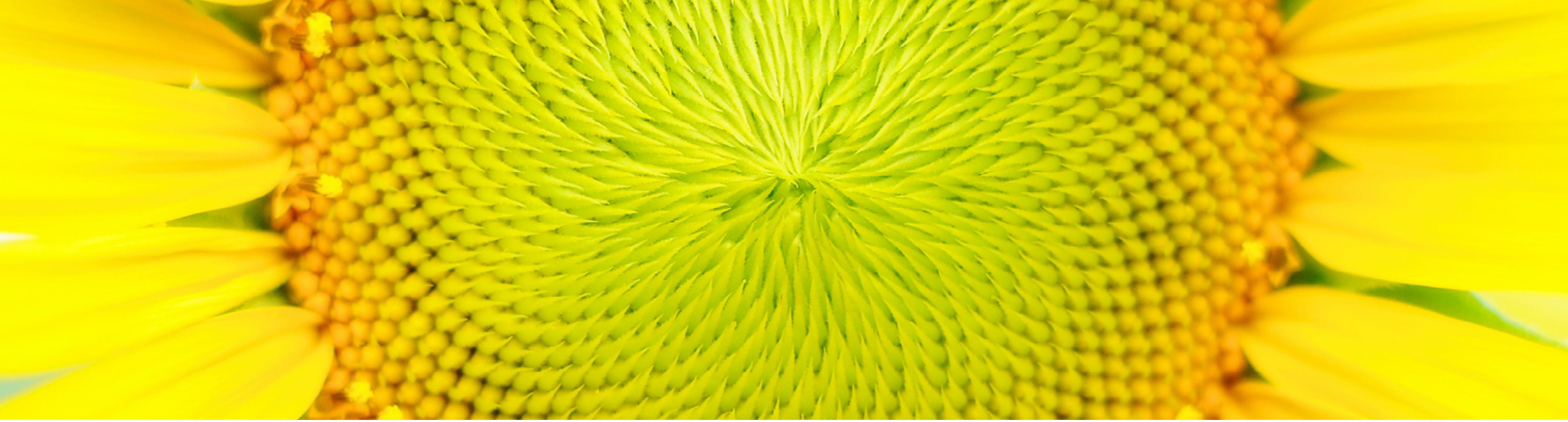
Not only an evolution of its hardware or software but of the very language it operates in.

The very essence of computing is its number system, our electronics still opperate using the binary number system, 6 decades after it was chosen. The binary system was the optimal system to use at the time.

However, it like a lot of human inventions is far from perfect and has room for improvement and evolution.

It is not a redundant number system (with built in error detection ability) and therefore has problems dealing with the real world hazardous conditions, noise and “unknown” errors witch can lead to real disasters.

The way to resolver this situation is to find and adapt what nature has worked out over billions of years and merge it with our electronics...



MATHEMATICS OF HARMONY

OVERVIEW
THE GOLDEN RATIO
THE FIBONACCI SEQUENCE
THE PLATONIC SOLIDS

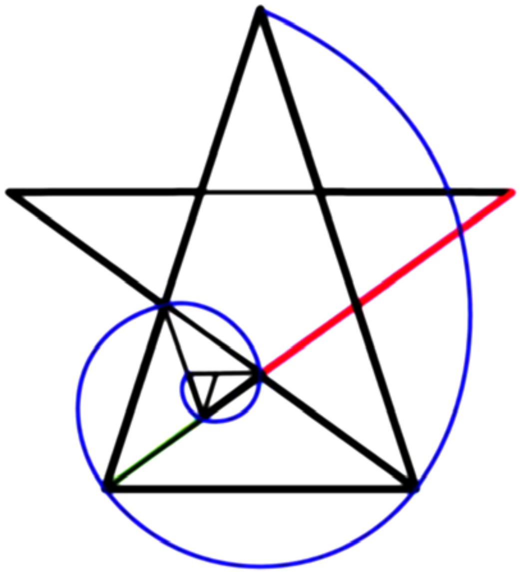
OVERVIEW

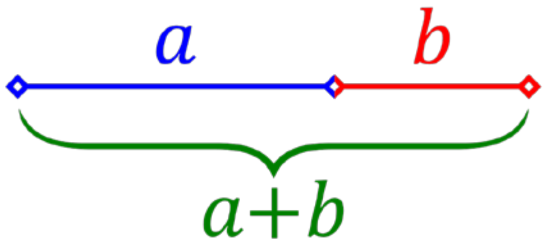
The **ancient Greeks**, were the first in the history of science to put forward an ambitious objective to create a mathematical theory of **Nature** and the **Universe**. This doctrine was set forth in **Euclid's "Elements"**. The idea of Harmony was a key concept of this doctrine. For the Greeks the idea of Harmony was expressed in the phrase "nothing unnecessary." Thinkers such as **Pythagoras** and **Plato** sought to uncover the mystery of Harmony, using mathematics.

The Mathematics of Harmony, which was studied by the ancient Greeks, is still an inspiring model for modern scientists. The discovery of a quantitative expression of Harmony "**the golden ratio**" throughout Nature and the Universe highlights its importance. The golden ratio was described by **Euclid in Book II** of his "**Elements**" in the form of "**the task for dividing the segment in extreme and mean ratio.**"

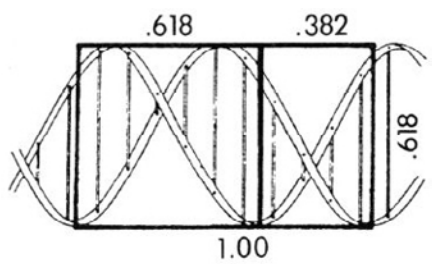
Euclid used this task for the creation of a geometric theory of the **Dodecahedron** - the "main" geometric shape of the universe, which was an expression of Harmony. The theory of regular polyhedra was described by **Euclid in the Book XIII.** According to the "**Proclus hypothesis**", this was the main purpose of Euclid's "Elements."

Thus, the concept of Harmony was th center of the mathematical theory of Nature, created by the ancient Greeks. The mathematics of ancient Greeks was the "**Mathematics of Harmony**", which was directly connected to the "**golden ratio**" - the most important mathematical discovery of the ancient science in the field of **Harmony**.





$a+b$ is to a as a is to b



THE GOLDEN RATIO

There is a fundamental ratio in the universe that is found all around us and even inside us.

This ratio is called the **Golden Ratio**. It manifests in the motion & shape of stars and planets, it displays itself in proportions of plants, insects and animals.

It is also intimately connected to us, from our body structure to our heart beat and even down to our **DNA**.

The full detailed list of its manifestations in Nature could fill up volumes of encyclopedias.

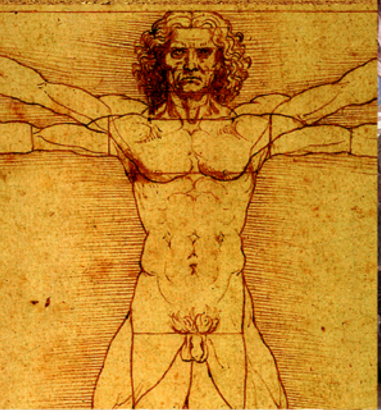
The golden ratio has a very simple expression: $\Phi = \dfrac{1+\sqrt{5}}{2}$

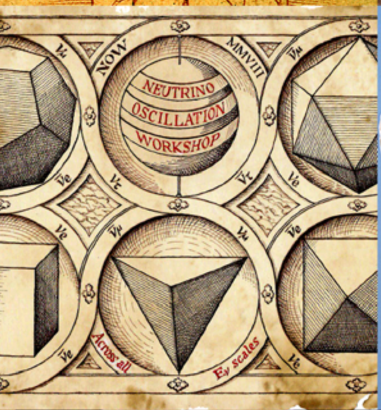
This irrational number vanishes into infinity and no man or machine has been able to ever fully calculate its precise value:

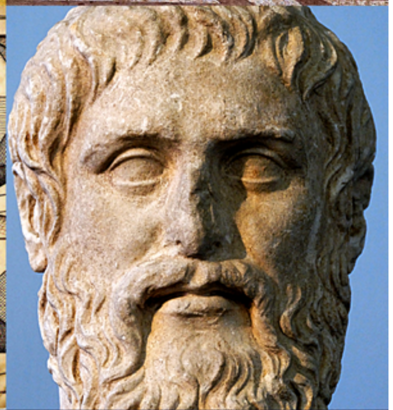
Φ = 1.618033988749894848204586834365638117720309... TO INFINITY !

Modern mathematicians have proven that the Golden Ratio has unique and remarkable mathematical properties that distinguish it from other irrational numbers.

Nature extensively uses these unique properties in its systems and technologies.







THE GOLDEN RATIO | CONTINUED

Early advanced civilizations used the Golden Ratio in their architecture and art.

Traces of it can be found in ancient **Egypt, India, Mexico** and others, but the ancient **Greeks** (**Pythagoras, Plato, Euclid**) were the first ones to study the "golden ratio" as a universal code of Nature. The Golden Ratio permeates Euclidean Elements, starting from Book II and ending with the Book XIII, in which Euclid presented the geometric theory of the Platonic solids, which are the foundation of **Universal Harmony** in ancient Greek science.

The Russian philosopher Alexey Losev wrote:

"From Plato's point of view, and generally from the point of view of all ancient cosmology, the universe is a certain proportional whole that is subordinated to the law of a harmonious ratio, the golden ratio."

During the Renaissance, under the direct influence of **Leonardo da Vinci**, the great Italian mathematician and monk **Luca Pachioli** published "*Divina Proportione*" in 1509, the first book on the golden ratio called the "Divine Proportion."

Mathematician **Johannes Kepler** in his "Harmonice Mundi" (The Universal Harmony", 1609) wrote:

"Geometry has two great treasures: one is the Theorem of Pythagoras; the other, the division of a line into extreme and mean ratio (Golden Ratio). The first, we may compare to a measure of gold; the second we may call a precious jewel."

THE FIBONACCI SEQUENCE

An infinite sequence of numbers : **0 1, 1, 2, 3, 5, 8, 13 ...** in which each successive number is equal to the sum of the two preceding ones.

The **Fibonacci sequence** is named after Italian mathematician **Leonardo of Pisa**, who was known as Fibonacci.

Fibonacci's 1202 book **Liber Abaci** introduced the sequence to Western European mathematics, although the sequence had been described earlier by an ancient Indian mathematician **Pingala** (**200 B.C.**)

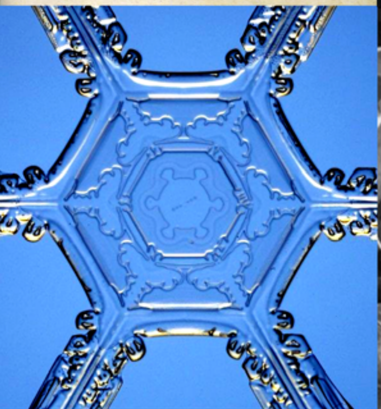
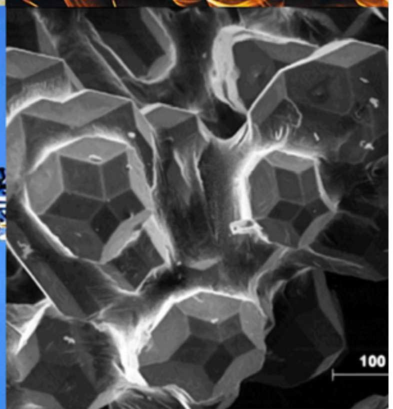
Fibonacci numbers are found in so many diverse places; galaxies, the plant & animal kingdom, the rise and fall of the stock market, our body etc.

