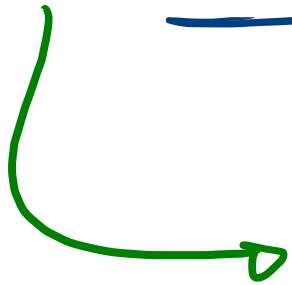


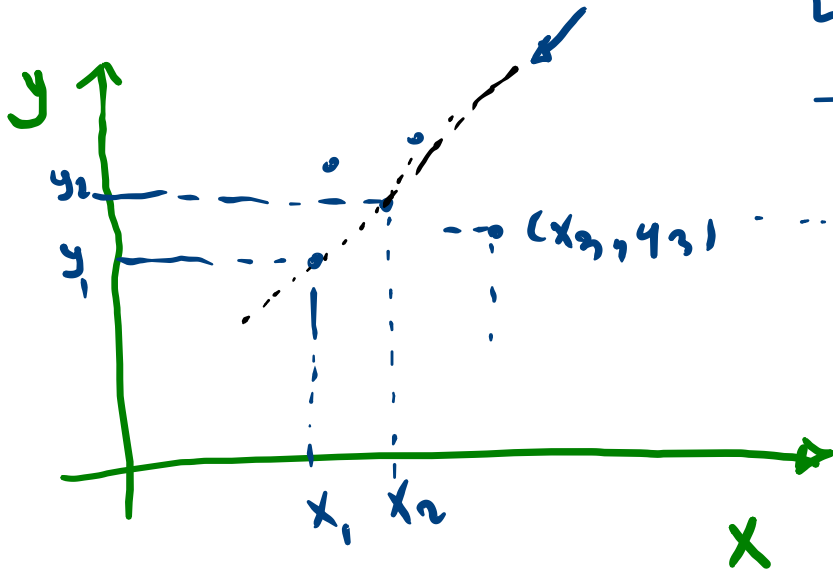
Hough Transform



line detection

circle detection

Line Detection

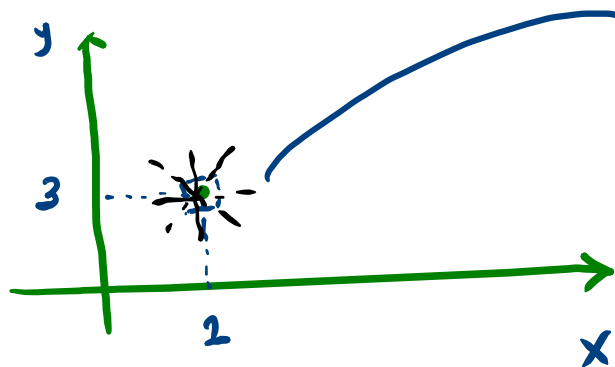


$$y = mx + c$$

مختصات c یا m

ضریب m در معادله $y = mx + c$

مختصات c در معادله $y = mx + c$

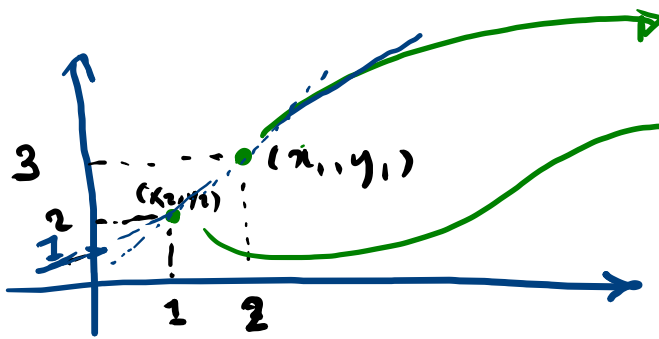


$$3 = m(2) + C$$



$$\rightarrow \underline{\underline{3 = 2m + C}}$$

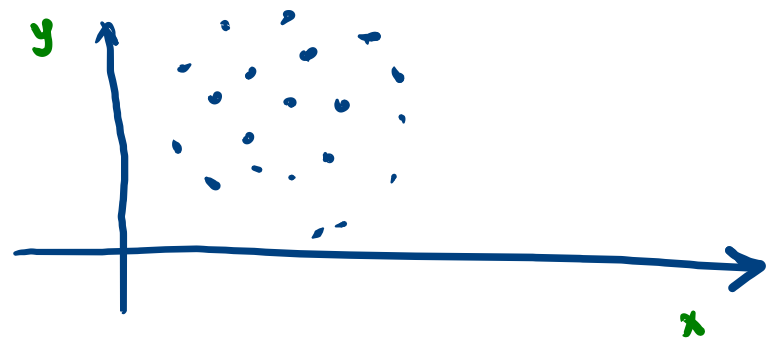
$$-\infty < m < \infty$$



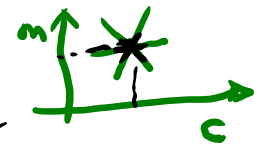
