JERUSALEM COLLEGE OF TECHNOLOGY
LEV ACADEMIC CENTER

The Chair for Mathematics, Education and Judaism

Glimpses at Mathematics and Jewish Art

☺ especially related to symmetry ☺

Thierry (Noah) Dana-Picard
Joint work with Sarah Hershkovitz (CET – Tel Aviv)
Vienna, July 21st, 2016

Limitations: Short tidbits on a Jewish attitude towards Art

Whether there exists a form of art that can be described as "Jewish Art" has long been a matter for discussion. What is indisputable is that at every stage of their history the Jews and their ancestors of biblical times expressed themselves in various art forms which inevitably reflect contemporary styles and fashions and the environment in which they lived. For purposes of cult and of religious observance, as well as for household and personal adornment, Jews have constantly produced or made use of objects which appealed in some fashion to their aesthetic sense. In a famous passage (Shab. 133b), the rabbis, commenting on Exodus 15:2, prescribed that God should be "adorned" by the use of beautiful implements for the performance of religious observances. A problem exists, however, regarding the Jewish attitude toward figurative and representational art. The Pentateuchal code in many places (Ex. 20:4; Deut. 5:8 and in great detail 4:16–18) ostensibly prohibits, in the sternest terms, the making of any image or likeness of man or beast.

Exodus 20,3 – Ten commandements

"Thou shalt not make unto thee a graven image, nor any manner of likeness, of any thing that is in heaven above, or that is in the earth beneath, or that is in the water under the earth"

Ref: the Jewish Virtual Library

Pros and Cons until 19th century

May exist

- Torah scrolls ornaments
- Enluminated books
- Music
- Etc...

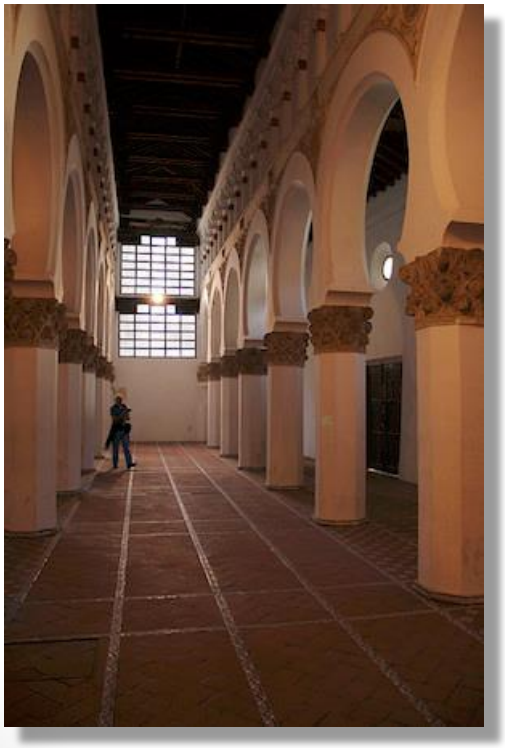
May not exist

- Monuments
- Sculptures (Figurative pictures of animals and human beings)
- Etc…

2D ≠ 3D

Jewish Art: Ancient items

Panel from a Torah Shrine from the Ben Ezra Synagogue in Cairo, 11th century, wood (walnut) with traces of paint and gilt, 87.3 x 36.7 cm (The Walters Art Museum). The patterns of vine scrolls and lozenges shows the influence of Islamic art.



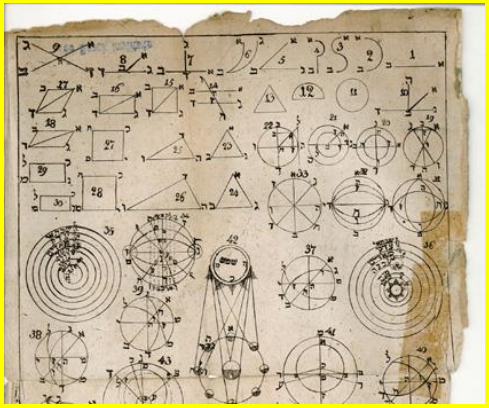
Santa Maria la Blanca, former synagogue in Toledo, Spain. Erected in 1180, it may be the oldest synagogue in Europe still standing. It is now owned and preserved by the Catholic Church as a museum
photo: Nik McPhee (CC BY-SA 2.0)

Religious items (Judaica)

Torah Crown, 1698-99, Bolzano, Italy (The Jewish Museum, New York) “Originally dedicated to an Italian synagogue in 1698/99, this crown was later plundered during a Russian pogrom and then recovered. It became part of the collection of the Great Synagogue of Danzig in the early 20th century. In 1939, it was sent to the Jewish Theological seminary in New York for safekeeping when the Nazis' rise to power forced the Danzig Jewish community to disband.”

