$q = ne \quad , \quad e = 1.602 \times 10^{-19}\,C$

q costante e invariante

$q > 0, \ < 0, \ = 0, \ q_{tot} \simeq 0$

interazione elettrostatica

$$\boxed{\vec{F} = k_e \frac{Q\,q}{r^2}\,\hat{r}} \qquad k_e = \frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}$$

"se un albero cade nella foresta e nessuno è lì ad ascoltarlo, fa comunque rumore?"

Sì

$$\vec{F} \Longrightarrow \vec{E} = \frac{\vec{F}}{q}$$

"rumore sentito" "rumore" virtuale

$$\vec{E}(\vec{r}) =$$ stato dello spazio prodotto dalla carica

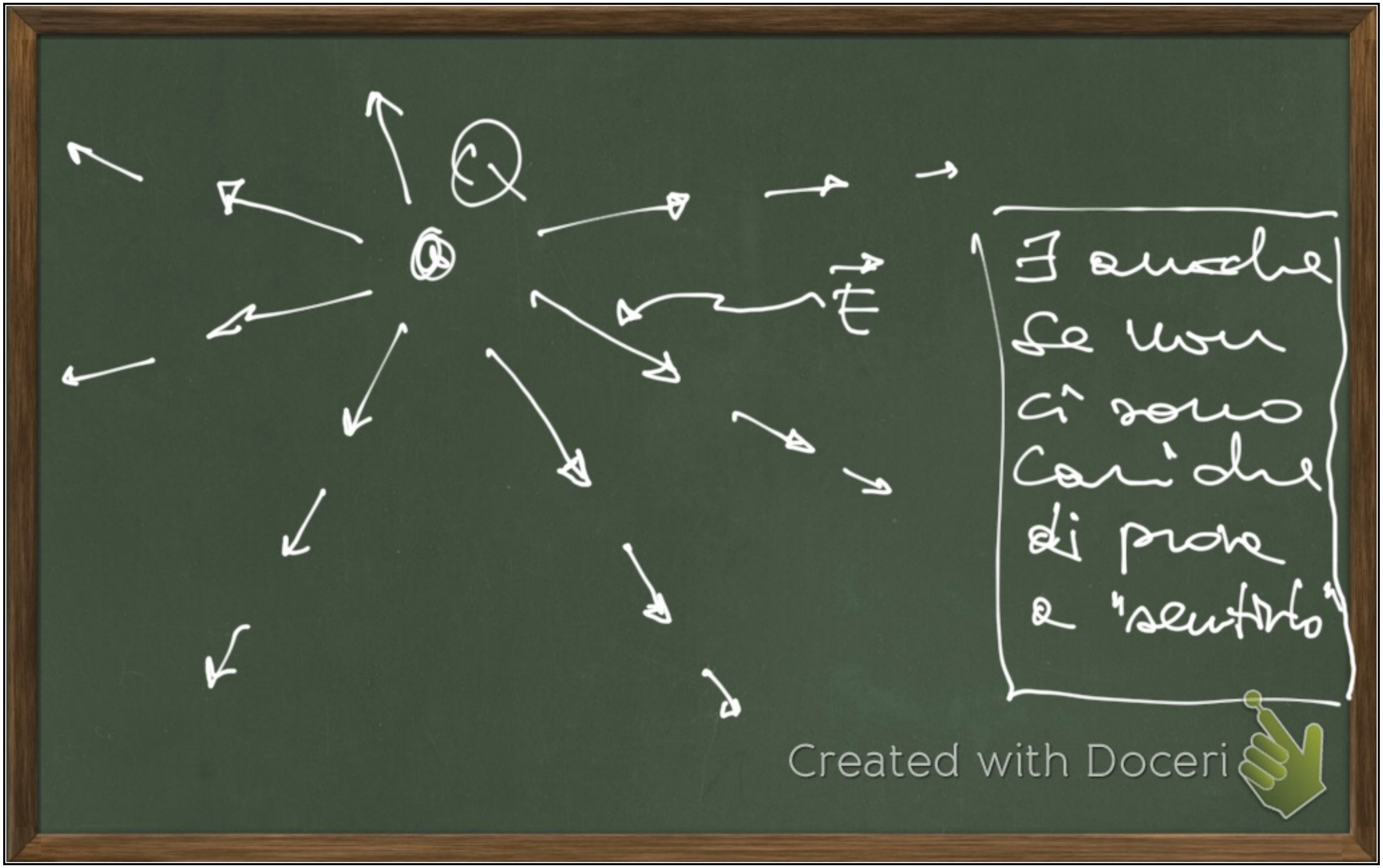
CAMPO ELETTRICO

carica puntiforme Q

$$Q \; \bullet \text{- - -} \; \overset{q}{\bullet} \longrightarrow \vec{F} = k_e \frac{qQ}{r^2} \hat{r}$$

$$\vec{E} = \frac{\vec{F}}{q} = \boxed{k_e \frac{Q}{r^2} \hat{r} = E_{c.punt.}}$$

