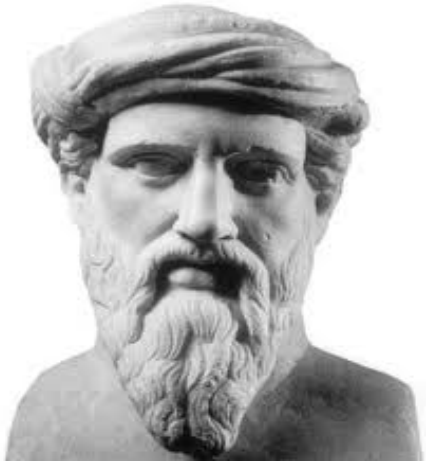


Pythagoras-Box

The comical side to a mathematical tragedy

The general project

Mathematics is generally considered a tricky science.
It is evident how the knowledge of mathematics is now a real access key to modernity, both on a scientific research level and from the point of view of being able to imagine and produce innovative technologies. However the general sense of inadequacy continues with respect to the knowledge of mathematics, as if opening this door of deductive knowledge was impossible. Pythagoras provides an effective passepartout to look out towards the wide horizon of scientific knowledge.

This project was born out of the necessity to make public an historical event which happened around 2500 years ago in Magna Grecia, to be precise in the Pythagoras Academy of Crotone.
The story was until today the object of study for mainly mathematicians and historians of science but its range of meanings is so dense with contact points to modernity that immediate disclosure is imperative. The story itself begs to become public domain.

In this respect two specific moments are taken into consideration that consent to outline the conceptual nucleus of the entire project:

1. **The intimate knowledge of the Pythagoras's Theorem.** The project sees the disclosure of one of the geometric demonstrations of the Theorem. The choice of such a demonstration has been determined by its formal immediacy and at the same time by it simplicity and beautiful elegance, so dear to the mathematical tradition.

2. **The knowledge of the fundamental paradigm of science** according to which a theory is true until someone proves otherwise. The discovery of irrational numbers and the historical event around such numbers seem to anticipate the fundamental themes of modern scientific thought.

1. The intimate knowledge of the Pythagoras's Theorem.

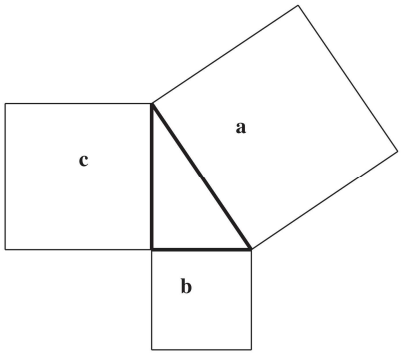
As often happens, mathematical notions stay in people's minds as mnemonic formulas. Pythagoras's Theorem states that

"The sum of the areas of the two squares on the legs equals the area of the square on the hypotenuse"

Fantastic! Many people remember this but how many people actually know what it really means? The demonstration presented below allows us to quickly and deeply understand the Theorem, to metabolize it, to transform this knowledge into personal and at the same time universal culture, valid for all citizens of the Planet.

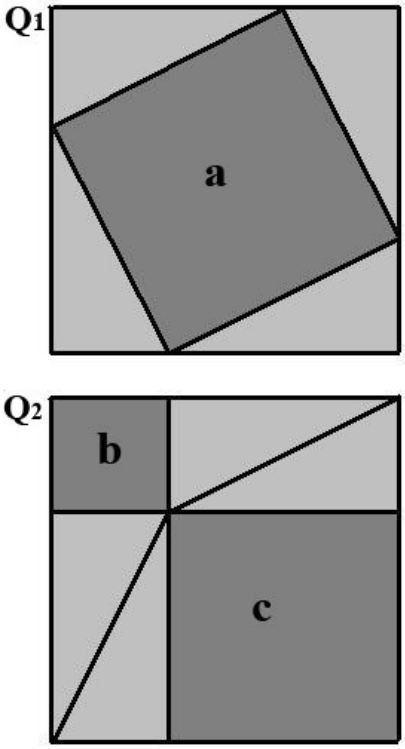
Pythagoras's Theorem is usually represented as in Fig. 1. Such a modality states the Theorem but it certainly doesn't demonstrate it.

Fig.1



a = b + c

Fig. 2 is a geometric demonstration



- The two big squares Q1 and Q2 contain shapes which are all equal, that is to say they have the same size surfaces.
- The triangles in Q1 and Q2 are 8 equal right-angle triangles, 4 in Q1 and 4 in Q2.
- The square “a” found within square Q1 is the square built on the hypotenuse of the triangles
- The square “b” is the square built on the minor cathetus (leg) of the triangle while “c” is build on the major cathetus (leg) of the triangle
- If we subtract from Q1 the four right-angle triangles’ surfaces we get square “a”
- If we subtract from Q2 the four right-angle triangles’ surfaces we get “b” + “c”.