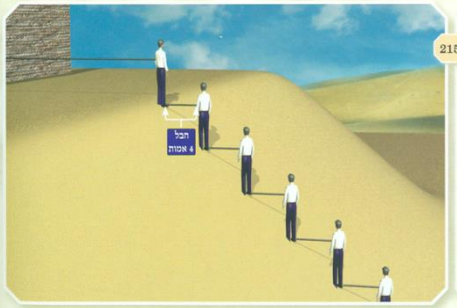
Torah Case, Iraq, 19th-early 20th century, silver overlaid on wood, with coral set cresting (The Jewish Museum, London)

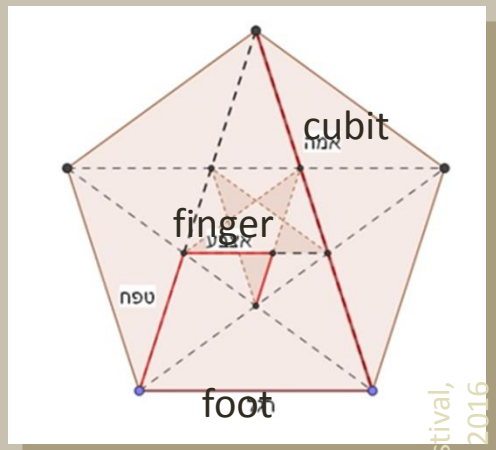
Jewish Maths (Talmud)

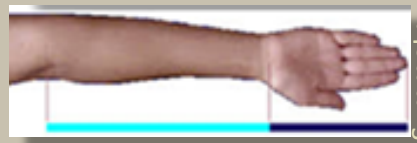


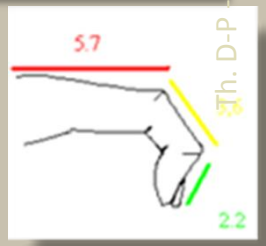
Computing the Jewish Calendar (lunar and solar)

An approach looking as integral calculus

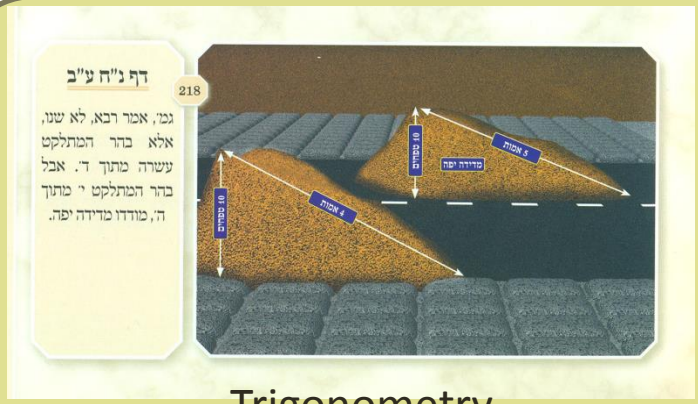








Biblical length units: Fibonacci numbers



Trigonometry

Ref: DP (2014): JCRME2.

Numerical values of letters in the Hebrew Alphabet (Gematria)

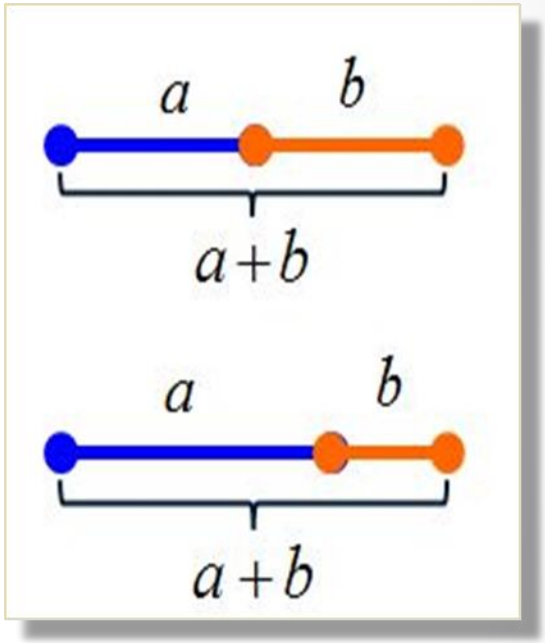
	ה	ב	ה	א
1				א
2		ב		
3		ב		א
5			ה	
8		ב	ה	א
13	ה	ב	ה	א

Love = אהבה

Fibonacci numbers = numbers of love

The Golden Section aka the Divine Proportion[1]

How to divide a quantity into two parts in a harmonious way?

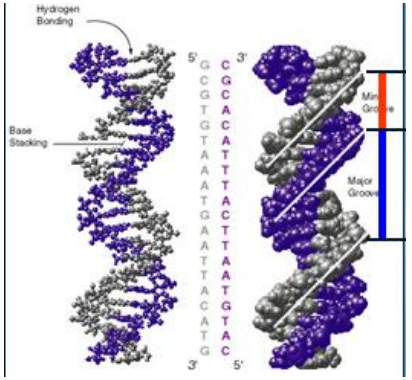


The Golden Section is realized when you take two numbers a et b such that the ratio of the sum a+b over the greatest one a is equal to the ratio of the greatest a over the least b.