dipende solo dalla carica "generatrice", non da quella di prova


Q
$\vec{E}$
∃ anche
se non
ci sono
cariche
di prova
a "sentirlo"
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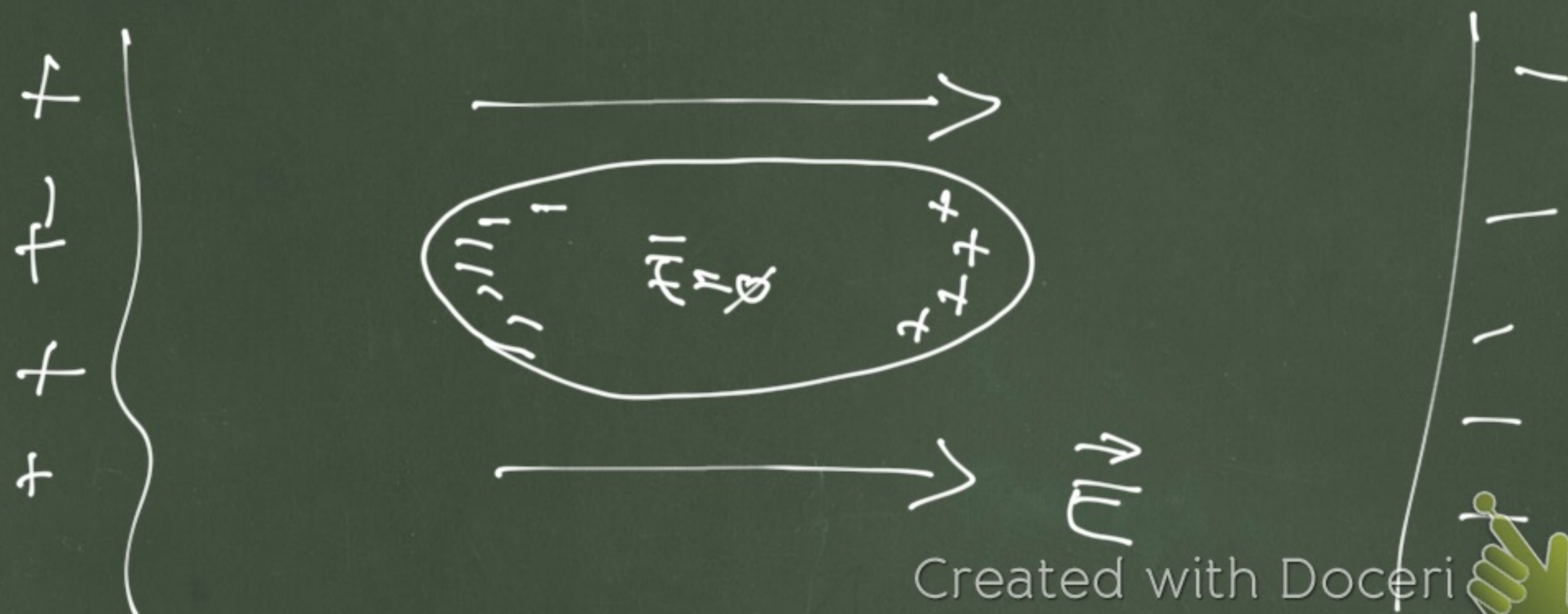
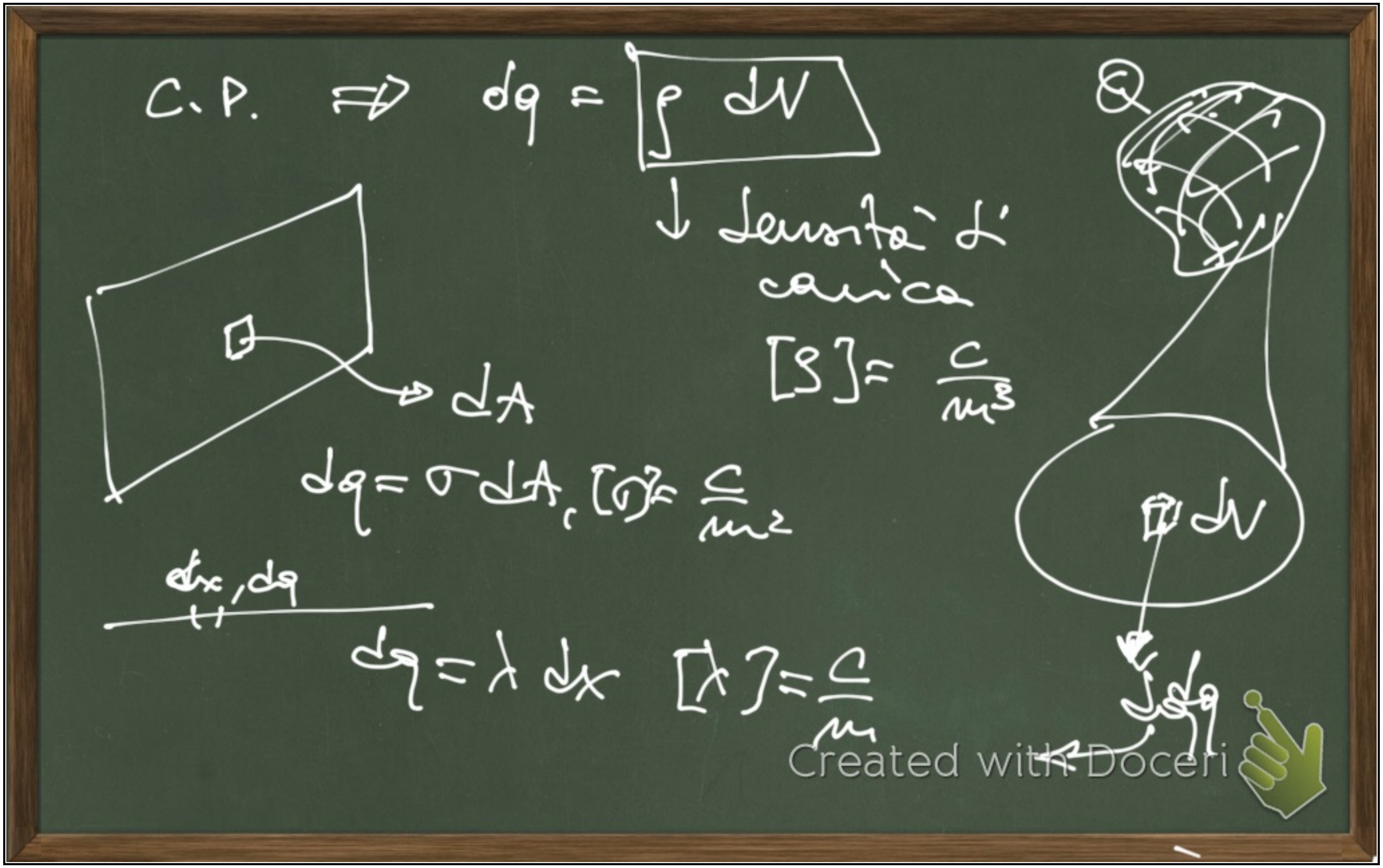
Dimenticarsi delle sorgenti

