History of Computing Machinery

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Why history?

- a stimulus for interests in the field of computation (???)
- a high-level view of computation out of your Python codes
- a good source of test questions for your midterm

Topics Overview

- history
  - ancient computation
    - earliest mechanical / electronic / personal computers
- present and future
  - the molecular level of computation
  - prospection of computing and AI

Topics Overview

- machinery v.s. machine
- hardware
- software
- the Mix

Topics Overview

- CSC104: *HOW* and *WHY* ...
  - why did/do they exist - motivation
  - how they work(ed) - algorithm and implementation

Ancient Computation

- hardware
  - strings, ropes, wooden-sticks
    - limited to things available at the time
- software/algorithm
  - basic understandings of the world

Ancient Computation

- Hardware
- **Strings**
- Ropes
- Wood-sticks

Ancient Computation

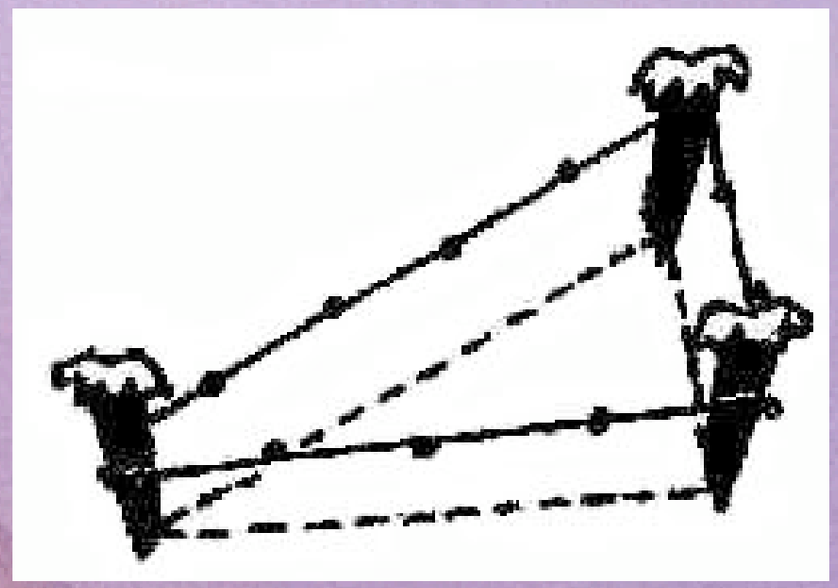
- How? (Algorithm)
  - clustering
  - knotting
  - coloring schemes