$$3 = 2m + c$$

$$2 = m + c$$

$$m, c \rightarrow \begin{matrix} m = 1 \\ c = 1 \end{matrix} \rightarrow y = x + 1$$



$$\underline{y = mx + c}$$



$$3 = 2\underline{m} + \underline{c}$$

$$1 = \underline{m} + \underline{c}$$

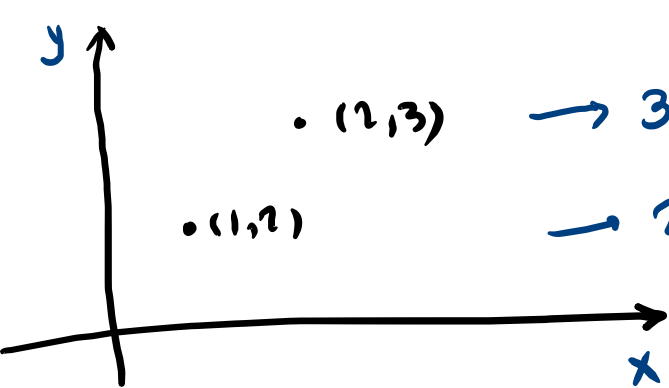
$$10 = 3\underline{m} + \underline{c}$$

$$7 = 6m + c$$

⋮

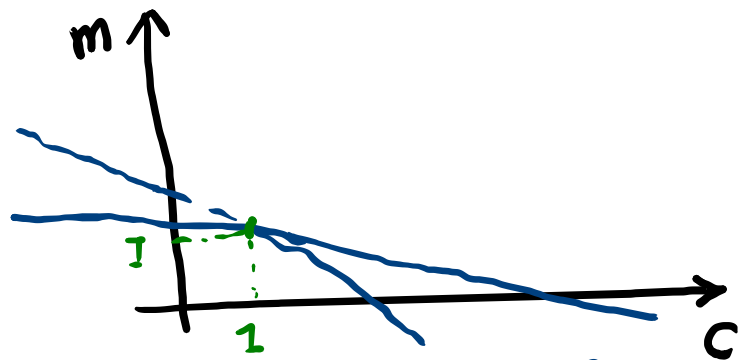
100

مر!



$\bullet (2, 3) \rightarrow 3 = 2m + c$

$\rightarrow 2 = m + c$



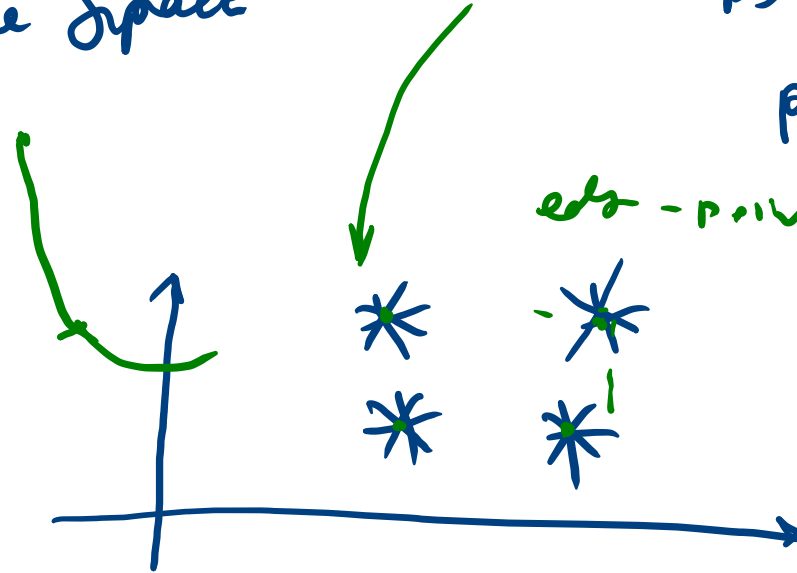
phase space.