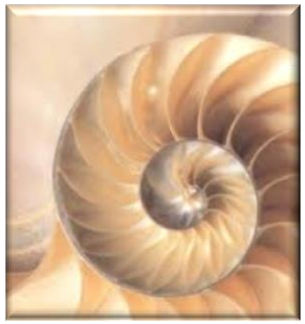
$$\frac{a+b}{a} = \frac{a}{b}$$

1 Luca Bartolomes Pacioli (Luca di Borgo): 1445 in Borgo Sansepolcro, Tuscany - 1517 in Rome.

Fibonacci spiral in nature



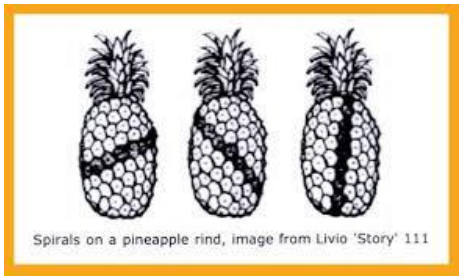
ADN

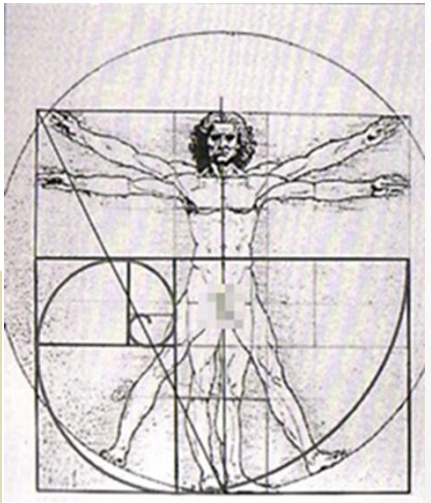


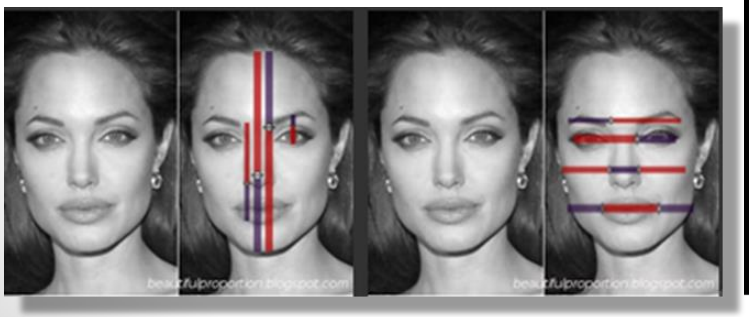
Nautile

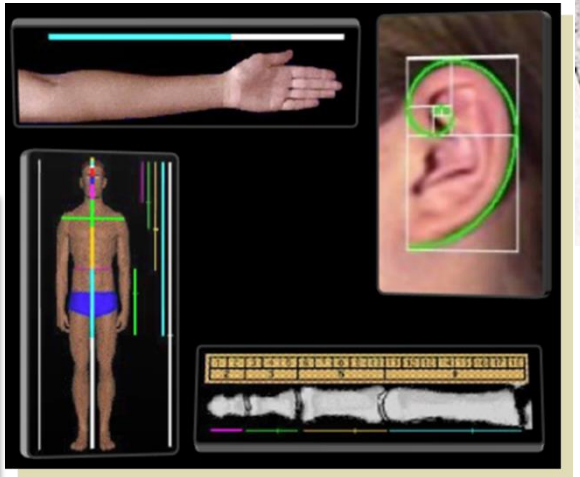
Sunflower

Pine

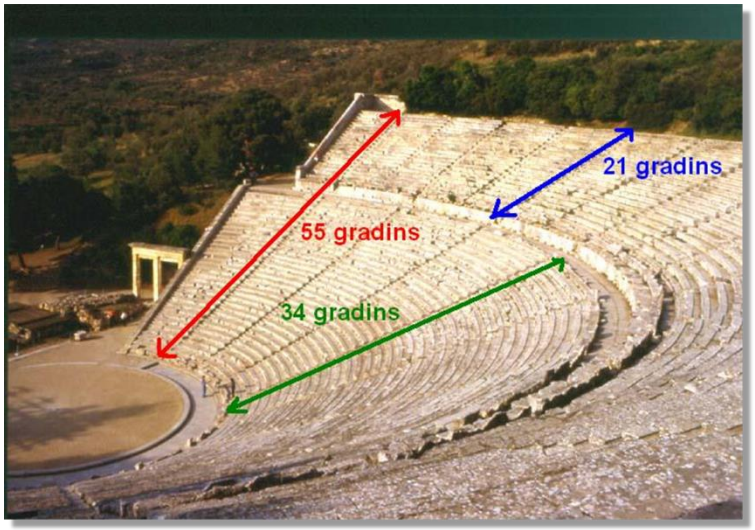




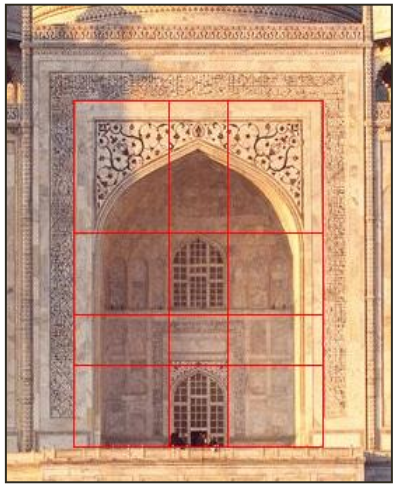


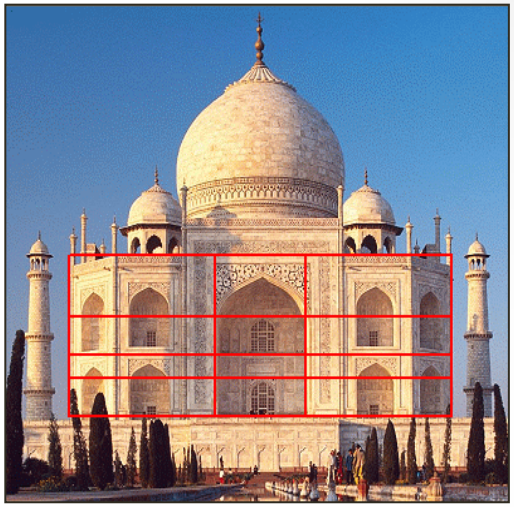


Golden Section in Architecture

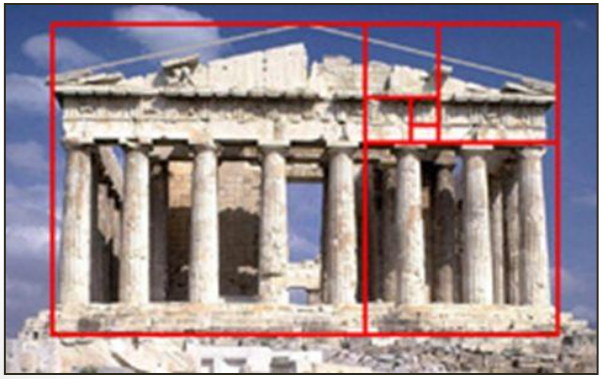


The theater in Epidauros

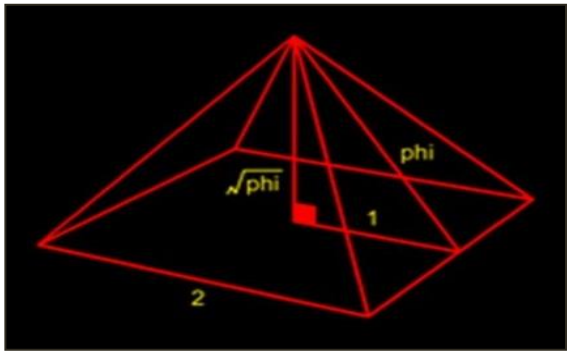




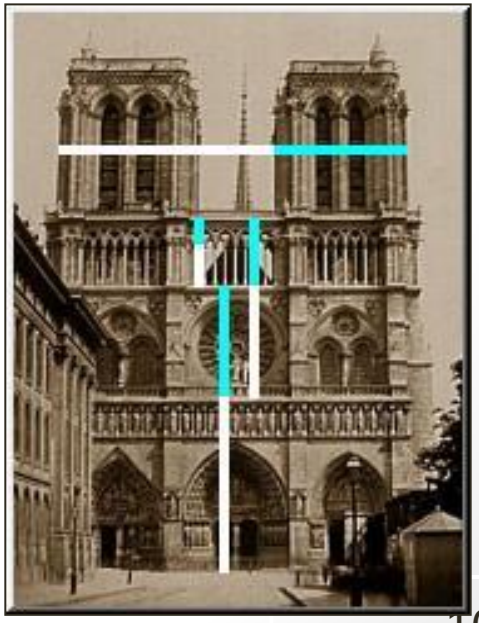
Taj Mahal



Parthenon



Cheops pyramid



And what in Jewish life?

- Biblical texts and Tradition
- Artefacts
- More modern buildings