è comodo: mi basta sapere $\vec{E}$




C.P. ⇒ dq = ρ dV
densità di carica
[ρ] = C/m³
dA
dq = σ dA, [σ] = C/m²
dx, dq
dq = λ dx [λ] = C/m
Q
dV
dq
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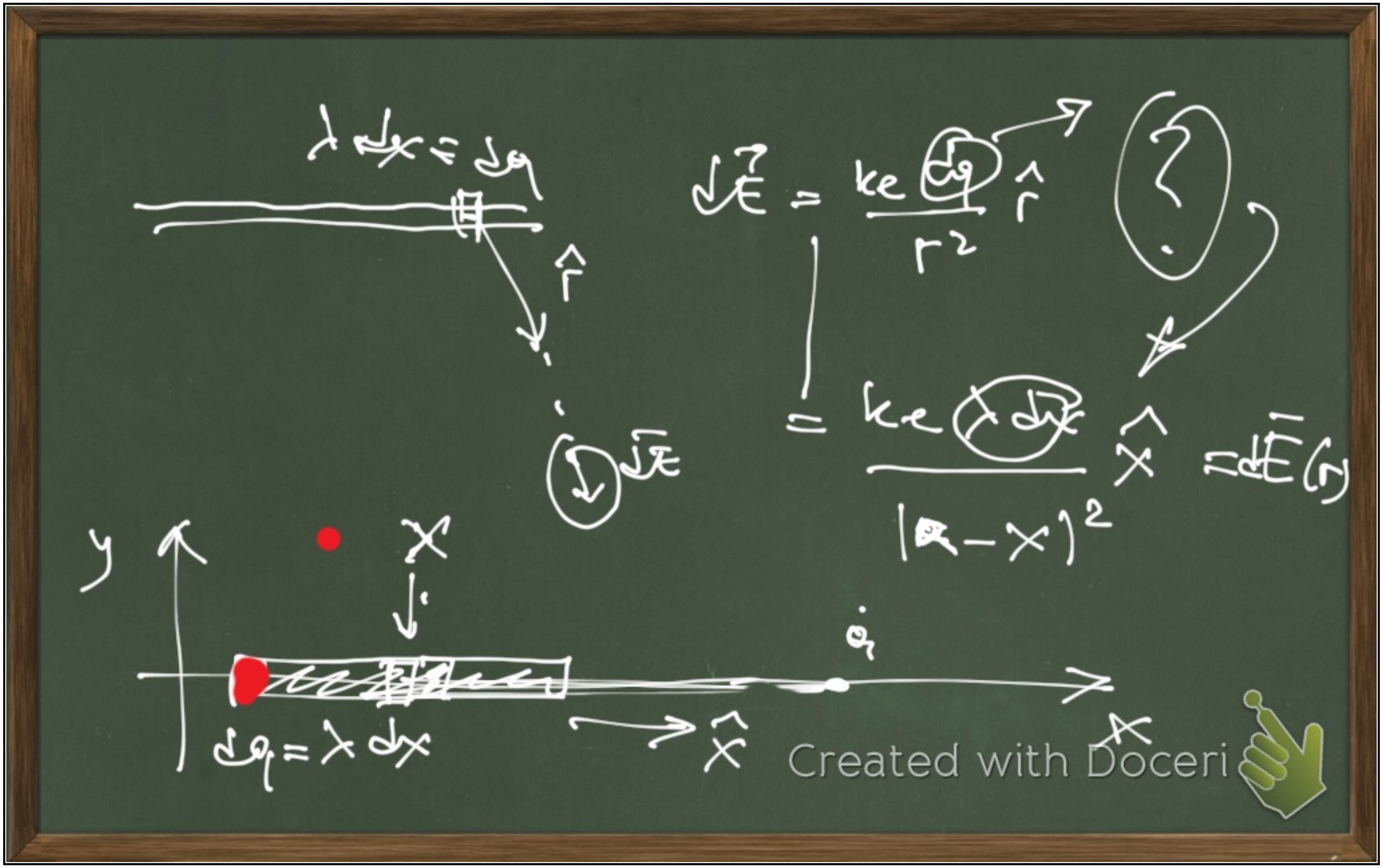
λ dx = dq
r̂
dE
dE = ke dq / r² r̂
= ke λ dx / |x − x|² x̂ = dE(r)
?
y
x
q
dq = λ dx
x̂
x
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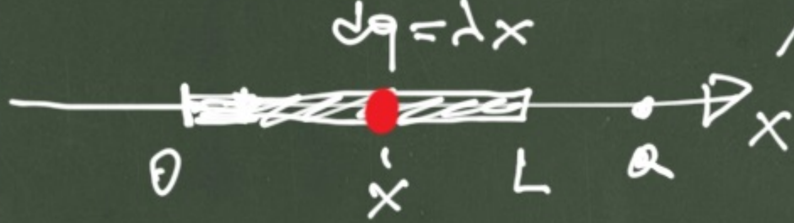


$$\lambda > 0 \rightarrow \hat{x}$$

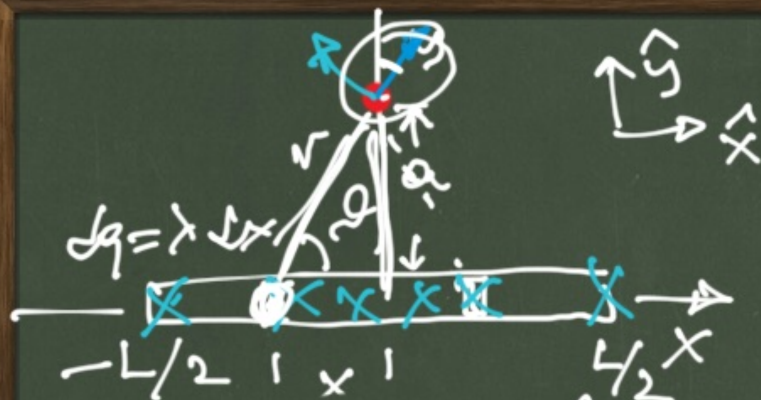
$$d\vec{E} = k_e \frac{\lambda dx \, \hat{x}}{(x-a)^2}$$