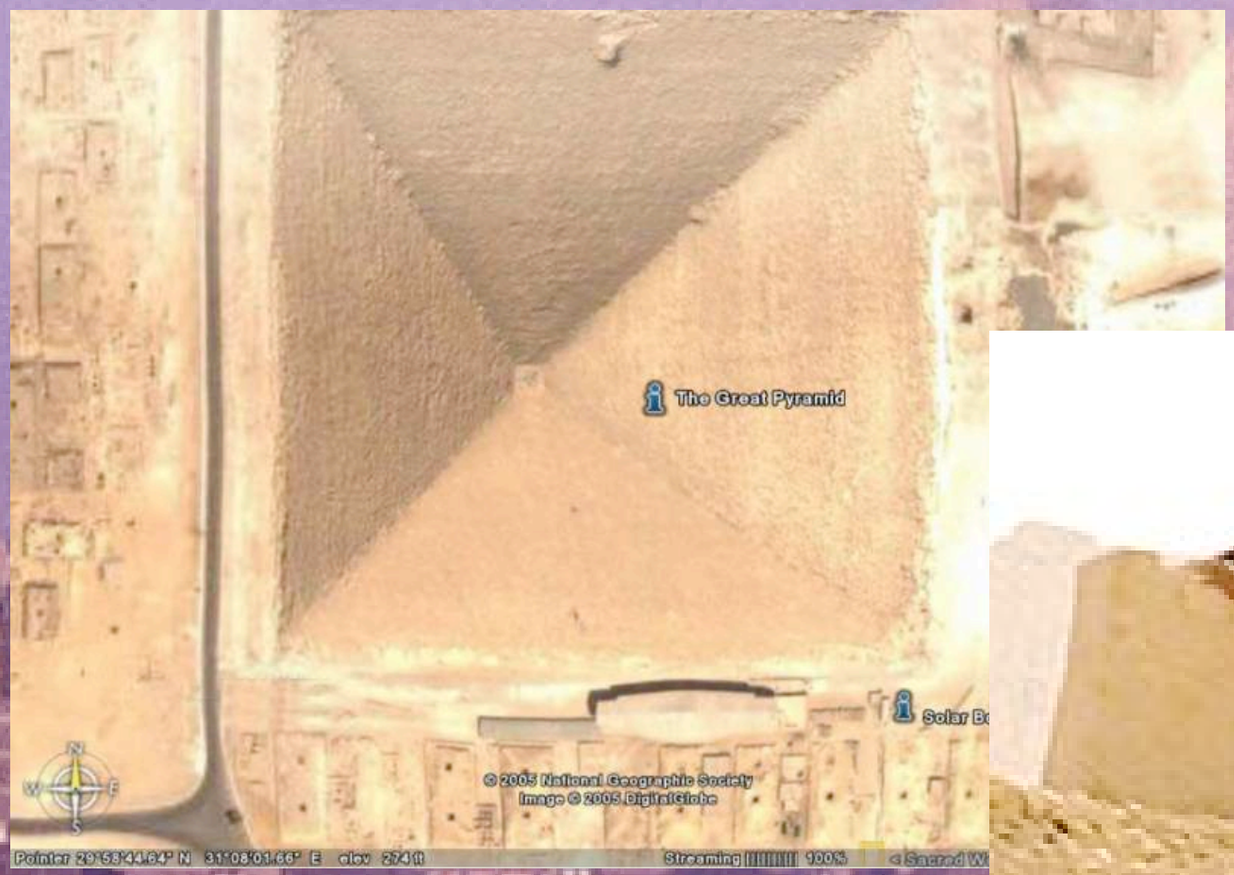
Ancient Computation

- Why? (Motivation)
  - numerically...
    - ledgers for keeping track of numbers
    - calculators for taxation and accounting
  - textually...
    - memo-pad
    - (maybe) language?

Ancient Computation

- Hardware
- Strings
- **Ropes**
- Wood-sticks




The Great Pyramid
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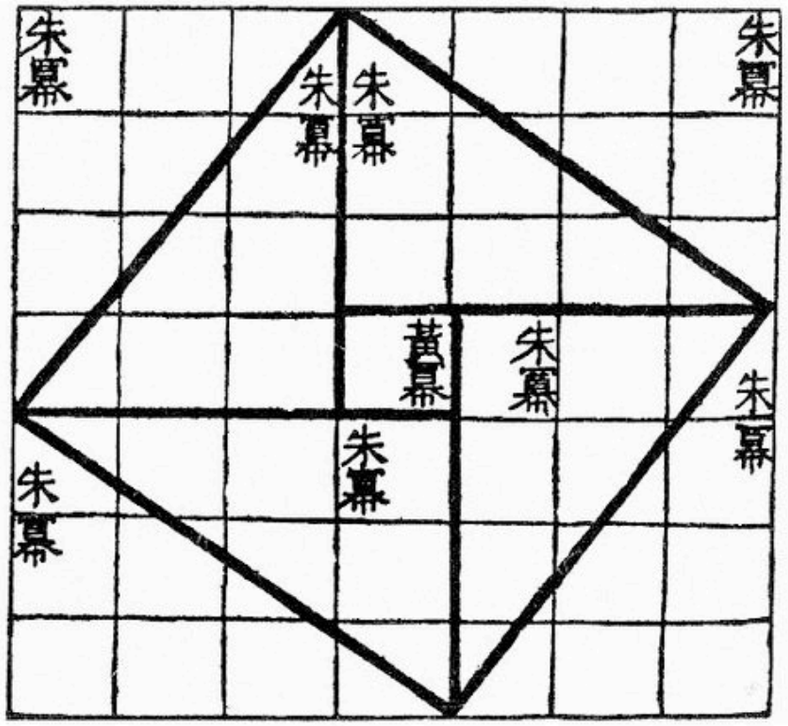
Ancient Computation

- Why? (Motivation)
  - Civil affairs (like building nicer tombs)
  - Emerging of sciences (like geometry)
- How? (Algorithm)
  - Pythagorean triples

句股冪合以成弦冪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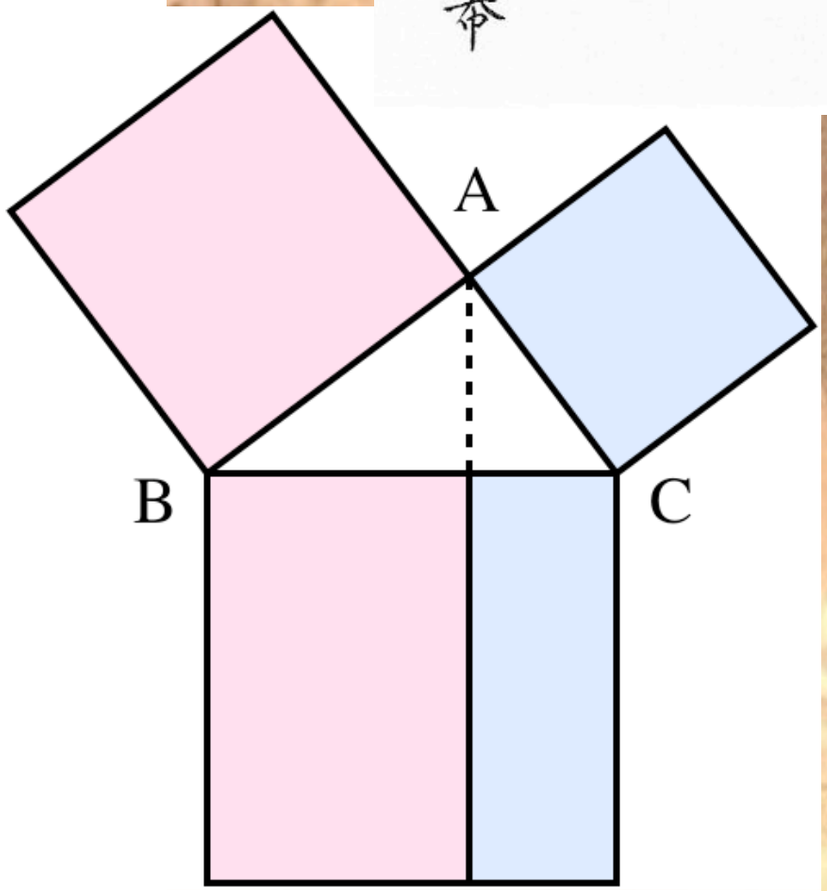
A
B
C