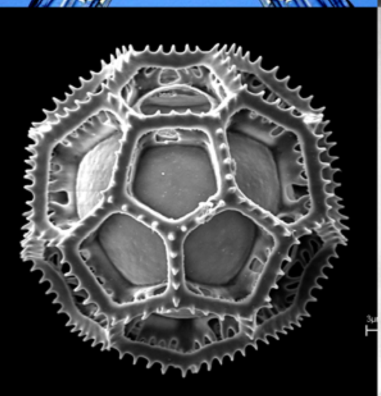
They are the foundation of Nature's harmonic mathematics and are a perfect inspiration for a new language of the harmonic digital electronics of the future.

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 597, 2584, 4181, 6765, 10946, 17711, 28657, 46368, 75025, 121393, 196418, 317811, ...

The proportion that arises in the relationship between these numbers with every step becomes closer to the Golden ratio **1.618 or 0.618.**






THE PLATONIC SOLIDS

Platonic Solids - five regular convex polyhedra (**tetrahedron, octahedron, cube, icosahedron, dodecahedron**), which were used in **Plato's cosmology** and associated with the **Harmony of the Universe**.

These the 5 unique building blocks are found throughout Nature and the Universe.

According to "Proclus' hypothesis," the main goal, pursued by Euclid in his "Elements," was to give a complete geometrical theory of the Platonic solids.

Platonic solids were the basis for two recent modern scientific discoveries, that were awarded the **Nobel Prize: Fullerenes (1996) and Quasi-crystals (2011)**.

Fullerenes - a special type of carbon compounds. Fullerene's molecule has a structure of a truncated regular icosahedron and has a form of football.

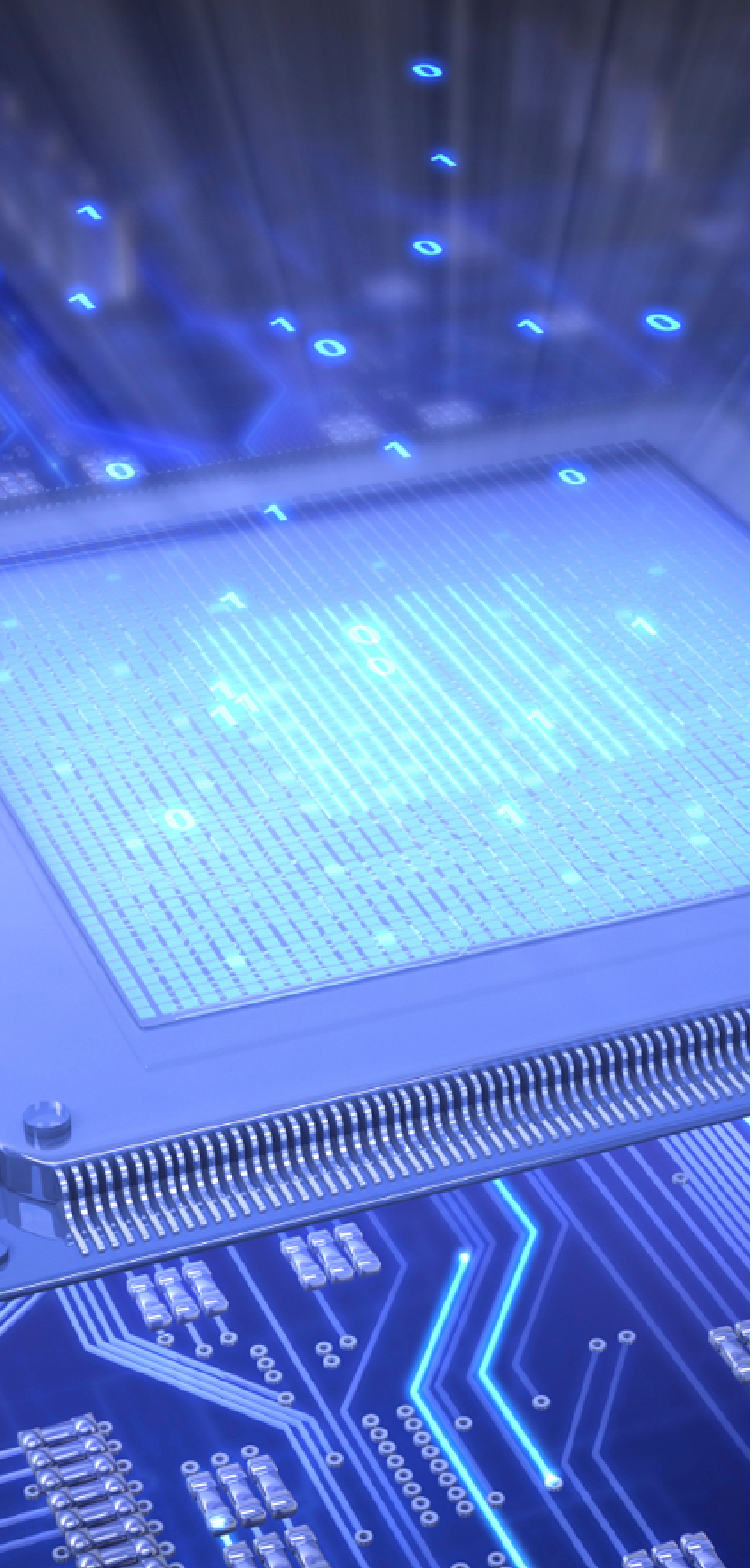
Fullerenes are named after the American architect Buckminster Fuller (1995-1983), who used a form of fullerene structure in his architectural designs.

In 1982 materials scientist Dan Shechtman observed that certain Aluminium-Manganese alloys produced the unusual diffractograms which today are seen as revelatory of quasi-crystal structures. Due to fear of the scientific community's reaction, it took him two years to publish the results for which he was awarded the Nobel Prize in Chemistry in 2011

The icosahedron and the dodecahedron are directly linked to the golden ratio, as part of the Mathematics of Harmony.

BINARY CODE BACKGROUND

THE BINARY CODE
REDUNDANCEY
ERROR DETECTION & CORRECTION
DANGERS OF CODE ERRORS



THE BINARY CODE

What is it ?

The binary number system, represents numeric values using two symbols **0** & **1**. All complex computations get converted to sequences of bits of **0** and **1**.

The binary number system is used as the fundamental computational language **in 99.9% of all digital devices.**

Why is the binary number system used everywhere?

It is the simplest number system that works well with the **on - off** (charged - uncharged) voltage of digital circuit boards. It was the most obvious choice at the time.

What is shortcoming of the binary system?

The binary code has “zero” redundancy. It means all binary combinations are “permitted” and therefore the errors, in principle, cannot be detected.
To better illustrate this, we can imagine the binary code combination : **1001100**; now we imagine due to a glitch of any kind the first 1 becomes a 0, the code combination changes to **0001100**. However, the system would not be able to interpret this as an error and would consider this erroneous code combination as correct. This can occur in data transfer as well as in all arithmetic operations.

Nature dose not use binary code, if it did we would not be here. In fact, the genetic code, as the basis of living nature, is a redundant code; Nature has taken care of its protection against external influences.

REDUNDANCY & ERROR CORRECTION

To deal with this problem of the binary code, methods and devices for error correction have been invented.

What is redundancy ?

Redundancy in information theory is the number of additional bits in the message. These extra bits are added to the original sequence in order to help detect and correct errors in data transmission.

What is error correction ?

Error correction is a process of detecting and correcting errors in code sequences which uses encoding and decoding techniques and devices to add redundancy to the original code.
There are 2 types of data transmission **serial (bit by bit)** and **parallel(e.g. 8 bits at a time)**.

Serial transmission is mainly used for communication between the transmitter and the receiver. The methods and devices used to correct errors in serial data transmission are not very complicated and provide a good level of efficiency.

Parallel transmission is mainly used inside computers and digital microchips, because it is fast transmission, but the devices, needed to gain a good level of error correction, become more complicated, than the actual systems they are monitoring. Then a problem of checking the system of error detection and correction arises, and the whole system becomes very complicated and not very efficient.

REDUNDANCY & ERROR CORRECTION CONTINUED

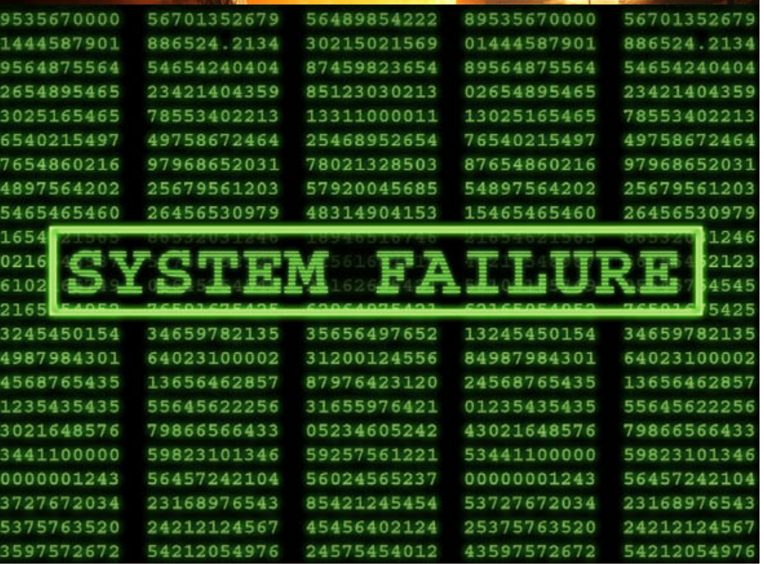
Therefore, error correction in today's computers is forced to use only the most simple error correction methods and devices, if any, to maintain simplicity and speed.

