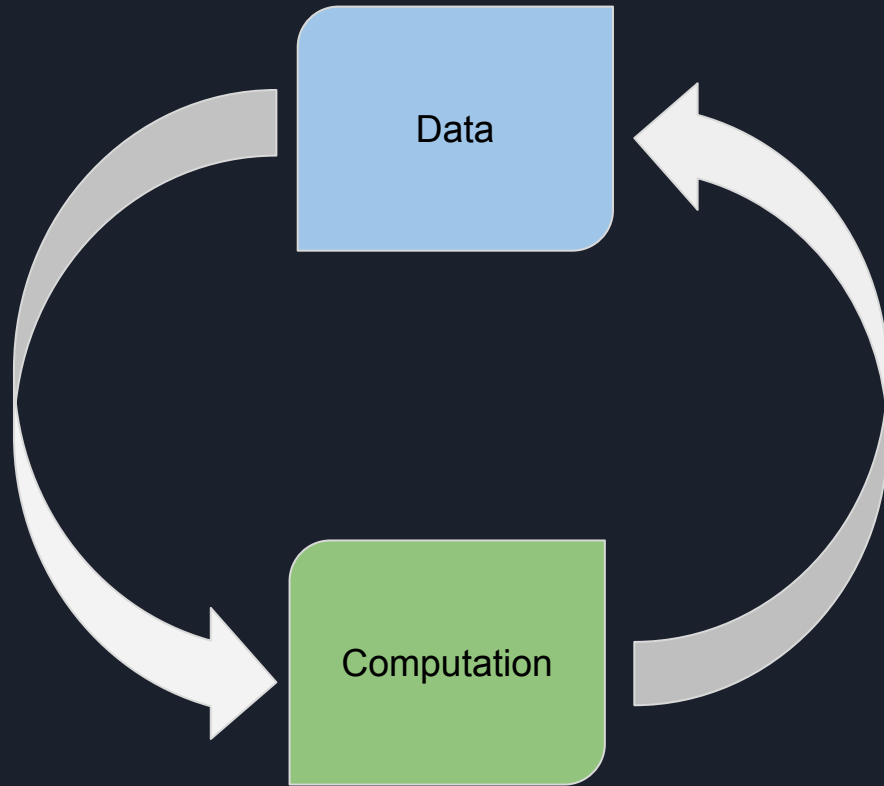

A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is a light green. They are positioned diagonally, with the blue one partially covering the green one.

