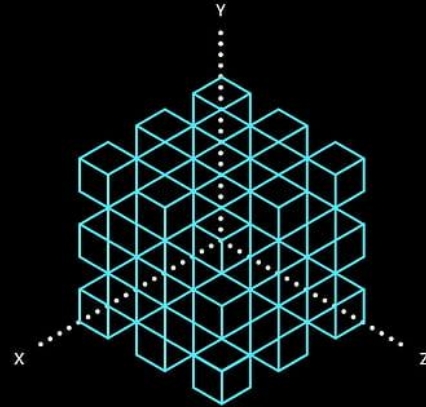
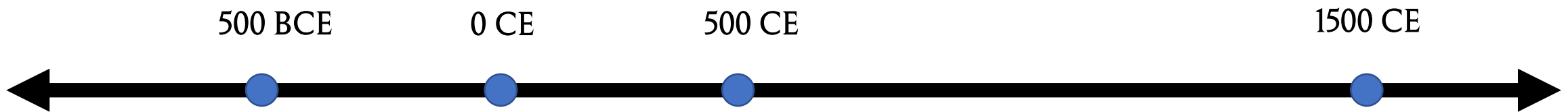


# Matematika Islam Abad Pertengahan

Aditya Firman Ihsan



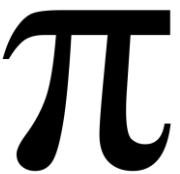
Kapan itu Abad Pertengahan?

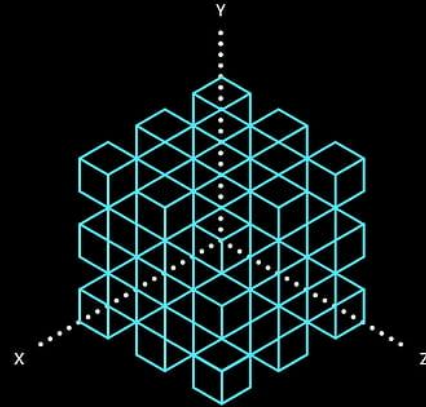


Yunani  
Klasik

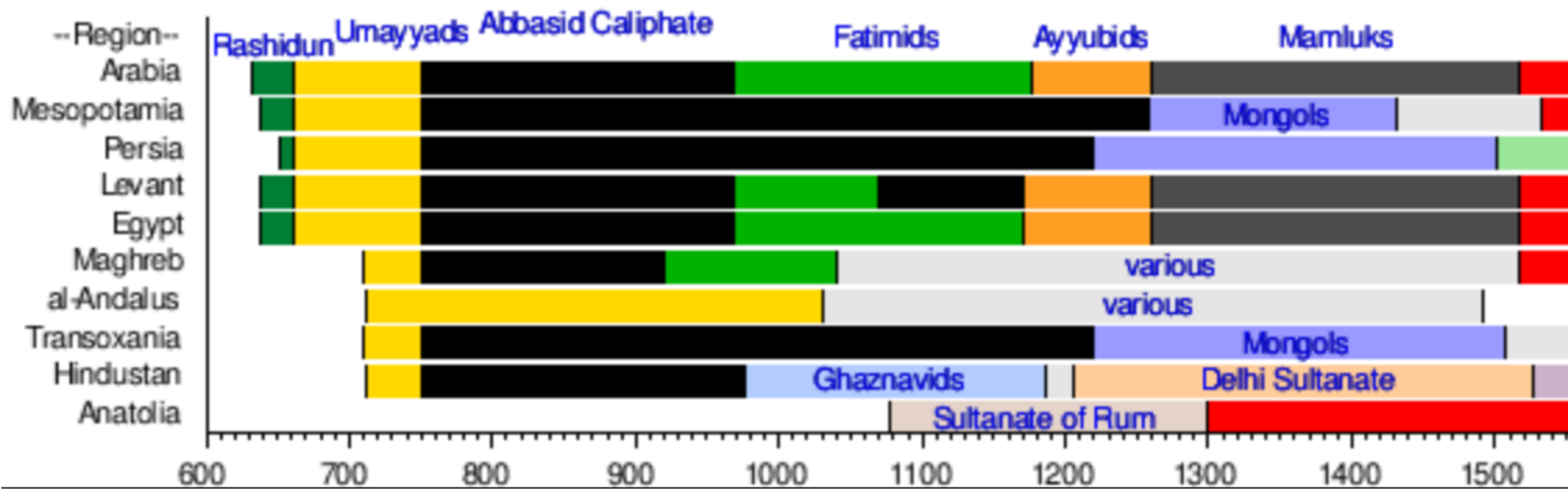
Era Gelap

476 CE: Kekaisaran Roma Runtuh  
1095 CE: Perang Salib



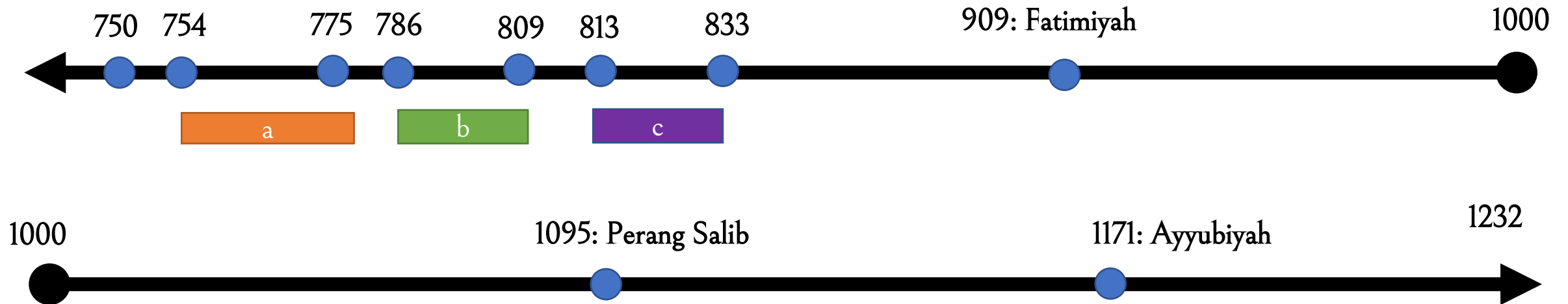


Ada apa dengan Islam di abad pertengahan?



$\pi$

# Daulah Abbasiyah



a. Kalifah ke-2: **Abu Ja'far Abdallah ibn Muhammad al-Mansur** (754-775 M)

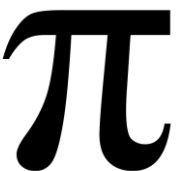
Membangun Baghdad; Memulai Pengumpulan Buku dan Manuskrip

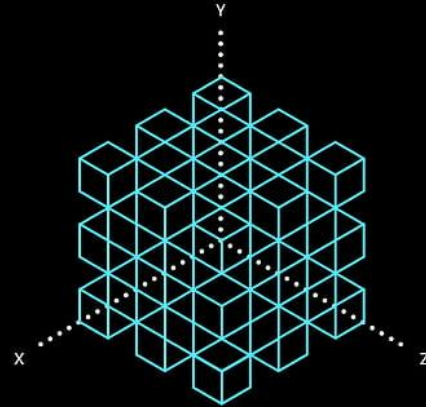
b. Kalifah ke-5: **Harun Ar-Rasyid** (786-809 M)

Gerakan Penerjemahan; Tidak hanya menerjemahkan, tapi juga membandingkan, merangkum, mengomentari, dll

c. Kalifah ke-7: **Abu al-Abbas Abdallah ibn Harun al-Rashid** (813-833 M)

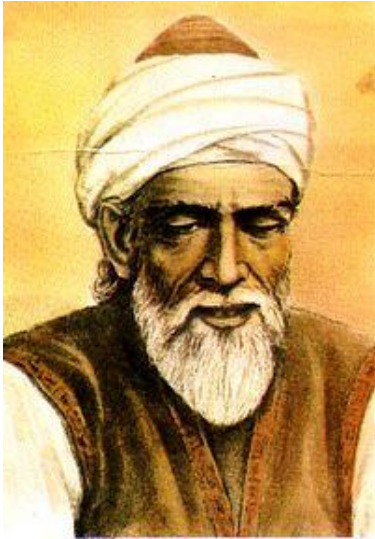
Baitul Hikmah, didirikan 832 M; Menjadi "*International Translation and Research Center*"





Matematika di Era Islam?

