CRC
Ricostruzione delle tracce dei muoni

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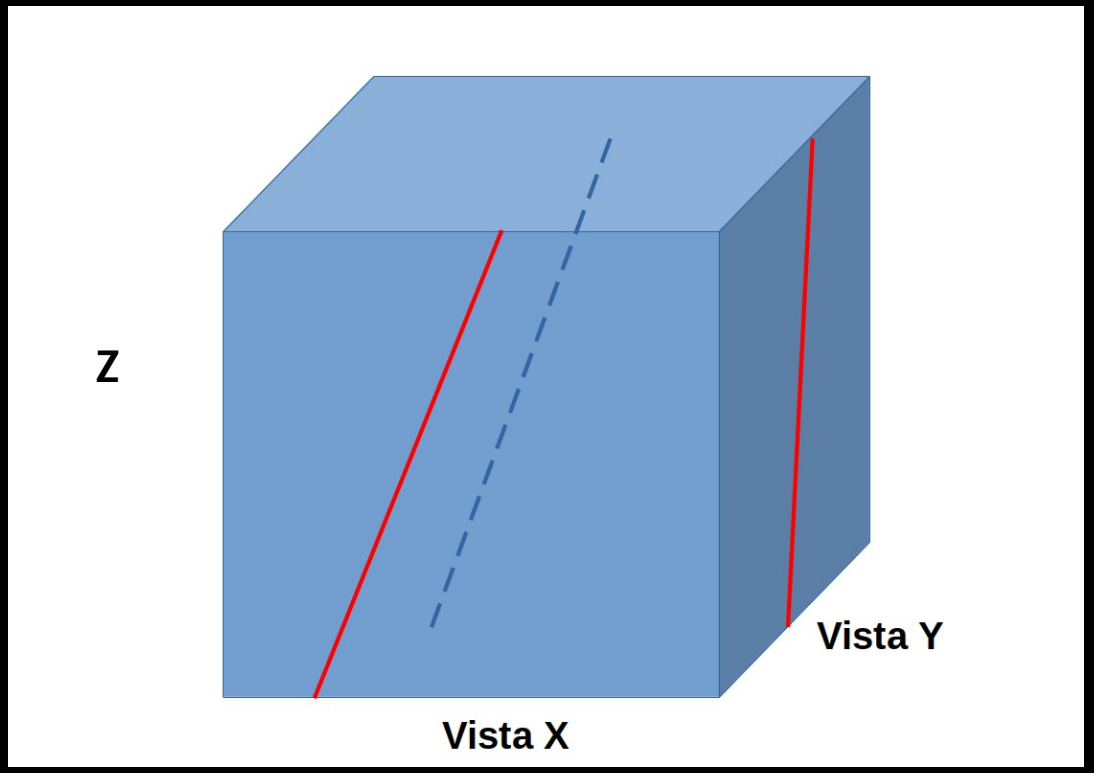
La traccia del muone

Le due viste del CRC
(vista x, vista y)



La traiettoria 3D del muone è scomposta in due proiezioni sulle due viste del cubo (X e Y)

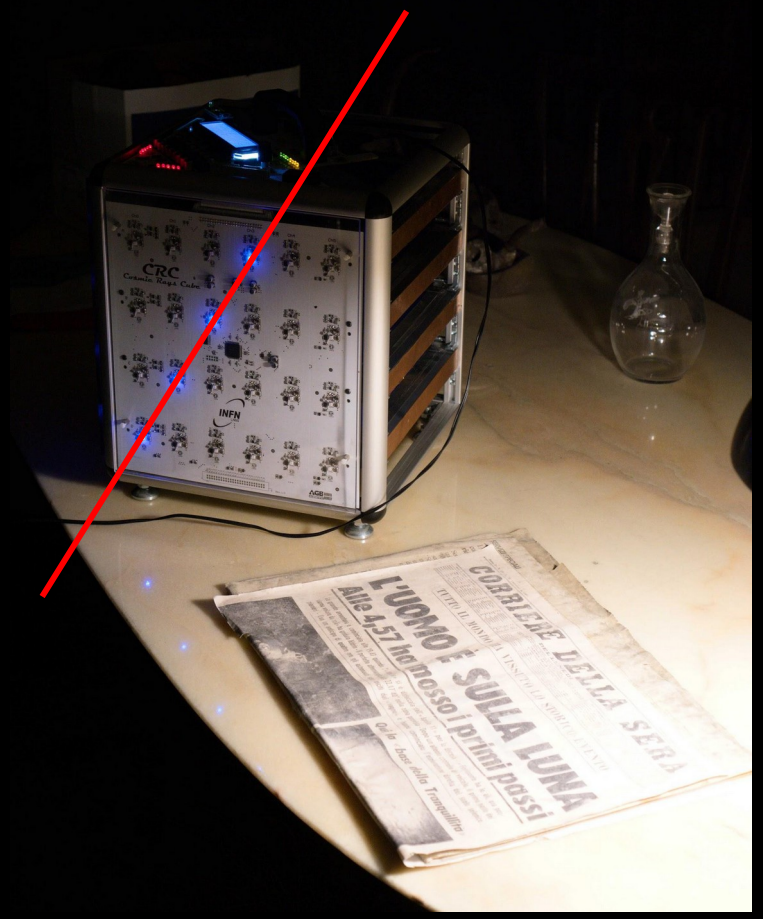
Ricostruzione della traccia a partire dai pixel accesi

