

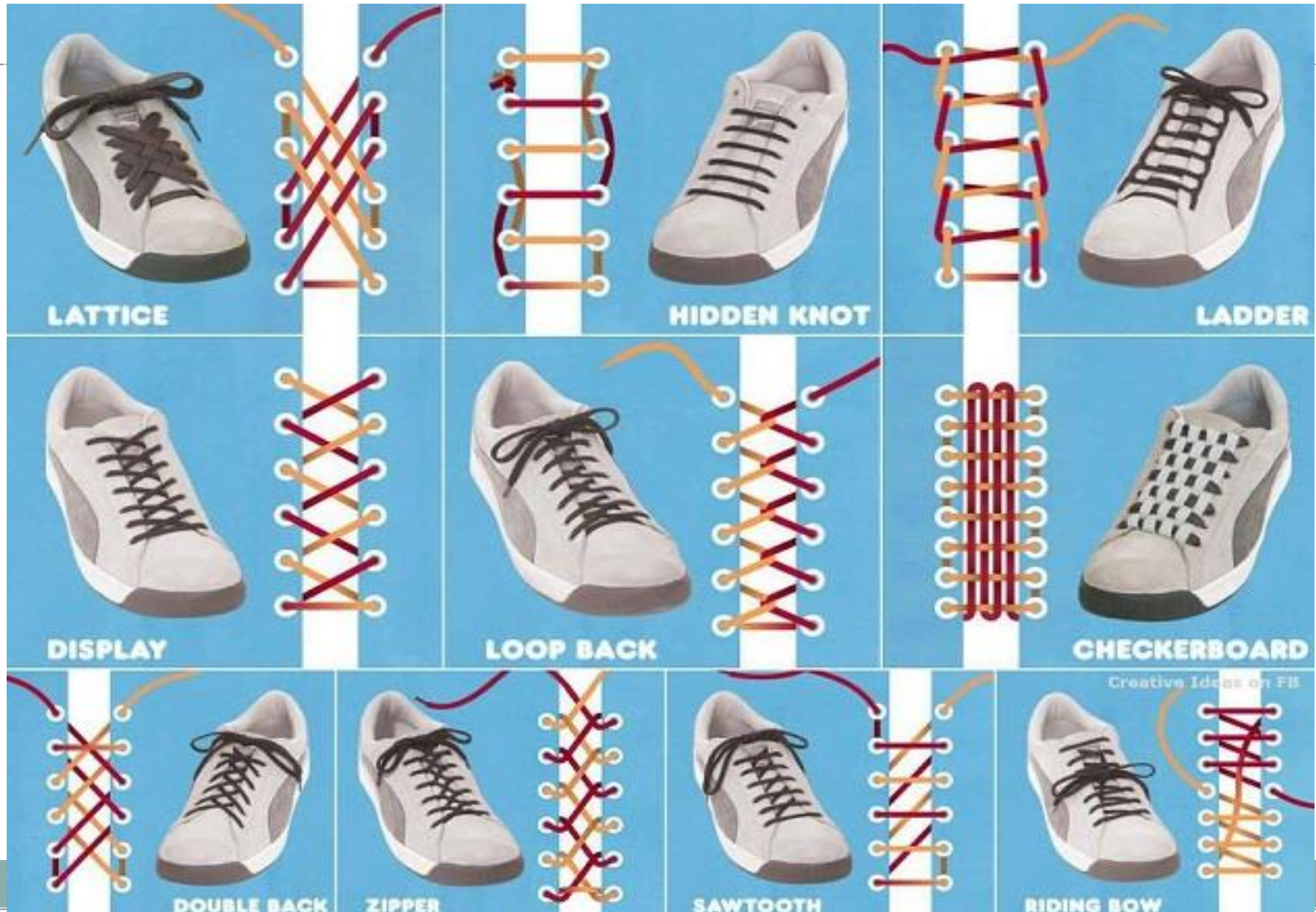


STORY OF MATH IN SHOELACES

NORMAL LACING



TYPES OF SHOE LACING



CLOSER LOOK---ITS ALL JOINING POINTS



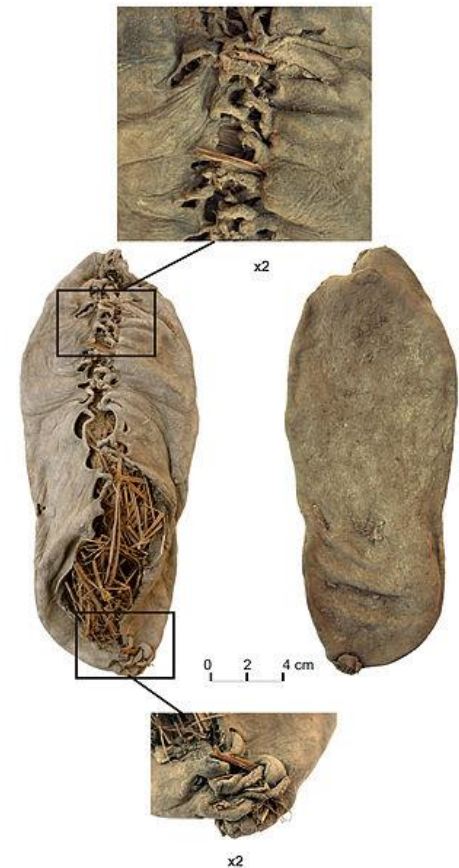
Guess in how many ways you can
tie your shoe laces. ○

51

The beginning. . .



It is as difficult to determine the exact history of shoelaces as it is for shoes. Archaeological records of footwear are rare. Because shoes were generally made of materials that deteriorated readily. The [Areni-1 shoe](#), which has been dated to around 3500 BC, is a simple leather "shoe" with leather "shoelaces" passing through slotted "eyelets" cut into the hide.