Introduction to computing

Luslab Computing Seminars



Computational Data Driver Layers



Storage /
Representation

Simple Arithmetic

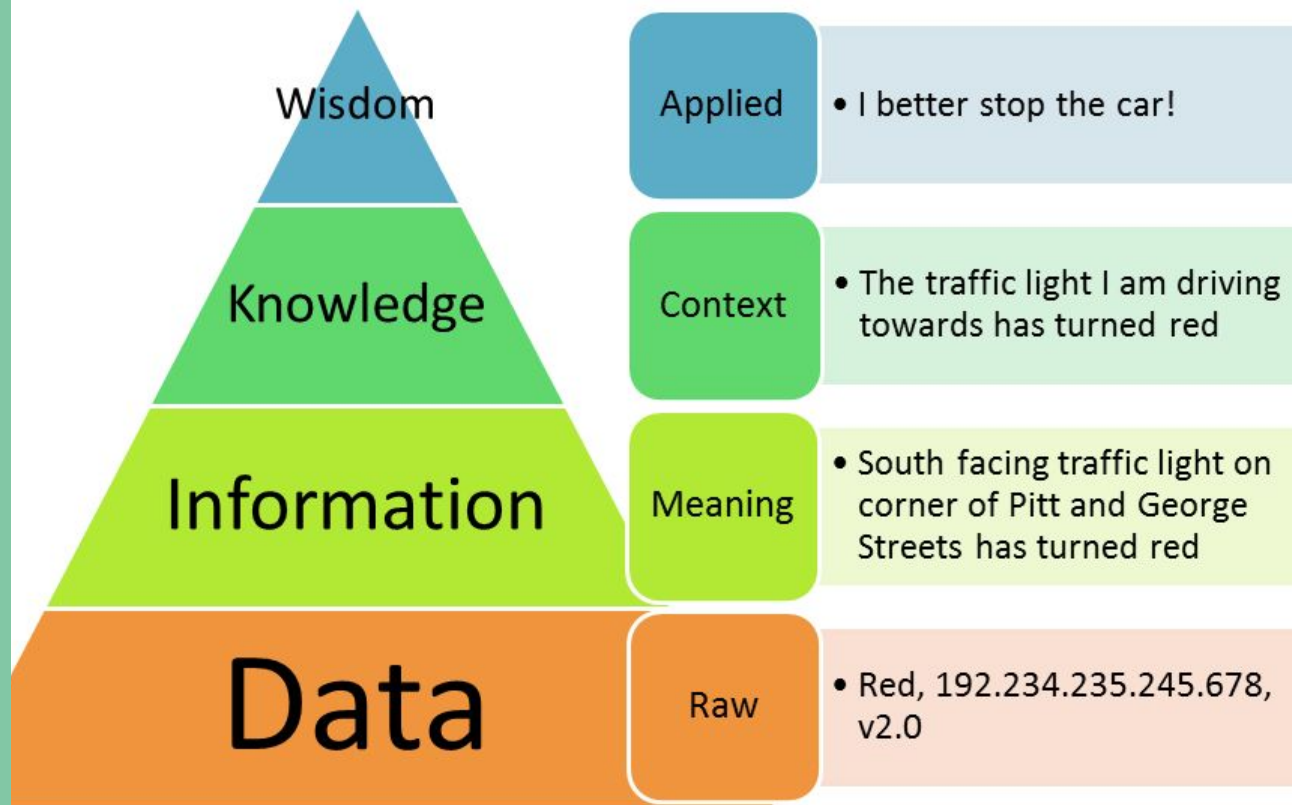
Higher Order
Calculation

Accuracy

Volume

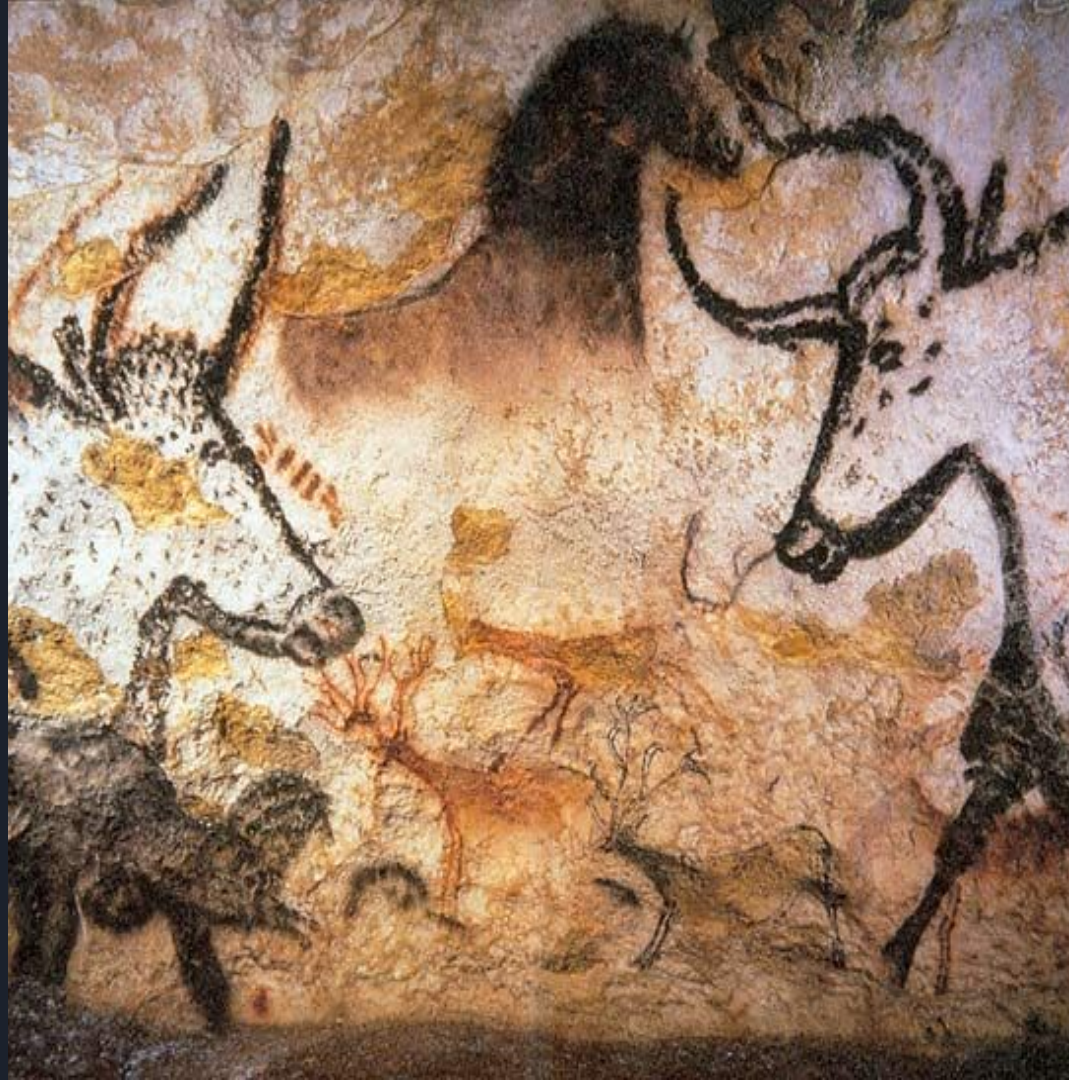
What is Data?