Ref: DP and G. Morali, book to appear (in Hebrew), 2016.

Noah's Arch
Genesis 6,15

וְזֶה אֲשֶׁר תַּעֲשֶׂה אֹתָהּ: שְׁלֹשׁ מֵאוֹת
אַמָּה אֹרֶךְ הַתֵּבָה חֲמִשִּׁים אַמָּה רָחְבָּהּ
וּשְׁלֹשִׁים אַמָּה קוֹמָתָהּ

And this is how thou shalt make it: the length of the ark three hundred cubits, the breadth of it fifty cubits, and the height of it thirty cubits.

$$\frac{50}{30} = \frac{5}{3} = \frac{2.5}{1.5} = 1.666$$

The Arch of Covenant Exodus 25,10

$$\frac{2.5}{1.5} = \frac{5}{3} = 1\frac{2}{3} \approx 1.66$$

וְעָשׂוּ אֲרוֹן עֲצֵי שִׁטִּים אַמָּתַיִם וָחֵצִי אָרְכּוֹ וְאַמָּה וָחֵצִי רָחְבּוֹ וְאַמָּה וָחֵצִי קֹמָתוֹ.

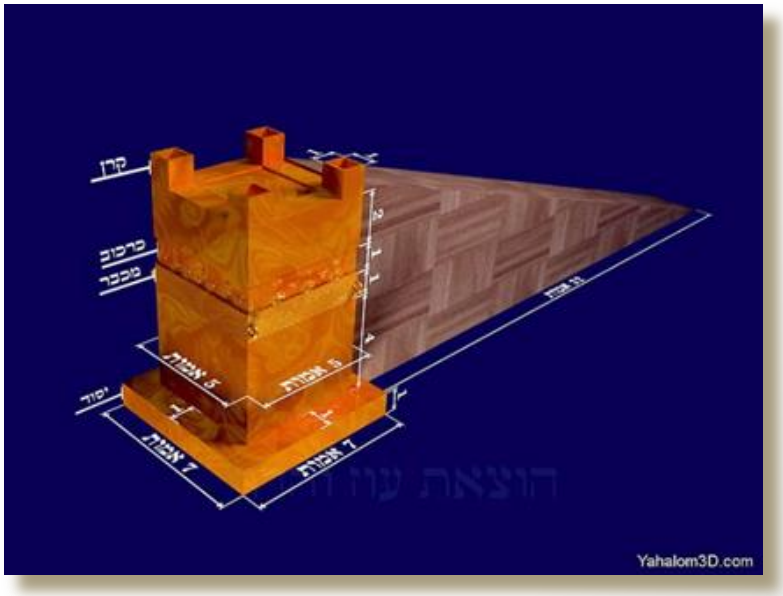
And they shall make an ark of acacia-wood: two cubits and a half shall be the length thereof, and a cubit and a half the breadth thereof, and a cubit and a half the height thereof.