$$E(a) = k_e \lambda \int_0^L \frac{dx}{(x-a)^2} = k_e \lambda \left[\frac{1}{(a-x)} \right]_0^L = k_e \frac{\lambda L}{L} \left[\frac{1}{(a-L)} - \frac{1}{a} \right]$$

$$\boxed{k_e Q \left[\frac{1}{L(a-L)} - \frac{1}{aL} \right]} \rightarrow k_e Q \left(\frac{\cancel{aL} - \cancel{aL} + \cancel{L}}{L^{\cancel{2}} a (a-L)} \right)$$

$$k_e\lambda\left[\frac{1}{a-L}-\frac{1}{a}\right]=k_e\lambda\left(\frac{\cancel{a}-\cancel{a}+L}{a(a-L)}\right)$$

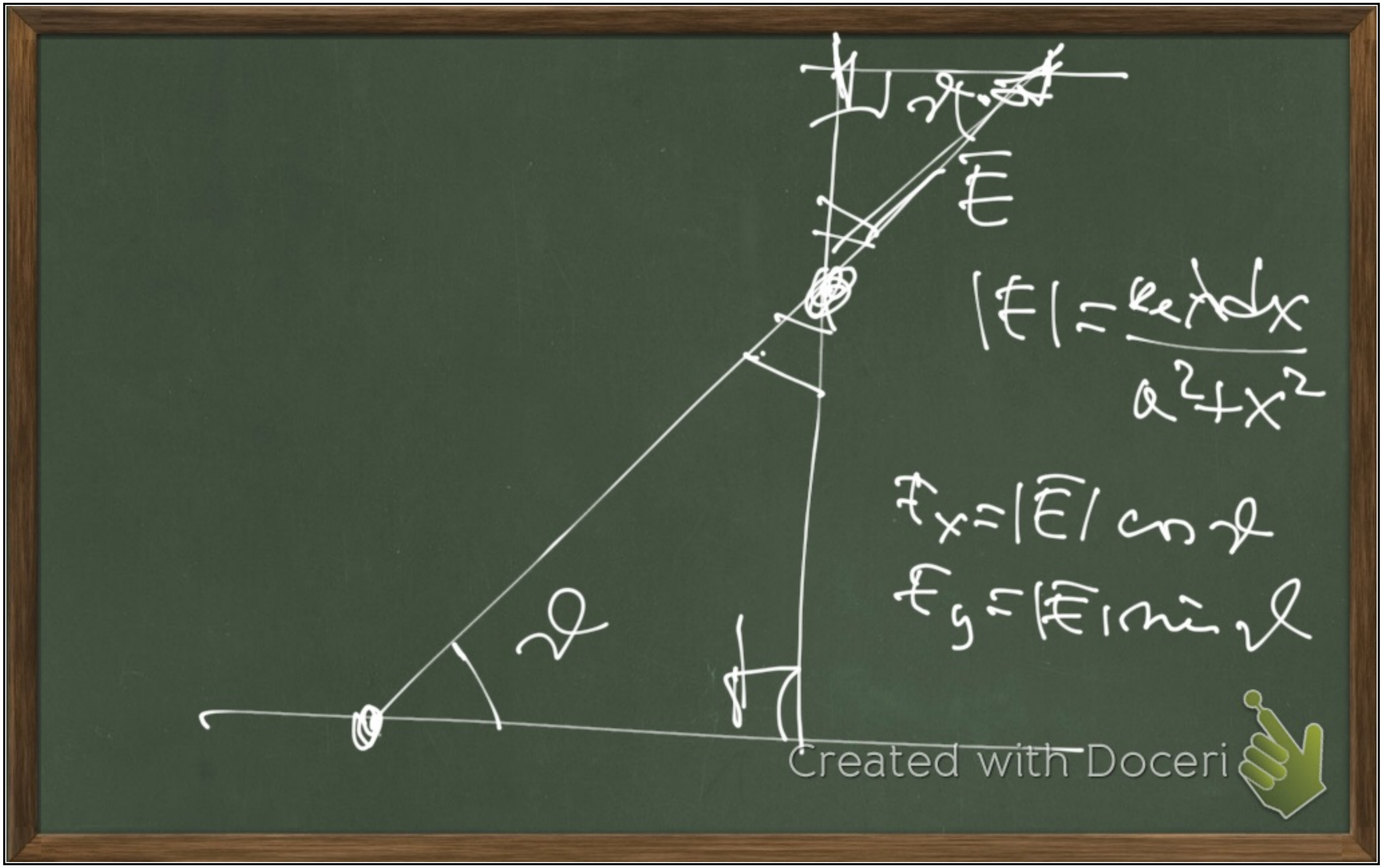
$$=k_e\frac{\lambda L}{\cancel{L}}\left(\frac{\cancel{L}}{a(a-L)}\right)=\frac{k_e Q}{a(a-L)}\underset{L\to 0}{\approx}\frac{k_e Q}{a^2}$$



$$r = \sqrt{x^2+a^2}$$

$$d\vec{E} = \hat{y}\,\frac{\lambda\, dx}{x^2+a^2}\,\sin\theta$$

$$\vec{E} = \hat{y}\,\lambda\int_{-L/2}^{L/2}\frac{dx\; a}{(x^2+a^2)\,r} = \hat{y}\,\lambda a\int_{-L/2}^{L/2}\frac{dx}{(x^2+a^2)^{3/2}}$$