From the latin *Datum* meaning “a piece of information”



Stone Age

- Modern anatomical humans appear 150,000 ya
- “**behavioral modernity**” ~50,000 ya
- Tool use, artifact diversity, art and elaborate graves all absent before this point
- Expansion from africa to europe





Stone Age Counting Systems

- Counting was probably first done using body parts
- Evidence in the etymology for some proto-numerals linking to body parts

Early Data Representation

Ability to count likely a selector for survival

- Time of year (when to sow crops)
- Numbers of items stored
- Trading / bartering



Stone Age Counting Systems

- Earliest stored counting system was tally marks
- Unary (1-based) number system
- First example of human data storage





Tally Clustering

- Parallel clustering systems developed to compress unary number system into symbols
- Very important step
- Earliest likely form of proto-writing

Proto-writing

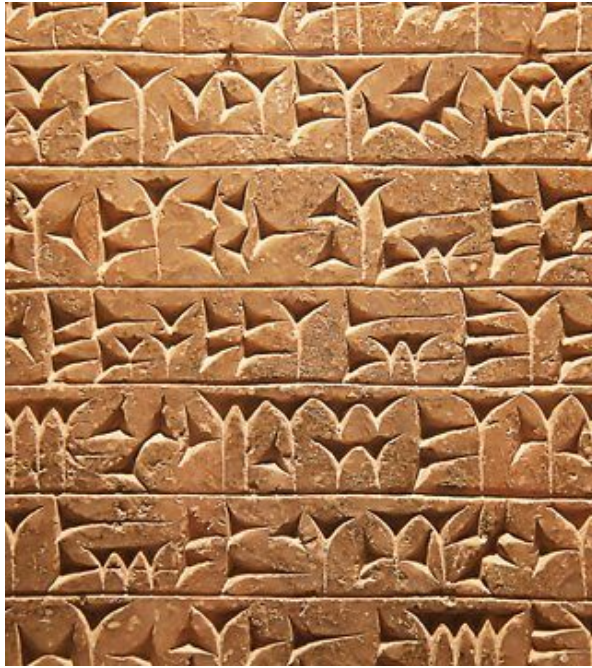
Tally systems combined with early pictorial symbolism representing ownership

Increased in complexity towards bronze age

Clay tokens (4,000 BC)

- Tokens were marked with symbol for item
- Outside marked with symbol and tally
- Could be broken in a dispute





Bronze Age Cuneiform (4,000 BC - 600 BC)

- One of the earliest writing systems
- Lead development from pictorial to symbolic representation of data
- Numerical representation followed



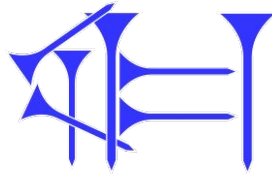
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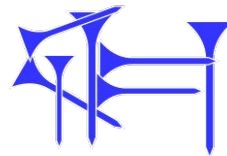
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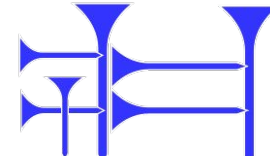
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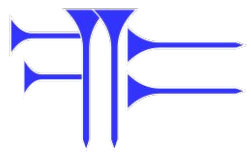
4



5



6



7

Number Systems

- Sumarian base 60 system - 5 hands of 12
- Many factors - dividing by 60 softens gives easy fractions
- Day - sunrise to sunset in 12 parts
- Combined day/night = 24 parts
- 60 mins, 360 degrees all came from this
- Babylonians turned it into a positional numbering system