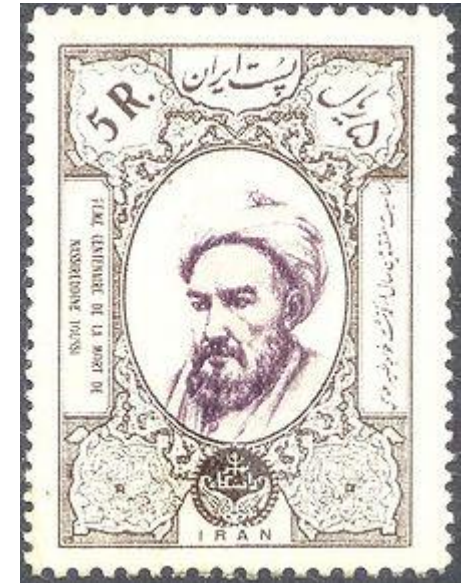
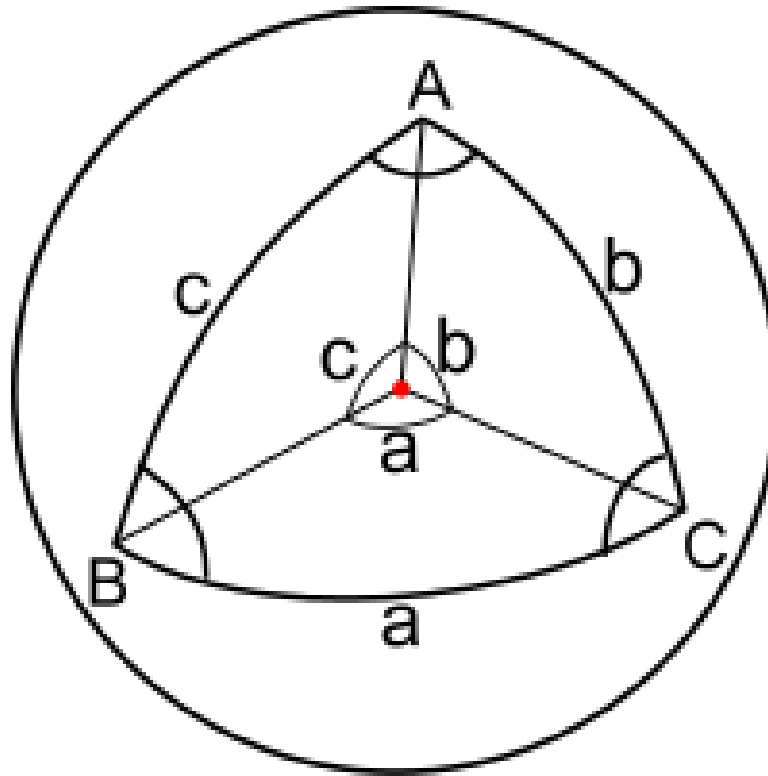
# Spherical Trigonometry



Abu al-Wafa' Buzjani  
(940-998)

Juga planar trigonometri

$$\frac{\sin(A)}{\sin(a)} = \frac{\sin(B)}{\sin(b)} = \frac{\sin(C)}{\sin(c)}$$

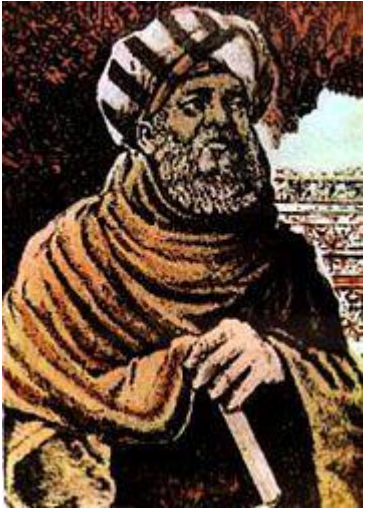


Nasir Ad-Din Al-Tusi  
(1201-1274)

$$\frac{\tan\left(\frac{A-B}{2}\right)}{\tan\left(\frac{A+B}{2}\right)} = \frac{\tan\left(\frac{a-b}{2}\right)}{\tan\left(\frac{a+b}{2}\right)}$$



# Teori Bilangan



Thabit Ibn Qurra  
(826-901)

Bilangan “amicable”



Hasan Ibn Al-Haytham  
(965-1040)

Formula Deret



Abu Bakar Muhammad bin  
al-Hasan al-Karaji (953-1029)

Koefisien Binomial &  
Segitiga Pascal  $\pi$

# Amicable numbers

220 & 284

## Divisor of 220

$$220 = 1 \times 220$$

$$220 = 2 \times 110$$

$$220 = 4 \times 55$$

$$220 = 5 \times 44$$

$$220 = 10 \times 22$$

$$220 = 11 \times 20$$

$$220 = 20 \times 11$$

$$220 = 22 \times 10$$

$$220 = 44 \times 5$$

$$220 = 55 \times 4$$

$$220 = 110 \times 2$$

Sum of the divisor :

$$1 + 2 + 4 + 5 + 10 + 11 + 20 + 22 + 44 + 55 + 110 = 284$$

## Divisor of 284

$$284 = 1 \times 284$$

$$284 = 2 \times 142$$

$$284 = 4 \times 71$$

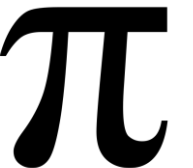
$$284 = 71 \times 4$$

$$284 = 142 \times 2$$

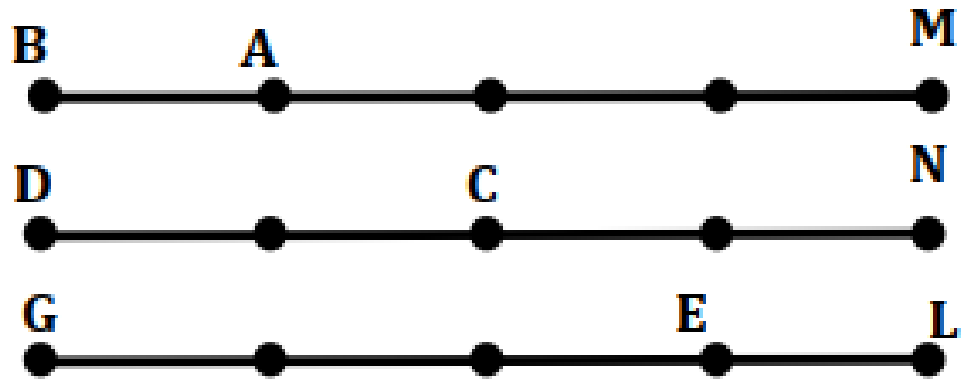
Sum of the divisor :

$$1 + 2 + 4 + 71 + 142 = 220$$

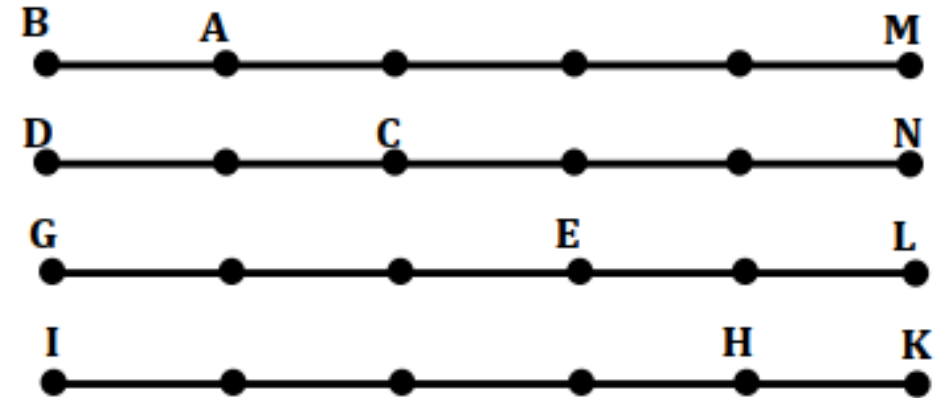
Two numbers are Amicable numbers



## Formula Deret



$$\begin{aligned}
 & 1 + 2 + 3 \\
 &= BA + DC + GE \\
 &= \frac{1}{2} [(BA + DC + GE) + (AM + CN + EL)] \\
 &= \frac{1}{2} [(BA + AM) + (DC + CN) + (GE + EL)] \\
 &= \frac{1}{2} [GE \cdot (GE + EL)] \\
 &= \frac{1}{2} (3)(3 + 1)
 \end{aligned}$$



$$\begin{aligned}
 & 1 + 2 + 3 + 4 \\
 &= BA + DC + GE + IH \\
 &= \frac{1}{2} [(BA + DC + GE + IH) + (AM + CN + EL + HK)] \\
 &= \frac{1}{2} [(BA + AM) + (DC + CN) + (GE + EL) + (IH + HK)] \\
 &= \frac{1}{2} [IH \cdot (IH + HK)] \\
 &= \frac{1}{2} (4)(4 + 1)
 \end{aligned}$$