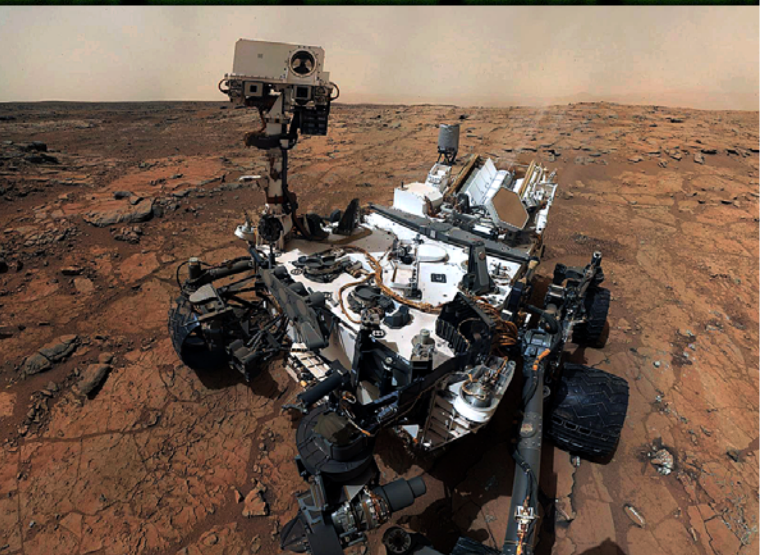
For today's computer systems and microchips, the parity check is used. This method is designed to check the binary sequence for parity of bits (in other words, if the sum of the digits is odd or even). This method is fast , but it has only **50% efficiency**.

This is far from the efficiency, which Nature needs. While such efficiency of error detection is considered adequate for non critical data and operations, when it comes to situations, where such errors could cause major failure, which could lead to crashes, destruction and death, 50% efficiency is simply not enough.

So in vital computing or mission critical as it is also known, were failure due to internal errors in the code is not an option a different approach needs to be found.

Where better to look for inspiration, then Nature.





DANGERS OF CODE ERRORS

Errors in the computer code of any mission critical device can lead to **“technological catastrophes”.**

During the launch of the Russian interplanetary station **“Phobos-Grunt”** to Mars in (2012) the propulsion system, controlled by an on-board computer crashed. **The Head of Roscosmos, Vladimir Popovkin** explained the causes of the accident: “In creating the automatic interplanetary station” Phobos-Grunt substandard imported microchips were used, this lead to device system failure. The use of imported microchips is not only our problem; **NASA** and the **U.S. Department of Defense** are also considering solution to prevent these potential problems. “

Nasa’s Mars Curiosity rover is the next example. On 18 March 2013 engineers concluded that incoming cosmic ray caused a **computer glitch** in the rover’s “A-side” computer memory, the engineers were forced to put it into “safe mode”. The Guardian newspaper wrote: “The real danger is when a cosmic ray hits a computer memory cell or processor, rather than an image detector. Perfect lines of code can be turned to gobbledygook. Back in the mid-90s, **IBM** estimated that **cosmic rays would cause one error per month for every 256MB of RAM in a computer on Earth**, sitting under the planet’s protective magnetic field. Without an appreciable magnetic field of its own, Mars is more exposed. Although Curiosity’s computers are “hardened” to withstand radiation, particularly energetic cosmic rays can sometimes get through.”

Code errors are very hard to narrow down as a cause of an accident once it has occurred, therefore often they are not identified as the root cause of malfunction.

They represent a vulnerability in information technology that needs to be fixed.

INNOVATIONS

OVERVIEW

Two practical problems were at the heart of ancient mathematics: measurement and counting. Historically, the development of these problems led to the creation of two fundamental theories of mathematics - geometry and number theory. The number systems were the first arithmetical results obtained in Babylon and ancient Egypt.

Positional principle of number representation was invented by Babylonian mathematicians and embodied by them in a base 60 number system, which was the first positional number system. All the known number systems, in particular, the decimal and binary (the basis of modern computers) are based on the Babylonian positional principle.

Unfortunately, in number theory proper attention was not given to the development of number systems. Therefore modern mathematics has not achieved much in this field in comparison to the period of its origin.

A new surge of interest in number systems was created by computer-science.

A new class of positional number systems, based on the Fibonacci p-numbers and the golden p-proportions, has been created by the Ukrainian mathematician Alexey Stakhov in the 1970's. The so-called algorithmic measurement theory underlies these number systems.

We are using them now in a new way to create mission critical microelectronics of the future.

GENERALIZATION OF THE FIBONACCI NUMBERS

In the framework of the algorithmic measurement theory Stakhov got a new mathematical result in the field of the **"Fibonacci numbers theory."**

He generalized the Fibonacci numbers, and showed that they are a special case of a more general class of the numerical sequences, called the Fibonacci *p*-numbers.

For a given integer p = 0,1,2,3,... the Fibonacci *p*-numbers $F_p(n)$ are numerical sequences, which are defined by the recurrence relation:

$$F_p(n) = F_p(n-1) + F_p(n-p-1)$$

at the following seeds:

$$F_p(1) = F_p(2) = \ldots = F_p(p) = F_p(p+1) = 1$$

It is proven that for p = 0, this is reduced to the classic binary sequence:

$$p = 0 : 1,2,4,8,16,32,64,128,\ldots, F_0(n) = 2^{n-1}.$$

For p=1, the Fibonacci *p*-numbers are reduced to the classic Fibonacci numbers:

$$p = 1 : 1,1,2,3,5,8,13,21,34,\ldots, F_1(n) = F_1(n-1) + F_1(n-2)$$

For p=2 the Fibonacci *p*-numbers are the following numerical sequence:

$$p = 2 : 1,1,1,2,3,4,6,9,13,19,28,41,60,\ldots, F_2(n) = F_2(n-1) + F_1(n-3)$$

Continuing this process, for the cases p = 3,4,5,... we obtain an infinite number of new numerical sequences.

GENERALIZATION OF THE GOLDEN RATIO

In 1980 Stakhov got another result in the "theory of the golden section", which goes back to Euclid's "Elements".

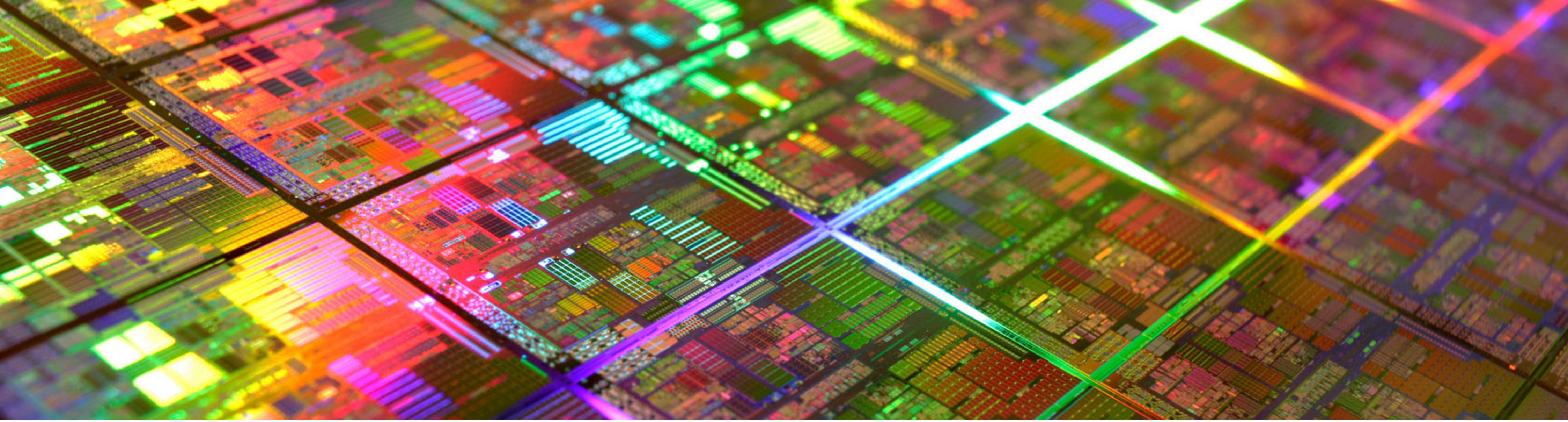
With this purpose, he divided the segment ***AB*** in the point ***C*** in the following proportion:

$$\frac{CB}{AC} = \left(\frac{AB}{CB}\right)^p$$ where $p = 0,1,2,3,...$

It is important to emphasize that for the case $p=0$ golden p-ratios are reduced to the simplest "dichotomy" (a division in half), and for the case $p=1$ to the classic golden ratio.

The solution of the problem was reduced to solving the following algebraic equation: $x^{p+1} - x^p - 1 = 0$ where $p = 0,1,2,3,...$ The positive root of the algebraic equation is called the golden p-proportion $\Phi_p\left(p = 0,1,2,3,...\right)$.

Thus, the number of sections, like the classic golden section, unexpectedly increased to infinity.



HARMONIC NUMBER SYSTEMS

THE BEGINNING OF HARMONIC DIGITAL TECHNOLOGY
FIBONACCI P-CODES (*P* =0,1,2,3, ...)
CODES OF THE GOLDEN *P*-PROPORTION
GOLDEN *P*-PROPORTION | CONTINUED
CONCEPT OF THE “MINIMAL FORM”

THE BEGINNING OF HARMONIC DIGITAL TECHNOLOGY

The classic binary system, the basis of modern digital technology, has a major problem. It has zero redundancy which means zero ability to detect errors in code sequences and arithmetic operations, which can result in malfunctions of digital elements and systems under the influence of various external and internal agressive factors.

Because of zero code redundancy and zero error detection ability, the classic binary system is not optimal for the design of specialized microelectronics with requirements for superior noise immunity and informational reliability for “mission critical” objectives.

To overcome the main drawback of the binary system, in the 1970’s Soviet mathematicians proposed an unusual approach for designing computing and measuring systems, which is based on two non-traditional number systems.

A distinctive feature of the “Harmonic” number systems is that they are based on the two important harmonic concepts – the golden ratio and Fibonacci numbers and their generalizations: the golden *p*-proportions and the Fibonacci *p*-numbers, introduced in the 1970’s. These concepts are relevant to the problem of system harmony, which has been studied in science, since the ancient times.

This approach opened up a new phase in the development of information technology - the **HARMONIC PHASE**, which brings information technology closer to Nature and the Universe.