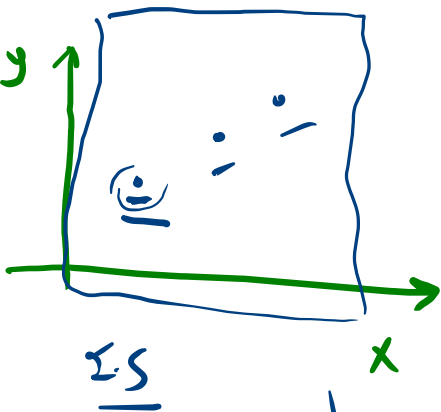
parameters space.

Image space

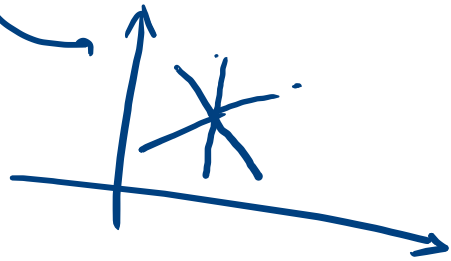
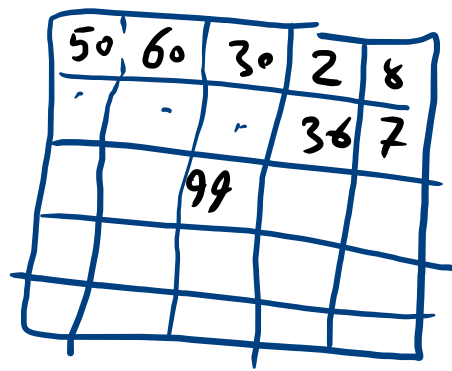
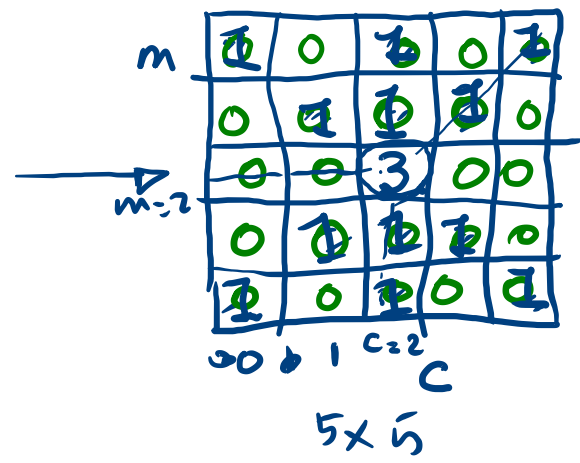
$y = mx + c$

edge-point (m, c)





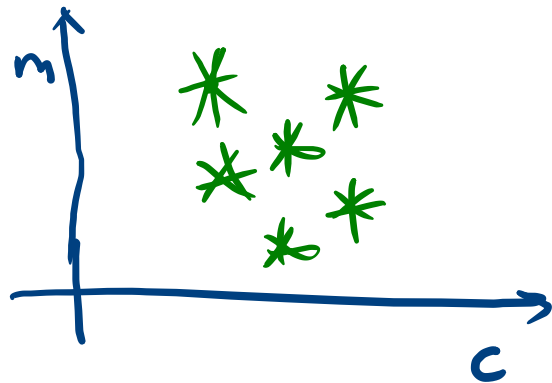
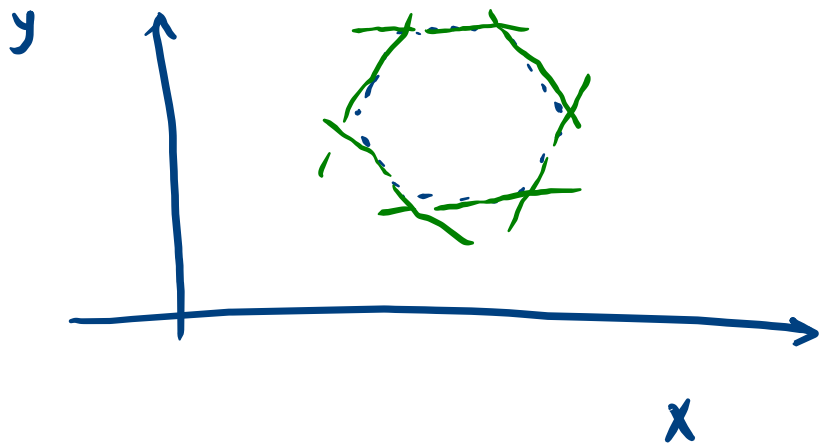
5x5

