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$y = mx + b$
$x = \frac{y - b}{m}$

Computer Graphics (CMP 205/CMP N205) Midterm Exam – Fall 2010 (90 minutes) -*Total Marks: 20*

14.5 / 15

Question 1 (5)	Question 2 (5)	Question 3 (5)	Question 4 (5)	Total (20)
5	4.5	3	5	18

$$R_x(\theta) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{pmatrix}, \quad R_y(\theta) = \begin{pmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{pmatrix}, \quad R_z(\theta) = \begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Question 1: [5 points]

1.a) [4 pt] Draw the following polyline using the optimized line drawing algorithm. Show your steps. (0,0), (8,7), (0,8)

fraction = .5 initial fract += m at loop

m = .125 for line (8,7) & (0,8)

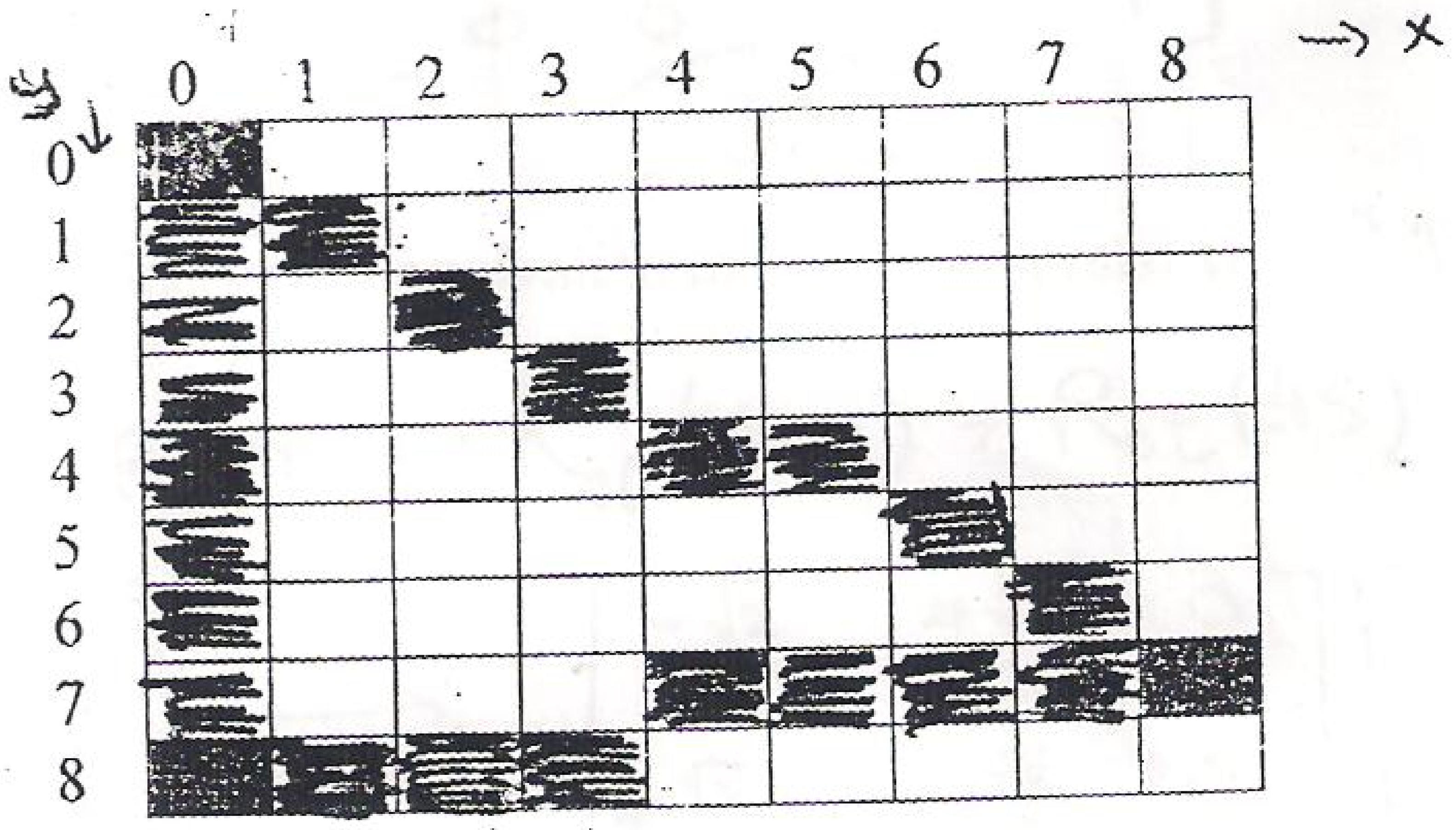
x	fraction	y
0	.5	8
1	.625	8
2	.75	8
3	.875	8
4	1	~~8~~ 7
5	.125	7
6	.25	7
7	.375	7
8	.5	7