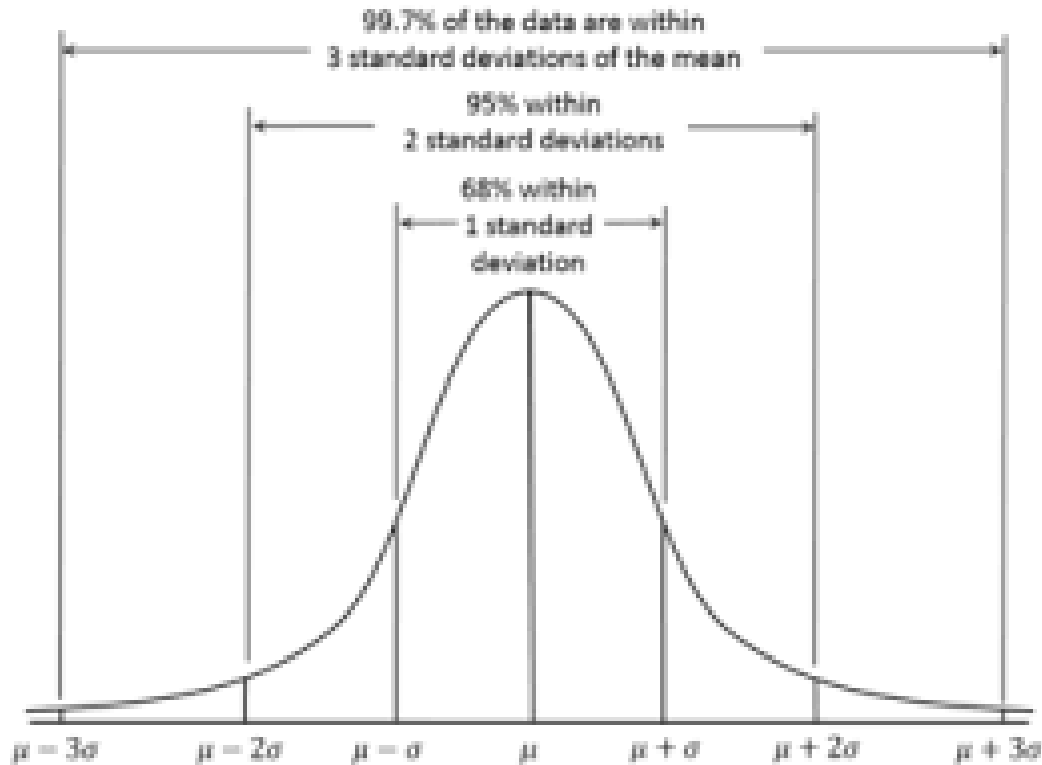


GAUSS FORMULA FOR SHOELACES

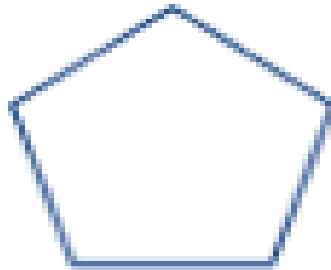


The *shoelace formula* or *shoelace algorithm* (also known as Gauss's area formula and the surveyor's formula^[1]) is a mathematical algorithm to determine the area of a simple polygon whose vertices are described by their Cartesian coordinates in the plane.^[2] The user cross-multiplies corresponding coordinates to find the area encompassing the polygon, and subtracts it from the surrounding polygon to find the area of the polygon within. It is also sometimes called the **shoelace method**.