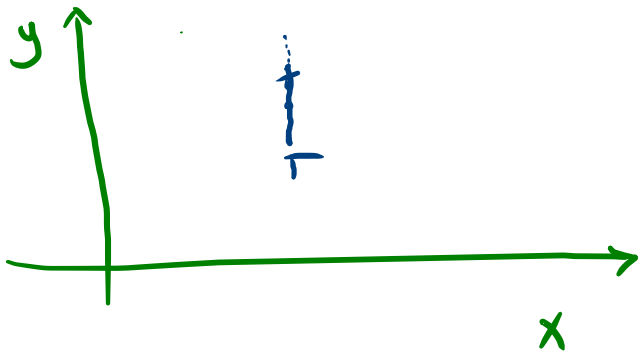


m.c

thresh. 4

~~40~~ 20





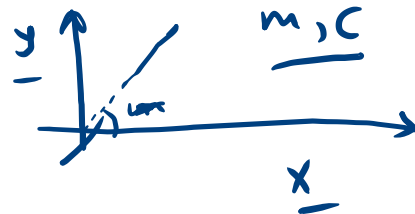
$$y = mx + c$$
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$m = \frac{\infty}{0} = \infty$$

A blue coordinate system with a horizontal x-axis and a vertical y-axis. A blue curve is drawn in the first quadrant, starting from the y-axis and curving upwards and to the right. A vertical dashed line is drawn in the first quadrant, parallel to the y-axis.

