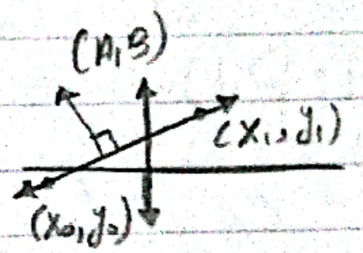
Mid 2019

1] a — الـ Vector هي اللي مش بتعاني

2] b

3] b, resolution independant.

4] d, — الرسمة:



5] a, d, $m_{line} = \frac{y_1 - y_0}{x_1 - x_0}$

$$m_{AB} = \frac{-1}{m_{line}} = \frac{x_0 - x_1}{y_1 - y_0} = \frac{x_1 - x_0}{y_0 - y_1}$$

$A = y_1 - y_0,\ B = x_0 - x_1$

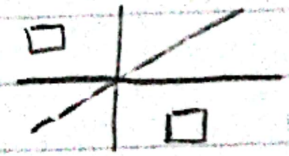
$A = y_0 - y_1,\ B = x_1 - x_0$

6] a, — من محاضرة 1، الـ Colors بتقبل الجمع عادي!

7] b, — لما شوفت $d = d + B + A$ عرفت إن a متطلعة خلاص

8] b, Recall $R^T = R^{-1}$

9] a,



* الـ Reflection ده عامل زي rotation! بالتالي آه orthonormal

* ديه زيادة ←

Reflection around x-axis + Reflection on $y = -x$ = Rotation about the origin

* من الطرق الروشة للموضوع، احسب المكان الجديد، وارسم دايرة بتعدي بالمكانين، لو طلعوا عليها ← نفس المسافة يبقى كده حصل rotation فعلاً.

which is usually the case!

Q:12 $R(90)R(90) = R(180) = -I$

$*S(\sigma) = \sigma I$

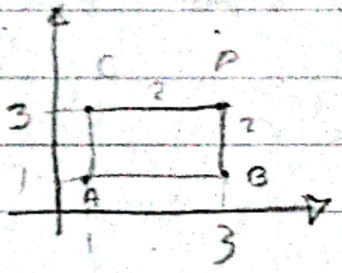
a) $R(\theta) * -I * \sigma I = -\sigma R(\theta)$

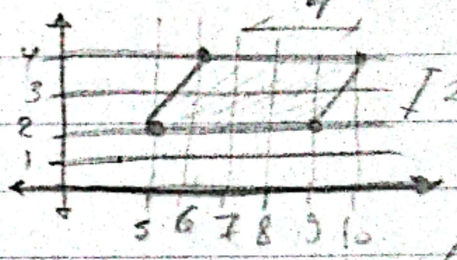
b) $\sigma I * -I * R(\theta) = -\sigma R(\theta)$

c) $\sigma I * -I * R(\theta) = -\sigma R(\theta)$

10] c, Shear-x: $\begin{bmatrix} 1 & sy \\ 0 & 1 \end{bmatrix}$

11] b,





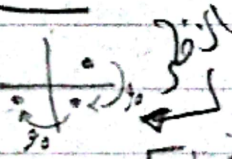
حلها بالنظر أسهل!

$x' = x + \frac{y}{2}$

	Translation	+ Non-uniform Scale $(Sx=2)$	+ Shear x $(S=\frac{1}{2})$	+ transl
A	(1,1) → (0,0)	→ (0,0)	→ (0,0)	→ (5,2)
B	(3,1) → (2,0)	→ (4,0)	→ (4,0)	→ (9,2)
C	(1,3) → (0,2)	→ (0,2)	→ (1,2)	→ (5,4)
D	(3,3) → (2,2)	→ (4,2)	→ (5,2)	→ (10,4)

as Rotation is I, -I فمفرقش

12] a, b, c



بالنظر

$P' = S(\sigma) * R(-x) * R(-y) * R(0) * P$

امشي كده! ←

$R(-x) * R(-y) = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

$R(180) = \begin{bmatrix} \cos\varphi & -\sin\varphi \\ \sin\varphi & \cos\varphi \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

$\therefore R(-x) * R(-y) \equiv R(180) \equiv R(90) * R(90)$

$R(90)R(90) = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

13] b, off-diagonal ≠ Main Diagonal

* كله عنده أصفار برا ال main diag ما عدا ال shear لازم ميبقاش فيه صفر!