FIBONACCI *P*-CODES ($P=0,1,2,3,\ldots$)

These codes are new binary positional representations of natural numbers of the following kind:

$N=anFp(n)+an\text{-}1Fp(n\text{-}1)+\ldots+aiFp(i)+\ldots+a1Fp(1)$,

where N is a positive integer, $p=0,1,2,3$, ... is a given integer, which indicates the number of the Fibonacci p-code, $a_i \in \{0,1\}$ is the bit of the i-th digit;, n is the number of digits in the Fibonacci p-code; Fibonacci p-number $Fp(i)$ is the weight of the i-th digit ($i=0,1,2,\ldots$,n). Important to emphasize that the p-Fibonacci codes ($p = 0$) are a generalization of the classical binary system and ($p = 1$) is the generalization of the classical Fibonacci code, in which the digit weights are Fibonacci numbers: 1,1,2,3,5,8,13, ...
Examples of the 8-bit Fibonacci p-codes ($p=0,1,2,\ldots,\infty$):

$p=0\left(\text{binary code}\right):$

$N=a_8 2^7+a_7 2^6+a_6 2^5+a_5 2^4+a_4 2^3+a_3 2^2+a_2 2^1+a_1 2^0$

$p=1\left(\text{Fibonacci 1 - code}\right):$

$N=a_8\times 21+a_7\times 13+a_6\times 8+a_5\times 5+a_4\times 3+a_3\times 2+a_2\times 1+a_1\times 1$

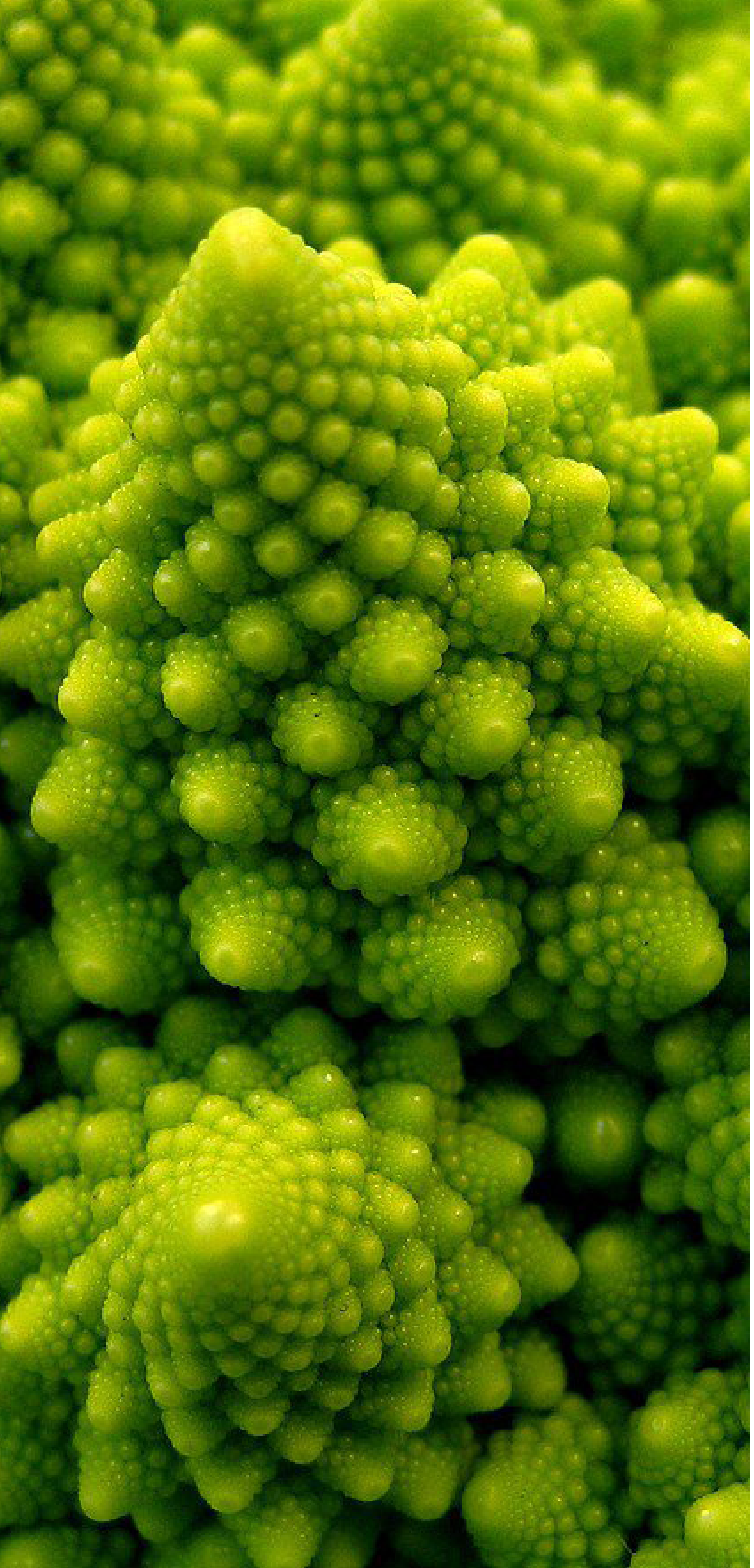
$p=2\left(\text{Fibonacci 2 - code}\right):$

$N=a_8\times 9+a_7\times 6+a_6\times 4+a_5\times 3+a_4\times 2+a_3\times 1+a_2\times 1+a_1\times 1$

....

$p=\infty\left(\text{Fibonacci }\infty\text{ - code}\right):$

$N=a_8\times 1+a_7\times 1+a_6\times 1+a_5\times 1+a_4\times 1+a_3\times 1+a_2\times 1+a_1\times 1$



CODES OF THE GOLDEN *P*-PROPORTION

These codes are new binary positional representations of real numbers: $A=\sum_i a_i \Phi_p^i \left(i=0,\pm1,\pm2,\pm3,\ldots\right)$, where A is a positive real number, *p*=0,1,2,3, ... is a given integer, $a_i \in \{0,1\}$ is the bit of *i*-th digit, Φ_p^i is the weight of the *i*-th digit, and is the golden *p*-proportion, the base of the code of the golden *p*-proportion.

Table of the bases of the codes of the *p*-proportion looks as follows:

p	0	1	2	3	...	□
$□_p$	2	1.618	1.465	1.324	...	1

Important to emphasize that the codes golden p-proportion are a generalization of the classical binary system (*p*=0) and the number system with an irrational base (golden ratio), proposed in 1957 by the American mathematician George Bergman.

Examples of the 6-bit codes of the golden p-proportion (*p*=0,1,2,3):

$p=0\left(\text{binary code}\right):$

$$A=a_3 2^3+a_2 2^2+a_1 2^1+a_0 2^0+a_{-1} 2^{-1}+a_{-2} 2^{-2}$$

$p=1\left(\text{code of the golden 1 - proportion, Bergman's system}\right):$

$$A=a_3(1.618)^3+a_2(1.618)^2+a_1(1.618)^1+a_0(1.618)^0+a_{-1}(1.618)^{-1}+a_{-2}(1.618)^{-2}$$

$p=2\left(\text{code of the golden 2 - proportion}\right):$

$$A=a_3(1.465)^3+a_2(1.465)^2+a_1(1.465)^1+a_0(1.465)^0+a_{-1}(1.465)^{-1}+a_{-2}(1.465)^{-2}$$

$p=3\left(\text{code of the golden 3 - proportion}\right):$

$$A=a_3(1.324)^3+a_2(1.324)^2+a_1(1.324)^1+a_0(1.324)^0+a_{-1}(1.324)^{-1}+a_{-2}(1.324)^{-2}$$

GOLDEN *P*-PROPORTION | CONTINUED

The golden *p*-proportions $\Phi_p \left(p = 0,1,2,3,... \right)$ are the weights of the golden proportion codes. They are connected between themselves with the following relations.

Additive relation: $\Phi_p^i = \Phi_p^{i-1} + \Phi_p^{i-p-1}$ Multiplicative relation: $\Phi_p^i = \Phi_p \times \Phi_p^{i-1}$

where *p*=,1,2,3,…; *i*=0,±1,±2, ±3, …

For the case *p*=0, $\Phi_{p=0} = 2$ and these relations take the following trivial form:

$2^i = 2^{i-1} + 2^{i-1}; \quad 2^i = 2 \times 2^{i-1}$

Note that these trivial mathematical relations underlie arithmetical operations in the classic binary system.

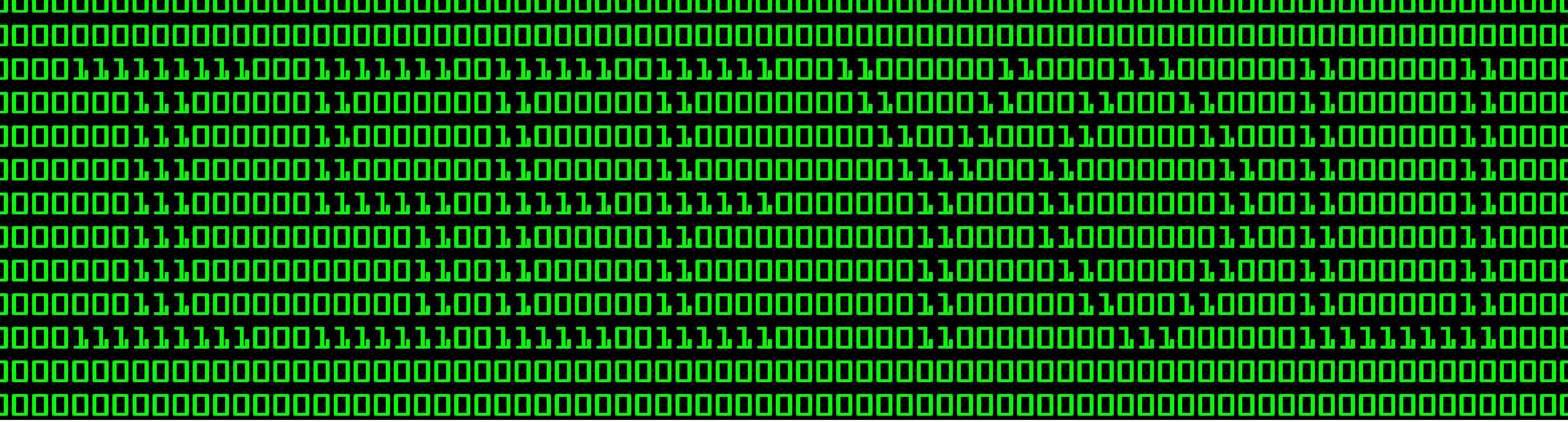
For the cases *p*=1,2,3, … these relations are the following, respectively:

$p = 1: \quad \Phi^i = \Phi^{i-1} + \Phi^{i-1}; \quad \Phi^i = \Phi \times \Phi^{i-1}; \quad \Phi = 1.618$

$p = 2: \quad \Phi_2^i = \Phi_2^{i-1} + \Phi_2^{i-3}; \quad \Phi_2 = \Phi_2 \times \Phi_2^{i-1}; \quad \Phi_2 = 1.465$