The exterior (copper) altar Exodus 27,1

וְעָשִׂיתָ אֶת הַמִּזְבֵּחַ עֲצֵי שִׁטִּים חֲמֵשׁ אַמּוֹת אׇרֶךְ וְחָמֵשׁ אַמּוֹת רׇחַב רָבוּעַ יִהְיֶה הַמִּזְבֵּחַ וְשָׁלֹשׁ אַמּוֹת קׇמָתוֹ

And thou shalt make the altar of acacia-wood, five cubits long, and five cubits broad; the altar shall be four-square; and the height thereof shall be three cubits.

$$\frac{5}{3} = 1\frac{2}{3} \approx 1.66$$



The fringes @ the 4 corners of a cloth – Numbers 15,38

וְעָשׂוּ לָהֶם צִיצִת עַל כַּנְפֵי בִגְדֵיהֶם לְדֹרֹתָם וְנָתְנוּ עַל צִיצִת הַכָּנָף פְּתִיל תְּכֵלֶת

… bid them that they make them throughout their generations **fringes** in the corners of their garments, and that they put with the fringe of each corner a **thread of blue**.

According to Maimonides:

- At least 7 groups of 3 knots

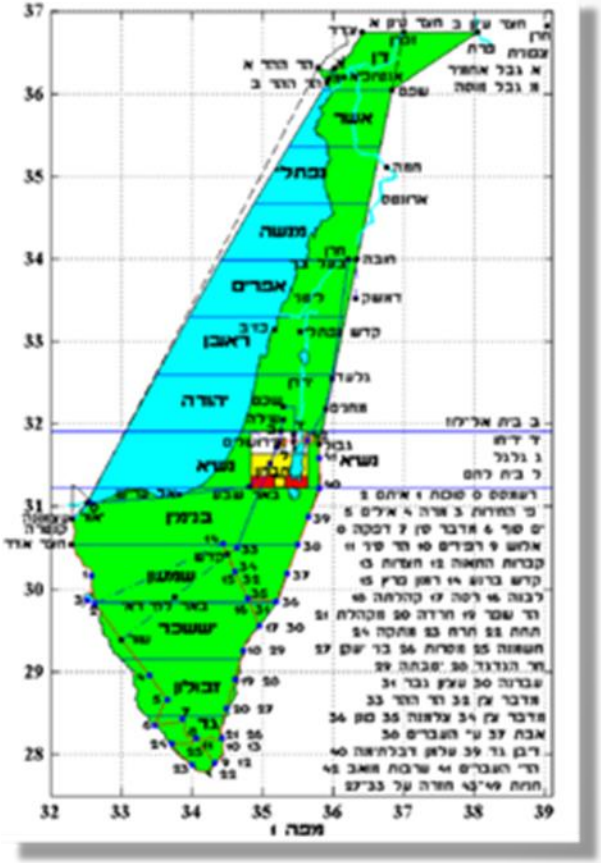
  7x3=21 = a Fibonacci number!

- At most 13 groups

  13 = a Fibonacci number!

Architecture
The Holy Temple of Jerusalem

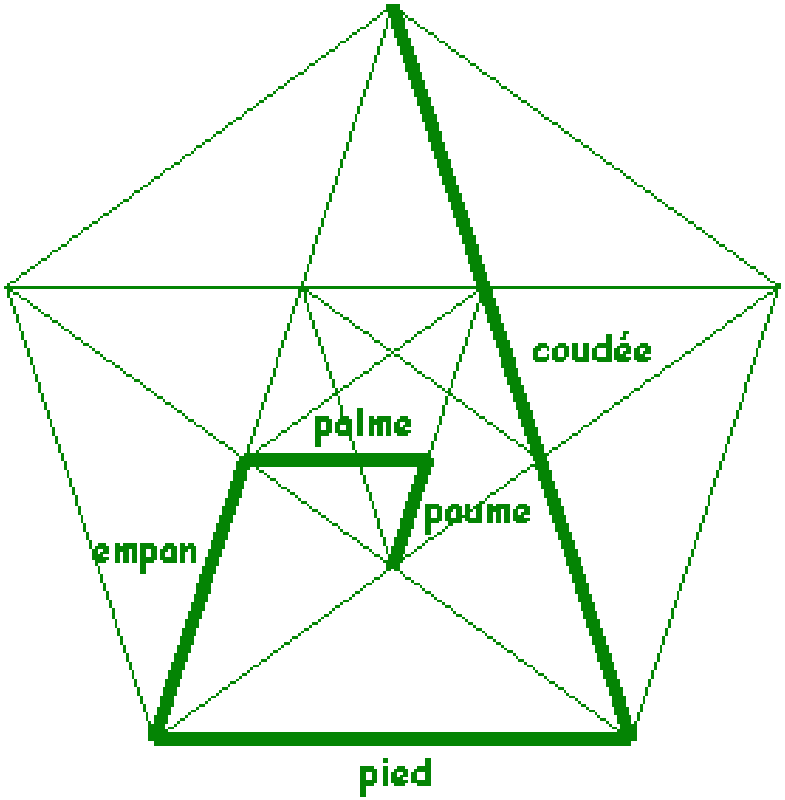
Model of the Temple (Herod's period)
Jerusalem Museum