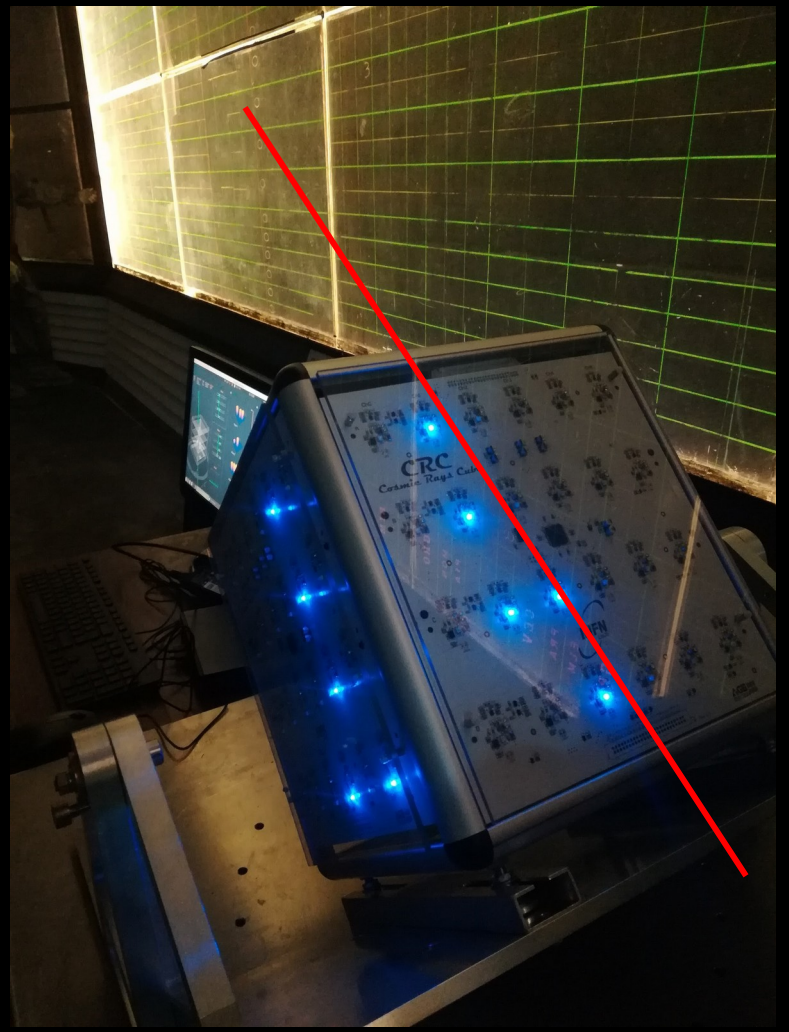
Scelta del sistema di riferimento opportuno

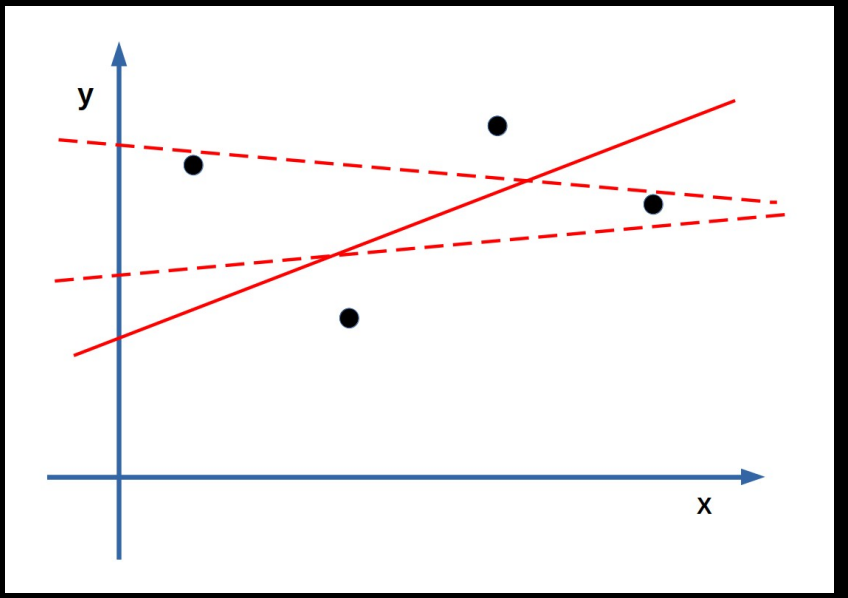
Parametri liberi: 4
- 2 coefficienti angolari
- 2 intercette