$\pi$

## Formula Deret

$$1 + 2 + \dots + n = \frac{n}{2}(n + 1)$$

$$1^2 + 2^2 + \dots + n^2 = \frac{n}{6}(n + 1)(2n + 1)$$

$$1^3 + 2^3 + \dots + n^3 = \frac{n^2}{4}(n^2 + 2n + 1)$$

$$1^4 + 2^4 + \dots + n^4 = \frac{n}{10}(n + 1)(2n + 1) \left( (n + 1)n - \frac{1}{3} \right)$$

**$\pi$**

Exponent

Pascal's Triangle

Binomial Expansion

0

1

$$(a+b)^0 = 1$$

1

1 1

$$(a+b)^1 = 1a + 1b$$

2

1 2 1

$$(a+b)^2 = 1a^2 + 2ab + 1b^2$$

3

1 3 3 1

$$(a+b)^3 = 1a^3 + 3a^2b + 3ab^2 + 1b^3$$

4

1 4 6 4 1

$$(a+b)^4 = 1a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + 1b^4$$

5

1 5 10 10 5 1

$$(a+b)^5 = 1a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + 1b^5$$

6

$\pi$

# Aljabar

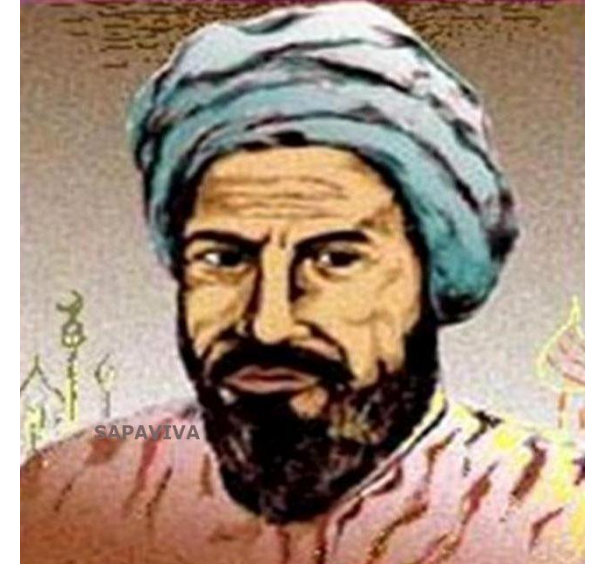


$$ax + b = 0$$
$$ax^2 + bx + c = 0$$
$$(a \pm b)(c \pm d)$$

Mugammad Ibn Musa al-Khawarizmi  
(780-850)

*al-Kitāb al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābalah*

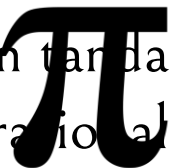
Persamaan Linier  
Persamaan Kuadrat



Abu Kamil Shuja  
(850-930)

*al-Kitāb al-Jabr wal-Muqābalah*

Sistem Persamaan Linier, aturan tanda  
(negative) bilangan irasional & rasional



# Bagaimana menyelesaikan $x^2 + 10x = 39$ ?

Perubahan ke bentuk kuadrat sempurna

$$\begin{aligned}x^2 + 10x &= 39 \\x^2 + 10x + 5^2 &= 39 + 5^2 \\(x + 5)^2 &= 39 + 25 \\(x + 5)^2 &= 64 \\x + 5 &= 8 \\x &= 3\end{aligned}$$

“rumus abc”

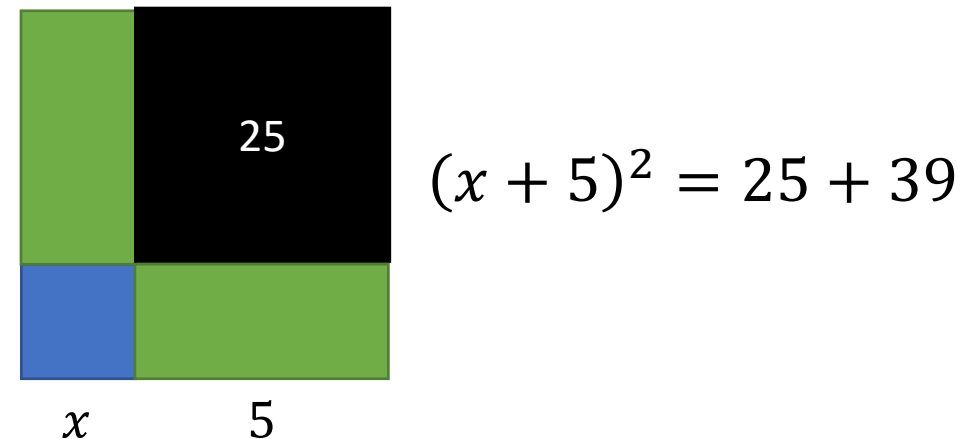
$$x = \frac{10}{2} - \sqrt{39 + \left(\frac{10}{2}\right)^2} = 3$$



Intuisi Geometrik



$x$    $x$    $= 39$

$x$   $10$



   $25$

$(x + 5)^2 = 25 + 39$

$x$   $5$

$\pi$

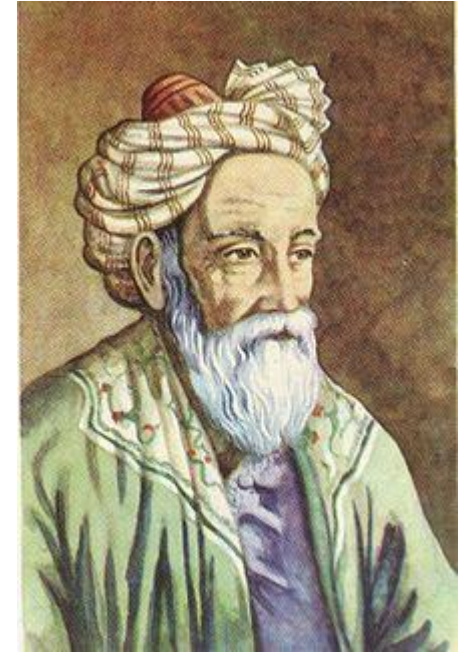
# Aljabar (2)



Sharaf Ad-Din Al-Tusi  
(1135-1213)