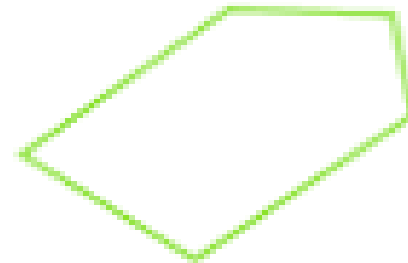
CARL FREDRICK GAUSS – FAMOUS FOR BELL CURVE DISTRIBUTION



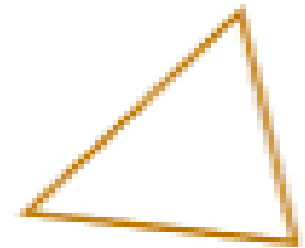
SHOELACE IS SEEN AS A Polygon with many vertices



Regular
Pentagon



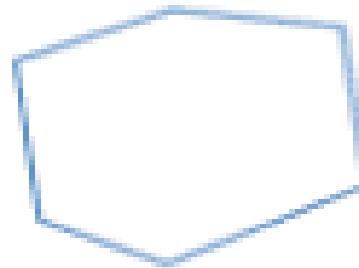
Irregular
Pentagon



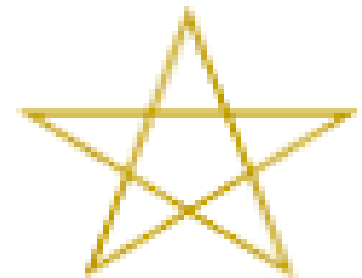
Triangle



Concave
Octagon



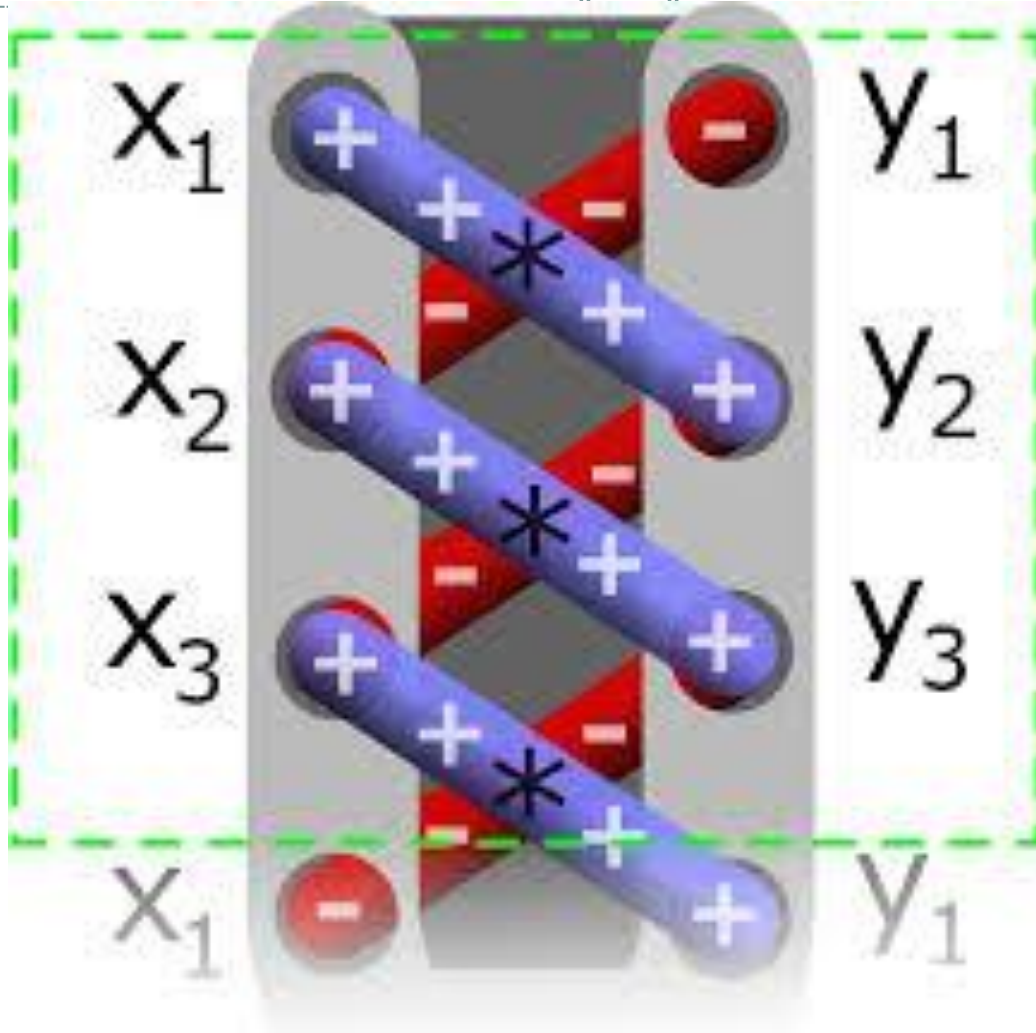
Irregular
Hexagon