Equazioni delle rette
- $x(Z) = m1\ z + q1$
- $y(z) = m2\ z + q2$

Risalire alla traccia

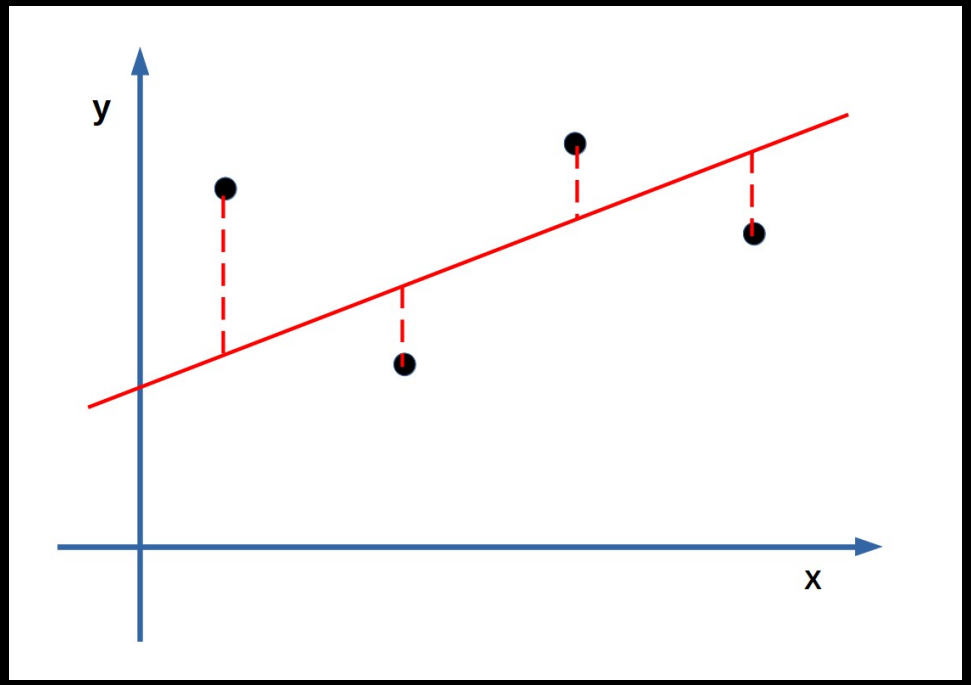


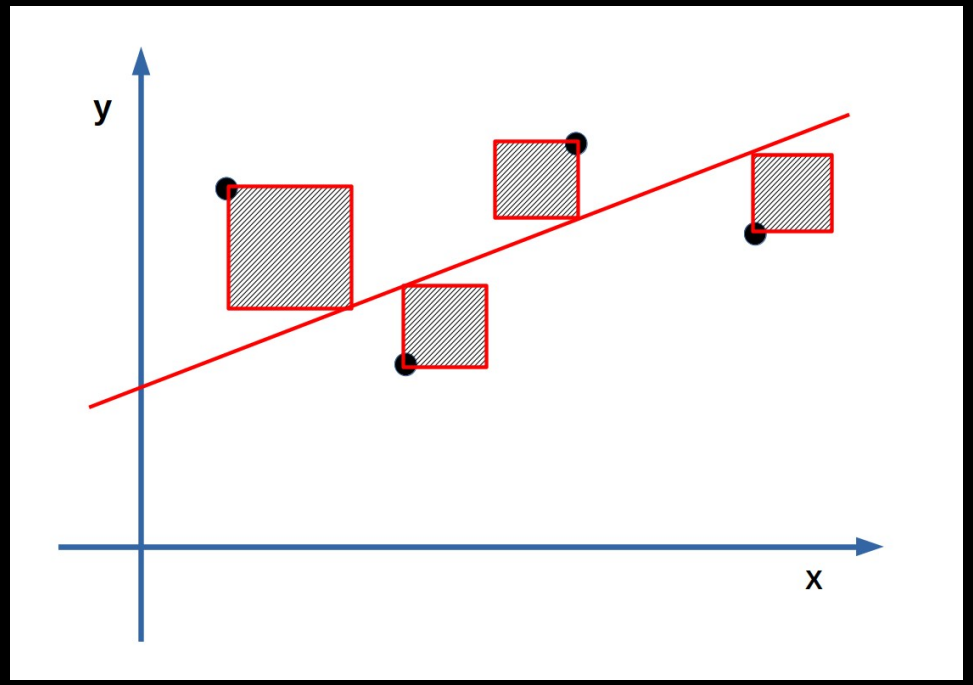




Qual è la migliore retta che passa per 4 punti non necessariamente allineati?

I minimi quadrati





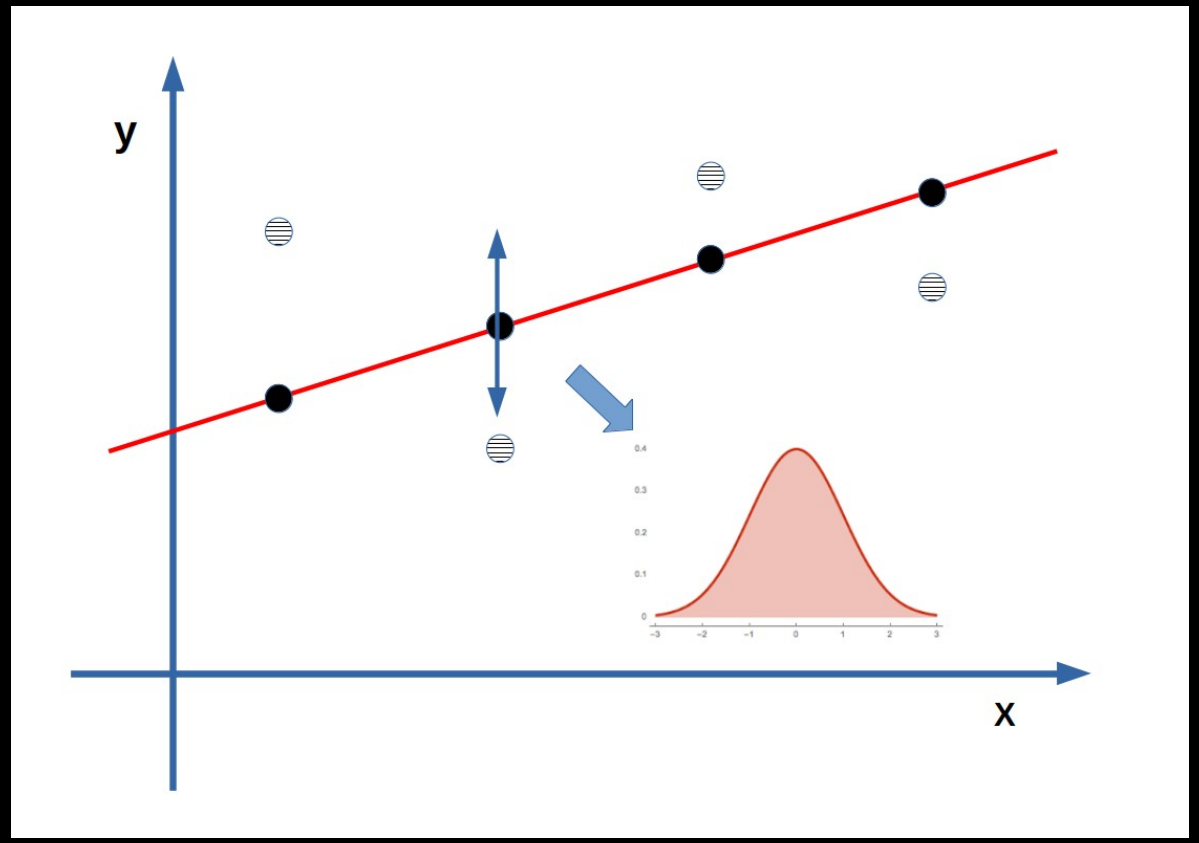
Minimo della somma delle distanze?