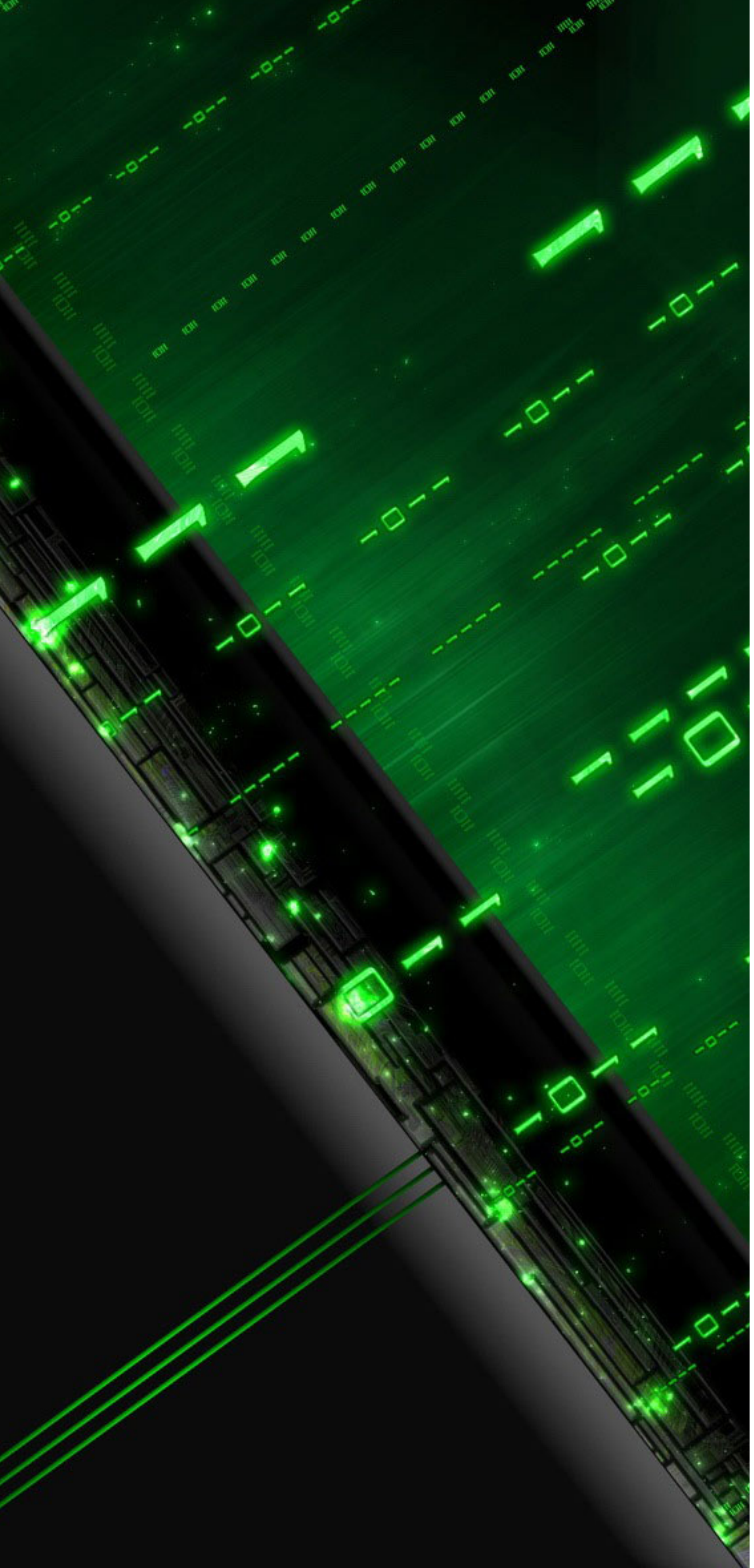
$p = 3: \quad \Phi_3^i = \Phi_3^{i-1} + \Phi_3^{i-4}; \quad \Phi_3^i = \Phi_3 \times \Phi_2^{i-1}; \quad \Phi_3 = 1.324$

By analogy with the binary system, these mathematical relations underlie arithmetical operations in the codes of the golden *p*-proportions.



DETECTION & CORRECTION OF ERRORS

CONCEPT OF THE "MINIMAL FORM"
DETECTION OF ERRORS
POTENTIAL ERROR DETECTION ABILITY
CODE REDUNDANCY
FIBONACCI PARITY CODE
FIBONACCI PARITY CODE: TECHNICAL ADVANTAGES
FIBONACCI PARITY CODE: OTHER ADVANTAGES | MINIMAL FORM
CONCEPT OF ELECTRONIC MEMORY AS A UNIVERSAL DATA CONVERTER
DUPLICATION OF HARMONIC SELF-CHECKING DIGITAL DEVICES



CONCEPT OF THE "MINIMAL FORM"

For $p>0$ the Fibonacci p-codes and codes of the golden p-proportion have a code redundancy. This redundancy manifests itself in two unusual properties of the Fibonacci p-codes and codes of the golden p-proportion. The first property is a multi-valence of the code representations of the same number. For example, the number N=20 in the Fibonacci p-code (p=1) has the following code representations:

n	7	6	5	4	3	2	1
$F_1(n)$	13	8	5	3	2	1	1
20 =	0	1	1	1	1	1	1
20 =	1	0	0	1	1	1	1
20 =	1	0	1	0	0	1	1
20 =	1	0	1	0	1	0	0

The bottom code representation 20=1010100 has a distinctive feature: at least one bit of 0 follows after each bit of 1 (from the left to the right). It is proved that for each positive integer N this code representation is unique.

This Fibonacci representation is called a "minimal form." There is the "minimal form" for any Fibonacci p-code But for the general case of $p>0$, at least p bits of 0 follow after each bit of 1 (from the left to the right) in the "minimal form.". It is proved that all the codes of the golden p-proportions have the same property.

Thus, for the given $p>0$ there is one-to-one correspondence between natural numbers and the "minimal forms" of the Fibonacci p-code and also between real numbers and the "minimal forms" of the codes of the golden p-proportion.

DETECTION OF ERRORS

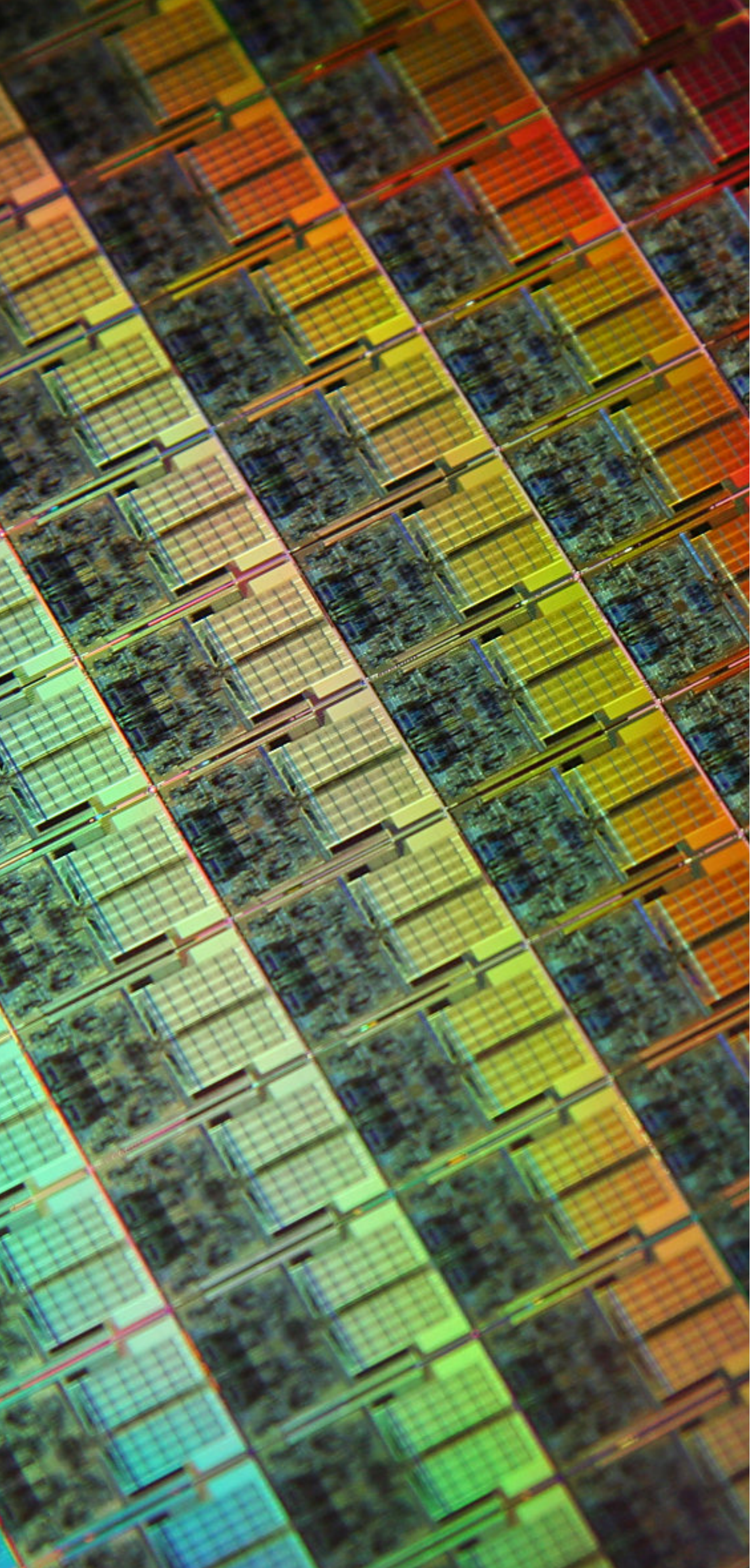
The concept of the "minimal form" plays a key role in the detection of errors in the Fibonacci digital devices.

The "minimal forms" are the "permitted" Fibonacci and "golden" representations of numbers, all other forms are considered as "forbidden" representations. Their appearance is a "natural" error signal in the code combinations that can occur at any stage of data transformation in Fibonacci computer or microchip. To determine the potential error detection ability of the code it is necessary to know the number of "permitted" and "forbidden" code combinations in the Fibonacci *p*-code and the code of the golden p-proportion.

The answer to this question is provided by the following theorem. Theorem (about the minimal forms). For a given *p*=0,1,2,3, we can represent $F_p(n+1)$ integers in the range from 0 to $F_p(n+1)-1$ in the "minimal form" of the *n*-bit Fibonacci *p*-code.
The following table defines the range of number representation in the "minimal form" for the different n-bit Fibonacci *p*-codes for the cases (*p*=0,1,2) and *n*=8,12,16,24:

n	8	12	16	24
$F_0(n+1)$	256	4048	65536	16777216
$F_1(n+1)$	34	233	1597	62215
$F_2(n+1)$	13	60	277	6450

This table gives us an opportunity to evaluate two important characteristics of the Fibonacci *p*-code the potential ability of the code to detect errors and its redundancy.



POTENTIAL ERROR DETECTION ABILITY

For example, consider the 24-bit Fibonacci p-codes for the cases *p*=0,1,2. Note that the row $F_0(n+1)$ corresponds to the classic binary (non-redundant) code (*p*=0). As follows from the table, the number of the binary combinations of the 24-bit binary code is equal to $F_0(25)=2^{24}=16777216$. On the other hand, the number of the 24-bit "minimal forms" of the Fibonacci *p*-code (*p*=1) and (*p*=2) is defined by the following expressions, respectively: $F_1(25)=62215; \quad F_2(25)=6450$ We see that the number of 24-bit "minimal forms" of the Fibonacci *p*-code (*p*=1) and (*p*=2) ($F_1(25)=62215; \quad F_2(25)=6450$) is negligibly small compared to the number of all possible 24-bit binary code combinations ($F_0(25)=2^{24}=16777216$).