Konsep fungsi  
Akar Kubik

$$ax^3 + bx^2 + cx + d = 0$$
$$y = f(x)$$





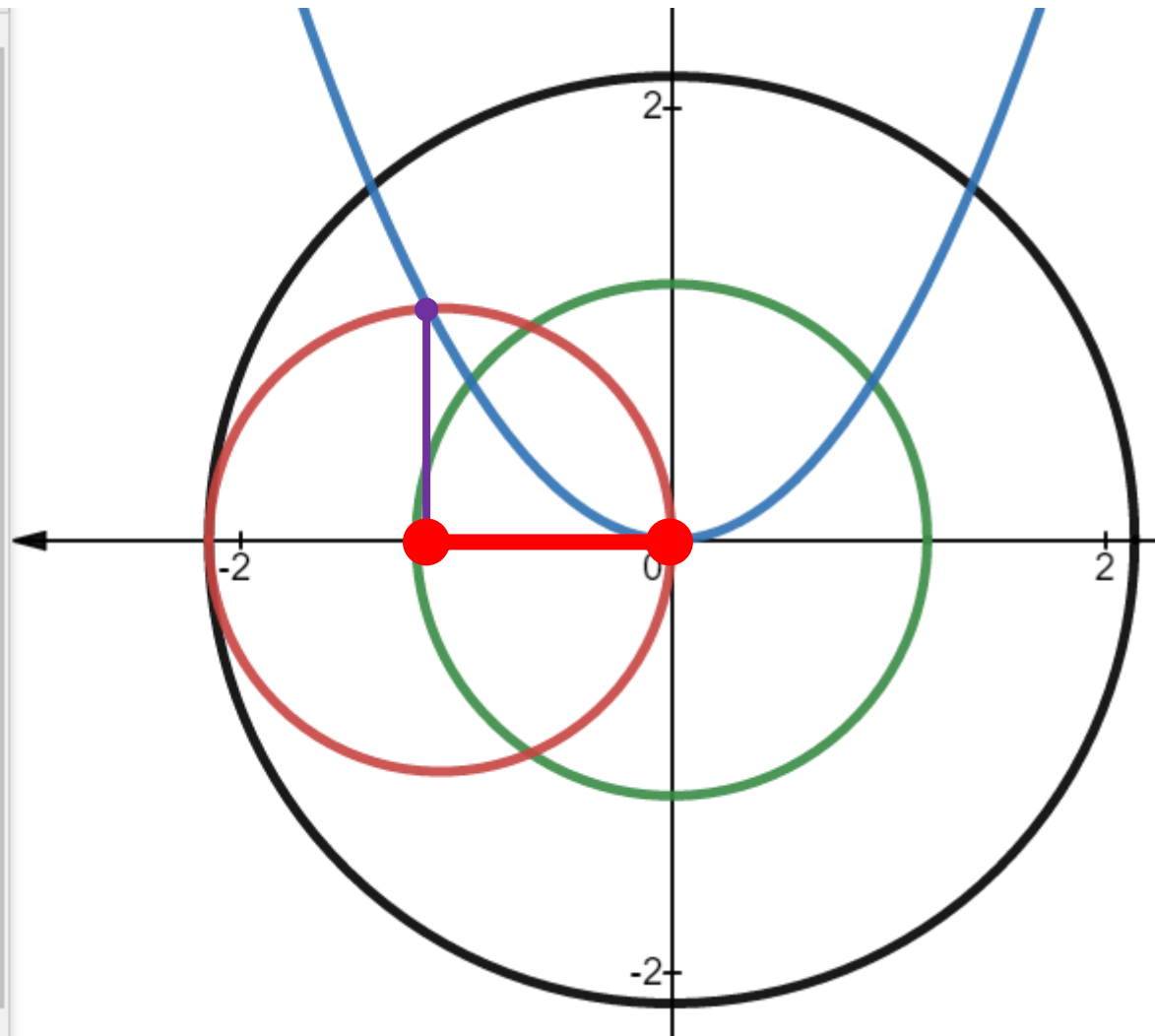
Omar Khayyam  
(1048-1131)

Aljabar Geometri  
Akar Kubik





1	$c = 1.4$	×
$\pi$	-10  10	
2	$d = 3$	×
$\pi$	-10  10	
3	$x^2 + y^2 = c$	×
4	$x^2 + y^2 = \left(\frac{d}{c}\right)^2$	×
5	$\left(x + \frac{d}{2c}\right)^2 + y^2 = \left(\frac{d}{2c}\right)^2$	×
6	$y = \frac{x^2}{\sqrt{c}}$	×



Solusi dari  $x^3 + cx = d$

$\pi$

# Lain-lain

Sistem bilangan basis 10

• ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩

1 2 3 4 5 6 7 8 9

I II III IV V  
1 2 3 4 5

VI VII VIII IX X  
6 7 8 9 10

L C D M  
50 100 500 1000

$\pi$

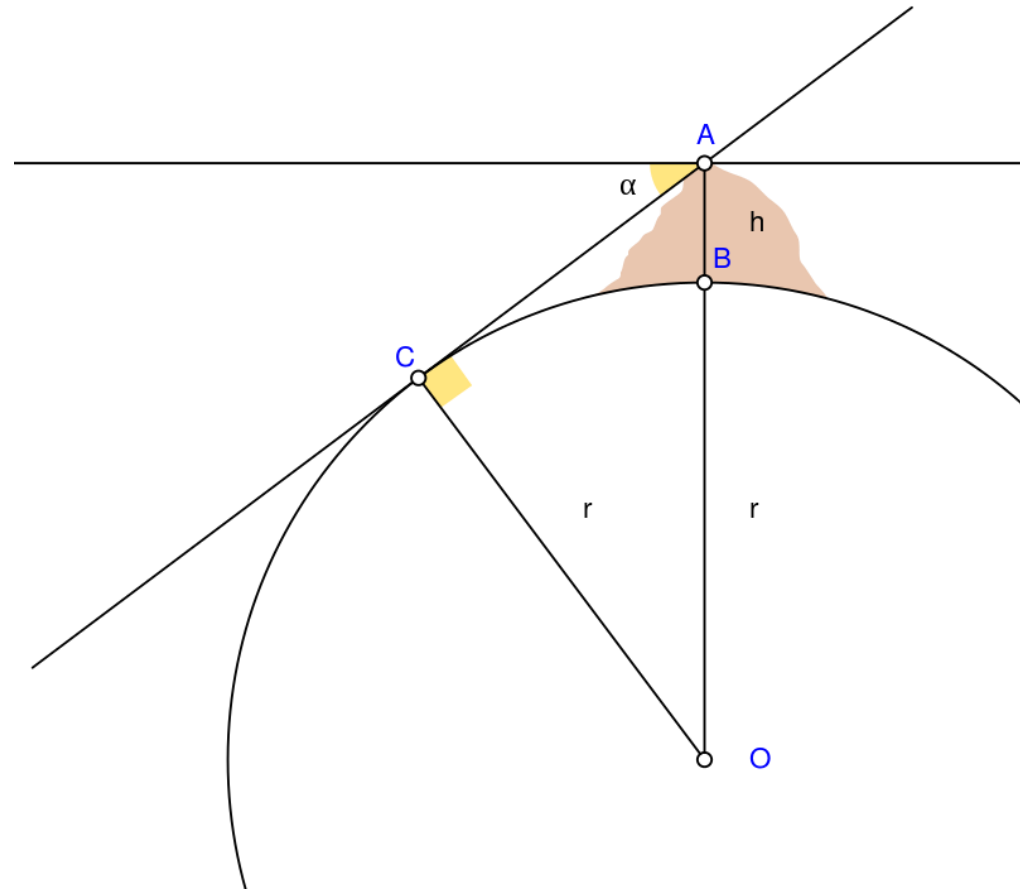
$$\begin{array}{r}
 42 \\
 69 \\
 \hline
 111
 \end{array}$$

$$\begin{array}{r}
 XLII \\
 \underline{LXIX} \\
 XXXX II \\
 L \quad X \quad V \quad III \\
 \hline
 L \quad \underbrace{XXXXX} \quad \underbrace{V \quad III \quad III} \\
 \quad \quad \quad L \quad \quad \quad V \\
 \quad \quad \quad \underline{LL} \quad \underline{VV} \quad I \\
 \quad \quad \quad CXI
 \end{array}$$

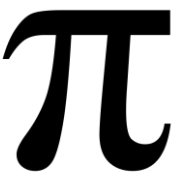
$\pi$

# Lain-lain

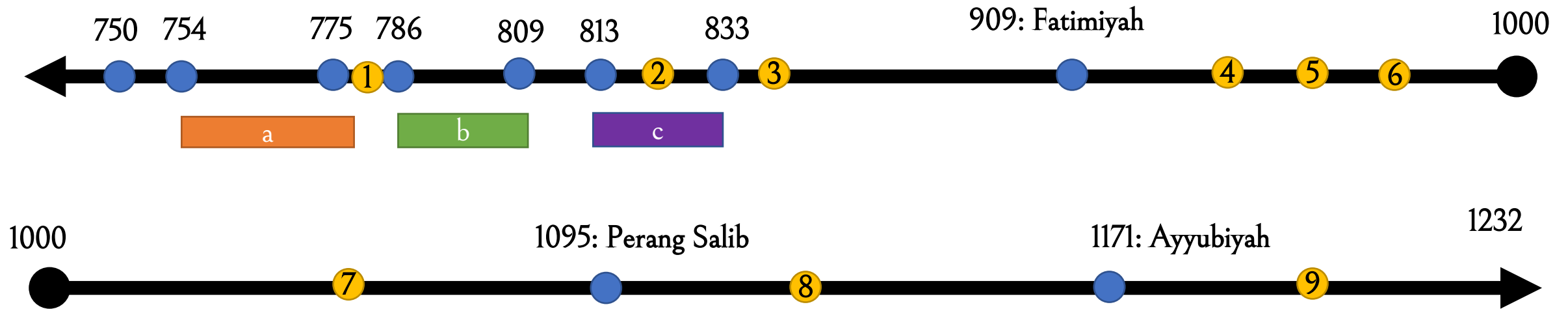
Radius Bumi (Al-Biruni): 3298.77 mil (3847.8 mil)