Complex
Polygon

.SHOELACE IS A POLYGON WITH MANY
VERTICES

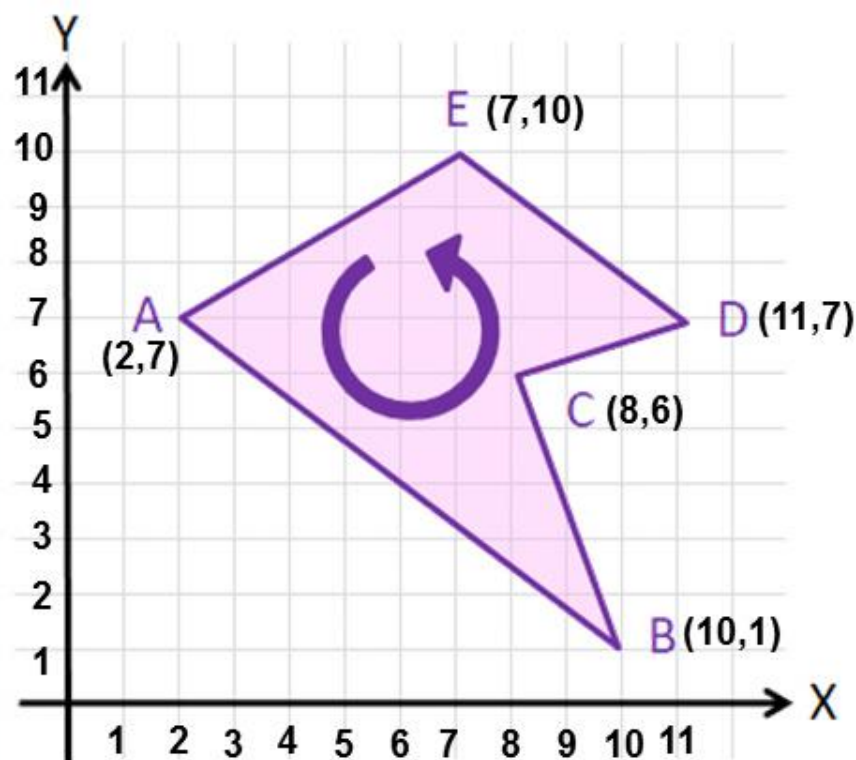
• .



GAUSS FORMULA FOR SHOE LACES

$$\text{Area} = \frac{1}{2} \left| \sum_{i=1}^{n-1} x_i y_{i+1} + x_n y_1 - \sum_{i=1}^{n-1} x_{i+1} y_i - x_1 y_n \right|$$

$$\text{Area} = \frac{1}{2} |x_1 y_2 + x_2 y_3 + \dots + x_{n-1} y_n + x_n y_1 - x_2 y_1 - x_3 y_2 - \dots - x_n y_{n-1} - x_1 y_n|$$