If we calculate the differences

$$\Delta_1 = F_0(25) - F_1(25) = 16777216 - 62215 = 16715001$$

$$\Delta_2 = F_0(25) - F_2(25) = 16777216 - 6450 = 16770768$$

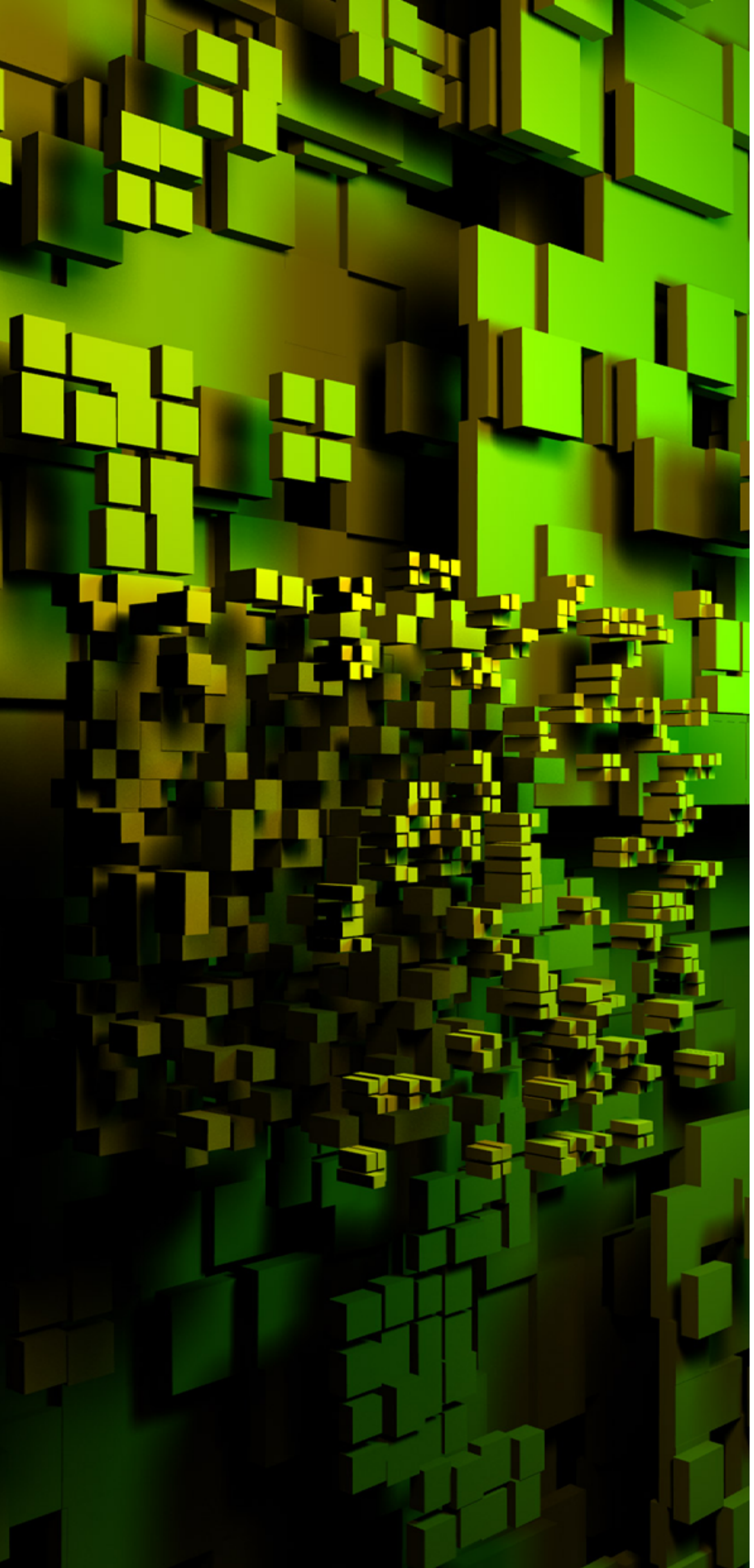
we get the number of the "forbidden" combinations of the Fibonacci *p*-code (*p*=1) and (*p*=2), respectively.

If we now calculate the ratios,

$$S_d(p=1) = \frac{\Delta_1}{F_0(25)} = \frac{16715001}{16777216} = 0.9963 = 99.63\%$$

$$S_d(p=2) = \frac{\Delta_2}{F_0(25)} = \frac{16770768}{16777216} = 0.9996 = 99.96\%$$

we obtain the numerical values of the potential error detection ability of the 24-bit Fibonacci *p*-code (*p*=1) and (*p*=2), respectively.



CODE REDUNDANCY

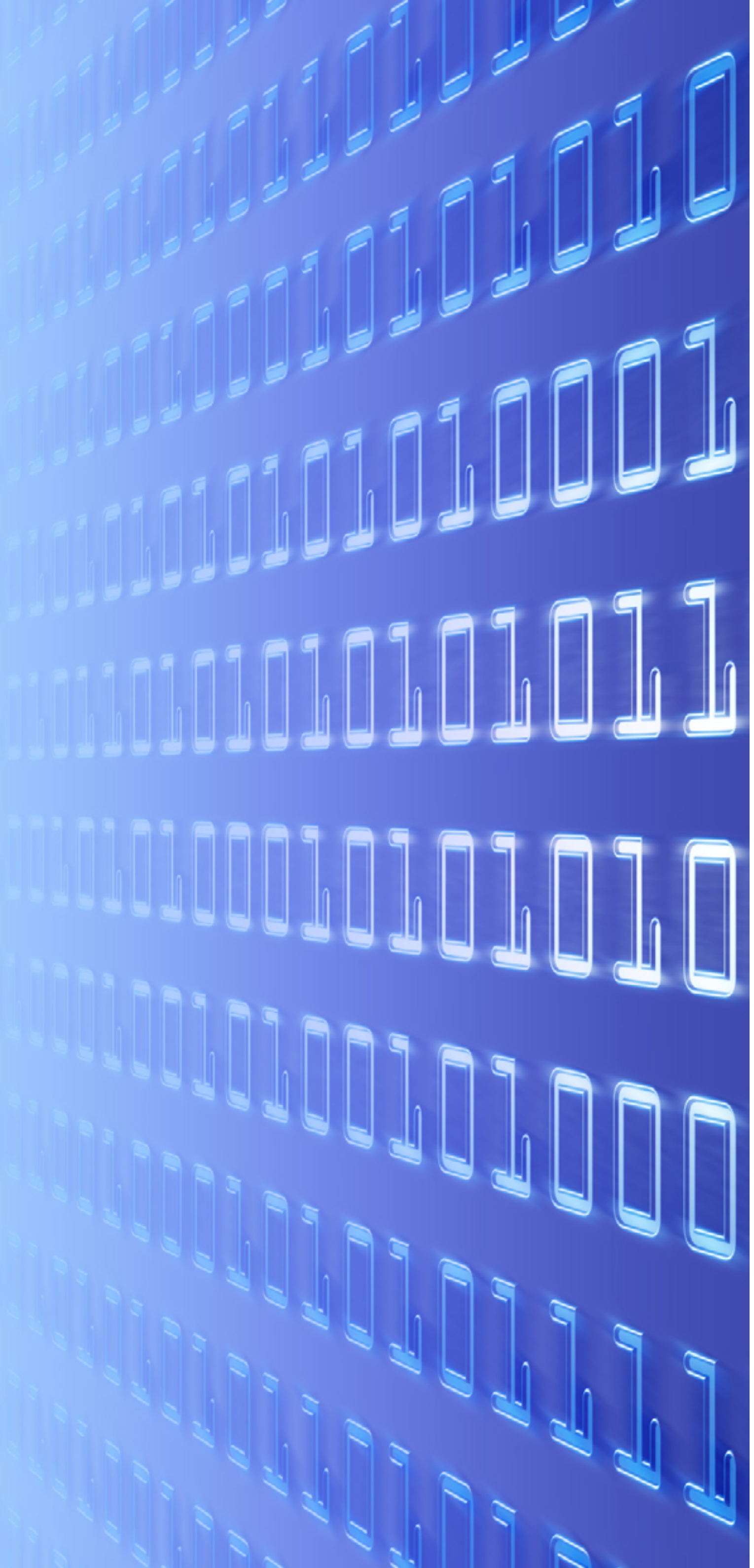
Using the table above, we can calculate the absolute and relative redundancy of the Fibonacci *p*-codes corresponding to *p*=1.2...

For example, by using the 24-bit Fibonacci *p*-code (*p*=1) in the "minimal form" we can represent the number range 62215. But approximately the same number range can be represented by the 16-bit binary code (the number range is equal to 65536). From these considerations it follows that the absolute redundancy of the 24-bit Fibonacci *p*-code (*p*=1) is equal:

24-16 = 8, and the relative redundancy. R is equal to the ratio $R = \frac{8}{24} \approx 0.33 = 33\%$.

This means that the 24-bit Fibonacci *p*-code (*p*=1) contains about 67% (16) informational digits and 33% (8) redundant digits.

Comparison of the classical binary code (*p*=0) with the Fibonacci *p*-code (*p*=2) shows that by using the 16-bit Fibonacci *p*-code (*p*=2) in the "minimal form" we can represent a number range, equal to 277. But about the same number range (256) can be represented by the 8-bit binary code (*p*=0). This means that the absolute redundancy of the 16-bit Fibonacci *p*-code (*p*=2) equals to 16-8=8 and the relative redundancy is equal to $R = \frac{8}{16} = 0.5 = 50\%$.



FIBONACCI PARITY CODE

Detection of errors in the Fibonacci *p*-codes and the codes of the golden *p*-proportion is based on the conception of “permitted” and “forbidden” Fibonacci and golden representations.

For example, if the single error of the kind **0** → **1** appears in the “minimal form” of the number 20 = 1010100, for example, 101**1**100, then this code combination is not “minimal form” and the appearance of the code combination 101**1**100 is an indicator of the error.

Unfortunately, the errors of the kind **1** → **0** in the “minimal form” cannot be detected. If the error of the kind **1** → **0** appears in the “minimal form” of the number 20=1010100, for example 10**0**0100, such an error will not be detected, because the property of the “minimal form” is not broken.

To overcome this, the present invention uses the conception of the **FIBONACCI PARITY CODE**. According to this conception the PARITY BIT added to the “minimal form” of the Fibonacci *p*-code or the code of the golden *p*-proportion. The PARITY BIT is equal to 0 if the number of bits 1 in the “minimal form” is even, and is equal to 1 otherwise.