dx/dy = 1/8 = .125

y	frac	x
0	.5	0
1	.625	0
2	.75	0
3	.875	0
4	1	
5		
6		
7		
8		

?

note when fraction accessed (one) I sub (frac − 1)



m = .875

x	frac	y
0	.5	0
1	1.375	1
2	1.25	2
3	1.125	3
4	1	4
5	.875	4
6	1.75	5
7	1.625	6
	1.5	7

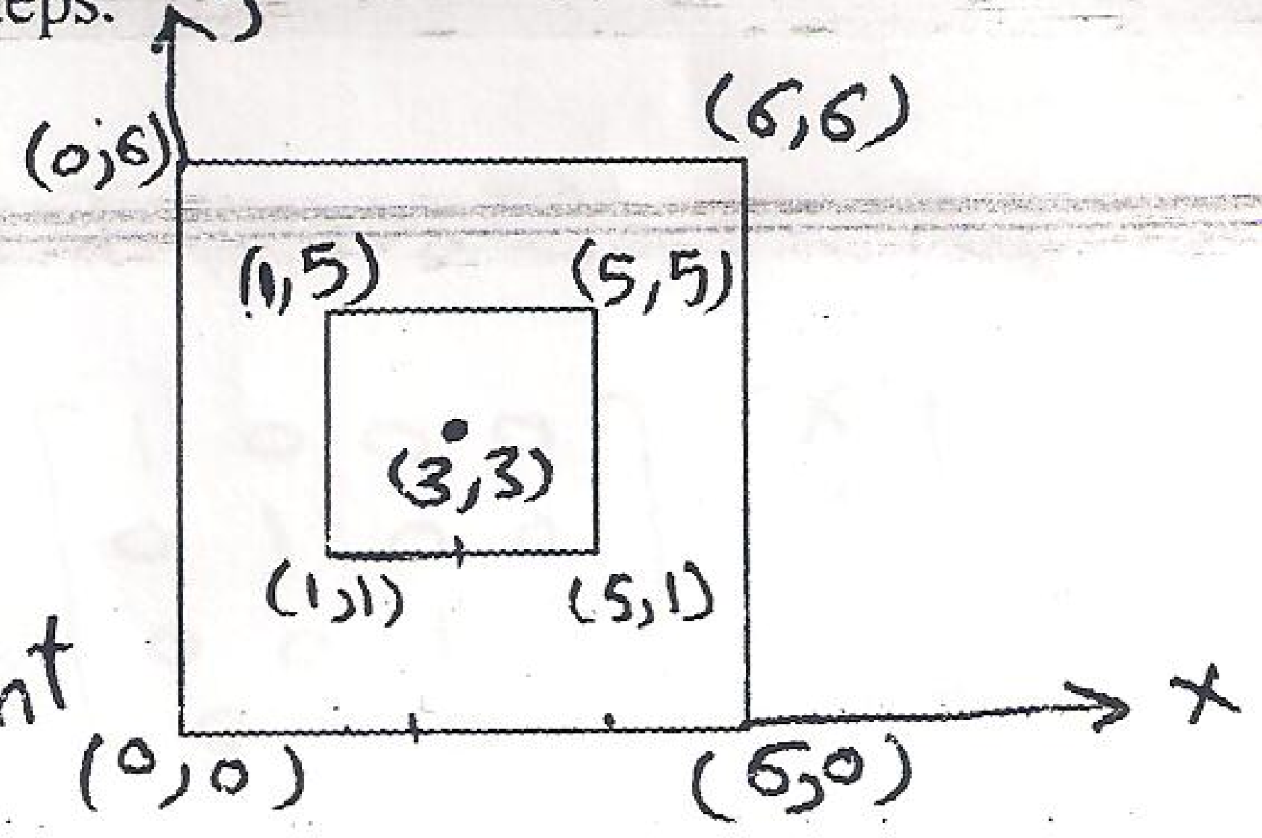
1.b) Why Bresenham's line drawing Algorithm is faster than the improved line drawing algorithm?