$$\mathcal{D}(m,q) = \sum_{i}^{N} |y_i - (mx_i + q)|$$

Minimo della somma dei quadrati!

$$\mathcal{X}^2(m,q) = \sum_{i=1}^{N} (y_i - (mx_i + q))^2$$

Il minimo della parabola



Interpretazione del metodo dei minimi quadrati

Riarrangiamento i termini del X2

$$\mathcal{X}^2(m,q) = \sum_{i=1}^{N} (y_i - (mx_i + q))^2 =$$

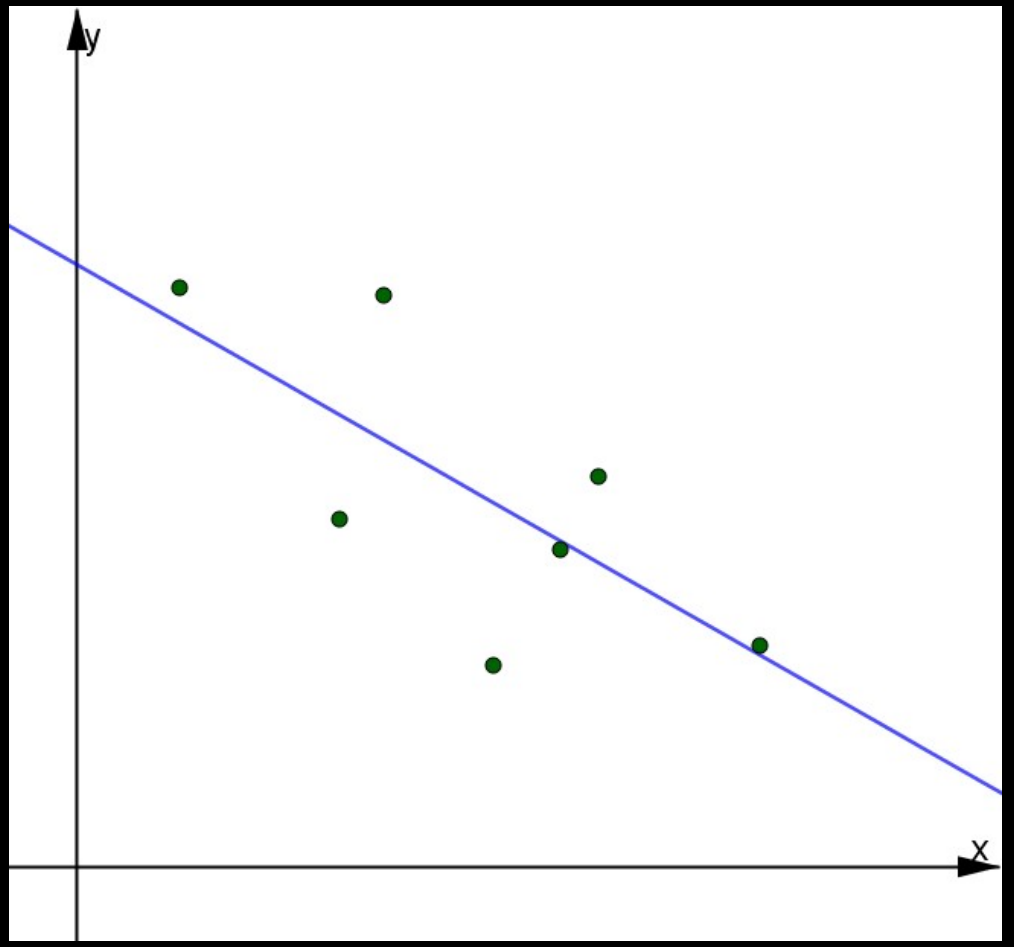
$$Am^2 + Bq^2 + Cmq + Dm + Eq + F$$

$$m = -\frac{Cq + D}{-2A}$$

$$q = -\frac{Cm + E}{-2B}$$

Minimo simultaneo rispetto a *m* e rispetto a *q*

La formula finale



$$\bar{X} = \frac{1}{N}\sum_{i=1}^{N} x_i \qquad \bar{Y} = \frac{1}{N}\sum_{i=1}^{N} y_i$$