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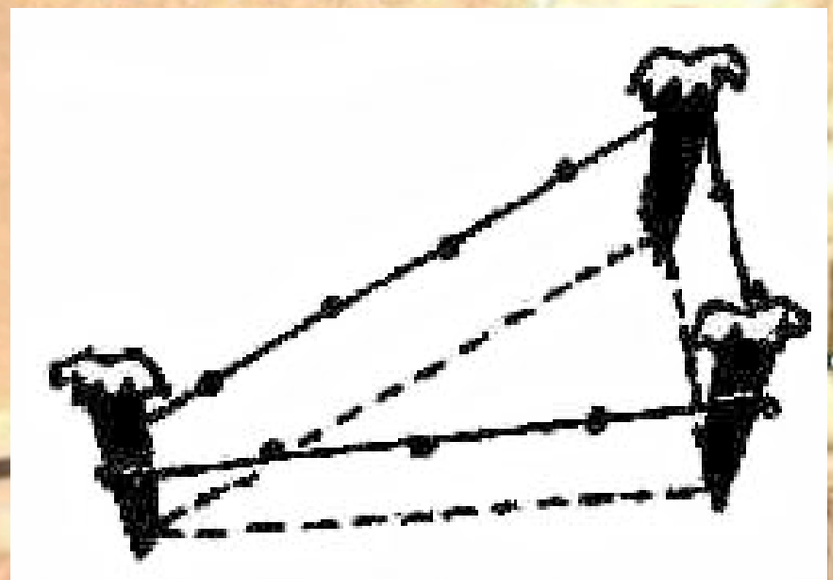