as we instead • div & multiplication by plus & mins
• float numbering by integer numbers
• compare with numbers by compare with zero

this make the Algorithm is faster

Question 2: [5 points] 4.5

2.a) [2 pt] Determine the form of the transformation matrix to enlarge the size of a square as shown in the figure below. The vertices of the original square are ((1,1), (5,1), (5,5), (1,5)) and the vertices of the new square are((0,0), (6,0), (6,6), (0,6)). Show your steps.



to make that make scaling to his centre point

$\boxed{1}$ Translate to origin

$\boxed{2}$ Scaling

$\boxed{3}$ Translate back to its centre point

$$T^{-1}(-3,-3) * S_{cale}(1.5, 1.5) * T(-3,-3)$$

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1.5 & 0 & 0 \\ 0 & 1.5 & 0 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & -3 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

-0.5

2.b) [3 pt] Show and prove that a reflection about the line y=x is equivalent to a reflection relative to the x-axis followed by a counterclockwise rotation of 90.

first to reflect $y=x$ $\quad \therefore X' = R_{ot}(45) * R_{ef}(y=0) * R_{ot}(-45)$

$$\begin{pmatrix} x \\ y \\ 1 \end{pmatrix} \xrightarrow[(-45)]{\text{Rotate}} \begin{bmatrix} \frac{\sqrt{2}}{2} & +\frac{\sqrt{2}}{2} & 0 \\ -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} \xrightarrow[y=0]{\text{Reflect}} \begin{bmatrix} -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

$$= \begin{pmatrix} -\frac{\sqrt{2}}{2}x + \frac{\sqrt{2}}{2}y \\ \frac{\sqrt{2}}{2}x + \frac{\sqrt{2}}{2}y \\ 1 \end{pmatrix} \xrightarrow[(45)]{\text{Rotate}} \begin{pmatrix} y \\ x \\ 1 \end{pmatrix}$$

final matrix $\boxed{1}$

econd

$$\begin{pmatrix} x \\ y \\ 1 \end{pmatrix} \xrightarrow[x]{\text{Refl}} \begin{pmatrix} x \\ -y \\ 1 \end{pmatrix} \xrightarrow[(90)]{\text{Rot}} \begin{pmatrix} +y \\ x \\ 1 \end{pmatrix}$$

final matrix $\boxed{2}$

They are the same

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Question 3: [5 points]

For the pyramid ((0,0,0), (10,0,0), (10,10,0), (0,10,0), (5,5,5)) derive its shape in a mirror placed at z=-2. Find first the transformation matrix then apply it to the pyramid vertices. Draw the pyramid and its mirrored shape.

$$T(0,0,2)^{-1} * R_f(-1,-1,0) * T(0,0,2)$$

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -2 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