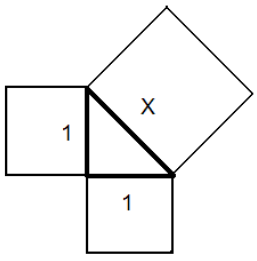
Therefore a = b + c

2. The knowledge of the fundamental paradigm of science

The history of mathematics gives usa curious and worrying story concerning the relationship between Pythagoras's Theorem and the discovery of the irrational number.

Around 500 A.C. Pythagoras founded in Crotone his school, the Pythagoras Academy. There he taught his fabulous namesake Theorem and with it a sort of mystical integer numbers in which the number 1 represented in some way the "Truth". Pythagoras had decided to assign a type of religious meaning to mathematics.The school was a great success, with many arriving from all corners of the Mediterranean to study and become followers of the Great Maestro.
One fine day, the young Hippasus from Metapont, one of his students, took an unusual initiative. He decided to apply the Pythagoras Theorem to a right-angle Isosceles Triangle. The triangle had 2 equal cateti that measured coincidentally, the number 1, the number of "Truth".

Hippacus applied in good faith and honesty the Theorem, carried out some calculations but didn't consider the terrible consequences on his life and the History of Humanity.



$$x = \sqrt{1^2 + 1^2} = \sqrt{1 + 1} = \sqrt{2}$$

Having thought the new number could be to many an inoffensive event, it was, instead, a very upsetting discovery.

Calculating the value of $\sqrt{2}$ meant in fact indicating the number which multiplied by itself is equal to the number 2.

Therefore $\sqrt{2}$ = **1,41421356237309… an infinite sequence of numbers without order, chaos**!

Hippasus from Metapont had discovered in the most dramatic way possible, **irriational numbers.** The mystical adoration for the number 1 and Pythagoras's Theorem had generated together a true numerical delirium. And so in the chaos the venerable Maestro and his followers were finished. Hippasus was condemned to death and drowned. The Pythagoras Accademy was set fire to. From that moment and until Descartes (XVII century), geometry and arithmetic were taught separately for fear of numerical, social and religious disorder.

Conclusion:

"When you think you have found the Truth,you could still be visited by someone who proves you wrong. Avoid drowning him and destroying his house. It is enough to change your mind!"

Why this is important

The dynamics of the story of Pythagoras and Hippacus from Metaponto bring us to the final consideration:

"If you think you have found the Truth, you could still be visited by a guy who proves you are wrong. Avoid drowning him and burning down his house. You can simply change your mind"

Such a conclusion greatly resembles the principal paradigm from the scientific method that says:

"A theory is true until proven otherwise"

How many people are prepared to change their mind, even with evidence of facts? Changing your mind, having the humility and the intelligence to modify your position when somebody proves you are wrong, expresses the same root of the possibility of scientific knowledge. Such an attitude should be inherent to all mankind.
That an event which happened so long ago could bring so many

universal values, forces us to tell this story to ensure that the precious secrets guarded in books and in few people's knowledge, can belong to everyone.