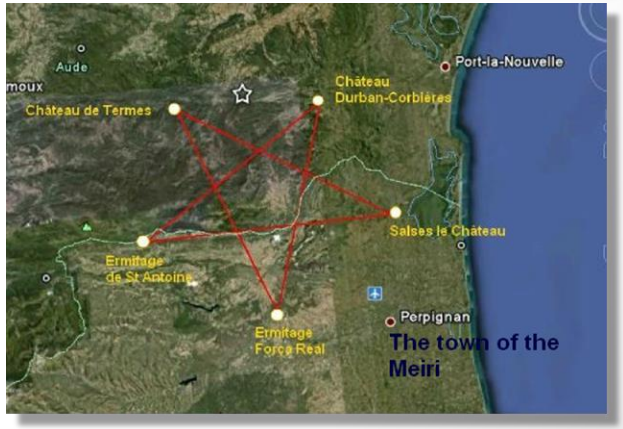


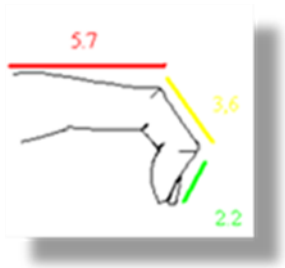
The Temple's dimensions and its surrounding area 's dimensions are related to Fibonacci numbers

The ratio of the distances to the northern and the southern biblical boarder lines of the Land of Israel is an approximation of the Golden Ratio