$\pi$

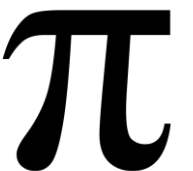


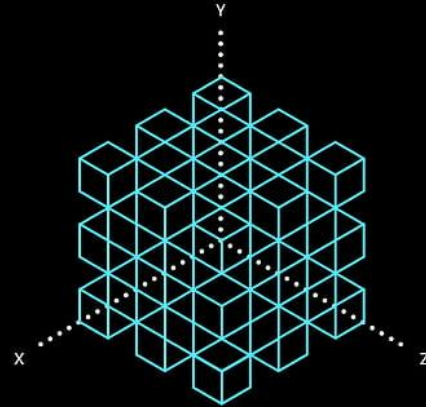
# Daulah Abbasiyah



- (1) 780: Al-Khawarizmi
- (2) 826: Ibnu Qurra
- (3) 850: Abu Kamil
- (4) 940: Buzjani
- (5) 953: Al-Karaji

- (6) 965: Ibnu Haytham
- (7) 1048: Omar Khayyam
- (8) 1135: Sharaf Ad-Din
- (9) 1201: Nasir Ad-Din





Apa hebatnya matematika islam?

# Sebelum Islam

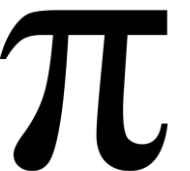
Sumeria, Babilonia, Mesir -> Bilangan, aritmatika dasar

Yunani Klasik:

- Euclid: Aksioma dasar geometri
- Archimedes: Bangun datar dan ruang
- Phytagoras: Trigonometri
- Apollonius: Irisan Kerucut
- Ptolemy: Trigonometri
- Diofantin: Aritmatika, Teori Bilangan
- Pappus: Poligon & Centroid

Cina: Bilangan, Pi, Lingkaran

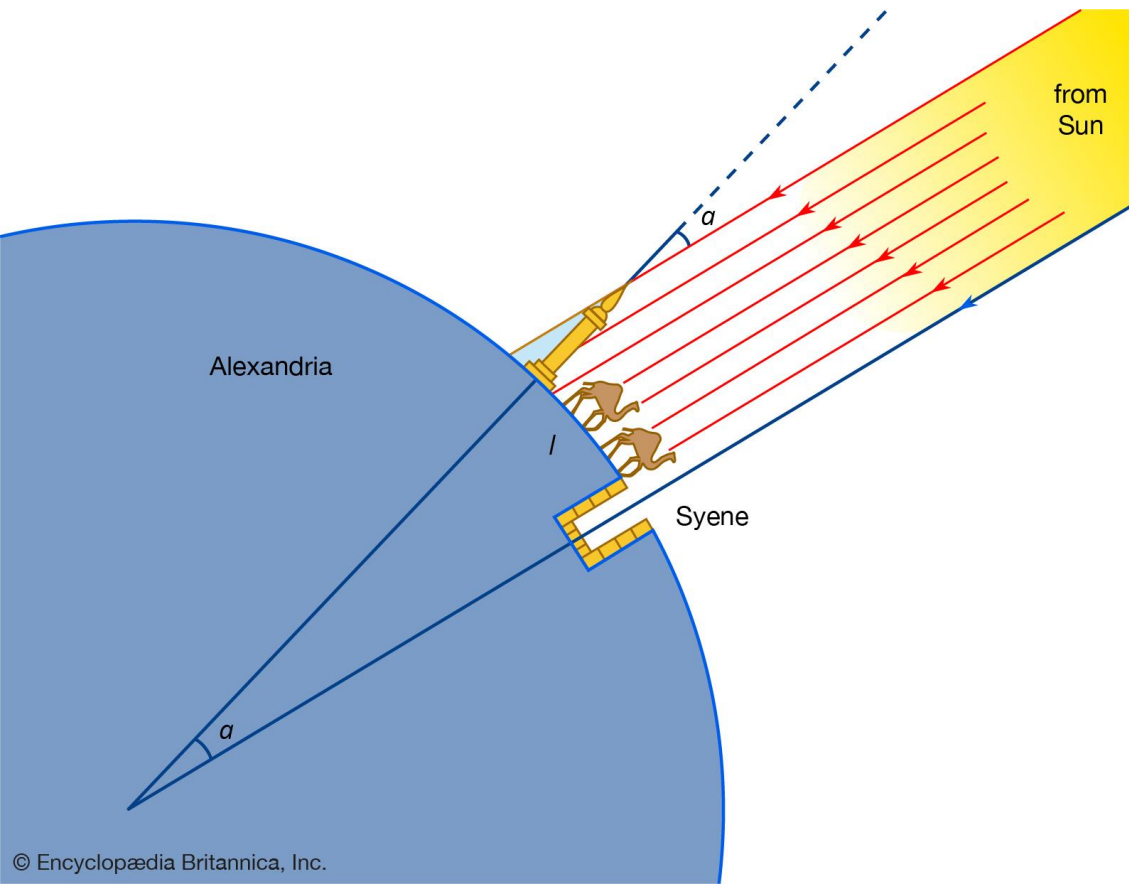
India: Bilangan, angka 0



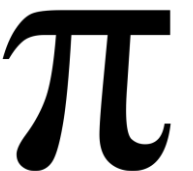
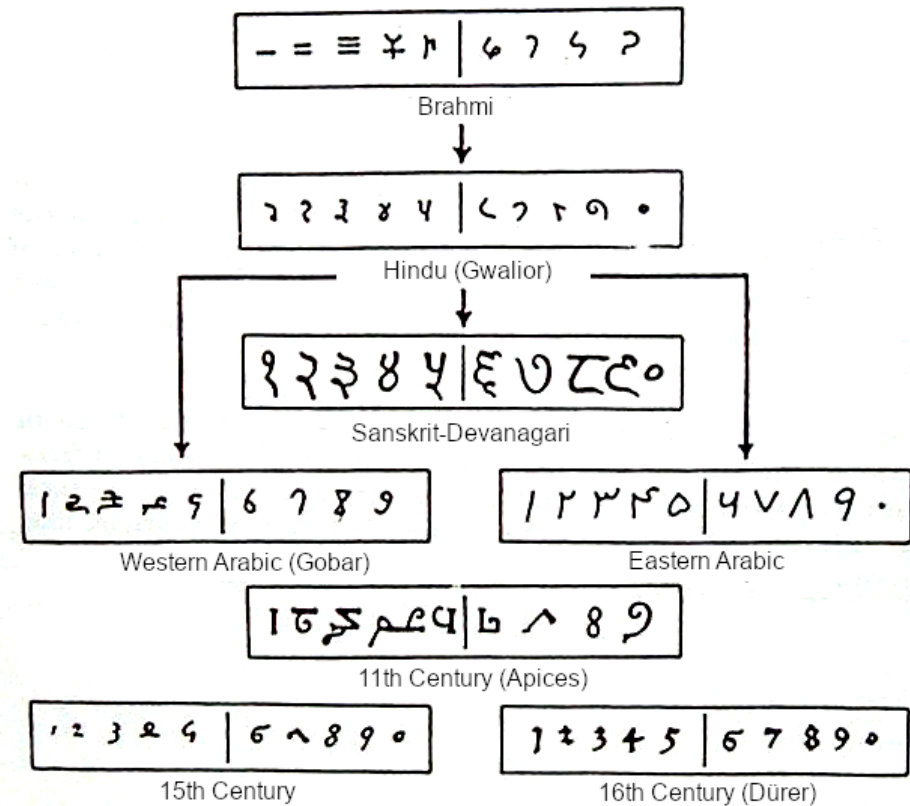