The Arrangements for Disseminating

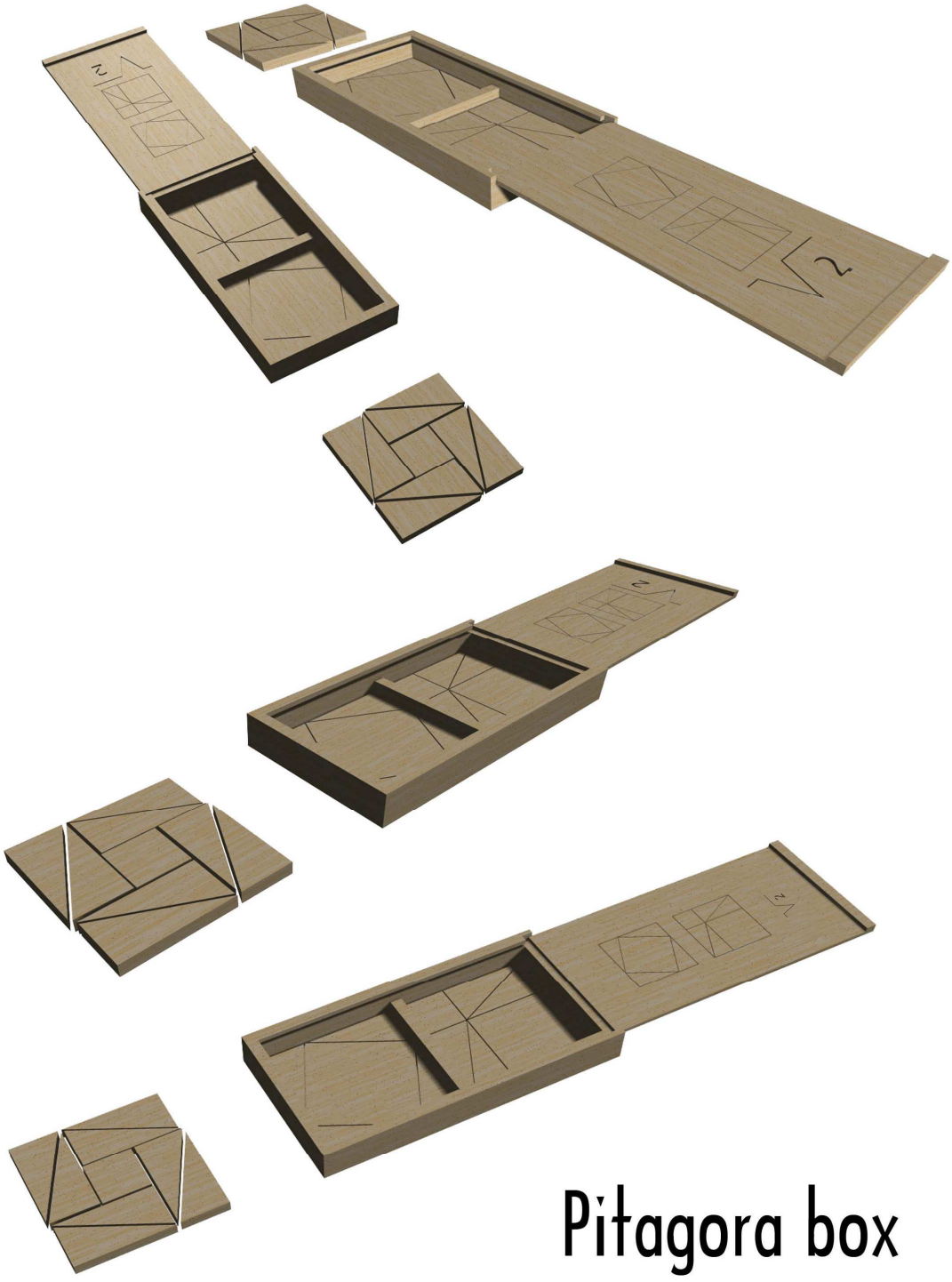
The Pythagoras Box Project marries all these initiatives to disseminate the important information set out above. 5 communication modes have been created from which the first two are already up and running.

1. The production of didactic wooden games which allow the player to become confident with the Theorem. The game also contains the history of Hippacus and the irrational numbers in diagram form. (see fig. 3)
2. The production of a theatre show. This show will be made up of both theatre and song and will use a communication mode adapted also to secondary school levels. It will be 60 minutes long.
3. The production of a fun filled animation video lasting approx. 10 minutes that explains the Theorem and the curious story of Pythagoras and Hippacus from Metaponto in a tragi-comedy way, close to a scientific thriller. The video will be sub-titled in the English language depending on how much International interest is generated.
4. To give more weight to the Pythagoras Box Project it would be very interesting to involve a series of visual artists in an exhibition about the Pythagoras Theorem. Historians, philosophers, mathematicians and journalists could be involved in this exhibition to give life to a debate and discussion about the themes found within the story.
5. A communication mode of utmost importance could be determined by the production of design objects. The demonstration of the Theorem could be reproduced in objects for the house or everyday objects such as stools, lamps, bathroom tiles. Many parents would be interested in their children using these objects so as to help them develop a happy connection with the language of mathematics.

The didactic wooden game

Below find a three dimensional didactic wooden game, already produced and patented.

Fig 3



The Show: “ The comical side to a mathematical tragedy”

The show is fruit of a funny contamination between theatre language, mathematics, music and the history of science. Pythagoras is an excellent prototype for this type of experimentation. He, in fact, besides having created the famous Theorem, was one of the most intellectually, more eccentric and eclectic personalities from history. Few know, for example, that he was 3 times boxing champion at the Olympics. A philosopher and mathematician, he was the first person to discover numerical laws which regulate musical harmony, studies which were concluded 2000 years after Vincenzo Galilei e Galileo Galilei.
Pythagoras inaugurated a mode of mathematical thinkingthat influenced Western culture from Plato to today. It is therefore the show is dedicated to him.The polyhedral nature of his personality especially suggests the necessity of an interdisciplinary vision that promises the discovery of some direct connections between numbers, geometry, music, acoustics, philosophy and language. With such a scope the show has an interactive form which involves the public in a series of fun scientific exercises and
paradoxical demonstrative activities.
The main objective of the show is to stimulate the audience and examine scientific themes or what was once known as Natural Philosophy. For all these reasons, the show also takes place in secondary schools.