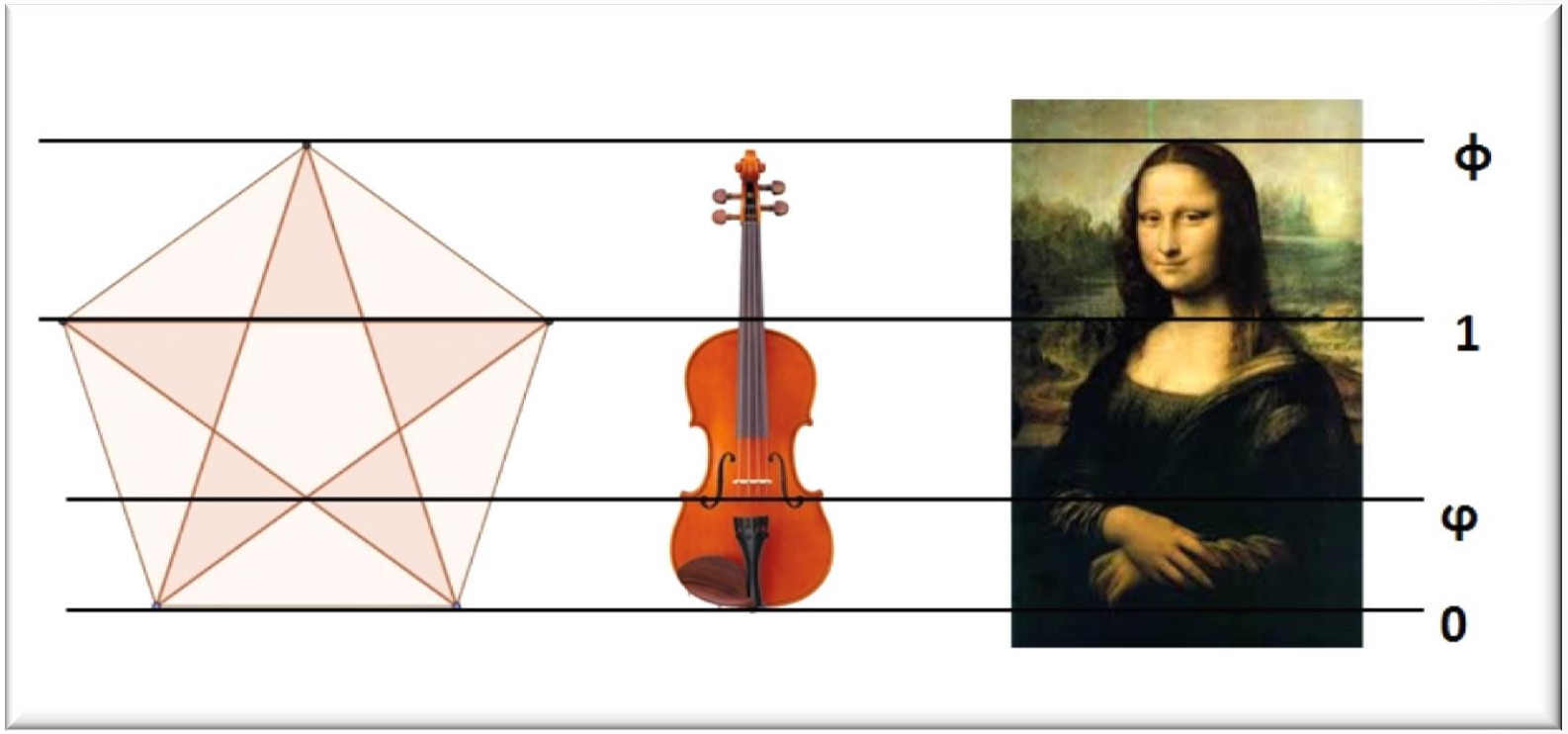
The pentagram







Playing a Stradivarius violin



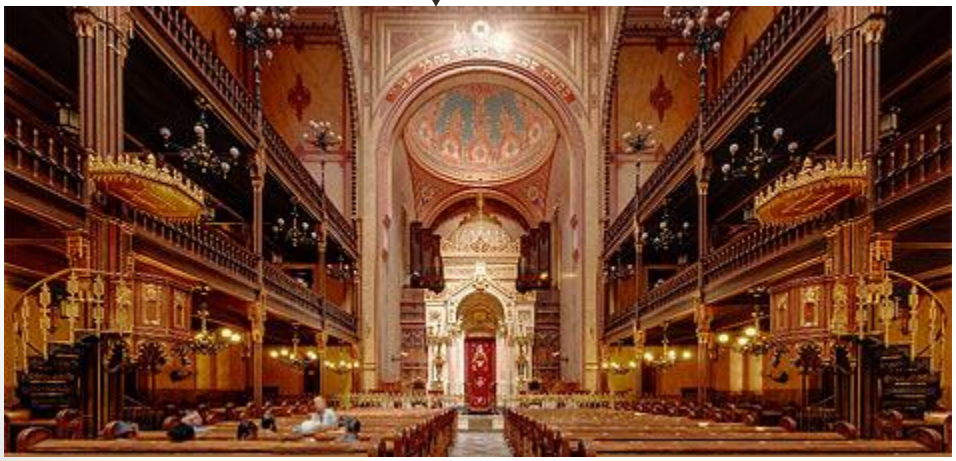
The Great Synagogue Dohány Street Budapest

Symmetries and Fibonacci numbers

↑

Rundbogenstil (Round-arch style)

↓



The Tree of Life: monument in the Raoul Wallenberg memorial garden, Budapest

The Tree of Life: monument in the Raoul Wallenberg memorial garden, Budapest

Hard vs soft symmetry

Bratislava

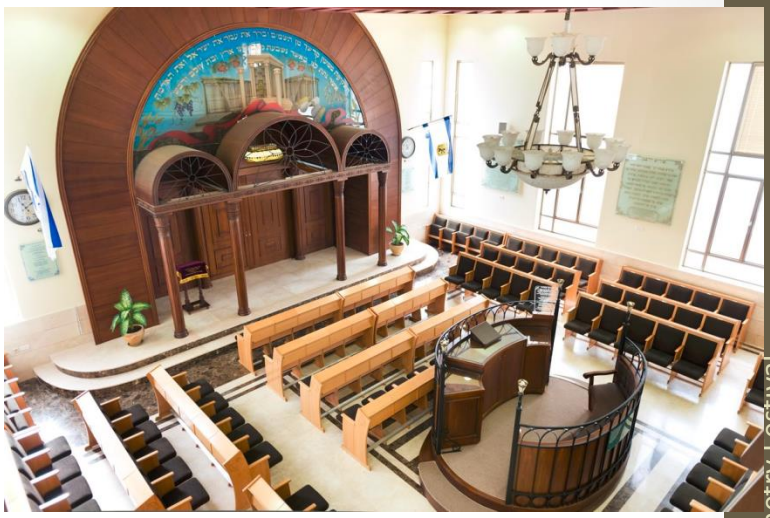
Liptovský Mikuláš
(Slovakia)

1839-1938
Kassel (Germany)
today

Trenčín (Slovakia)

Soft symmetries

Mishkan Its'hak synagogue in Jerusalem



cycloid

Rundbogenstil

Bet Its'hak synagogue in Jerusalem

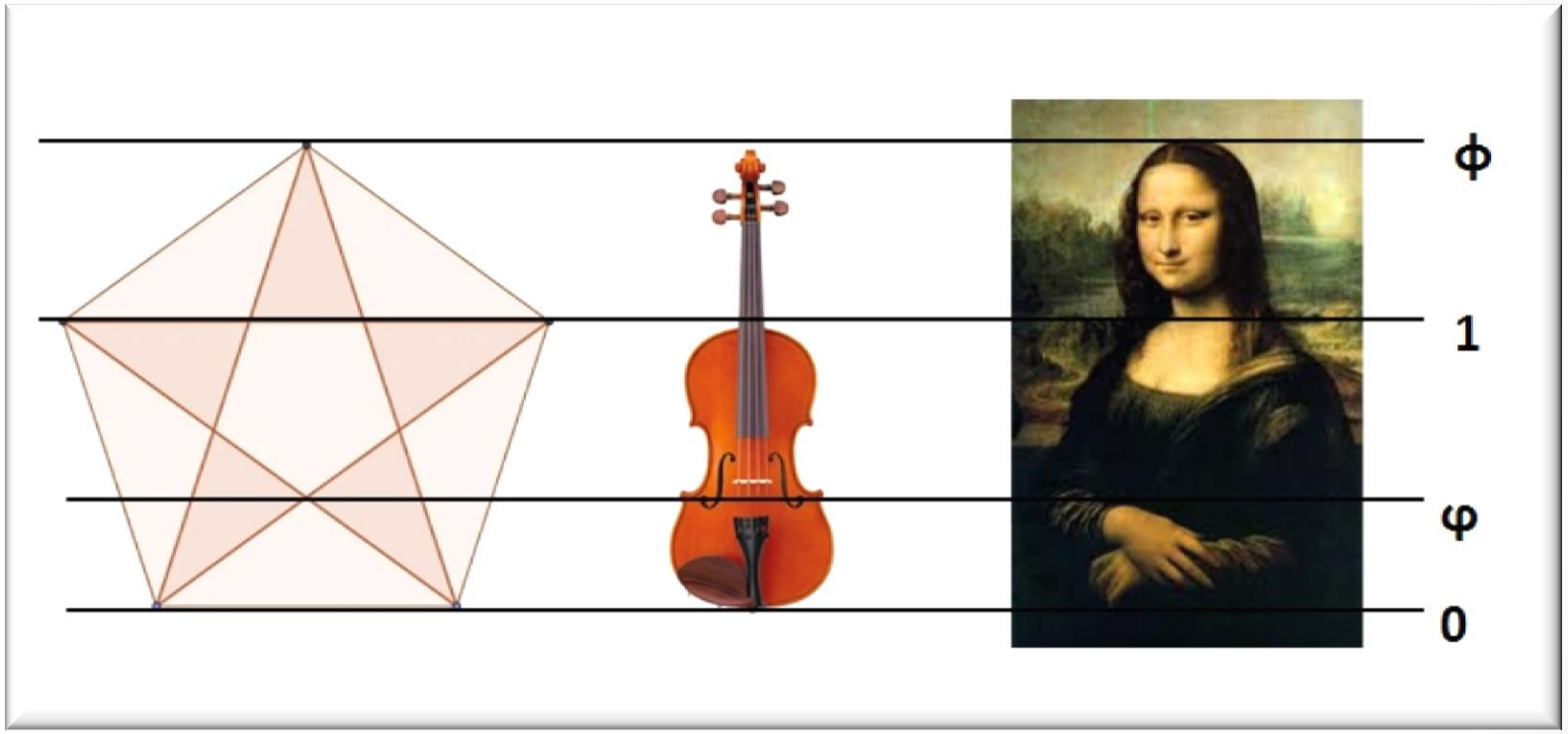
The same motives in a more ancient synagogue