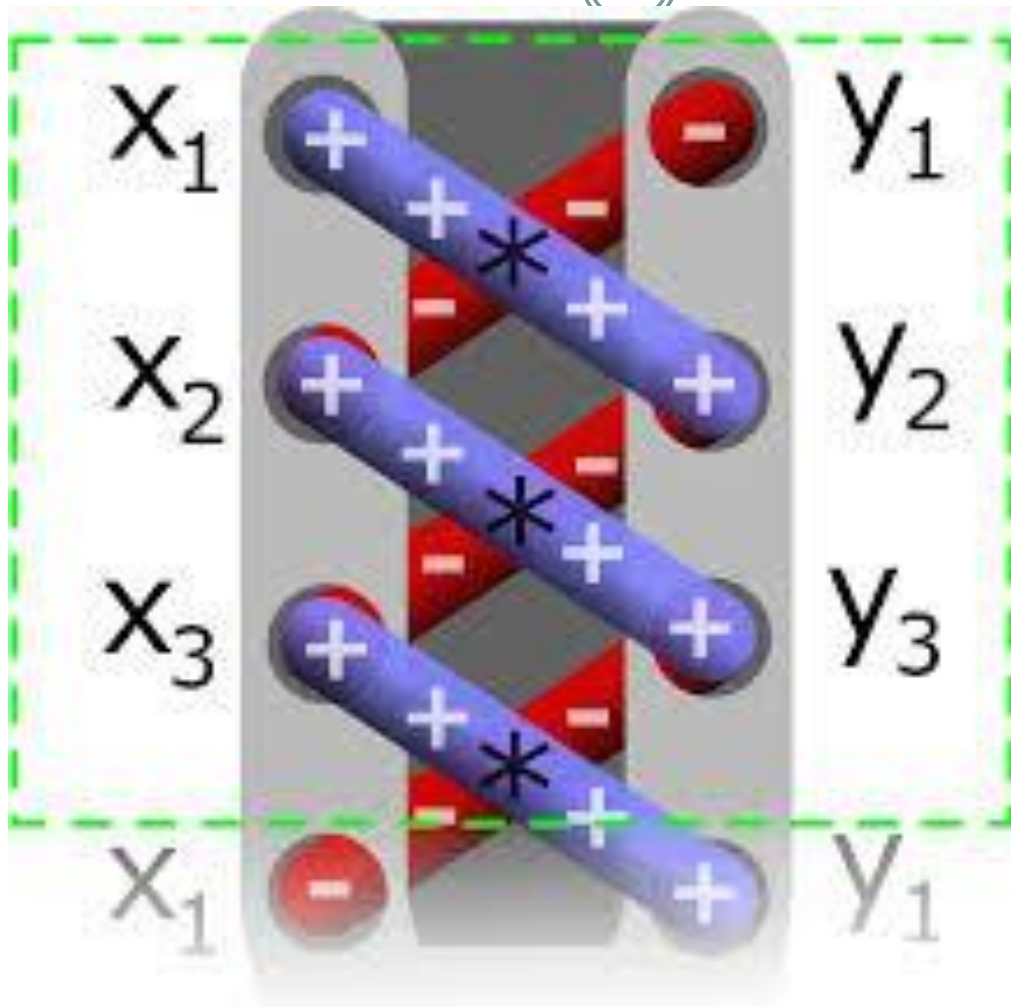
Vertices	x	y
A	2	7
B	10	1
C	8	6
D	11	7
E	7	10

Step 1: $(2 \times 1) + (10 \times 6) + (8 \times 7) + (11 \times 10) + (7 \times 7)$
 $2 + 60 + 56 + 110 + 49 = 277$

Step 2: $(7 \times 10) + (1 \times 8) + (6 \times 11) + (7 \times 7) + (10 \times 2)$
 $70 + 8 + 66 + 49 + 20 = 213$

Step 3: $\text{Area} = \frac{|277 - 213|}{2} = \frac{64}{2} = 32 \text{ sq units}$

CROSS MULTIPLY POSITION COORDINATES AS IN SHOELACES





$$\begin{aligned}\mathbf{A} &= \frac{1}{2} \left| \sum_{i=1}^{n-1} x_i y_{i+1} + x_n y_1 - \sum_{i=1}^{n-1} x_{i+1} y_i - x_1 y_n \right| \\ &= \frac{1}{2} |x_1 y_2 + x_2 y_3 + \cdots + x_{n-1} y_n + x_n y_1 - x_2 y_1 - x_3 y_2 - \cdots - x_n y_{n-1} - x_1 y_n| \end{aligned}$$

How shoelace pattern was used in history.



IT WAS W W 2 Operation TIDE RACE

Singapore liberated by Mountbatten



AND THE USES...



Gurkha soldiers



AND THE USES...



Gurkha-Japanese have both
Mangoloid faces



Identification of Friend or Foe
was a problem

- SO GURKHA SOLDIERS WERE ASKED TO LOOK TO THE SHOE LACES TO FIND FRIEND OR ENEMY SOLDIERS



INDIAN SHOE



- LOOK TO THE SHOE BEFORE YOU SHOOT ----- WAS THE INSTRUCTION