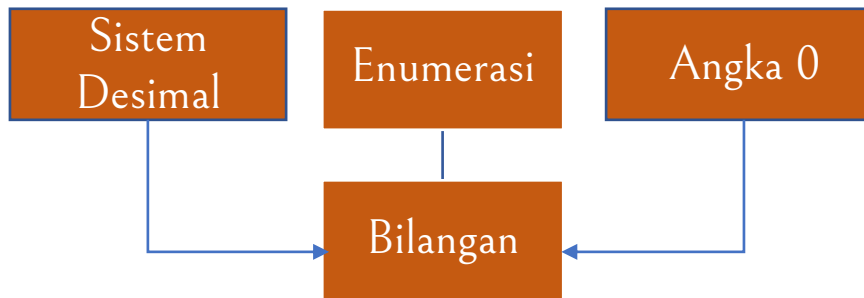
# Sebelum Islam

Keliling Bumi (Erathostenes):  
40rb km (40.075 km)



Bilangan basis 10 (dan 0)  
(Brahmagupta)





Aritmatika

Persamaan Linier

Polinom

Sistem Persamaan Linear

Aljabar Abstrak

Aljabar Linier

Teori Grup

Kriptografi

Sistem Dinamik

Teori Kontrol

Teori Koding

dll

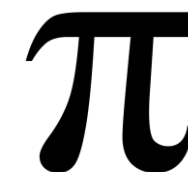
Optimisasi

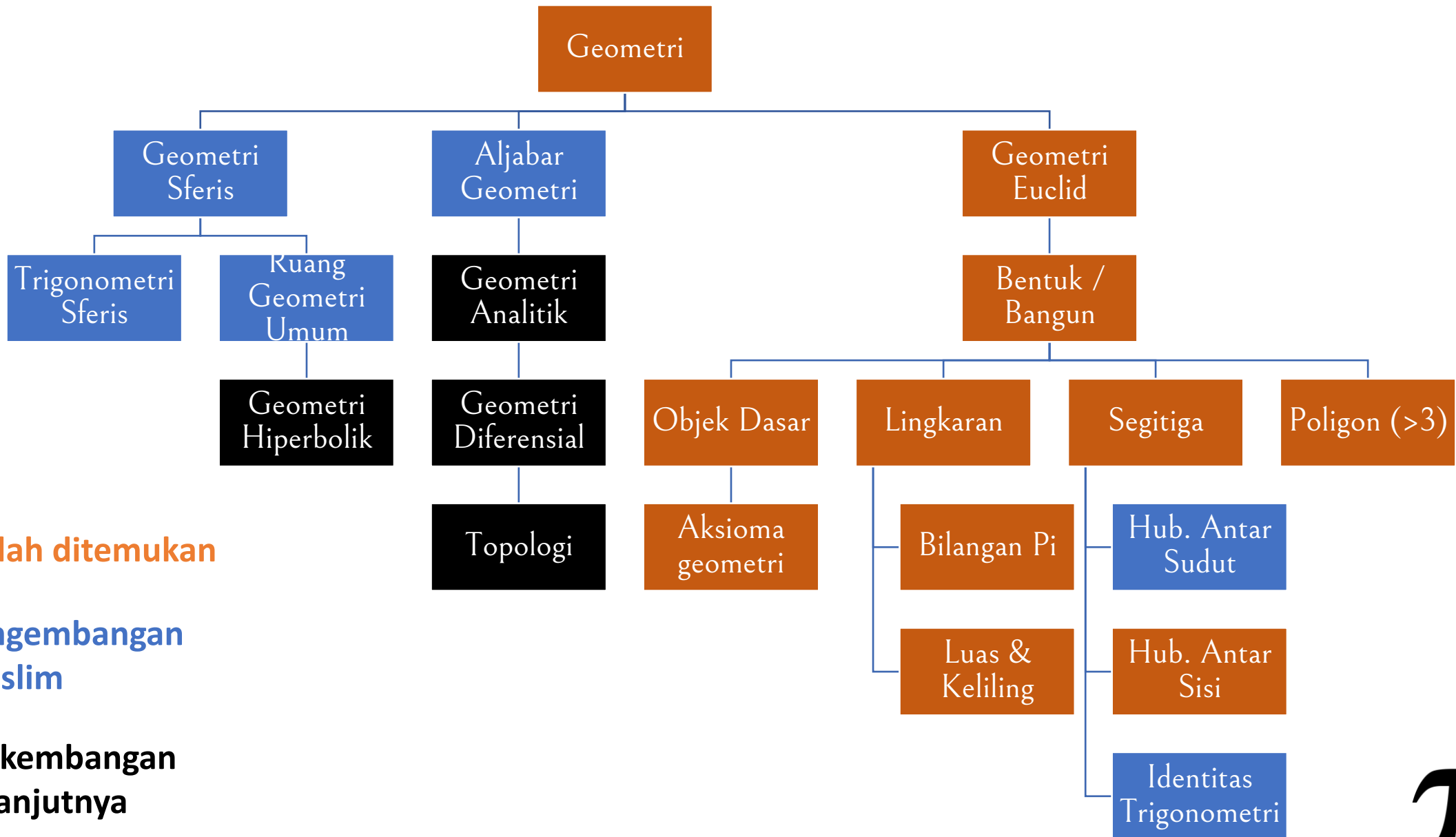
dll

Sudah ditemukan

Pengembangan Muslim

Perkembangan Selanjutnya

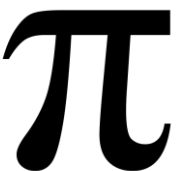


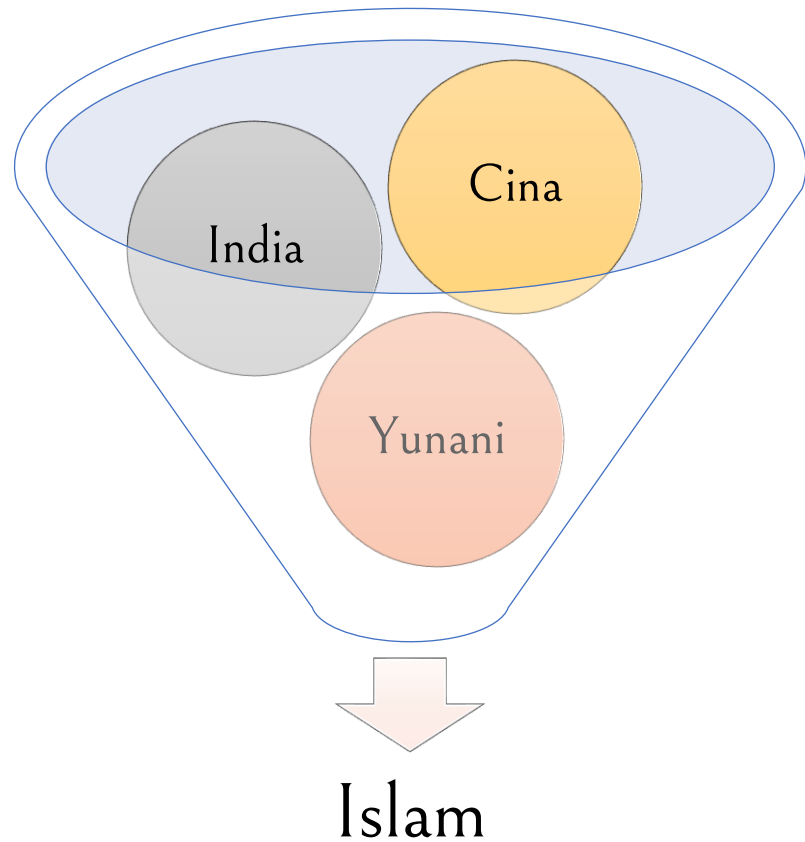


Sudah ditemukan

Pengembangan Muslim

Perkembangan Selanjutnya





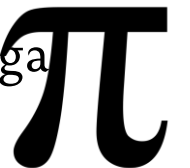
Tidak ada yang “baru” dalam keilmuan (matematika) islam.