Synagogue « Yohanan ben Zakkai »
In the Old City of Jerusalem

The vaults‘ shapes are not circles

Numbers of windows

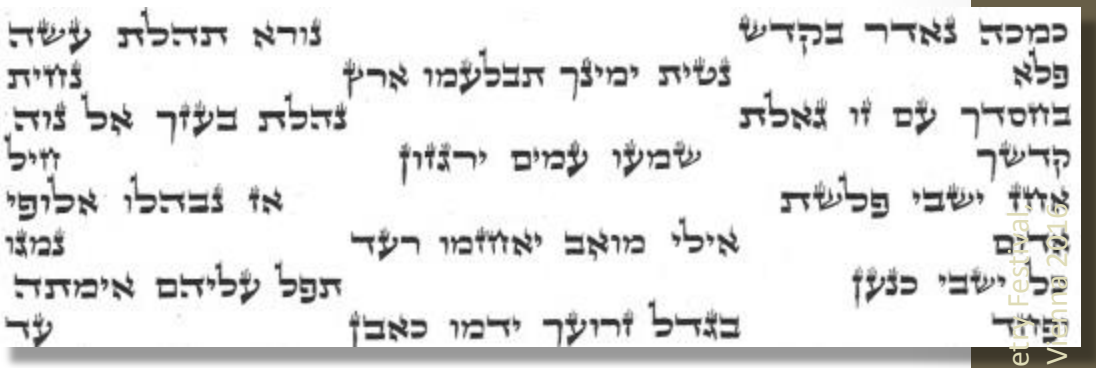
A non official reason why Jews play so often the violin



Audio-visual presentation of biblical text

Text with a very positive athmosphere (joy, happyness, gratitude after Exodus): the scripture expresses stability like the building of a stone wall

Exodus 15,1



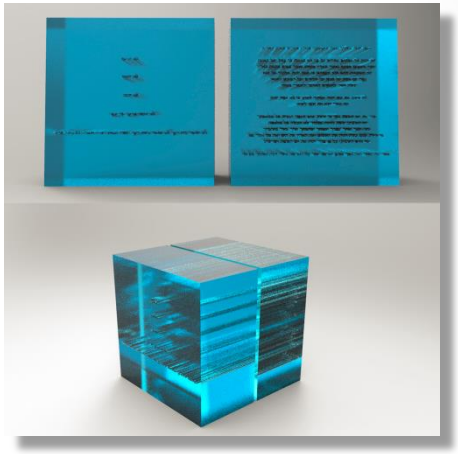
Text with anxiety and lack of hope: the scripture expresses unstability

Deuteronomy 32,1

Symmetry in Tables of the Covenant

Synagogue of Lausanne

Prague: the
Spanish Synagogue



The issue of the tables' symmetry has been addessed in details by **Rabbi Moshe ben Yossef di Trani** (1500-1580), one of the most important Talmudists from his time until today, in Safed (Galilee).

Relevance to Math Education

The example of the orthodox population

- The so-called orthodox population does not learn maths (at least a large fringe of it)
- A move has been made during the last years:
  - Private initiative of certain institutions/associations
  - Governmental decisions afterwards

Relevance to Math Education

Advantages

- Maths do not contradict the orthodox way of life
- Maths do not contradict the orthodox way of thinking
- Maths can be conveyed using objects of students' everyday life as examples
- People who have learnt Talmud for years are accustomed to logical reasoning
- The Talmud itself is full of mathematical content:
  - Geometry
  - Number Theory
  - The bases of the infinitesimal reasoning
- Last but not least: orthodox and non-orthodox students can learn together

Relevance to Math Education

In Israel:

- Pupils learn reflection in 1st grade, translation in 2nd grade and rotation in 3rd grade.
- They are requested, not only to learn the theory, but also to look for concrete example in their natural surroundings.
- Regarding orthodox children, this includes home, the synagogue where they go to pray together with their dad, etc.

Thank you
for your attention