𐎶 1	𐎶𐎵 11	𐎶𐎵𐎶 21	𐎶𐎵𐎶𐎵 31	𐎶𐎵𐎶𐎵𐎶 41	𐎶𐎵𐎶𐎵𐎶𐎵 51
𐎶𐎶 2	𐎶𐎶𐎵 12	𐎶𐎶𐎶 22	𐎶𐎶𐎶𐎵 32	𐎶𐎶𐎶𐎵𐎶 42	𐎶𐎶𐎶𐎵𐎶𐎵 52
𐎶𐎶𐎶 3	𐎶𐎶𐎶𐎵 13	𐎶𐎶𐎶𐎶 23	𐎶𐎶𐎶𐎶𐎵 33	𐎶𐎶𐎶𐎶𐎵𐎶 43	𐎶𐎶𐎶𐎶𐎵𐎶𐎵 53
𐎶𐎶𐎶𐎶 4	𐎶𐎶𐎶𐎶𐎵 14	𐎶𐎶𐎶𐎶𐎶 24	𐎶𐎶𐎶𐎶𐎶𐎵 34	𐎶𐎶𐎶𐎶𐎶𐎵𐎶 44	𐎶𐎶𐎶𐎶𐎶𐎵𐎶𐎵 54
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The Abacus

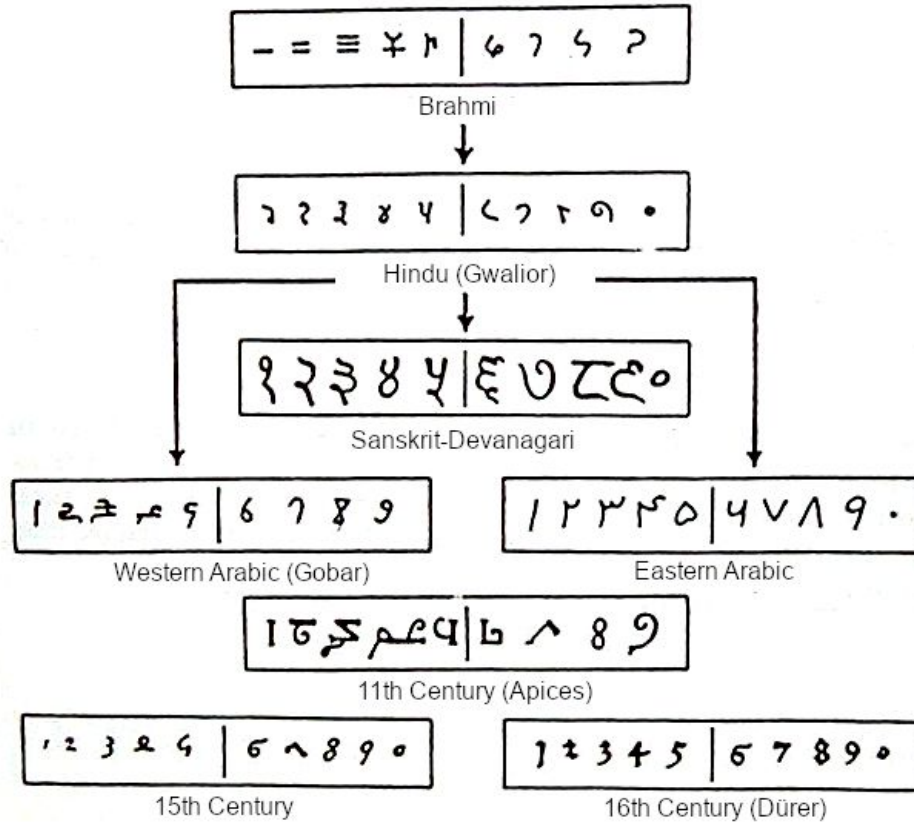
- Probably the most important computational aid ever developed

Roman Numerals

- Based on tally sticks
- Semi-positional
- Not as advanced as previous systems



Hindu-Arabic numeral system



- Based on tally system
- Became 0 based and positional
- Developed by indian mathematicians, brought to baghdad and taken up by arabic scholars in 8th century
- Introduced to europe by Leonardo Fibonacci
- Replaced roman numerals by 15th century

European Medieval Onwards

1613 'R. B.' Yong Mans Gleanings 1, I have read the truest computer of Times, and the best Arithmetician that ever breathed, and he reduceth thy dayes into a short number.