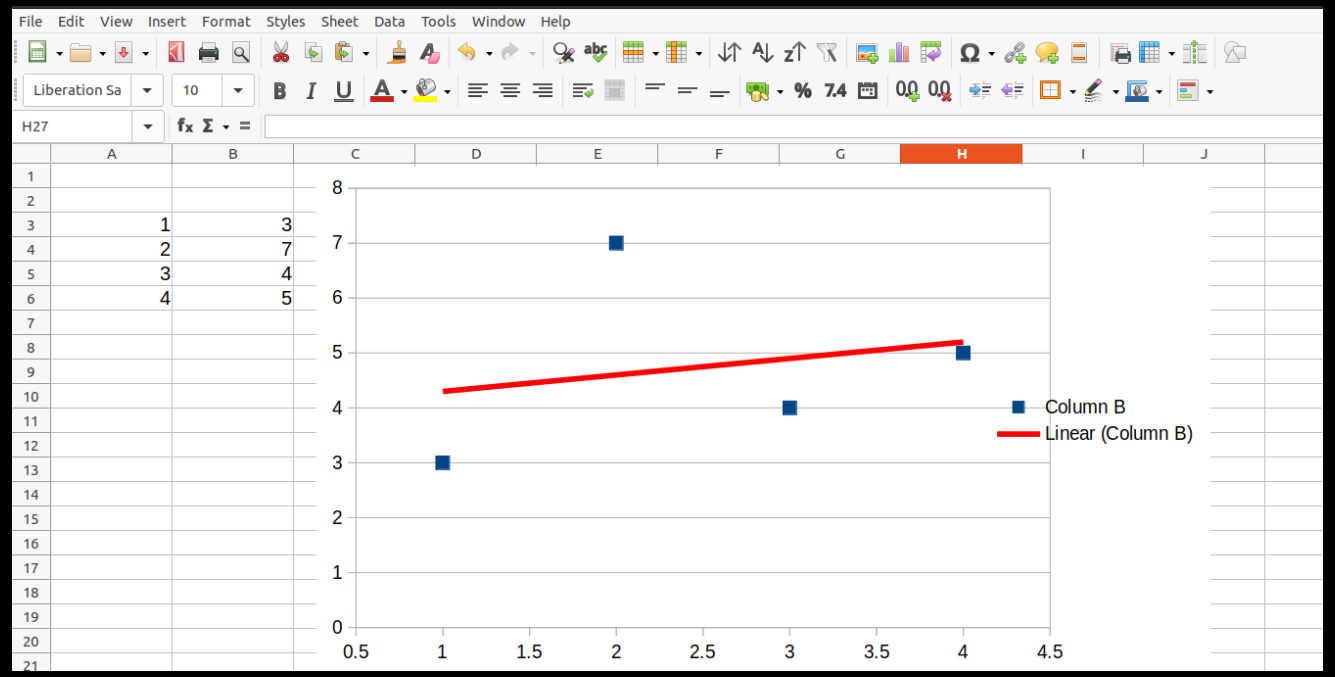
$$m = \frac{\sum(x_i - \bar{X})(y_i - \bar{Y})}{\sum(x_i - \bar{X})^2}$$

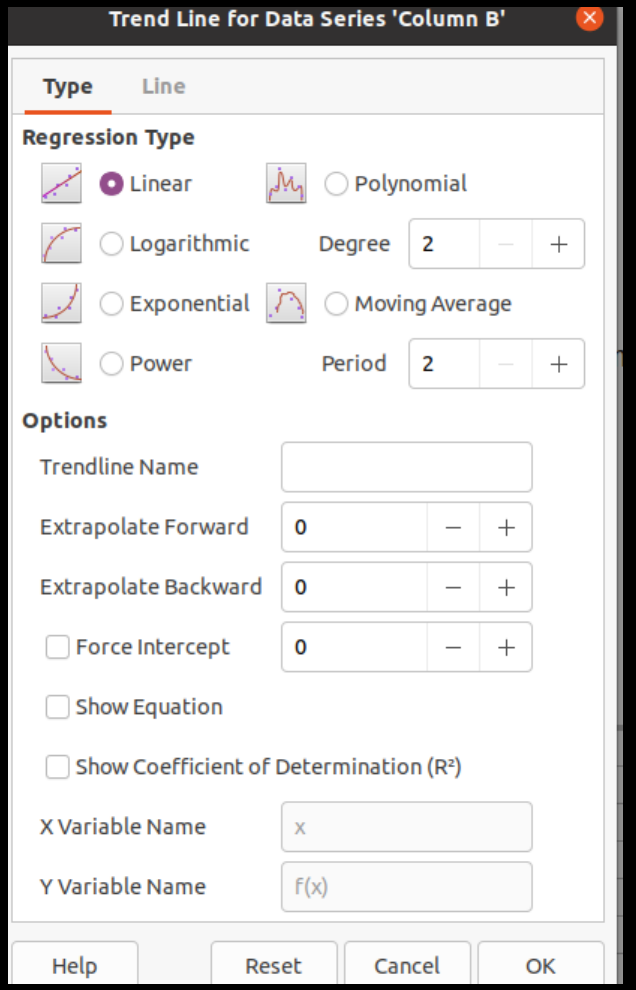
$$q = \bar{Y} - m\bar{X}$$

Costruzione manuale della linea di tendenza (regressione lineare o fit lineare).