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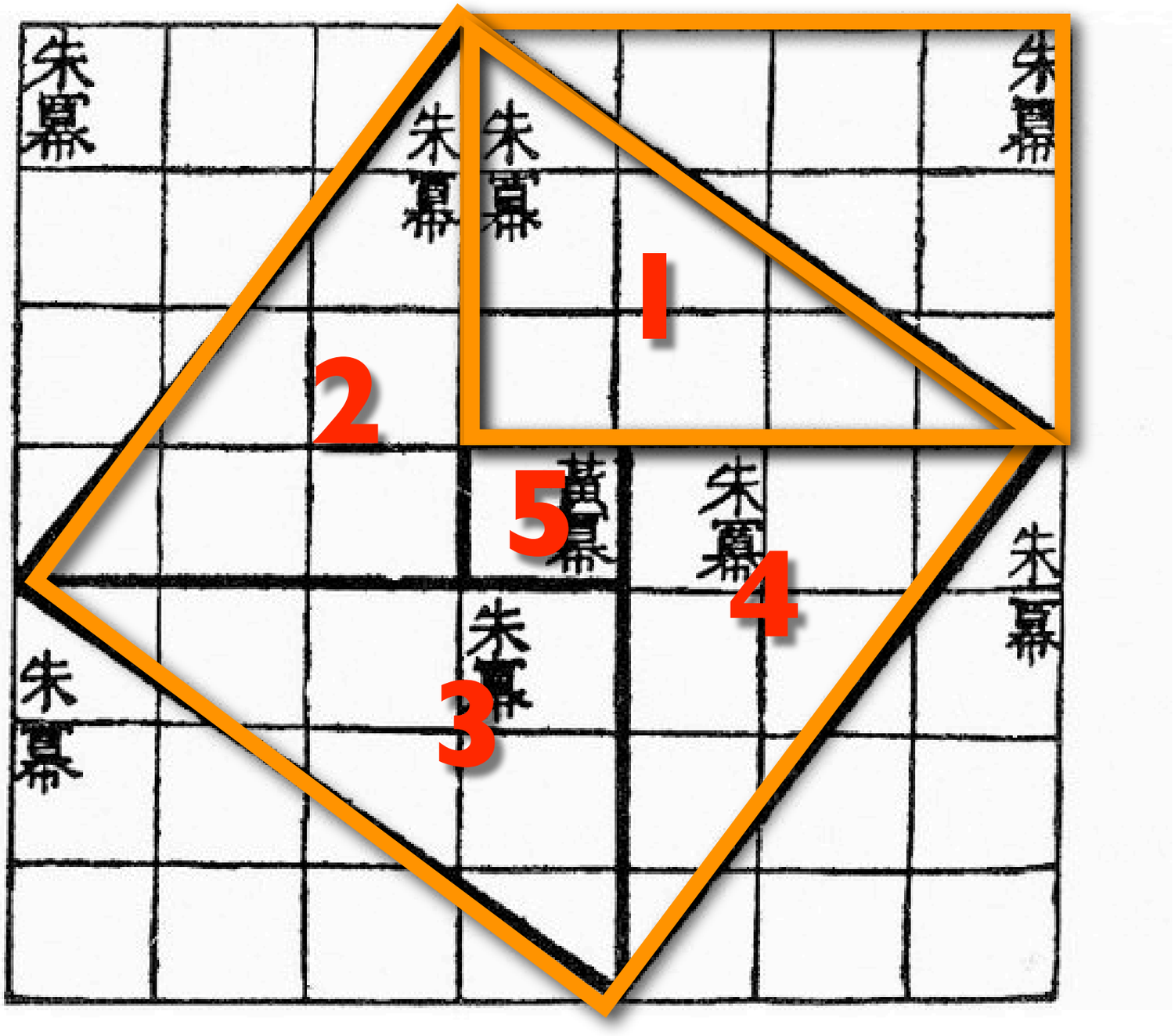
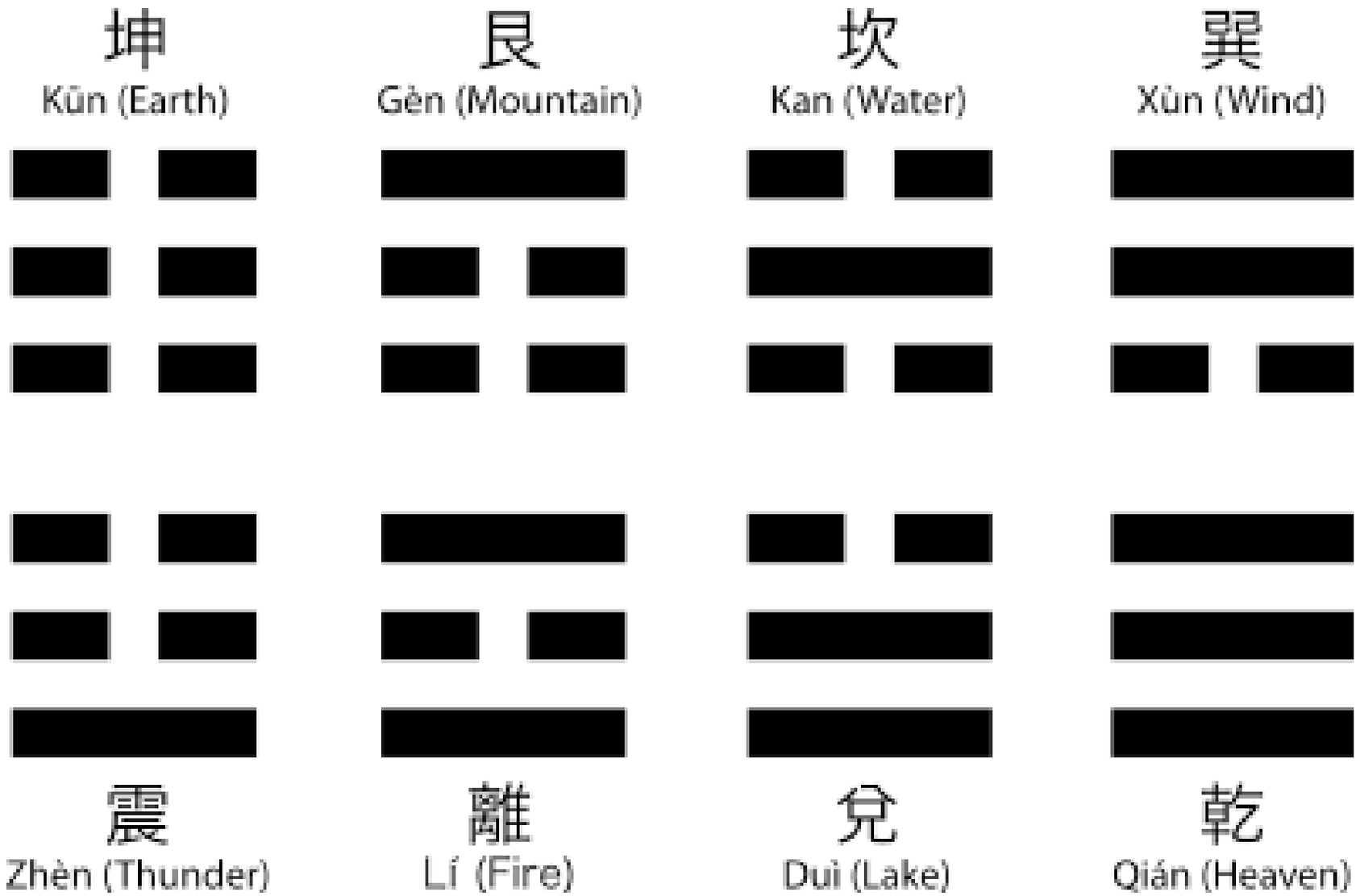


- Pythagoras Theorem (Hundred Cattle Theorem)
- The Egyptian Triangle
- Gougu Theorem (勾股定理)

Ancient Computation

- Hardware
- Strings
- Ropes
- **Wood-sticks**

Eight Trigrams in Yi Jing (2,800 BC)



Eight Trigrams in Yi Jing (2,800 BC)