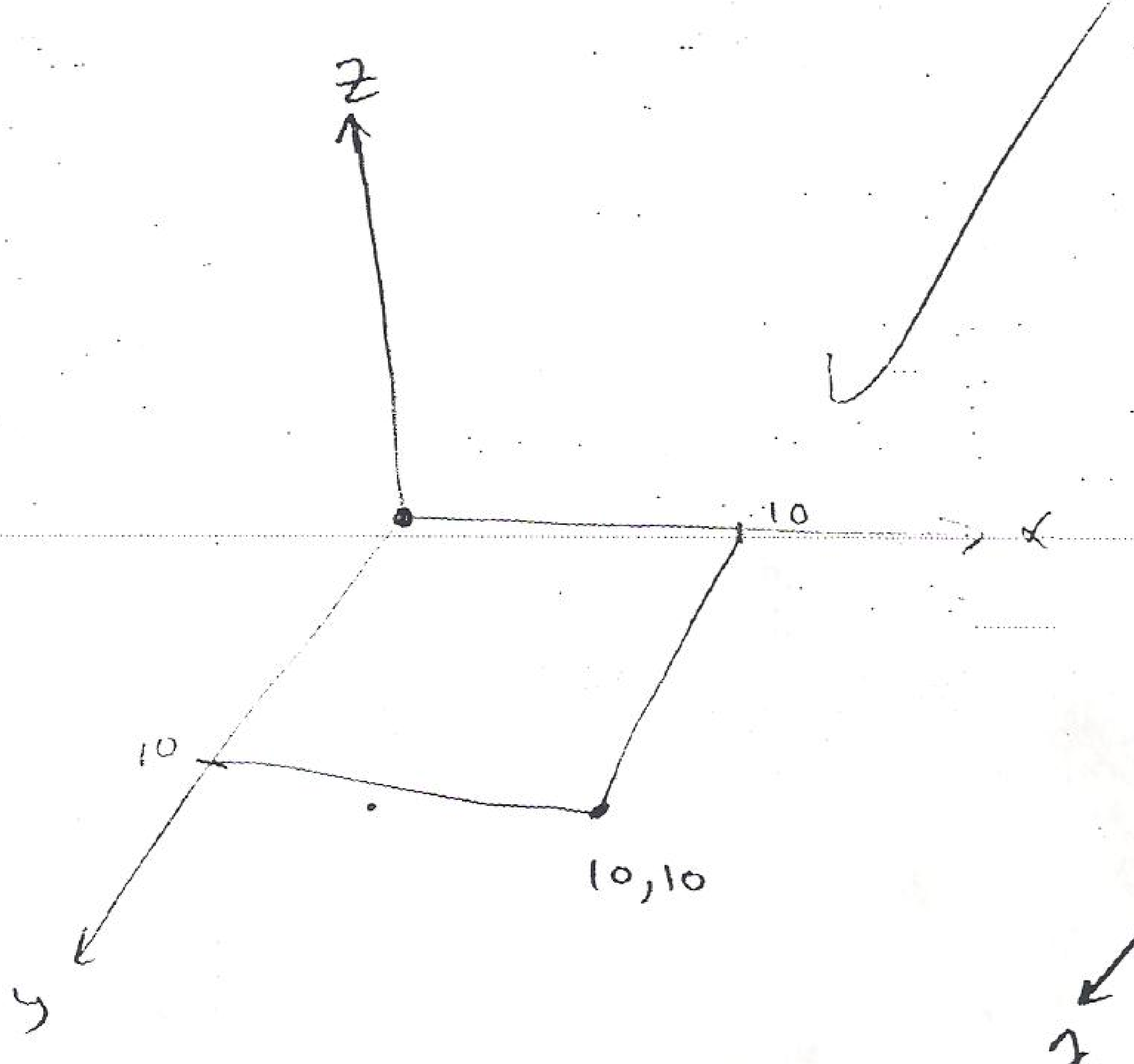
$$= \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} ??$$