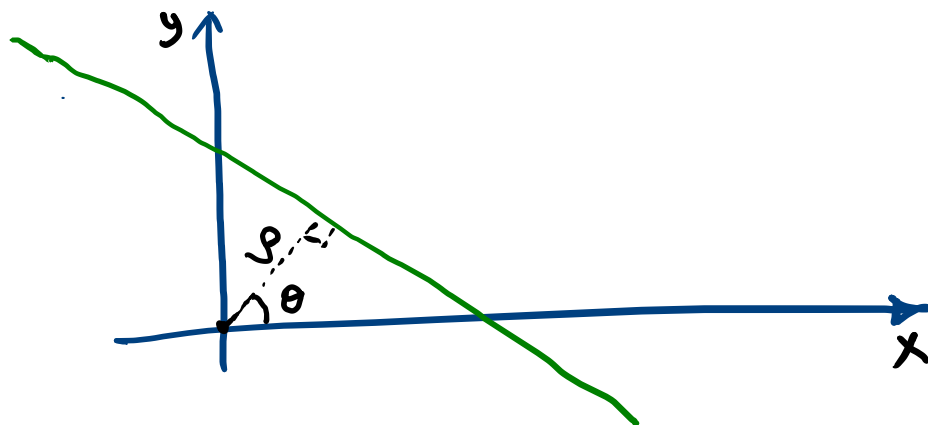


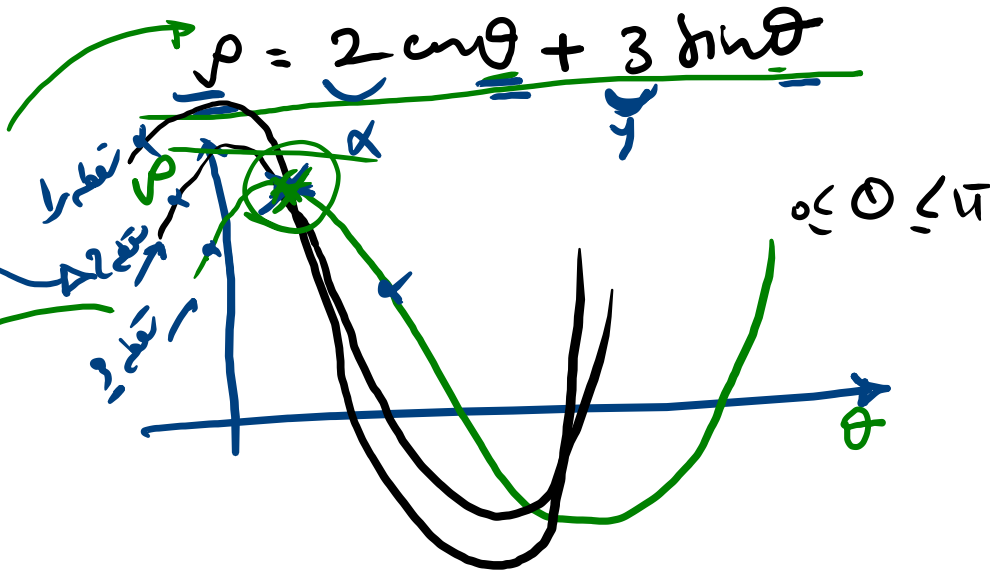
rho

polar

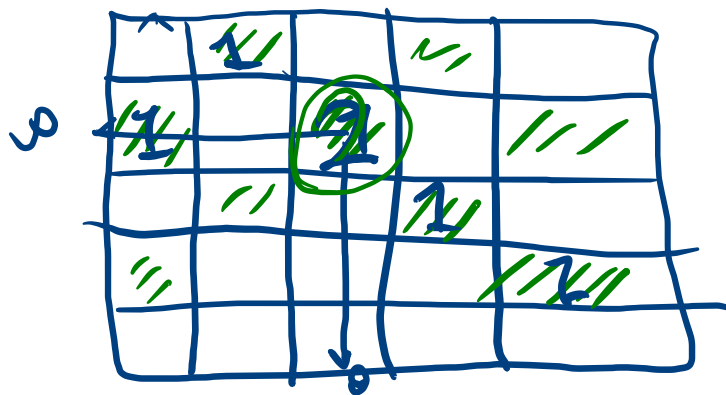


$$\rho = x \cos \theta + y \sin \theta$$



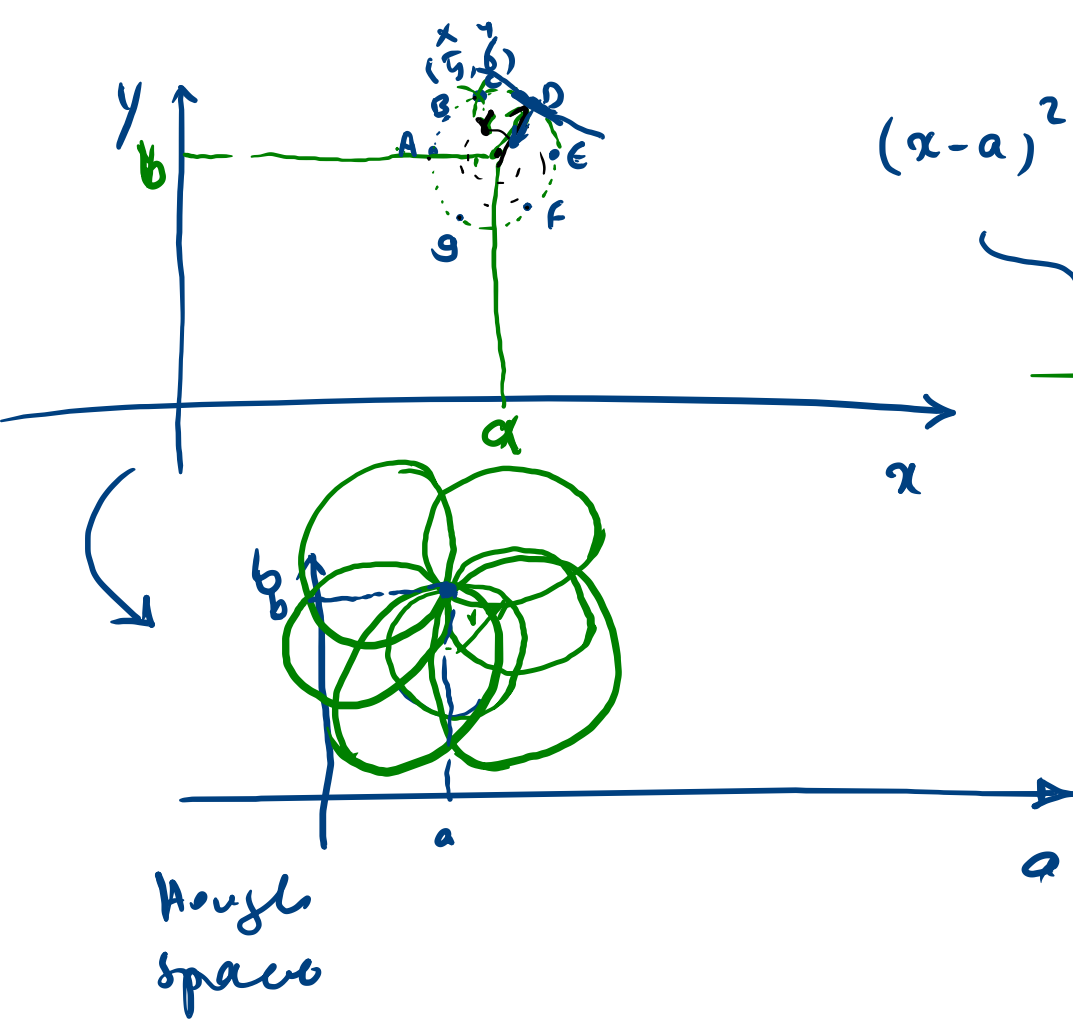


Hough space!



→ Voting ✓

Circle
Detection



$$(x-a)^2 + (y-b)^2 = r^2$$

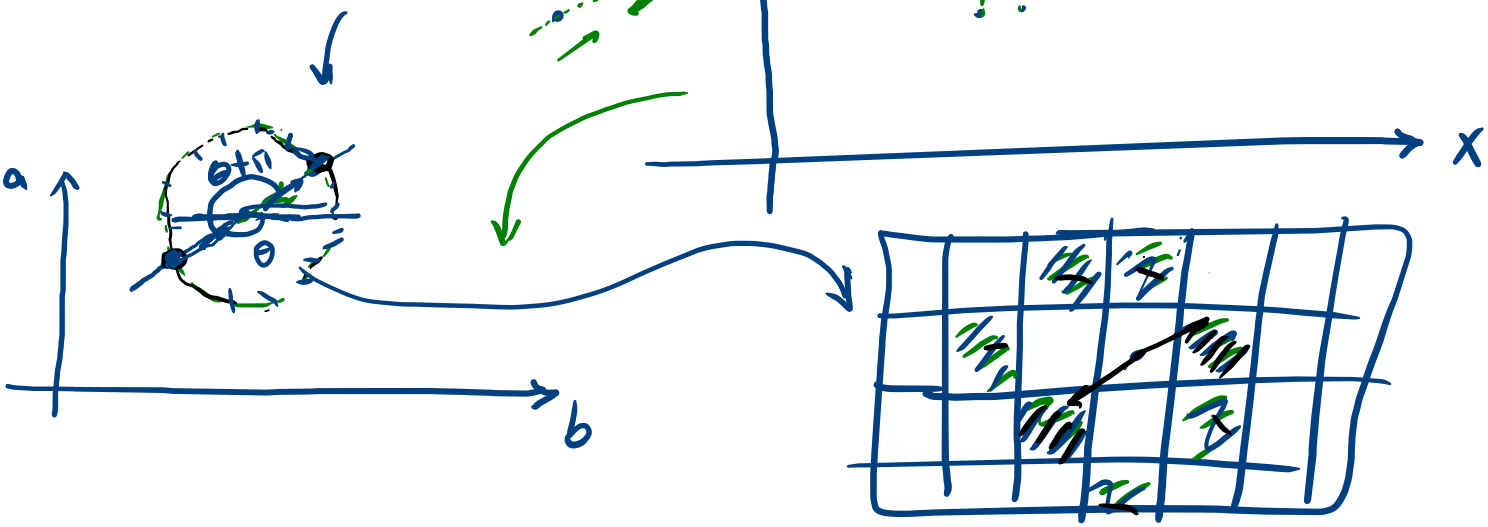
$$\rightarrow (\underline{x} - \underline{a})^2 + (\underline{y} - \underline{b})^2 = \underline{r}^2$$


$\xrightarrow{\quad \quad \quad} \quad \quad \quad \xrightarrow{\quad \quad \quad}$
 $\quad \quad \quad a \quad \quad \quad b$
 $\quad \quad \quad (a, b, r)$
 $\quad \quad \quad \underline{\quad \quad \quad}$
 $\quad \quad \quad ! \text{ 3 دوائر } !$