Eseguibile per esempio tramite foglio di calcolo

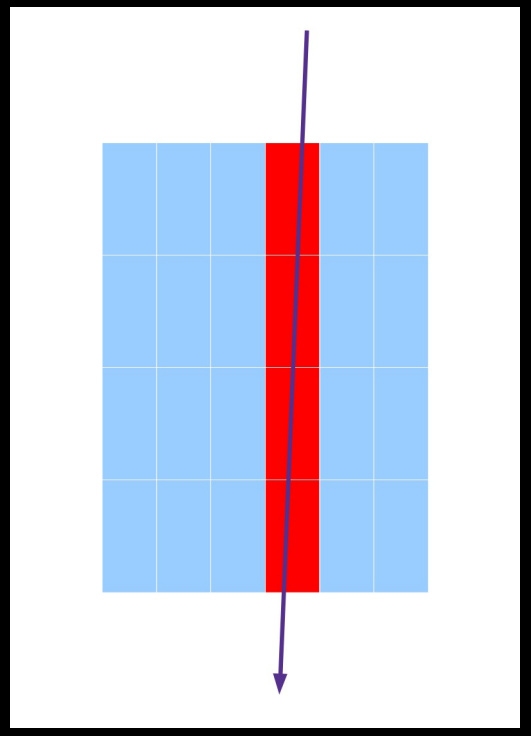
Con foglio di calcolo





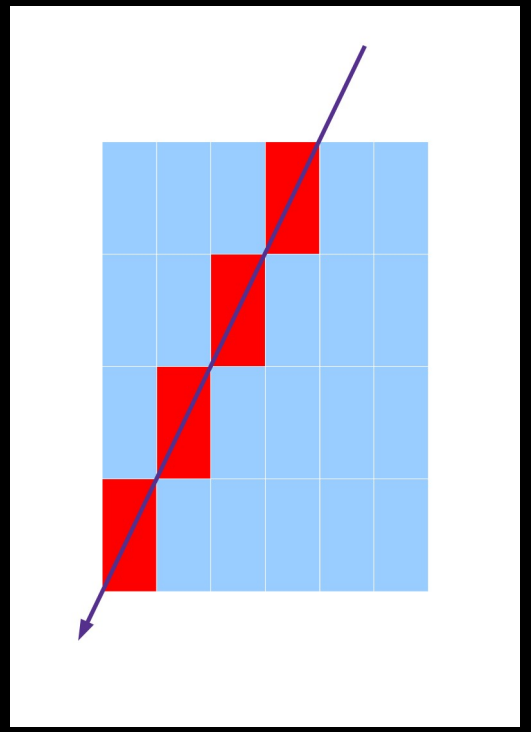
Dopo aver disegnato i punti, cliccando su un punto qualsiasi si sceglie trend, o linea di tendenza, e poi → fit lineare o regressione lineare, etc.…