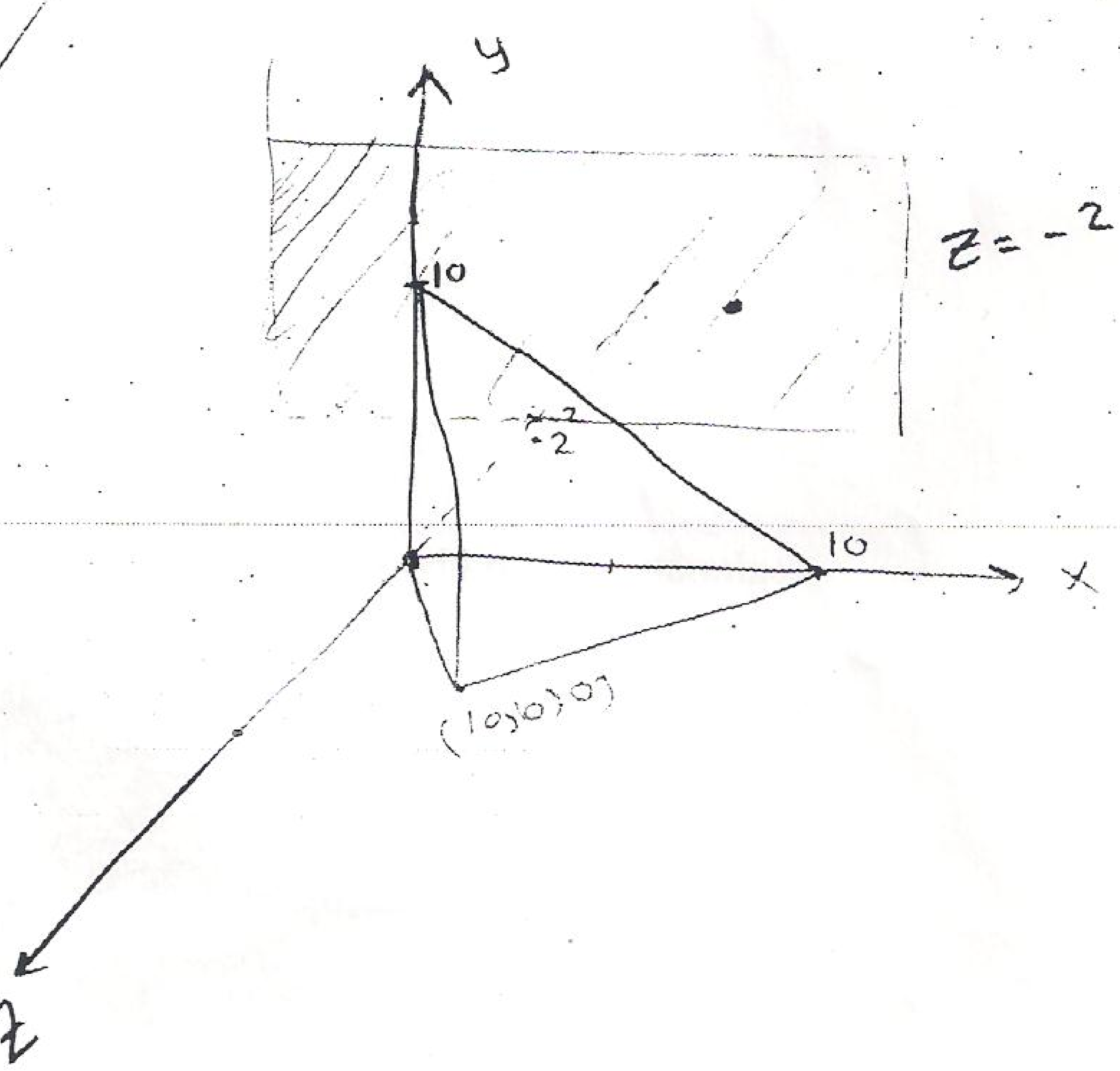
assumed we get the final matrix of transformation

so applyinto the pyramid vertix

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \text{Transformation matrix} \end{bmatrix} \begin{bmatrix} \text{Points of the shape original} \end{bmatrix}$$