3-bit binary table

	Trigram Figure	Binary Value	Name	Translation: *Wilhelm*[3], others	Image in Nature [4]	Direction [5]	Family Relationship [6]	Body Part [7]	Attribute [8]	Stage/ State [9]	Animal [10]
1	☰ (?)	111	乾 *qián*	*the Creative*, Force	heaven, aether (天)	northwest	father	head	strong	creative	horse
2	☱ (?)	110	兌 *duì*	*the Joyous*, Open	swamp, marsh (澤)	west	third daughter	mouth	pleasure	tranquil (complete devotion)	sheep
3	☲ (?)	101	離 *lí*	*the Clinging*, Radiance	fire (火)	south	second daughter	eye	light-giving, dependence	clinging, clarity, adaptable	pheasant
4	☳ (?)	100	震 *zhèn*	*the Arousing*, Shake	thunder (雷)	east	first son	foot	inciting movement	initiative	dragon
5	☴ (?)	011	巽 *xùn*	*the Gentle*, Ground	wind (風), wood	southeast	first daughter	thigh	penetrating	gentle entrance	fowl
6	☵ (?)	010	坎 *kǎn*	*the Abysmal*, Gorge	water (水)	north	second son	ear	dangerous	in-motion	pig
7	☶ (?)	001	艮 *gèn*	*Keeping Still*, Bound	mountain (山)	northeast	third son	hand	resting, stand-still	completion	wolf, dog
8	☷ (?)	000	坤 *kūn*	*the Receptive*, Field	earth (地)	southwest	mother	belly	devoted, yielding	receptive	cow

6-bit binary table

Hexagram	R. Wilhelm
01. ䷀ Force (乾 qián)	The Creative
02. ䷁ Field (坤 kūn)	The Receptive
03. ䷂ Sprouting (屯 chún)	Difficulty at the Beginning
04. ䷃ Enveloping (蒙 méng)	Youthful Folly
05. ䷄ Attending (需 xū)	Waiting
06. ䷅ Arguing (訟 sòng)	Conflict
07. ䷆ Leading (師 shī)	The Army
08. ䷇ Grouping (比 bǐ)	Holding Together
09. ䷈ Small Accumulating (小畜 xiǎo chù)	Small Taming
10. ䷉ Treading (履 lǚ)	Treading (Conduct)
11. ䷊ Prevading (泰 tài)	Peace
12. ䷋ Obstruction (否 pǐ)	Standstill
13. ䷌ Concording People (同人 tóng rén)	Fellowship
14. ䷍ Great Possessing (大有 dà yǒu)	Great Possession
15. ䷎ Humbling (謙 qiān)	Modesty
16. ䷏ Providing-For (豫 yù)	Enthusiasm
17. ䷐ Following (隨 suí)	Following
18. ䷑ Corrupting (蠱 gǔ)	Work on the Decayed

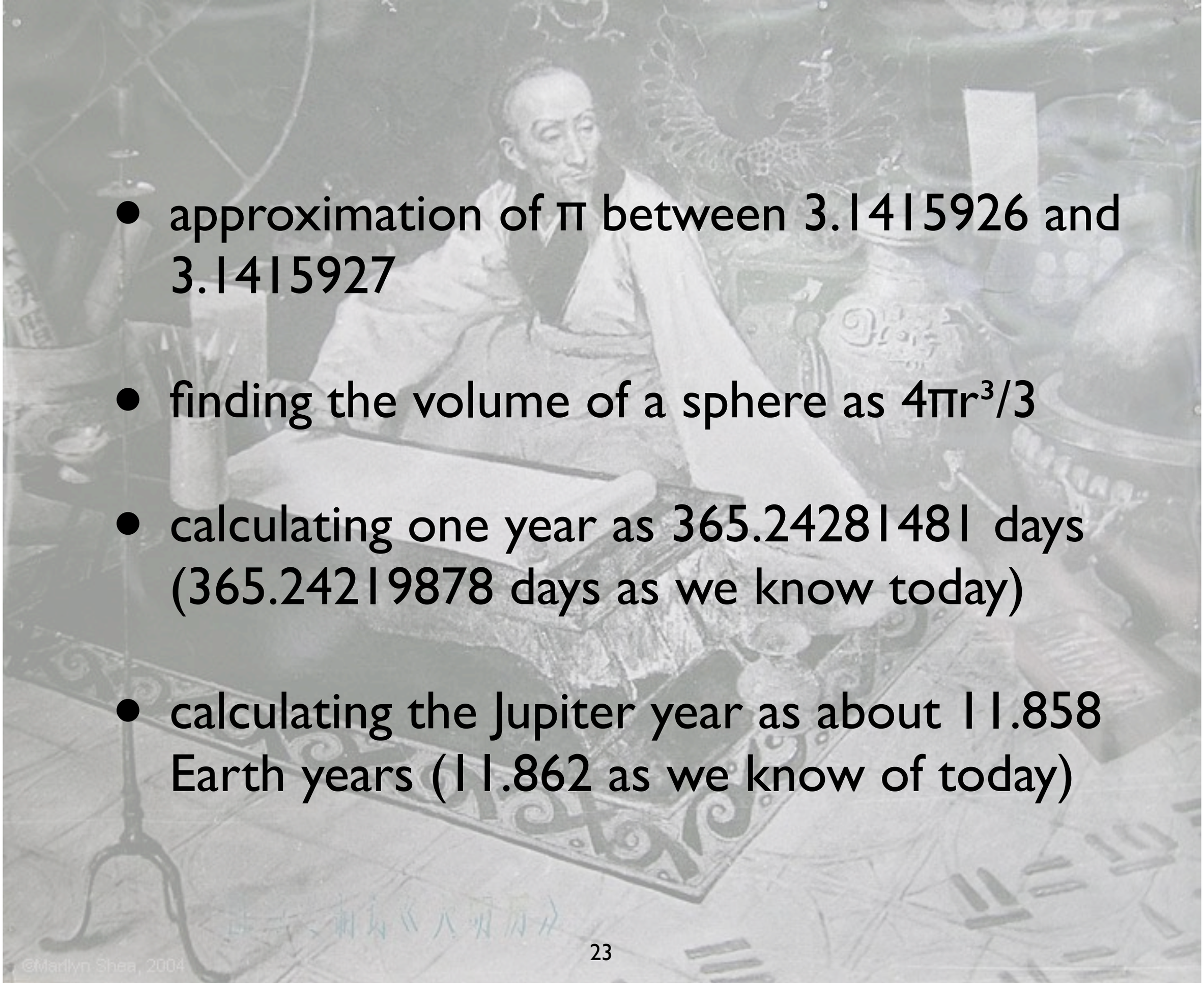
Hexagram	R. Wilhelm
33. ䷠ Retiring (遯 dùn)	Retreat
34. ䷡ Great Invigorating (大壯 dà zhuàng)	Great Power
35. ䷢ Prospering (晉 jìn)	Progress
36. ䷣ Brightness Hiding (明夷 míng yí)	Darkening of the Light
37. ䷤ Dwelling People (家人 jiā rén)	The Family
38. ䷥ Polarising (睽 kuí)	Opposition
39. ䷦ Limping (蹇 jiǎn)	Obstruction
40. ䷧ Taking-Apart (解 xiè)	Deliverance
41. ䷨ Diminishing (損 sǔn)	Decrease
42. ䷩ Augmenting (益 yì)	Increase
43. ䷪ Parting (夬 guài)	Breakthrough
44. ䷫ Coupling (姤 gòu)	Coming to Meet
45. ䷬ Clustering (萃 cuì)	Gathering Together
46. ䷭ Ascending (升 shēng)	Pushing Upward
47. ䷮ Confining (困 kùn)	Oppression
48. ䷯ Welling (井 jǐng)	The Well
49. ䷰ Skinning (革 gé)	Revolution
50. ䷱ Holding (鼎 dǐng)	The Cauldron