This innovation improves significantly the error detection ability of the code. For example, consider the FIBONACCI PARITY CODE of the number 20=1010100:

FIBONACCI PARITY CODE

$$N = 20 = \underbrace{1010100}_{FIBONACCI} \quad \underbrace{1}_{PARITY\ BIT}$$

FIBONACCI PARITY CODE: TECHNICAL ADVANTAGES

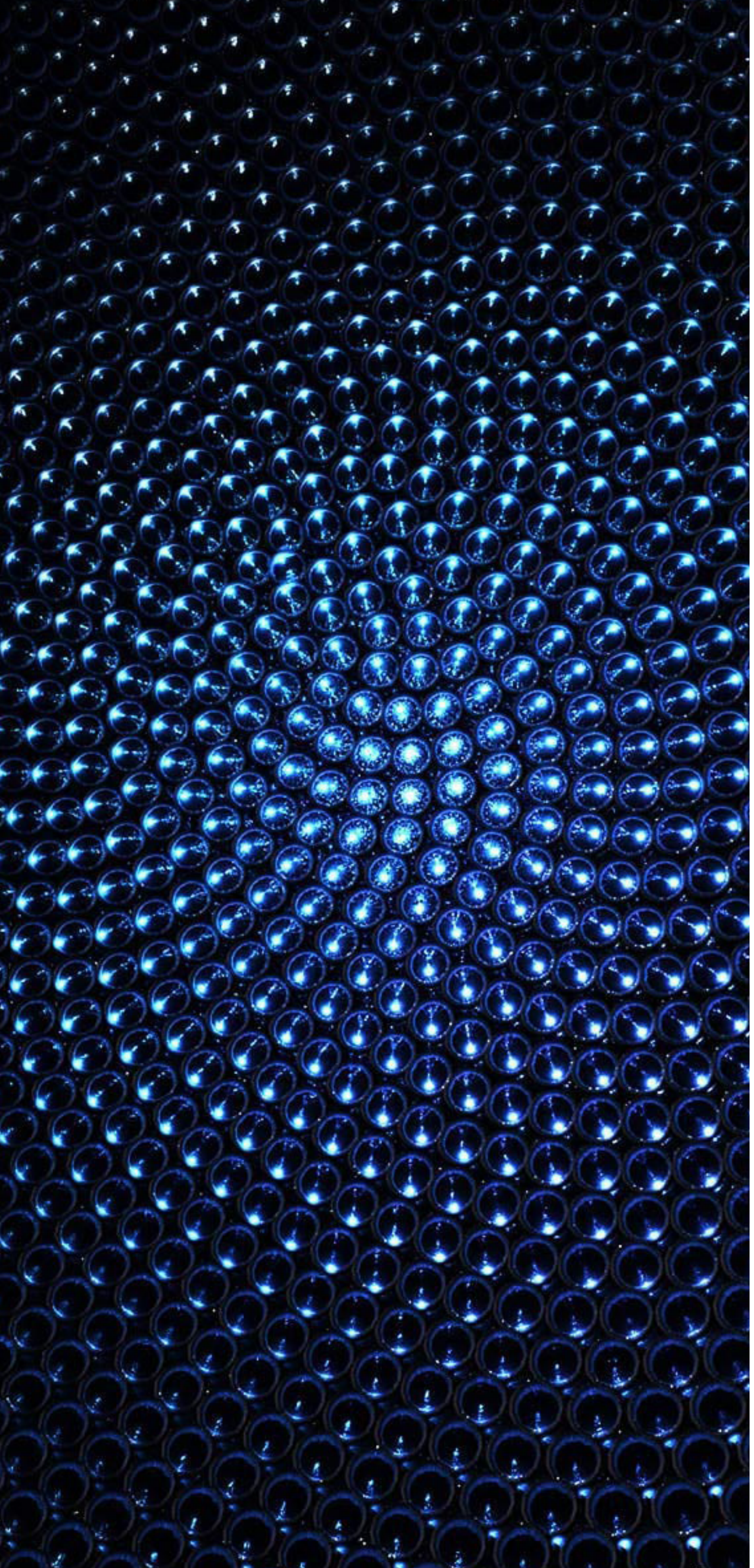
In this example the PARITY BIT equals 1, because the number of 1's in the code combination FIBONACCI is odd.

In such a codeword every single error of the kind $0 \to 1$ or $1 \to 0$, and indeed, any multiple odd errors are detected.

The table below gives the potential error detection ability of the FIBONACCI PARITY CODE for the cases *p*=1.2 and *n*=8,12,16,24.

n	8	12	16	24
$S_d(p=1)$	0.9335(**93.35%**)	0.9715(**97.15%**)	0.988(**98.8%**)	0.998(**99.8%**)
$S_d(p=2)$	0.9749(**97.49%**)	0.9919(**99.19%**)	0.998(**99.8%**)	0.9998(**99.98%**)

The system for error detection, based on the **FIBONACCI PARITY CODE**, has the following technical advantages:
a) continuous error detection for all phases of the transfer, processing and storage of information in the microchip.
b) detection of errors as they occur and their correction by means of repeating the micro operation.
c) blocking the passage of erroneous information for further processing, which prevents the execution of false commands.
d) the detection of errors in the Fibonacci and golden representations is realized in parallel data transmission.
e) the system for error detection is simple for technical implementation and does not significantly affect the speed of information processing in the microchip.

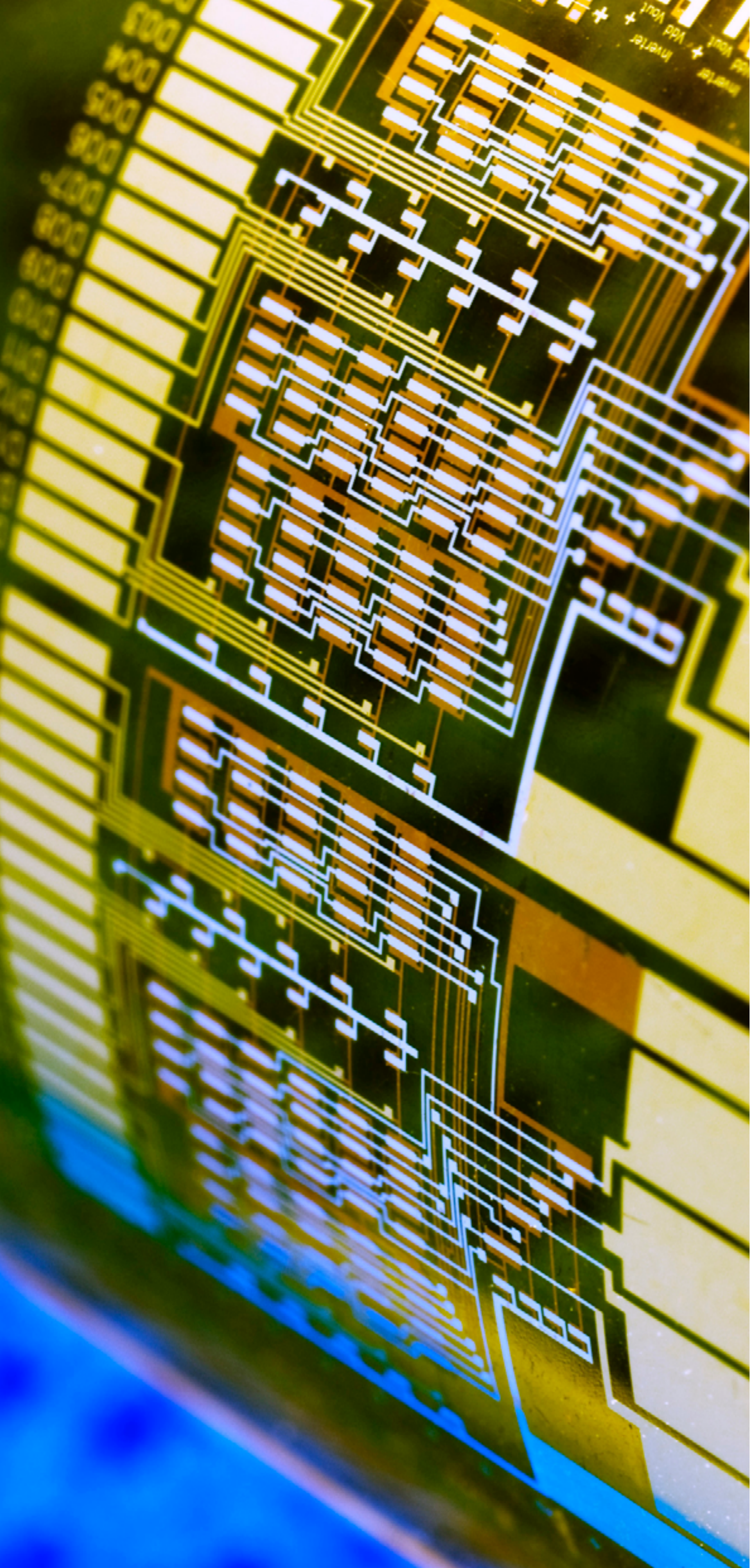


FIBONACCI PARITY CODE: OTHER ADVANTAGES | MINIMAL FORM

Besides error detection, the concept of the "minimal form" leads to other technical advantages over the classical binary system:

1. Inbuilt properties of the «minimal form" are used to reduce energy consumption in electronic memory as well as to greatly reduce power dissipation, particularly, in **ROM**. For the case p=1 the energy consumption could be reduced up to **1.5 times** for the case p=2 more than **2 times**.

2. A property of **self-synchronization**, which is inherent in the minimal forms of all the Fibonacci p-codes and codes of the golden p-proportion for the cases p> 0. This property provides an effective solution for synchronizing serial transmission of bits 1 and 0.