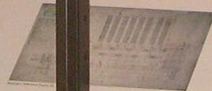
- A melting pot of systems based on literacy level
- Navigation, astronomy and engineering with calculus more important
- High order calculation is now added as a driver
- Still done with same technology - with human “computers”



Industrial Revolution

- Solid numerical system in use for ~250 years
- Mathematics and astrology are advancing quickly
- Most series (logarithmic / trigonometric) were calculated by human computers
- Transcriptional and computational errors were commonplace
- Huge implications for engineering, navigation, astrology and surveying

Difference Engine No. 2



Charles Babbage's Difference Engine No. 2 was a mechanical calculator designed to calculate and print out long tables of numbers, such as logarithms, trigonometric functions, and other mathematical tables. It was a significant improvement over his first design, the Difference Engine No. 1, and was intended to be a general-purpose calculator. The engine was designed to be built in two stages, with the first stage being a prototype and the second stage being the full-scale machine. The engine was designed to be built in two stages, with the first stage being a prototype and the second stage being the full-scale machine.

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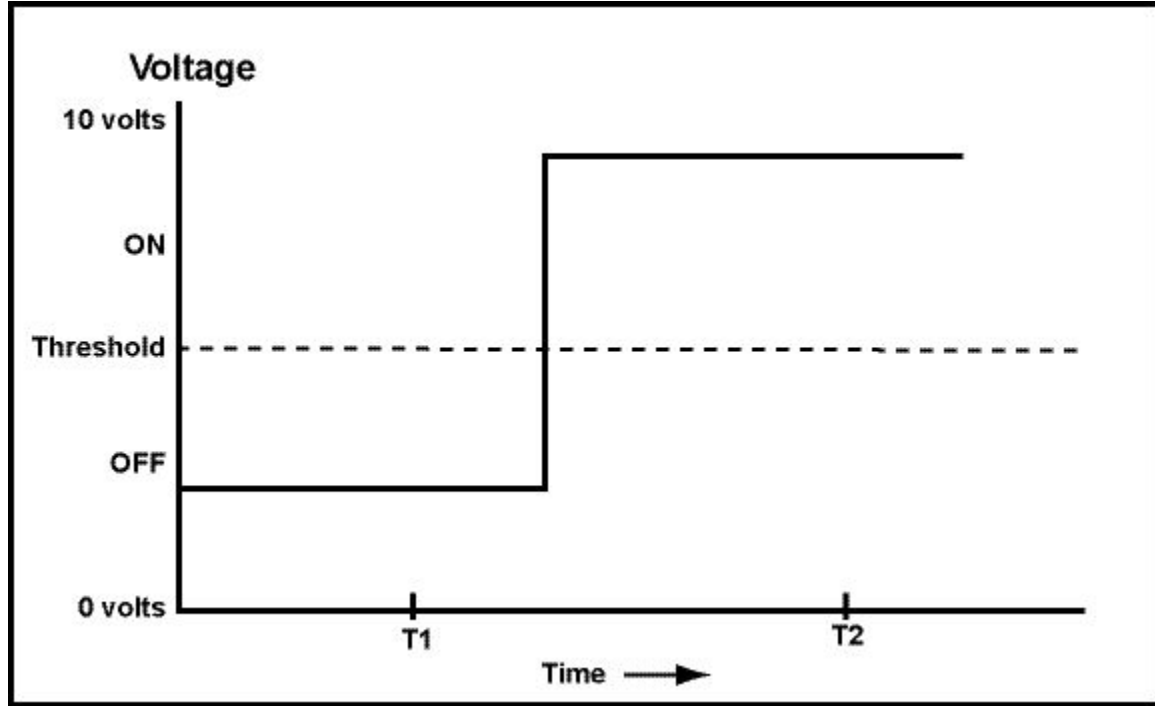
Modern Era

- STILL primarily done by humans
- WW2 pushed this forward - Electromechanical revolution
- Finally the electrical/digital revolution
- Primary driver becoming VOLUME



Switch to binary

- Base 10 needs enough voltage in between numbers to make a correct reading
- Base 2 is either on/off - convenient
- The more possible states for one digit you have the more electronics you need to represent it
- Has the lowest base number system and so other number systems can be built on top
- Binary logic is easy to understand





Summary

- Reason to represent data
- We have several number systems and symbolic encodings to present the amount of an object or a relationship
- We can record data
- Perform arithmetic to create **information**
- We can tabulate to relate previous calculations to each other
- **Forms the basis of all of our data today**
- We have several drivers for better storage, accuracy and processing rate that created the first non-human computers