Shear $= \begin{bmatrix} 1 & dy \\ 0 & 1 \end{bmatrix}$

Scale $= \begin{bmatrix} Sx & 0 \\ 0 & Sy \end{bmatrix}$, Ref $= \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$, Scal × Ref $\begin{bmatrix} Sx & 0 \\ 0 & -Sy \end{bmatrix}$

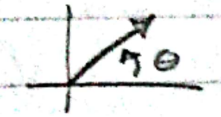
Trang. Rota.

14] a, c, d, → $mx+c$ → mx → x → Reflection!

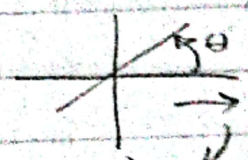
* حاسس الـ Rotation ملهاش لازمة أوي ، بس ممكن نستعملها!

15] b, * واحد عنان نقيل الـ c ون reflect ، بعدين واحد تاني كمان رجعنا الـ c

16] d, * مش عتاجينه ← Like rotation around arbitrary axis

17] b,  , $|\theta| = |\tan^{-1} m|$ ∵ $\tan\theta = m$

18] d, $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ R



→ $(0,1)^T$

$(\cos\theta, -\sin\theta)$ around the origin CW

e.g

$R\begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} \cos\theta \\ -\sin\theta \end{bmatrix}$

19] b, $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -x \\ y \end{bmatrix}$

20] b, $M = M_2 M_1$

21] a, c, $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \xrightarrow{\square^{-1}} = \square^T = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

$\Downarrow$

$\begin{bmatrix} \cos -\theta & -\sin -\theta \\ \sin -\theta & \cos -\theta \end{bmatrix}$

Recall: $\cos -\theta = \cos\theta$

$\sin -\theta = -\sin\theta$

22] b , $R=\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}$, $S=\begin{bmatrix}\cos\alpha & -\sin\alpha\\ \sin\alpha & \cos\alpha\end{bmatrix}$

23] a , $\begin{bmatrix}x\\y\end{bmatrix} \Rightarrow \begin{bmatrix}x\\y\\1\end{bmatrix}$ (Point) زود 1 تحت لو

24] b , $\begin{bmatrix}x\\y\end{bmatrix} \Rightarrow \begin{bmatrix}x\\y\\0\end{bmatrix}$ [Vector] زود 0 تحت لو

25] d , Rotation then a translation in 2D

26] b, c , $\begin{bmatrix}u' & v' & w'\end{bmatrix}$ uvw frame, xyz frame $xyz \xrightarrow{\text{Rotate}} uvw$

RT

27] a , $\begin{bmatrix}-u-\\-v-\end{bmatrix}\begin{bmatrix}1 & 0 & -x_e\\ 0 & 1 & -y_e\\ 0 & 0 & 1\end{bmatrix}$, xyz frame is called canonical frame

$xyz \to uvw$ frame $e \to 0$

28] c , $n' = Nn \to N=(M^{-1})^T$, $R^{-1}=R^T \to N=(R^{-1})^T = R = M$

29] a , b , c مش لازم كل الخطوات !

30] a , slides look

31] b , 1 or 2 or 3

32] a , _____

33] b , _____

34] c, slides lec 4

35] b, ———

36] d, ———

37] c, in modelling Transformation we Place the obj in the world frame on a certain Position with a specific orientation

38] b, slides lec 4

39] b, $M_{cam} = \begin{bmatrix} -u- & 0 \\ -v- & 0 \\ -w- & 0 \\ 0^T & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -x_c \\ 0 & 1 & 0 & -y_c \\ 0 & 0 & 1 & -z_c \\ 0 & 0 & 0 & 1 \end{bmatrix}$ If $e = 0^T$, $M_{cam} \neq I$

40] c, the distance holds!

---

* في ميد سنت بعدها جت نفس بالظبط بس كان فيه السؤال ده زيادة:

$\begin{bmatrix} x_u & y_u & 0 \\ x_v & y_v & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -x_c \\ 0 & 1 & -y_c \\ 0 & 0 & 1 \end{bmatrix}$ represents?

xyz frame → uvw frame e → 0

Canonical to frame Transformation