Islam merupakan tempat pengukuhan, asimilasi, penyempurnaan, penguatan, pengembangan, semua ilmu yang sudah ada di dunia saat itu

$\pi$

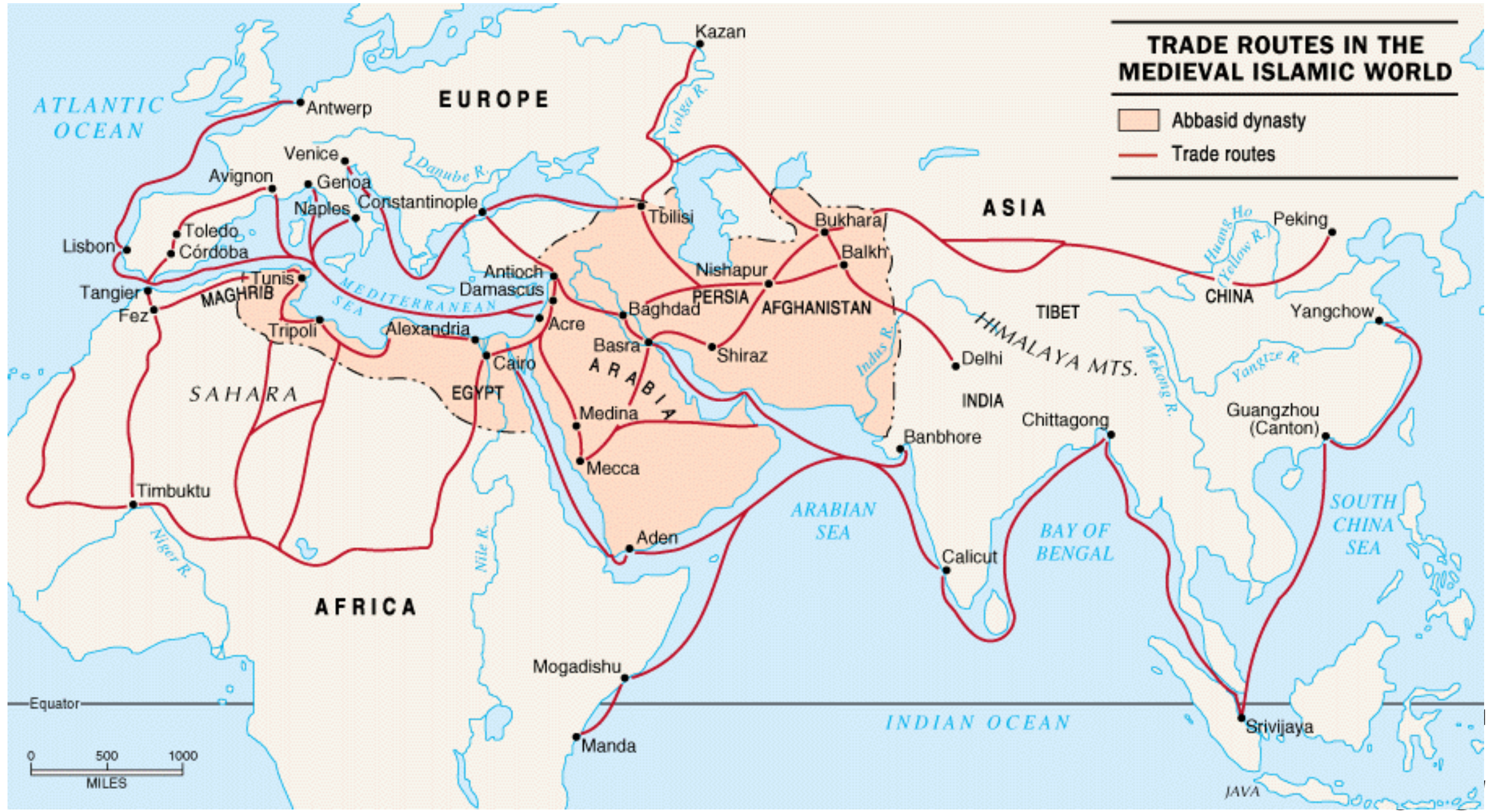
# Gerakan Penerjemahan

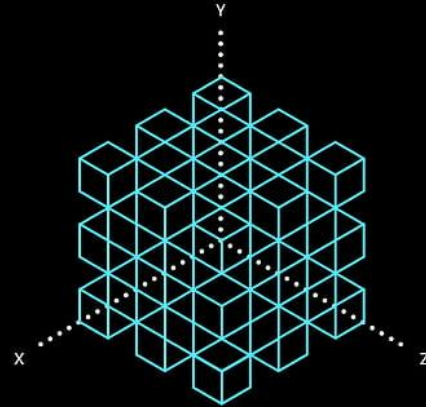
- Para ahli bahasa dalam dewan penerjemah (**diwan at-tarjamah**) ditugaskan untuk:
  - Mengumpulkan sebanyak mungkin karya-karya asing (non-Arab) dan menerjemahkannya
  - Memudahkan dan mempercepat perpindahan ilmu pengetahuan
  - Proses asimilasi istilah dan konsep asing dalam bahasa Arab (islamisasi)
- Peneliti yang bekerja di dalamnya digaji sebesar timbangan berat karyanya
- Tidak hanya diterjemahkan, karya-karya peradaban lain juga dikomentari, diteliti, dikritik, dibandingkan,
- Berbagai karya filsuf Yunani, India, dll berhasil diterjemahkan dan dijelaskan. Karya-karya inilah yang dimanfaatkan bangsa Eropa selanjutnya.
- Perburuan manuskrip sampai ke Asia Kecil, Mesopotamia, Syiria, Palestina, bahkan hingga Mesir.



# TRADE ROUTES IN THE MEDIEVAL ISLAMIC WORLD

- Abbasid dynasty
- Trade routes





Ada apa dengan Islam & Matematika?

“Dan Dia menundukkan untukmu apa yang ada di langit dan apa yang ada di bumi semuanya (sebagai rahmat dari-Nya). Sesungguhnya pada yang demikian itu benar-benar terdapat tanda-tanda kekuasaan Allah bagi kaum yang berpikir.”

(Q.S. al-Jatsiyah: 13)

“Sesungguhnya Kami menciptakan segala sesuatu dengan ukuran (qadr)”

(Q.S. al-Qamar: 13)

