

NUMBERS : WHAT ARE THEY ?
HOW DID THEY DEVELOP ?

Components of a numbering system are its symbols or glyphs
... and its base

BASE

Many systems developed with base = 10,

e.g. the Roman system:

I, II, III, IV, V, VI, VII, VIII, IX, X

Also the "arabic" system as adapted in Europe:

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

... the concept of zero later developed, so that we instead describe
base numbers in this system as 0 to 9

However the Babylonian system was sexagesimal, with base = 60,
Hard to memorise all those symbols - but in part it survived

Other bases include :

- duodecimal ... with base = 12,
- binary ... with base 2,
- hexadecimal ... with base = 16

The latter were recent methods evolved from the 1950s and 1960s for
COMPUTING, for purposes both of counting and addressing,
i.e. location within a computer memory chip, or disk.

Binary symbols are: 00, 01, 10, 11, 100, 101, 110, 111 etc

Hexadecimal symbols are:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

for example,

hexadecimal "2E" = $2 \times 16 + 14 = 46$ in our decimal method

SYMBOLS (or glyphs) ... and how these developed

Many early societies began their counting in 10s or 20s, which seem likely to have been sourced from the numbers of human digits, i.e. fingers and toes.

The Egyptians are recorded as using longer numbers in their later kingdoms, during 3000 – 1600 BC. It can be seen as one source of Roman numerals, which continued in use for two thousand years, despite their limits for calculation.

	<u>Egyptian</u>	<u>Roman equivalent</u>
e.g.		
1		I
3		III
10	^	X
23	^^	XXIII or IIXIII

(note : most societies including in the Middle East write right-to-left)

Babylonians (c 1750 BC) developed their numbering system with base = 60, which gave a memory task in recalling all the symbols representing 1–59, but arguably was also compact, e.g.

‘223’ = $2 \times 60^2 + 2 \times 60 + 3 = 7323$ in our system !

However, their base of 60 was also used to define units of time – both minute and second hands in later clocks retained the use of 60 to represent a full circle of each hand.

While Egyptians developed early concepts of geometry in designing their temples and structures, this subject really matured with the Greeks – Euclid (d 220 BC), and his pupil Archimedes (d 212 BC) – some of Euclid’s texts remained the basis for geometry teaching until the 20th century ! Their work included important theory using circles – and concepts like Pi or π ... which is a mathematical constant whose value is the ratio of any circle's circumference to its diameter – approximately equal to 3.14159 in our decimal notation.

Decimal numbers – evolved in north India from about 300 BC, and this system spread via Persia into Arabia during 825–950 AD, with first records of using zero (0) in Central India about 870 AD, and also in Persia. The Persian mathematician Mūsā al-Khwārizmī (d 850 AD) is attributed with the development of algebra, and also the decimal point to separate integral and fractional parts of a number.

A variation of this ‘Hindu–Arabic’ system evolved in eastern Muslim lands, to Maghreb in north Africa, and Andalus in Spain. E.g.

(.١٢٣٤٥٦٧٨٩) i.e. 0 1 2 3 4 5 6 7 8 9

It may be seen how Europeans later simplified this into our present decimal numbers. From Spain it was circulated from about 1000 AD, via traders, and also by scholars in the Roman Catholic church in its European areas of influence despite their tradition of Roman numerals which continued in formal use not requiring calculation.