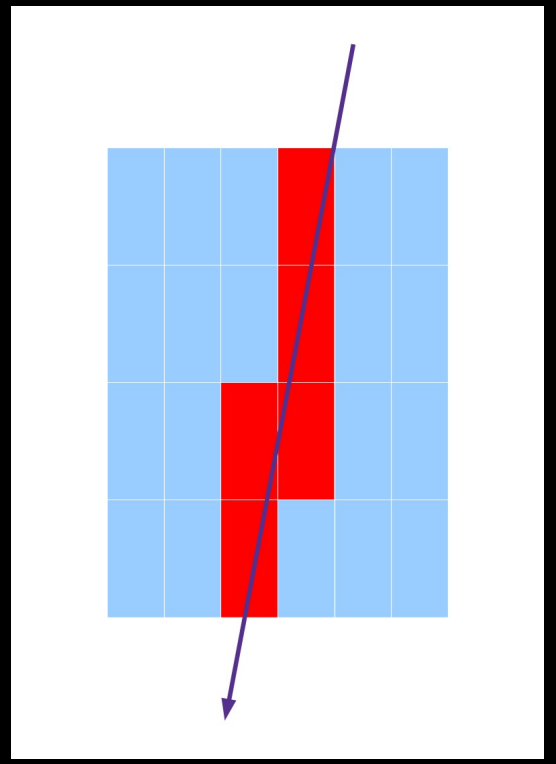
Esempi di eventi



1

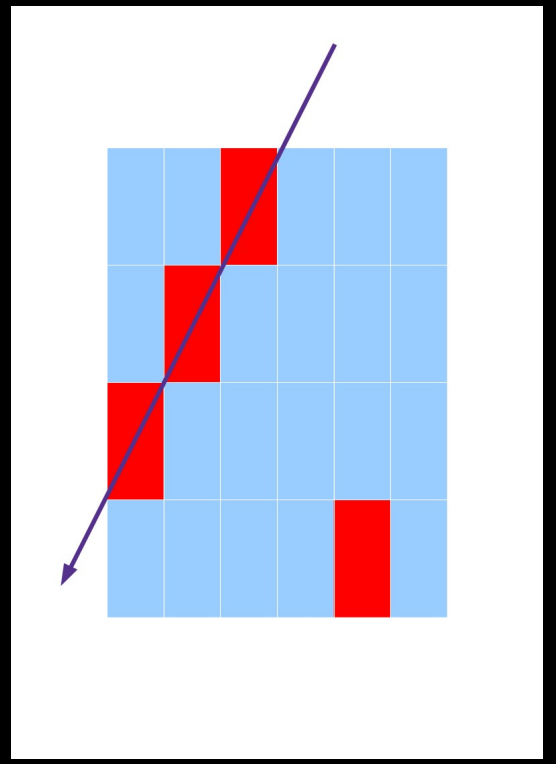
2





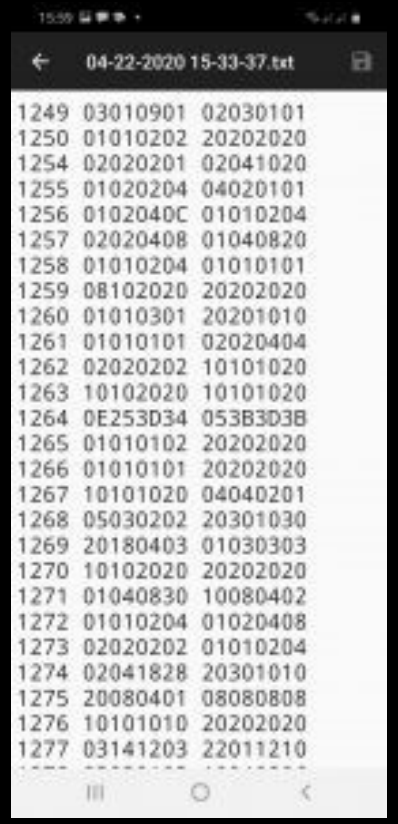
3

4



Un esempio di evento

Dall'esadecimale…

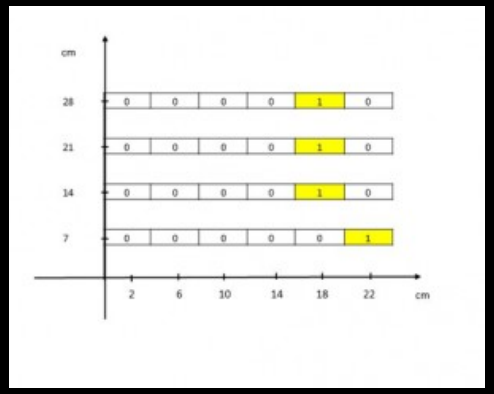


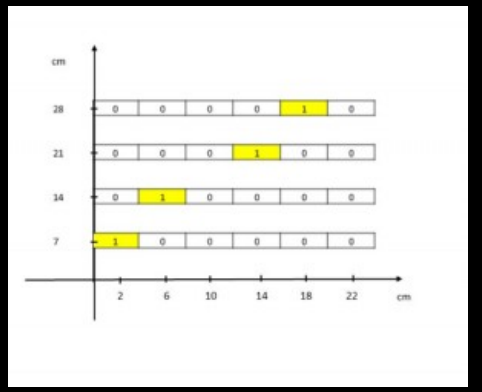
- 02 −>000010
- 02−>000010
- 02−>000010
- 01−>000001