$\vec{E}$
$|\vec{E}| = \frac{k_e \lambda dx}{a^2 + x^2}$
$E_x = |\vec{E}| \cos\theta$
$E_y = |\vec{E}| \sin\theta$
θ
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$$\hat{y}\,\lambda a k_e \int_{-L/2}^{L/2} \frac{dx}{(x^2+a^2)^{3/2}} = k_e \lambda a \hat{y} \left[\frac{x}{a^2(a^2+x^2)^{1/2}}\right]_{-L/2}^{L/2}$$

$$= \frac{k_e \lambda \cancel{a} \hat{y} L}{a^{\cancel{2}}\left(a^2+L^2/4\right)^{1/2}}$$

$$= \frac{k_e \lambda L}{a\left(a^2 + L^2/4\right)^{1/2}}\,\hat{y} = \frac{k_e \lambda \cancel{L}}{\cancel{L}\, a\left(\frac{a^2}{L^2} + \frac{1}{4}\right)^{1/2}}$$

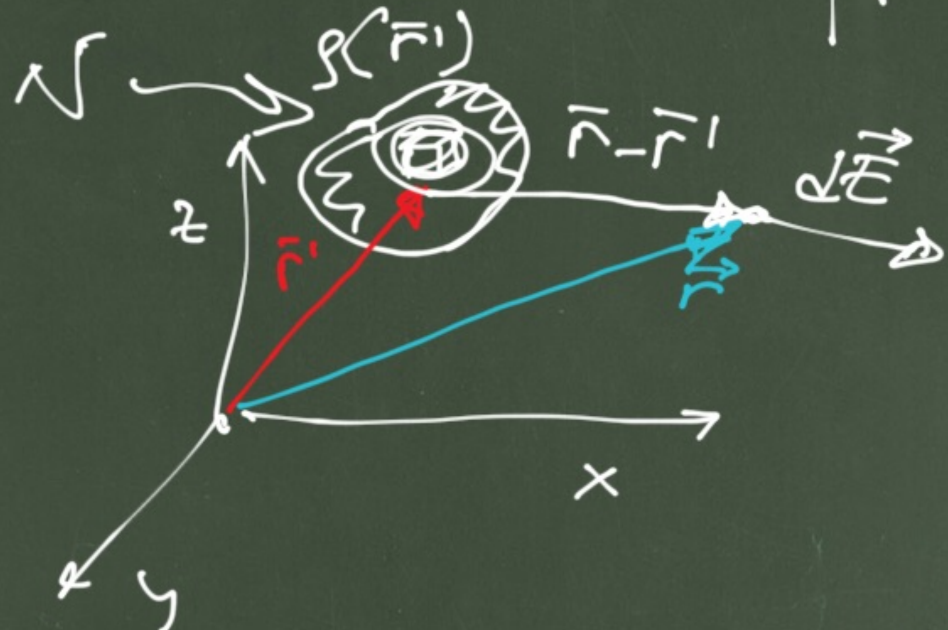
$$\xrightarrow[L \to \infty]{} \;\simeq\; \boxed{\frac{2 k_e \lambda}{a} = E_{filo}}$$

$$[E] = \left[\frac{N}{C}\right]$$

$$= \frac{k_e \lambda L}{a\left(a^2 + L^2/4\right)^{1/2}} \hat{j} = \frac{k_e Q}{a\left(a^2 + \frac{L^2}{4}\right)^{1/2}} \quad L \to 0$$

$$\sim \frac{k_e Q}{a^2}$$

$$d\vec{E}(\vec{r}) = k_e \frac{\rho(\bar{r}')\, d\bar{r}'}{|\bar{r} - \bar{r}'|^2}$$



$$d\bar{r} = dx\,dy\,dz$$

$$= r^2 \sin\theta\, dr\, d\theta\, d\varphi$$

$$|\bar{a}|^2 = a_x^2 + a_y^2 + a_z^2$$

$$\vec{E}(\vec{r}) = \int_V k_e \frac{\rho(\vec{r}\,')\,d\vec{r}\,'}{|\vec{r} - \vec{r}\,'|^2}\,\hat{p}$$

$$= k_e \iiint \frac{\rho(x', y', z')\,dx'\,dy'\,dz'}{(x-x')^2 + (y-y')^2 + (z-z')^2}\,\hat{p}$$