$\pi$

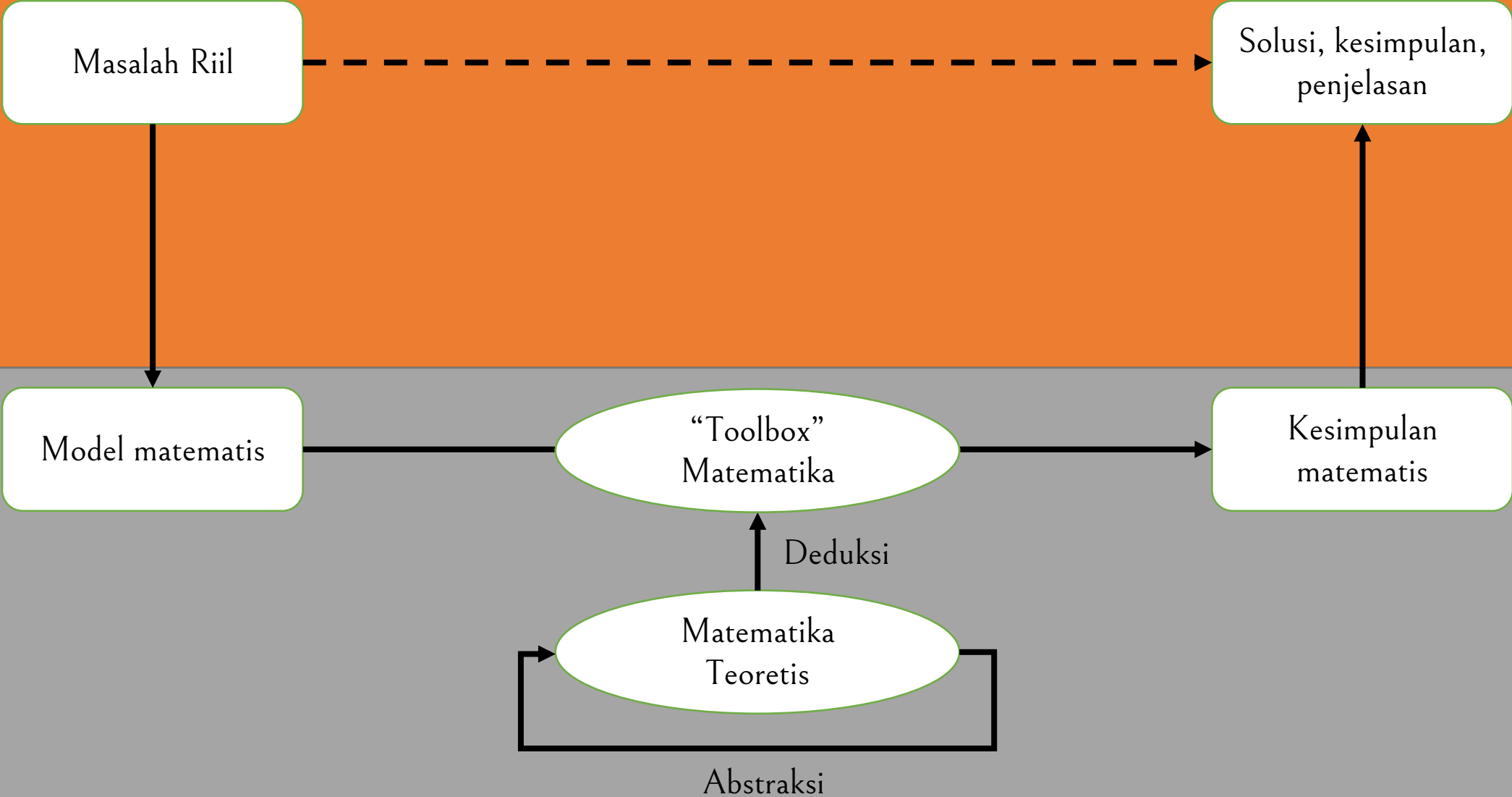


That fondness for science, by which God has distinguished the IMAM AL MAMUN, the Commander of the Faithful (besides the caliphate which He has vouchsafed unto him by lawful succession, in the robe of which He has invested him, and with the honours of which He has adorned him), that affability and condescension which he shows to the learned, that promptitude with which he protects and supports them in the elucidation of obscurities and in the removal of difficulties,—has encouraged me to compose a short work on Calculating by (the rules of) Completion and Reduction, confining it to what is easiest and most useful in arithmetic, such as men constantly require in cases of inheritance, legacies, partition, law-suits, and trade, and in all their dealings with one another, or where the measuring of lands, the digging of canals, geometrical computation, and other objects of various sorts and kinds are concerned—relying on the good-

ness of my intention therein, and hoping that the learned will reward it, by obtaining (for me) through their prayers the excellence of the Divine mercy: in requital of which, may the choicest blessings and the abundant bounty of God be theirs! My confidence rests with God, in this as in every thing, and in Him I put my trust. He is the Lord of the Sublime Throne. May His blessing descend upon all the prophets and heavenly messengers!

$\pi$

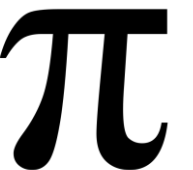
Dunia nyata

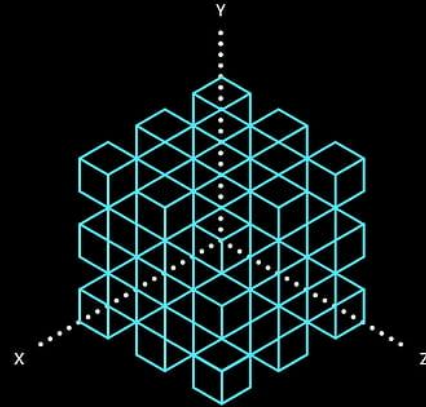


Dunia Matematis

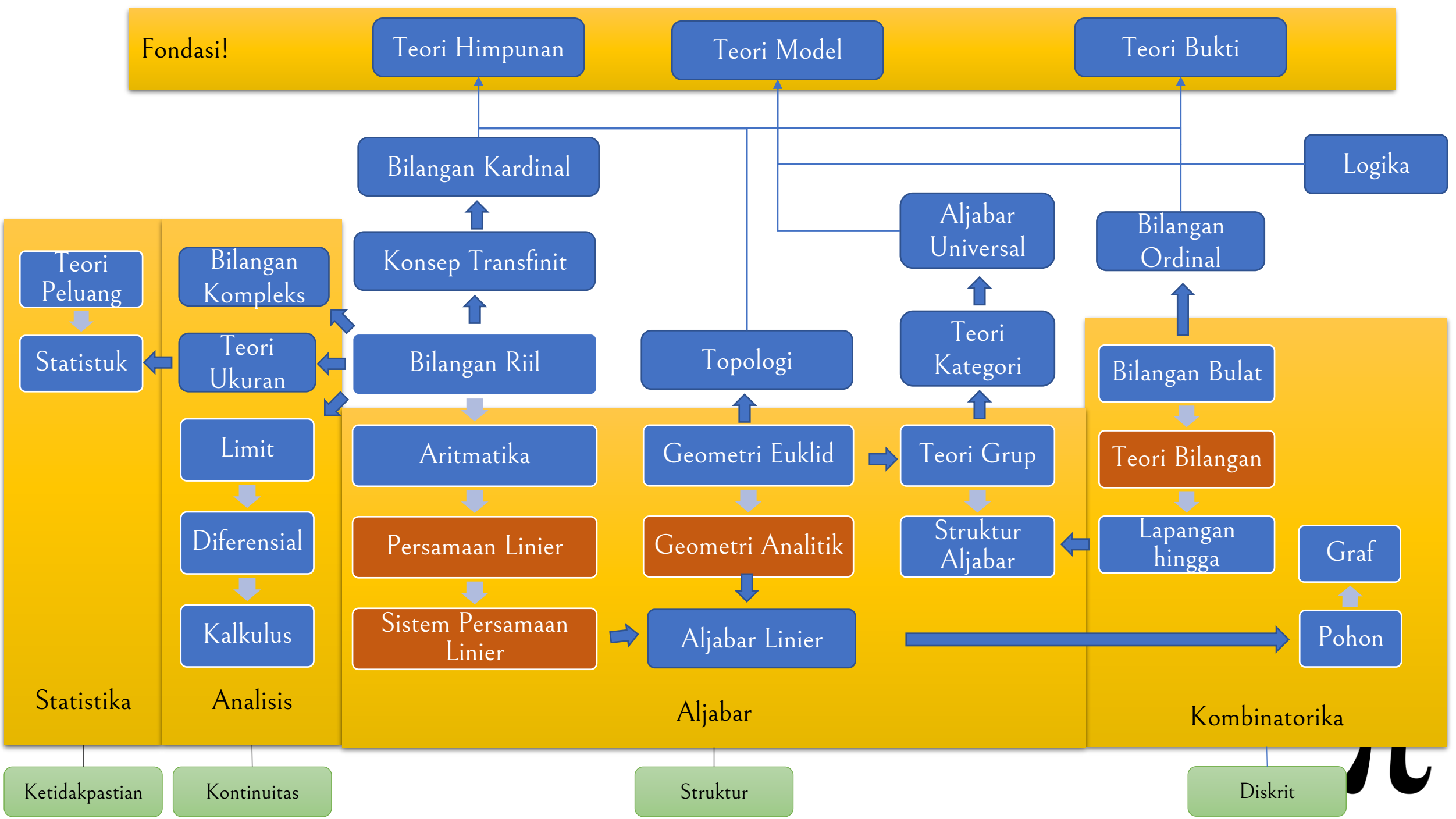
Matematika, sebagaimana ilmu lain, dalam Islam selalu hanya merupakan “alat” dalam rangka tujuan manusia yang sesungguhnya:

- Mendekatkan diri pada Allah (Ibadah)
- Mengembangkan peradaban (khilafah)





Matematika sekarang?



Dunia Awam

Masyarakat

Pasar / Pemerintah

Sistem / Produk /  
Teknologi / Kebijakan

Aplikasi / Implementasi

Matematika

Jurnal Ilmiah, Makalah, dll

Pengajaran

Latihan Soal Tes  
CPNS, TPA, dll

Buku Cinta /  
Nikah / Jodoh

Tips & Trick

Novel

Tutorial

Motivasi

Buku teks

Jurnal

dll

Perbukuan

GAP

Dunia Akademik

Dunia Awam

Permasalahan Umat  
(Muslim)

GAP

Perkembangan  
Barat

Sistem / Produk /  
Teknologi / Kebijakan

Aplikasi / Implementasi

Islamic Worldview

Matematika

Jurnal Ilmiah, Makalah, dll

Dunia Akademik