Ancient Computation

- Why? (Motivation)
  - Eagerness in describing/predicting the nature
  - Reinforcing political dictatorship
- How? (Algorithm)
  - 3-bit/6-bit binary system
  - Listing and indexing

Ancient Computation

- Hardware
- Strings
- Ropes
- **Wood-sticks**



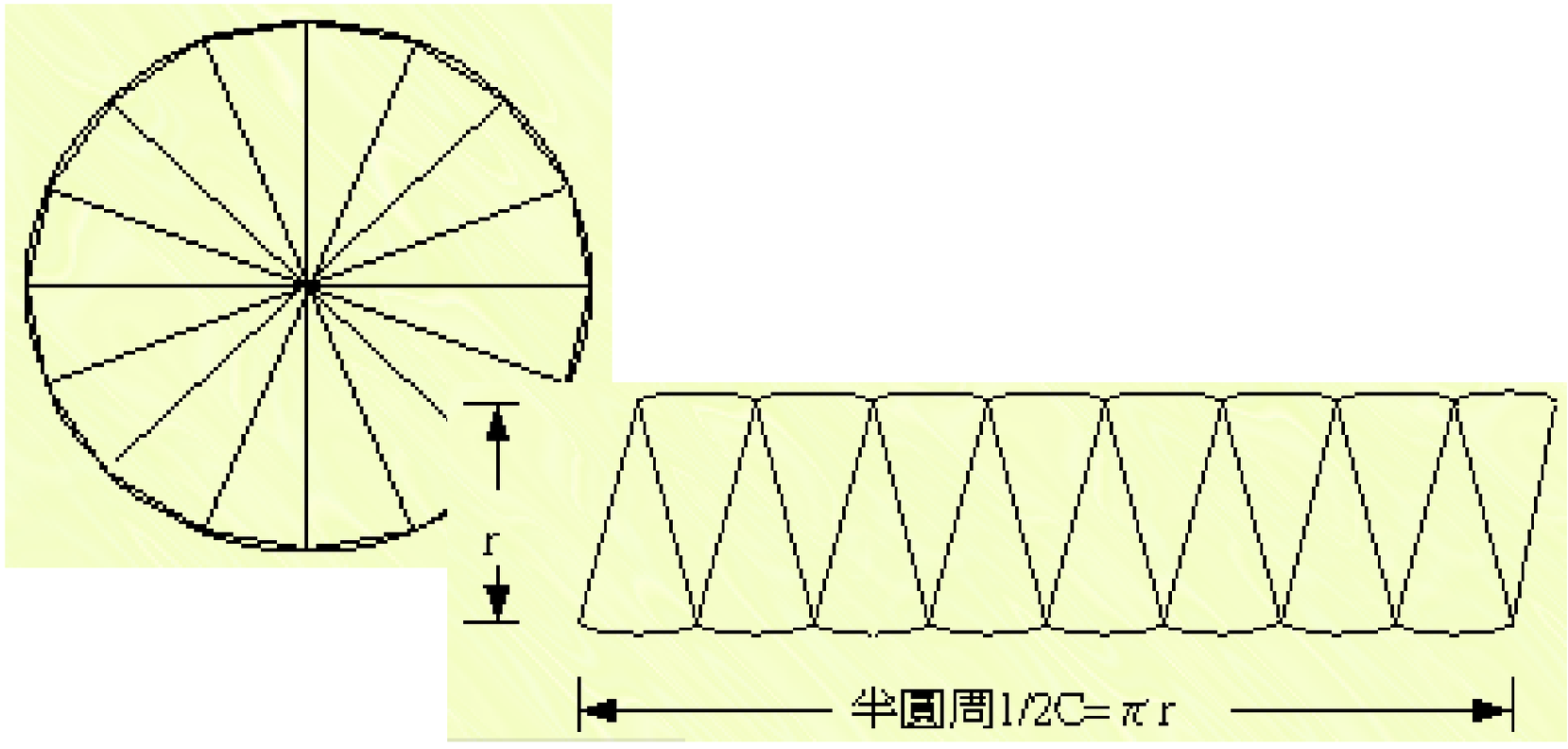
- approximation of π between 3.1415926 and 3.1415927
- finding the volume of a sphere as $4\pi r^3/3$
- calculating one year as 365.24281481 days (365.24219878 days as we know today)
- calculating the Jupiter year as about 11.858 Earth years (11.862 as we know of today)