$$= E(x, y, z)$$

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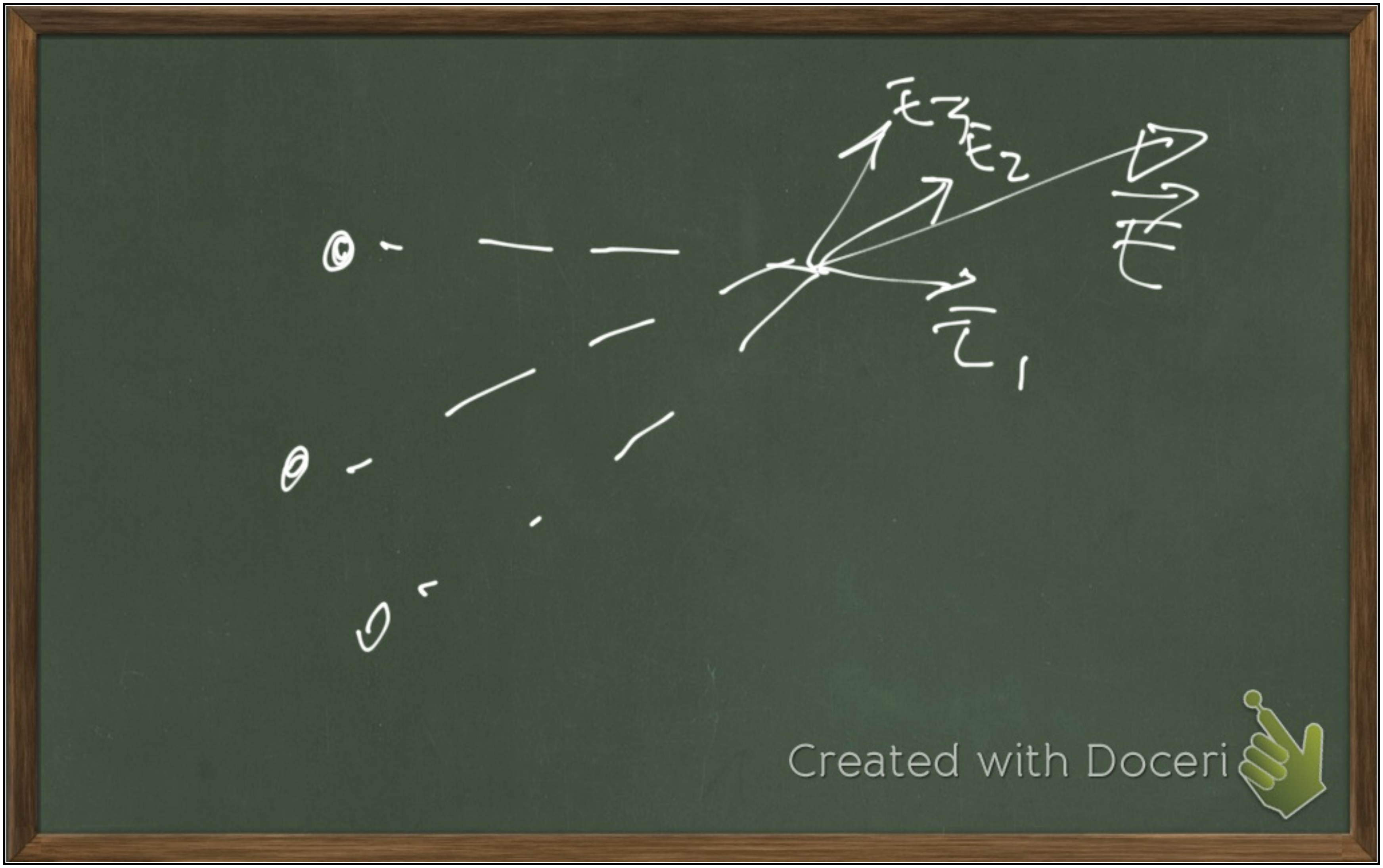
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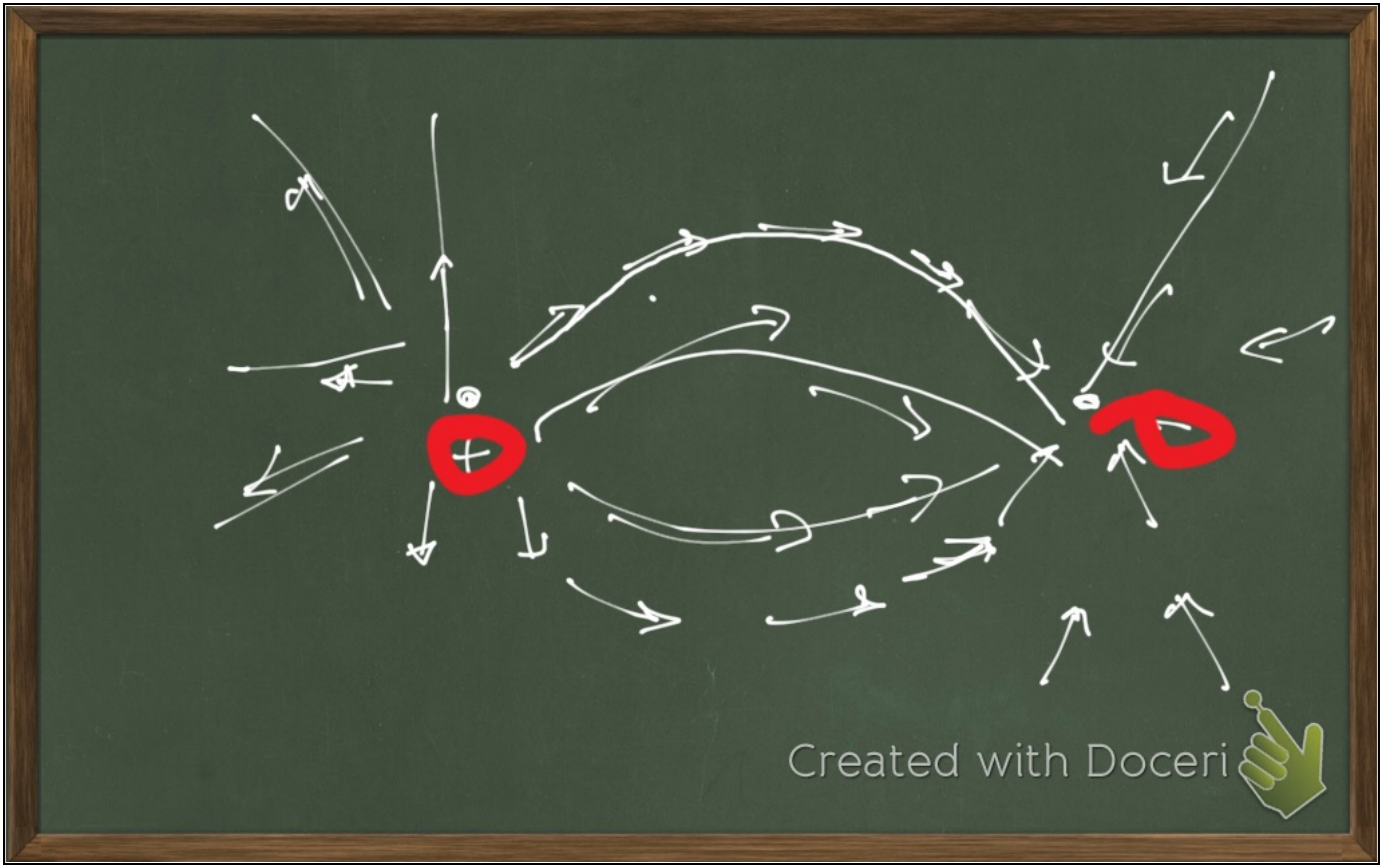