to get the mirrored shape points





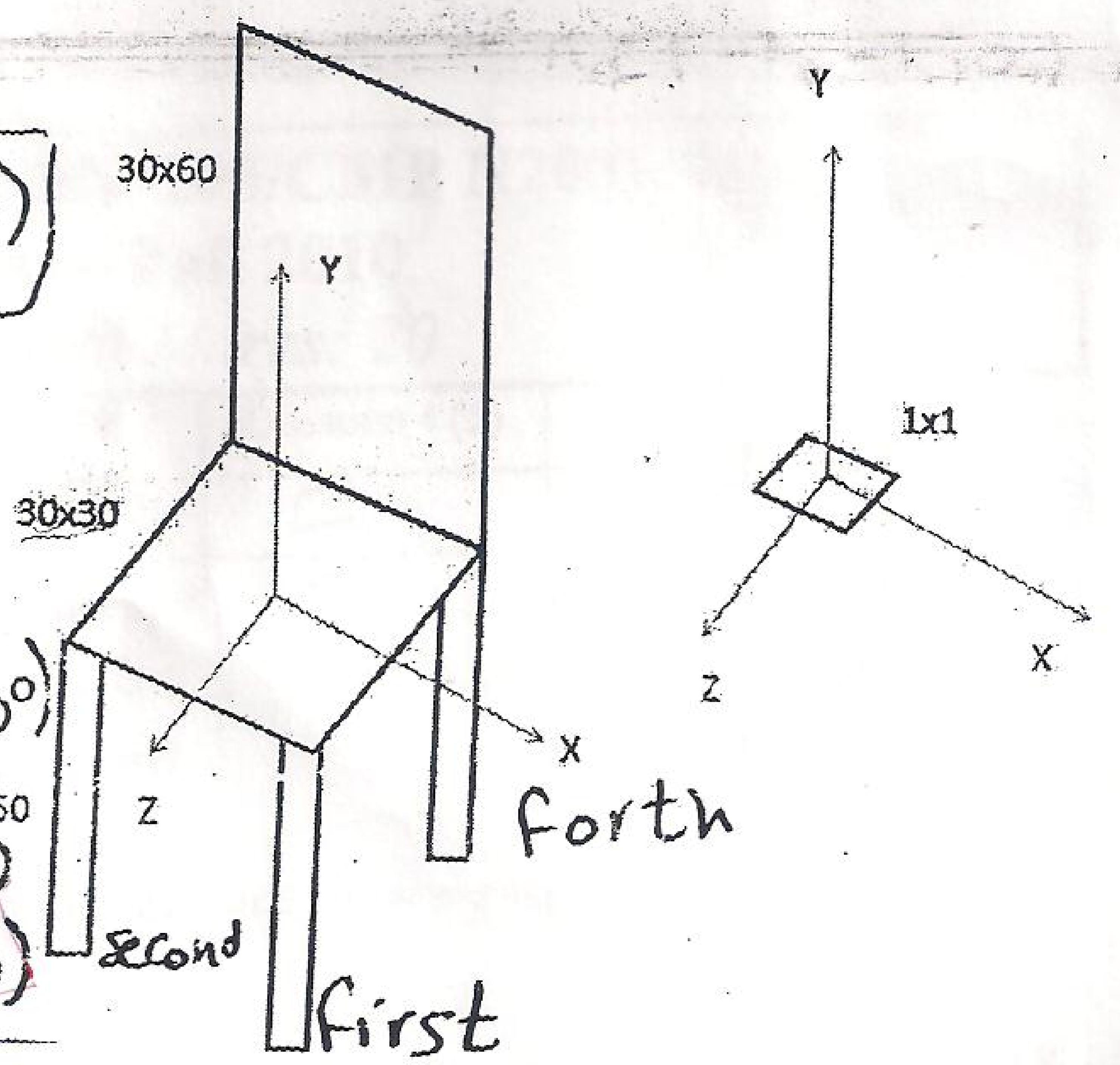
Question 2)
the answer written is correct but
If we want to make scaling in its position
we can put the center will change so the answer will be
1- Scale(1.5,1.5)
2- Translate (3-9/2 , 3-9/2) ====> (3) means center before scaling , (9/2) means center before scaling

Question 3)
Reflaction (1,1,-1) not the written (as it wrong)

Question 4)
first need to put parameters ok in the transformation
must take care about sequence (its operate from down level to up level)
there are root (big father) take from it

Question 4: [5 points]

4.a) [4 pt] Show a scenegraph representation for a chair model constructed using only a unit cube as shown in the figure. Show the transformation type and parameters for each part. Assume there is no depth for the cube and the chair parts. The chair should have a base, a back and four legs.



base — Scale(30,30,0)

Scale(10,50,0)
Rot(0,90,0)

leg — (10,50,0)

back — Scale(30,60,0) R_ot(0,90,0) T(0,0,15)

leg: third, second, first

first → T(15,0,15)

second → T(-15,0,15)

third → T(~~+~~15,0,-15)

T(15,0,-15)

4.b) [1 pt] For the following polygon, fill its interior region. Use the even-odd rule to determine whether a point is inside or outside the polygon

* قطعت no odd يعني ألونه

* قطعت no even يعني ملونش