- 02−>000010
- 04−>000100
- 10−>010000
- 20−>100000

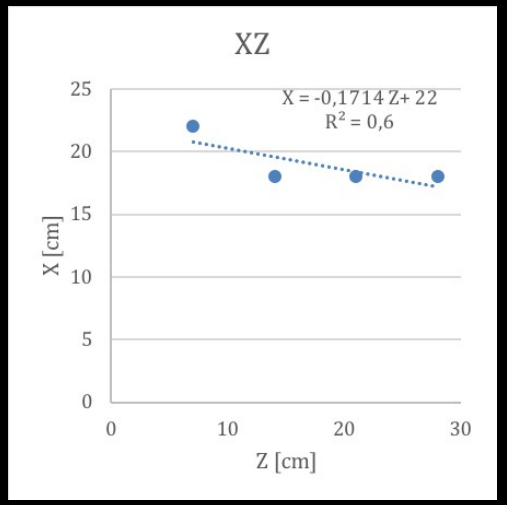
Z [cm]	X [cm]
28	18
21	18
14	18
7	22

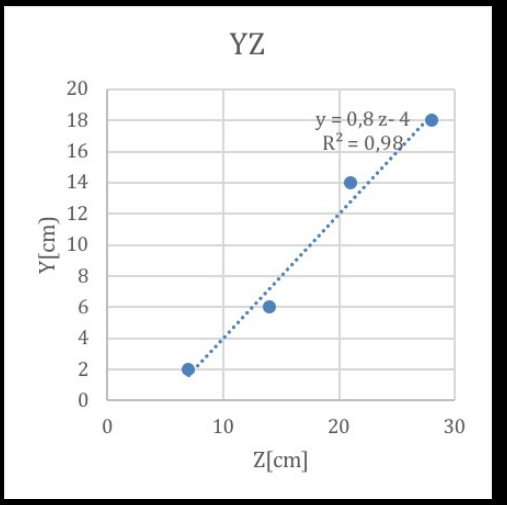
Z [cm]	Y [cm]
28	18
21	14
14	6
7	2



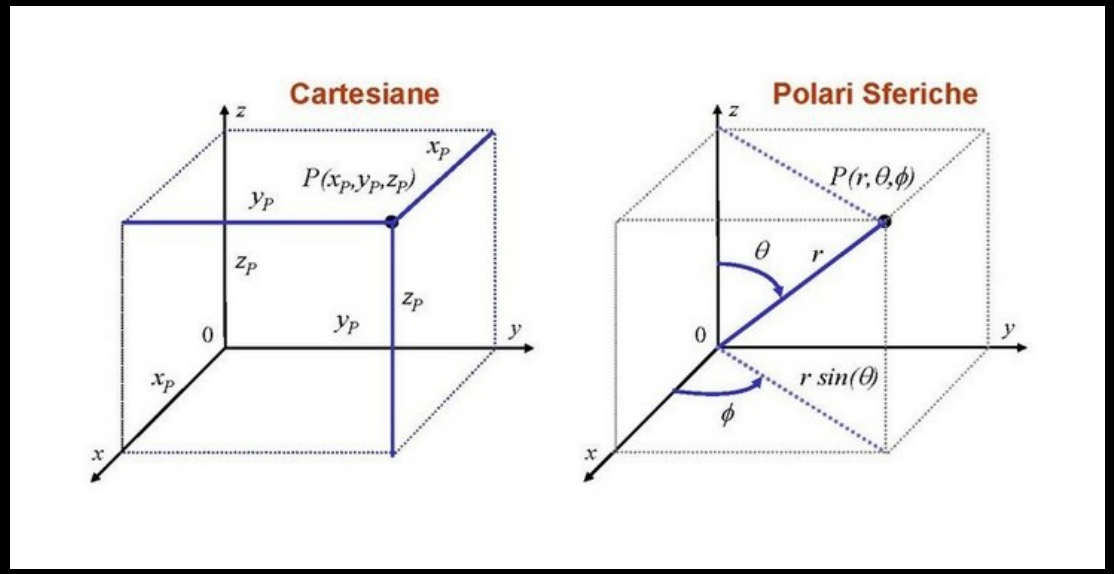


… alla traccia



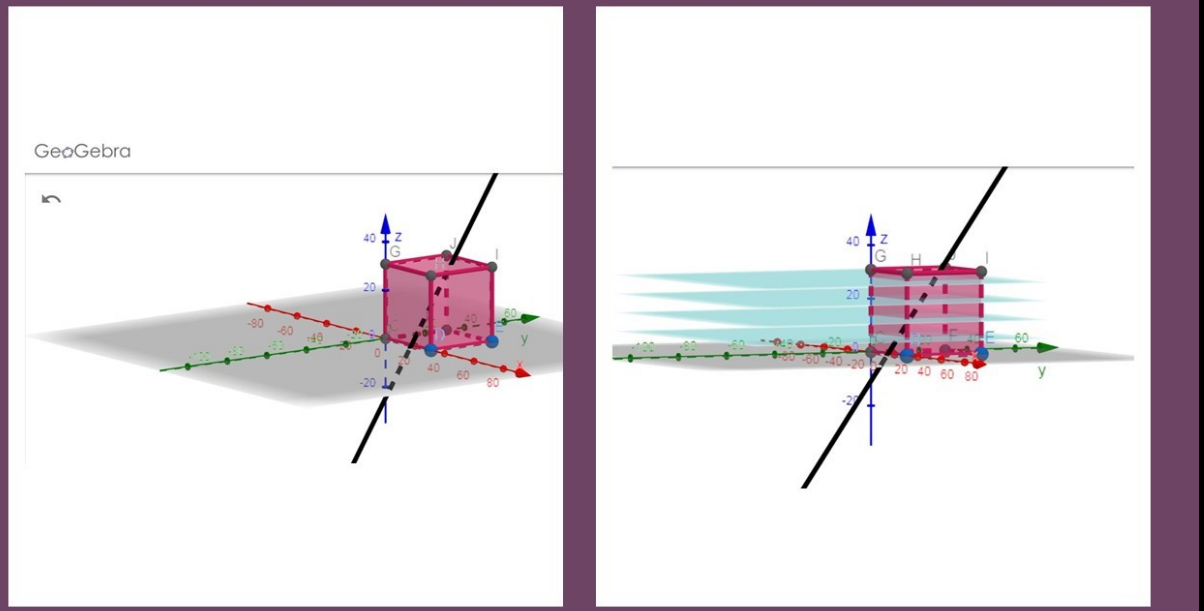


Rappresentazione 3D

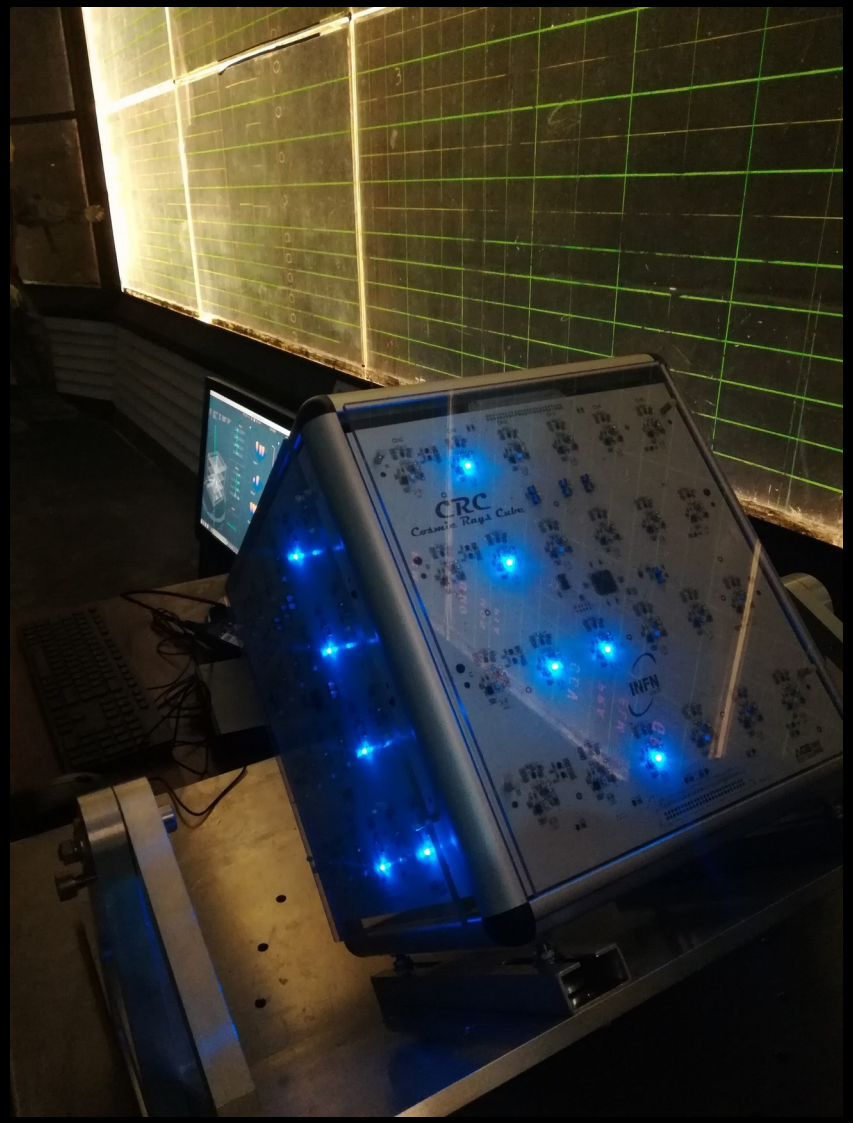


$$\cos\theta = \frac{V_z}{|V|} \qquad \tan\phi = \frac{V_y}{V_x}$$

$$x(z) = m_x z + q_x$$
$$y(z) = m_y z + q_y$$
$$V = (V_x, V_y, V_z) =$$
$$(x(1), y(1), 1) = (m_x, m_y, 1)$$



Ricostruzione con Geogebra



Grazie per l’attenzione!