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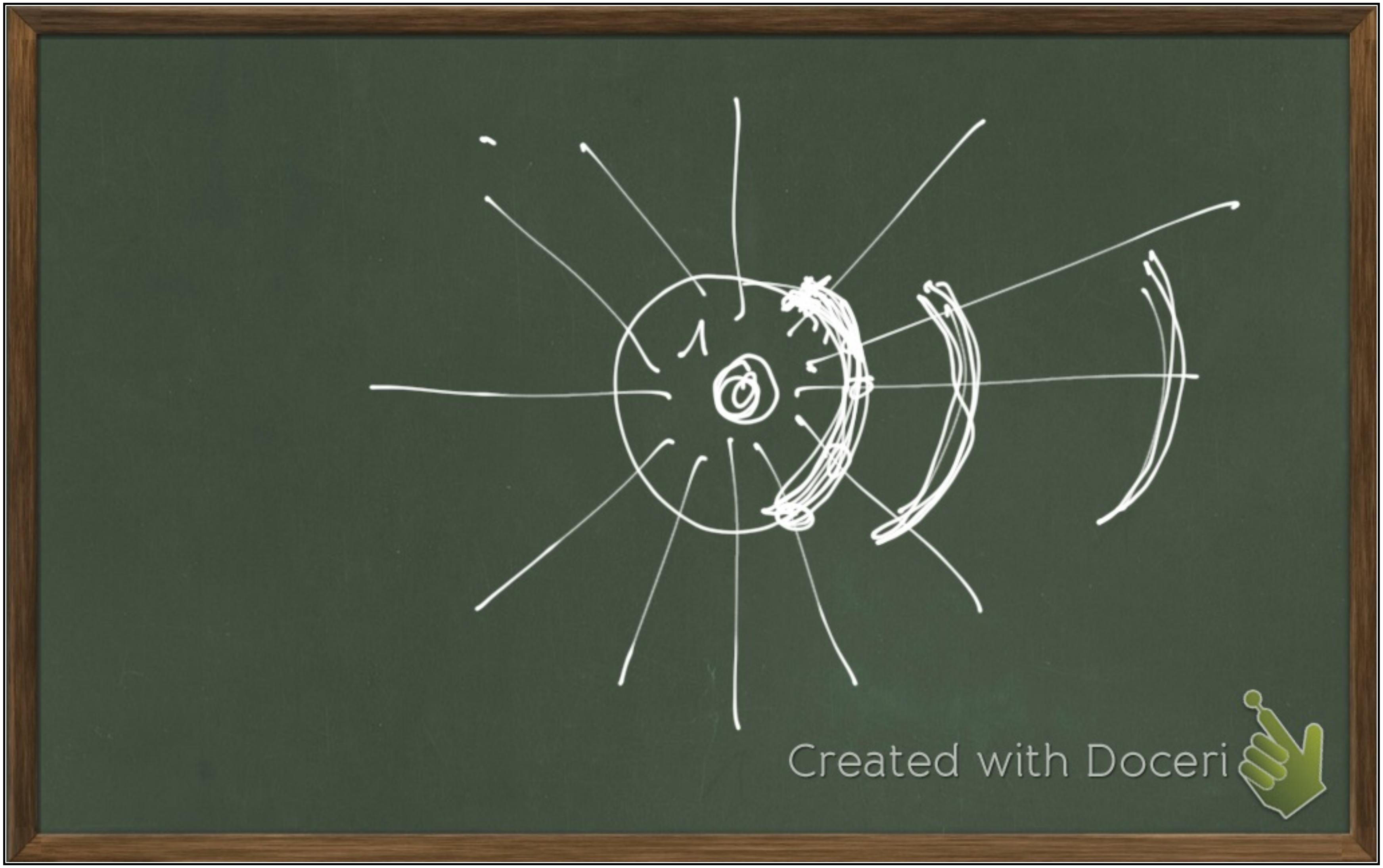
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