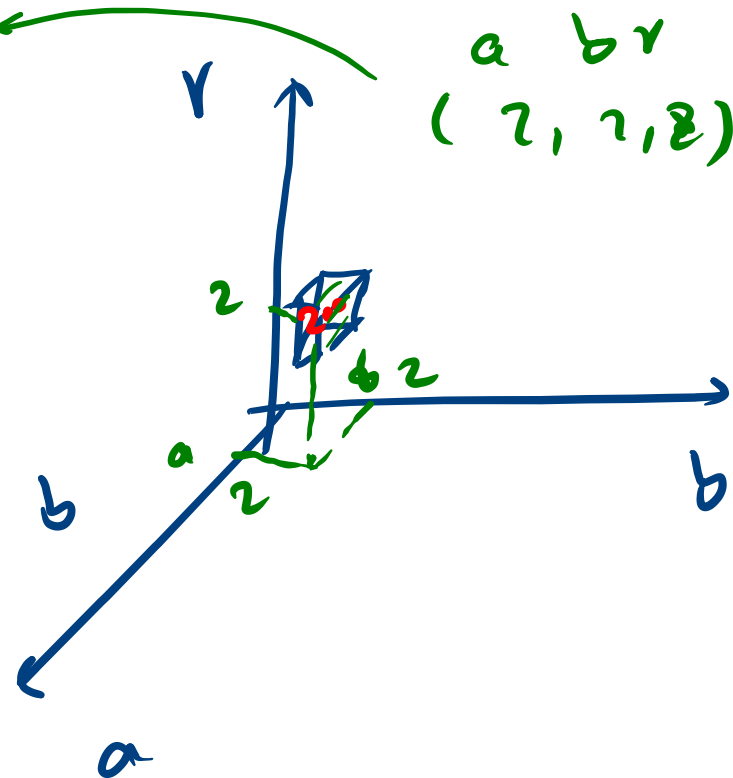
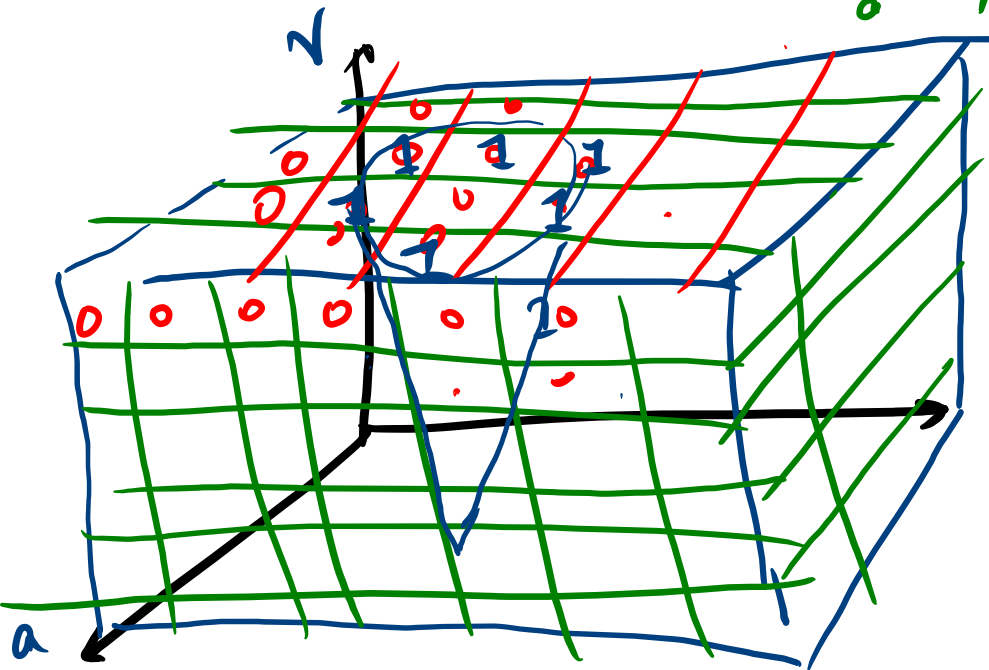
~~top~~
Gmny
Grad -

Gradient → magnitude
 → orientant von!

$$(5-a)^2 + (6-b)^2 + c^2$$



$$(x-a)^2 + (y-b)^2 = r^2 \quad \times$$




End