Themes examined in the show

-Pythagoras’s Theorem
-Rational numbers and the tragic discovery of irrational numbers
-The density of Q, the concept of Time in Plato
-The rudiments of acoustics: sound waves and their space propagation
-The Pythagorean discovery of the relationship of numbers in musical harmony
-The anatomy of the first musical instrument: the harmonic voice

CV Andrea Mazzacavallo

1. Born in Thiene (Vicenza) Italy on 2 February 1971. At the age of 9 he begins studying classical piano.
2. In 1990 he receives a secondary school diploma from the *Liceo Scientifico Corradini* in Thiene.
3. He proceeds to study jazz piano and vocal experimentation.
4. In 1995 he wins the award dedicated to Demetrio Stratos called ***The Singing Voice.*** He subsequently receives a study grant from the Labor Ministry to continue his musical studies.
5. Beginning in 1996 he works in Milan as author of *Aspirin Music*. Thanks to this contract h is able to continue with his university studies.
6. In 2000 he publishes his first album with the same publishing house. He participates in Sanremo 2000 and is ranked in last place.
7. Two months later he receives a **Bachelor's Degree in History and Philosophy** from the University of Bologna with his thesis entitled "A Game of Simulation and Human Knowledge."
8. He proceeds to work for Edel, the German multinational company. He publishes his second musical work with the label for a comic theatre production entitled ***Low-fi.***
9. He continues his activity as musician and composer in the theatre field and is involved in numerous cabaret and theatre song productions.
10. From 2000 to 2003 he teaches modern keyboard playing at the *Istituto Civico Musicale di Schio (Civic Musical Institute of Schio, Vicenza).*
11. In 2003 he participates in the finals for ***Premio Città di Recanati*** and publishes the single *Telegenerali* for the Edel record label. This song leads to his participation in many peace protests. That same year he is invited to the Uzbeck music festival in Taskent.
12. In 2000 he begins teaching vocal experimentation and piano in Bologna.
13. In 2004 he completes the soundtrack for the film ***Cavedagne*** di Francesco Merini.
14. In 2006 he wins the ***Leoncino d'oro alla Biennale Teatro di Venezia*** (The Little Golden Lion of the Venice Theatre Biennial) with the soundtrack for the production ***Il Corvo*** by Carlo Gozzi
15. In 2007 he performs in the Italian Embassy in Seoul and gives a seminar on *Music and*

Vocals in the Art of Comedy at the Korean University.

16. In 2007 he completes the soundtrack for the production entitled *L'ultima Casa (The Last House)* written by Tiziano Scarpa, winning the award *Chi è di Scena* at the Biennale of Venice.
17. In 2008 he completes the music for the circus-theatre production *Cirk,* through the stage direction of the Dutchman Ted Kaijser.
18. Still in 2008 he completes the soundtrack for the program *Pit Stop Lavoro* broadcasted in CNBC and produced by Man Power.
19. In September 2008 he completes the music and writes the signature tune for the program *Premio Nazionale del Lavoro 2008* broadcasted on RAI 2.
20. In February 2009 he writes the text and the music for the show *Il Pesce è Muto* produced by the Venice Casino under the leadership of Ted Kaijser.
21. In 2009 he publishes his book of short stories "Ticket" for Zona Editrice (AR).
22. The same year he completes the music for the theatre production "Kallakalkon" through the stage direction of Stella Parland for the Klockrike Teater of Helnsinki.
23. In 2010 he realizes as director 8 short films for Rai 1 for "National Award of Work".
24. In 2010 and in 2012 he completes the music for the theatre productions Menecmi and Pseudolo for the Plautusfestival.
25. In 2011 he writes the music and the songs for "Don Giovanni in carne e legno" (Tap Ensamble production).
26. In 2012 and in 2013 he teaches theatre for Campus Company (Civic Theatre Foundation of Schio)
27. In 2013 he realizes as director and musician the cartoon and the play "Pitagora-box" about the history of irrational numbers and in collaboration with the National Museum of Science.
28. In 2015 he works in collaboration with the director of Opera Wien Theater Klaus Rohrmoser for Pythagoras-box.

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