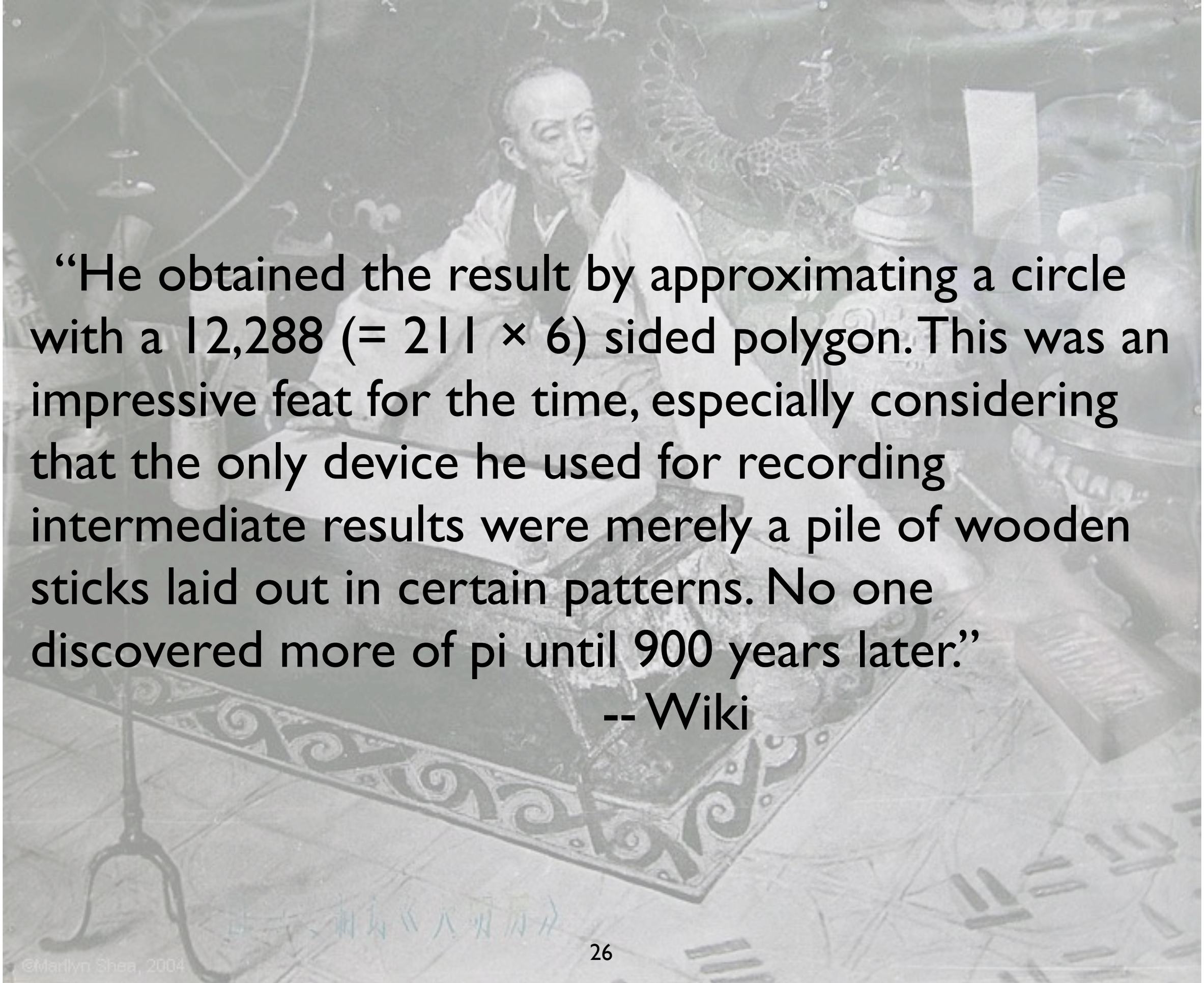
Ancient Computation

- Why? (Motivation)
  - Boosting development of sciences (geometry, trigonometry, astronomy, etc.)
  - In general, better understanding of the world

Ancient Computation

- How? (Algorithm)