CONCEPT OF ELECTRONIC MEMORY AS A UNIVERSAL DATA CONVERTER

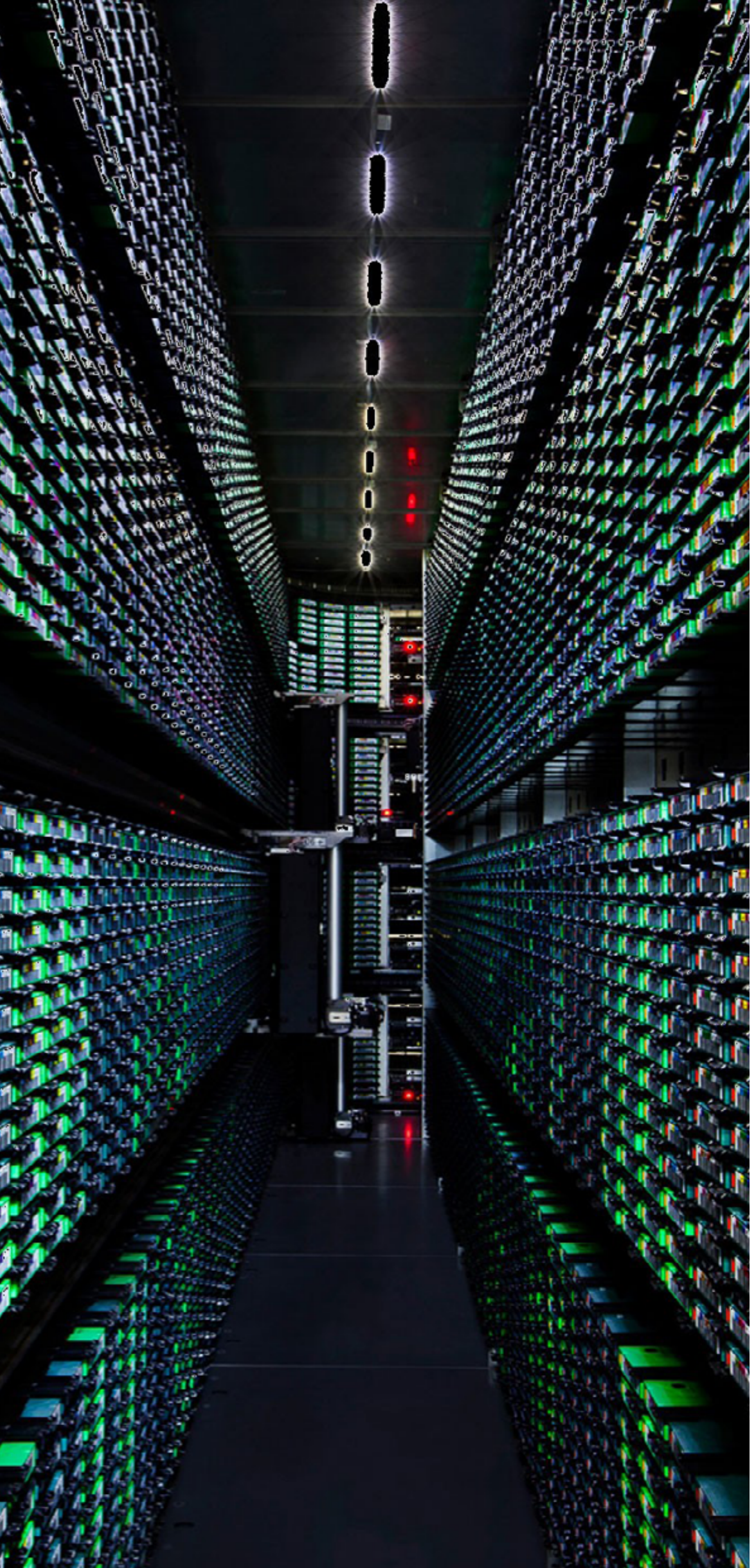
The well known **"times 10"** multiplication table demonstrates the basic principle for the realization of arithmetical and other operations in the Fibonacci *p*-codes and the codes of the golden *p*-proportion. According to the "times 10" table, two addresses; **"horizontal address" A1** and **"vertical address A2** determines the result of arithmetical operation (multiplication), which is the **output data DO** as a function of the addresses **A1** and **A2**.

A2=5

A1=4 → row 4 → DO=20

X	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

The **electronic memory (EM)** plays a role of the operational table for all arithmetical and other operations. The addresses, and all data of the EM (output data DO) are represented in the FIBONACCI-PARITY CODE, which provides a very high level of error detection for all addresses at the input of EM and all data at the output of EM. The use of the FIBONACCI-PARITY CODE for the coding of the addresses A1 and A2 and all data in EM leads to two advantages:
1) High level of error detection in the addresses and output data DO and
2) High speed of arithmetical operation, which is determined by time of reading from EM.



DUPLICATION OF "FIBONACCI" SELF-CHECKING DEVICES

There is a distinction between **constant and random failures** of digital devices. It should be noted that the random failures in electronic elements occur more frequently than constant failures. The frequency of the random failures increases with the miniaturization of electronic components. Therefore the problem of creating of the noise-resistant digital microelectronic devices is extremely important.

In the event of **constant failure**, the device completely breaks down and stops functioning. To increase fault tolerance, often device duplication is used. In this method when a constant failure occurs in the main device the functionality of the system is restored by instantly switching to duplicated device.

The **random failures** lead to the temporary disruption of functionality in digital device. They occur under the influence of various external and internal factors (**heat, radiation, electromagnetism, voltage surges**). The random failures can also lead to false commands in the control systems, which can cause serious technological disasters. Protection from random failures is realized by creating self-checking digital devices, which are capable of detecting failures in the device at the time of their occurrence and switching to a backup duplicated device.

The duplication of the "Fibonacci" self-checking digital devices has the same fail-safe advantages and can be used to **increase reliability to up to 100%.** Every duplicated device constantly monitors the output information. In the event of a random error, the "Fibonacci" device blocks the passing of the false information and automatically switches to the backup device in order to keep the system functioning correctly.

SUMMARY

OVERVIEW
OBJECTIVE
STRATEGY
FUTURE
CONTACT

OVERVIEW

The binary number system has played a vital role in the development of information technology. However, its **major drawback - zero redundancy and zero ability to detect errors** in digital devices - led to the development of alternative positional number systems that provide a high level of error detection at all stages of the transfer, storage and processing of information in future “mission critical” systems.

Harmonic number systems (Fibonacci *p*-codes and codes of the golden *p*-proportions) are generalizations of the classic binary system. They retain all the technical advantages of the binary system and have code redundancy necessary for error detection. Harmonic number systems are based on the “Mathematics of Harmony” (Golden Ratio, Fibonacci numbers and their generalizations), which brings information technology clouser to Nature. Using these number systems in a new way we can create an entierly new error free cybernetics that would still be compatible to all classic binary systems.

Proposed areas of application are:

1. **SPACE**: spacecraft control and on-board systems, satellites, probes, etc.
2. **ENERGY**: nuclear power stations and other energy facilities.
3. **TRANSPORT**: aircraft, trains, subway and cars.
4. **AUTOMATION**: banks, factories and public services.
5. **MEDICAL**: computerized medical equipment.
6. **COMMUNICATION**: telephony, Internet.
7. **SCIENCE**: research computers, super computers.
8. **MEDIA**: digital television, radio broadcasting.
9. **ROBOTICS**: control systems for robots and robotic tools
10. **NANO**: this invention can be used as a basis for the creation of nano-computers and electronics where reliability and survivability are vital.

OBJECTIVE

The objective of this presentation is to find the right strategic partners to develop and bring this technology to market.

An entiere “eco-system” of products can be created and patented:

HARMONIC microchip
HARMONIC microcontroler
HARMONIC rom memory
HARMONIC ram memory
HAMRONIC flash memory
HARMONIC digital to analouge & analouge to digital converters.

Producing super reliable and energy efficient information technology for all vital industries.

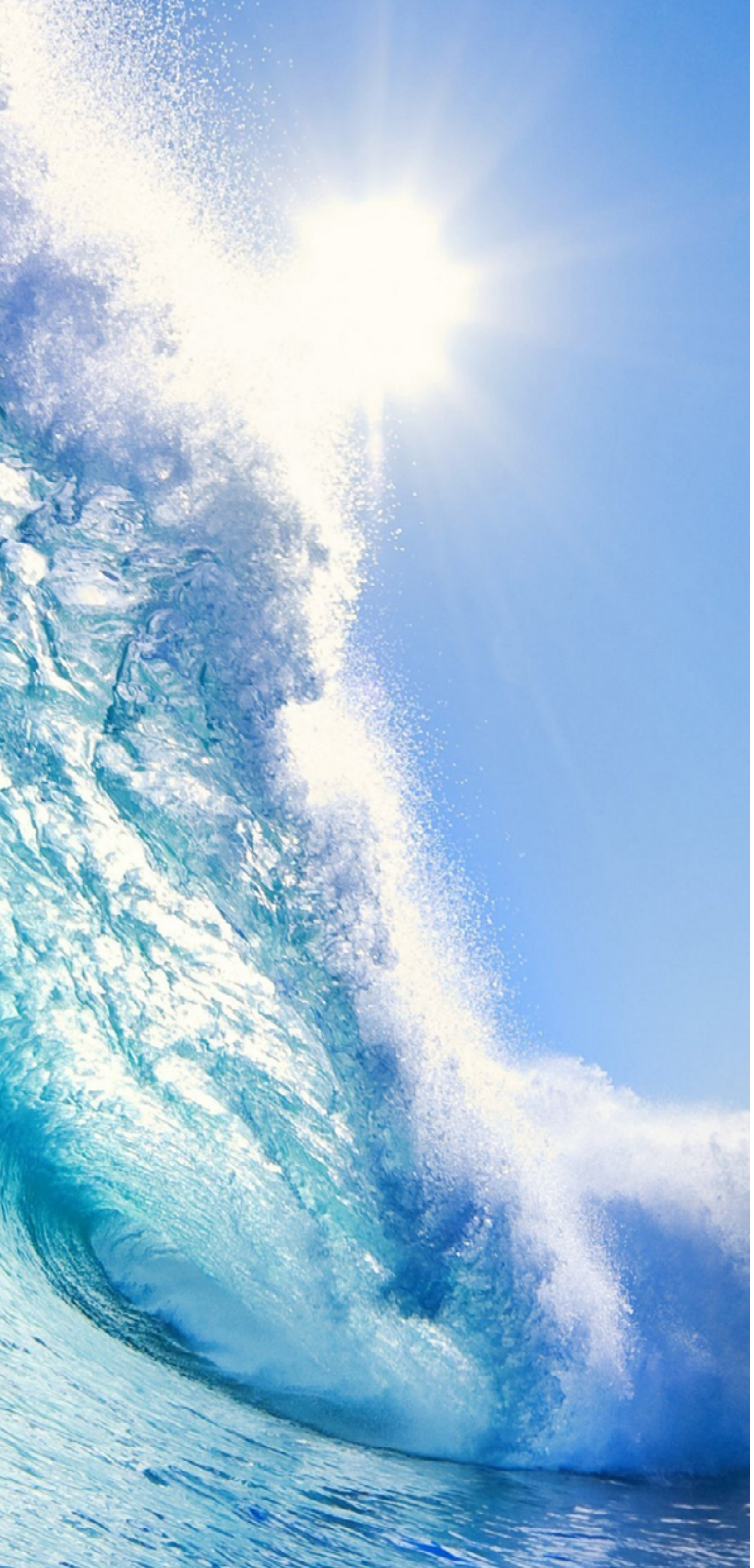
Bringing about a new era of Nature inspired computing.

STRATEGY

In order to fully realize the global and commercial benefits of this technology, as well as to maintain priority for years to come we propose the following strategy.

- Virtual and physical prototyping of the “harmonic” digital microelectronics.
- Thorough testing.
- Full non-provisional international patenting.
- Technology licencing presentation - package.
- Licencing technology to key global players in all internaitonal markets.

This would enable a very rapid wave of new and unique technology to hit the global markets.



FUTURE

The future of this technology is very bright.

It does not stop at just the **super stable "harmonic" microchips and memory**, it extends further into the development of entire **"harmonic" computer systems**, as well as other specialized digital equipment and technology in numerous vital industries.

The next phase would be to apply these principals to the nano scale and see if they can resolve the problems of creating the **first nano computer**, stable, controllable and not in conflict with the laws that govern the very particles of matter and energy that it would be made from.

Same applies to **DNA computing** and the development of **artificial intelligence** and **advanced robotics**, surely in these fields the only thing worth copying is Nature.

CONTACTS

Thank you for taking the time to read this presentation, we hope it has given you a new perspective and understanding of Hamonic Nature inspired computing.

If you would like to get in touch or find out more information about this project please contact:

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