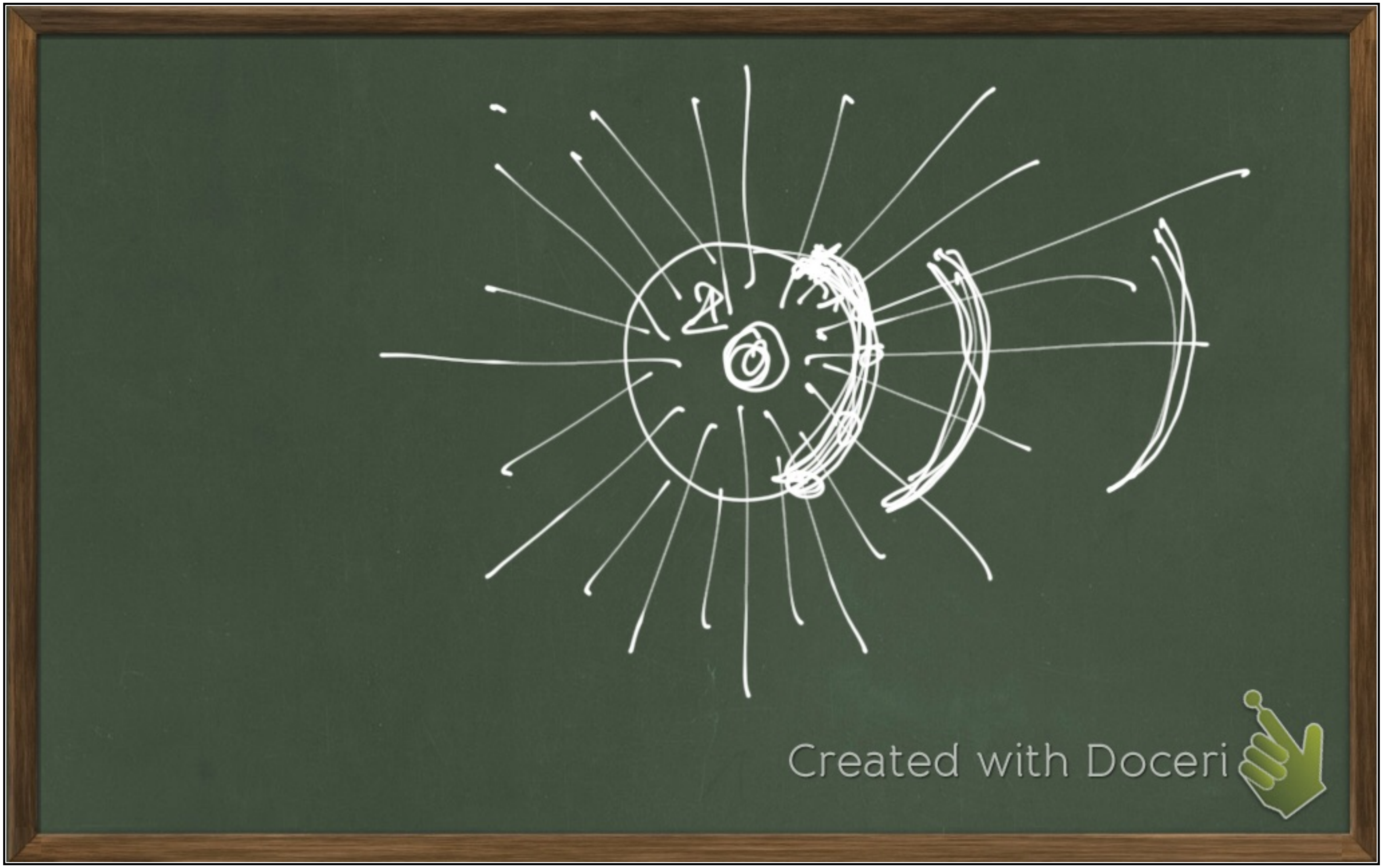
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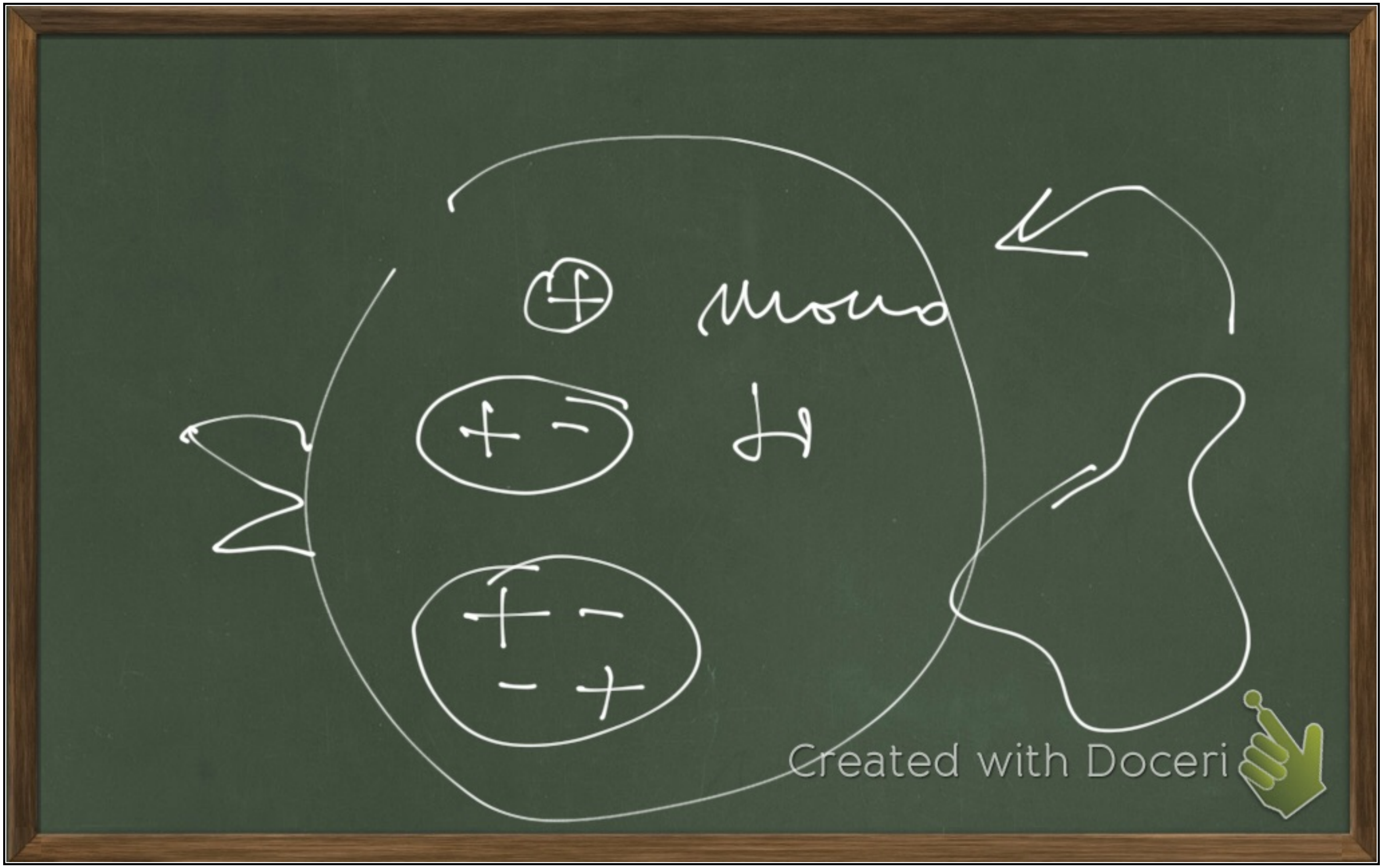
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