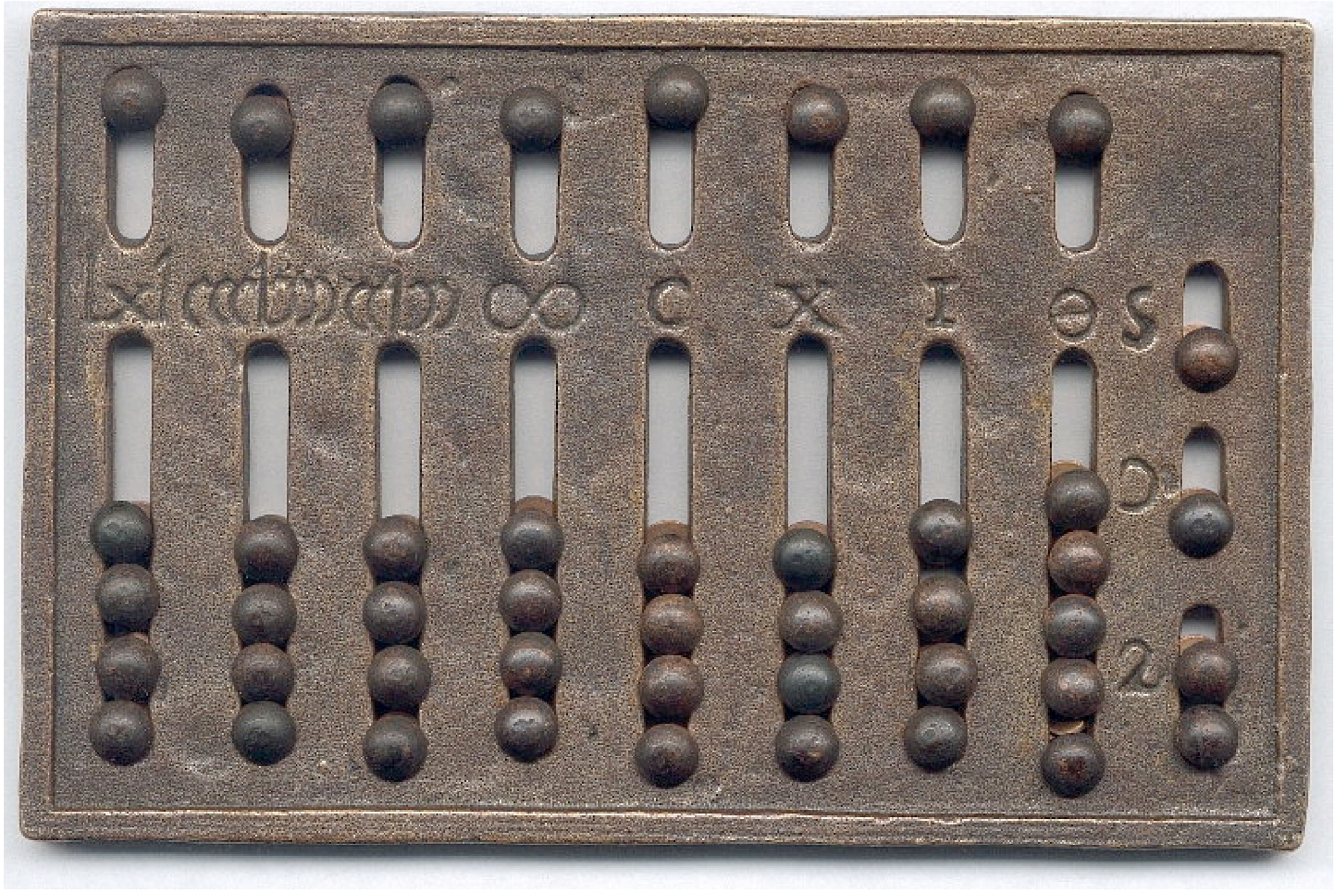




"He obtained the result by approximating a circle with a 12,288 (= 211 × 6) sided polygon. This was an impressive feat for the time, especially considering that the only device he used for recording intermediate results were merely a pile of wooden sticks laid out in certain patterns. No one discovered more of pi until 900 years later."

-- Wiki

The Mechanical Age



The Mechanical Age

- Why? (Motivation)
  - Boosting of trades and businesses
  - Needs for accounting and related calculation
- How? (Algorithm)

The Mechanical Age

一、加法口诀表

	不进位的加		进位的加	
	直加	满五加	进十加	破五进十加
一	一上一	一下五去四	一去九进一	
二	二上二	二下五去三	二去八进一	
三	三上三	三下五去二	三去七进一	
四	四上四	四下五去一	四去六进一	
五	五上五		五去五进一	
六	六上六		六去四进一	六上一去五进一
七	七上七		七去三进一	七上二去五进一
八	八上八		八去二进一	八上三去五进一
九	九上九		九去一进一	九上四去五进一

二、减法口诀表

	不退位的减		退位的减	
	直减	破五减	退位减	退十补五的减
一	一下一	一上四去五	一退一还九	
二	二下二	二上三去五	二退一还八	
三	三下三	三上二去五	三退一还七	
四	四下四	四上一去五	四退一还六	
五	五下五		五退一还五	
六	六下六		六退一还四	六退一还五去一
七	七下七		七退一还三	七退一还五去二
八	八下八		八退一还二	八退一还五去三
九	九下九		九退一还一	九退一还五去四

The Mechanical Age

The Mechanical Age

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The Mechanical Age