Multiview

Name	Dharini Baskaran
Identity Key	dhba5060

	Level	Completed
	Beginner	16
	Intermediate	5
	Advanced	0
	Expert	0

Goal	
4722	18
5722	20
Total Completed	
21	

Multiview

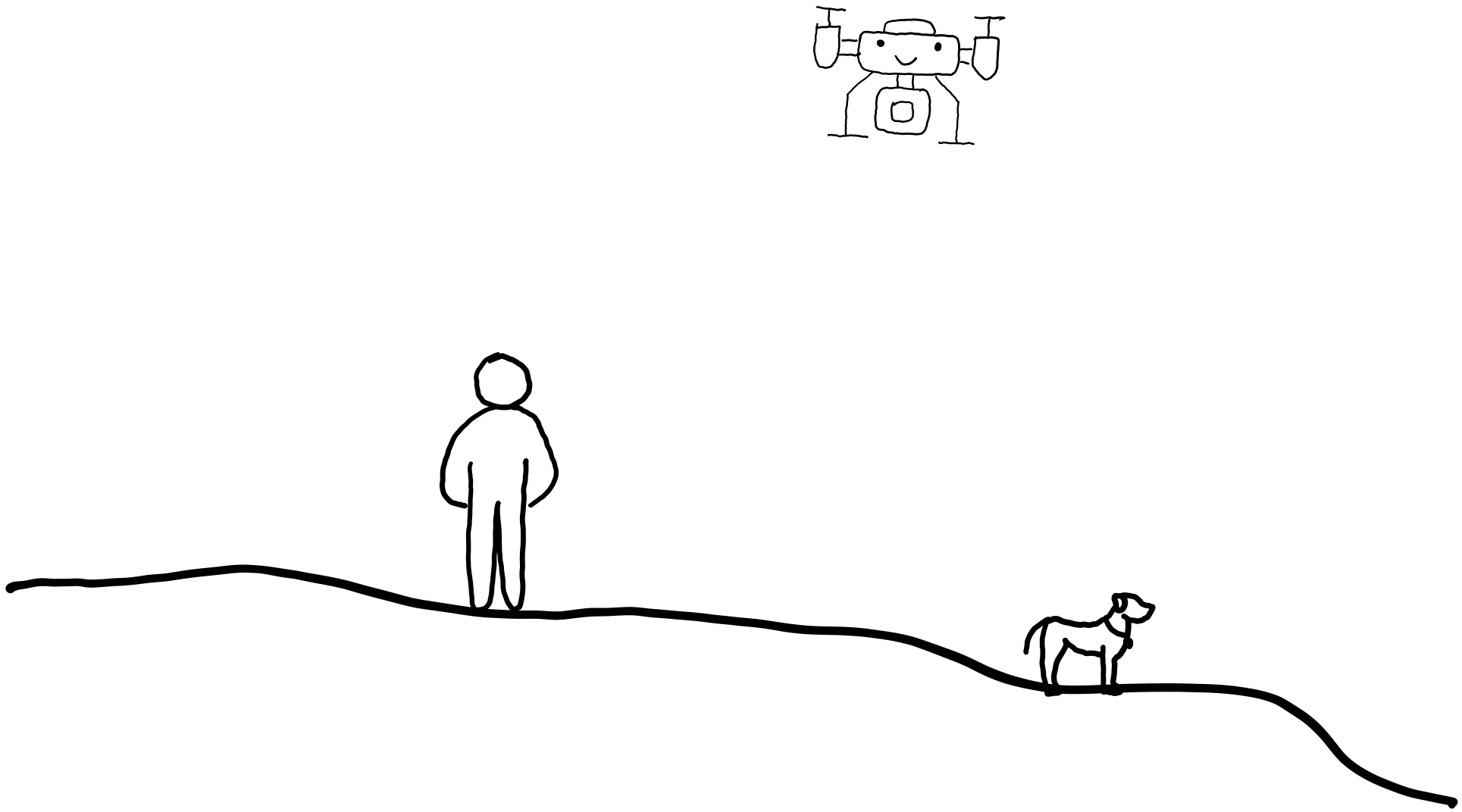
CSCI 5722/4722: Computer Vision

Spring 2024

Dr. Tom Yeh

Dr. Mehdi Moghari

Motivation



Where is the ball in the photo?

Key questions

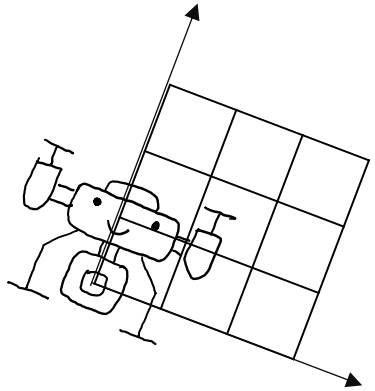
1. Where is the object in relation to the camera? (Multiple Coordinate Systems)
2. Where is the camera? (3D Translation)
3. Where is the camera pointing at? (3D Rotation)
4. How is the object “seen” by the camera? (Projection)

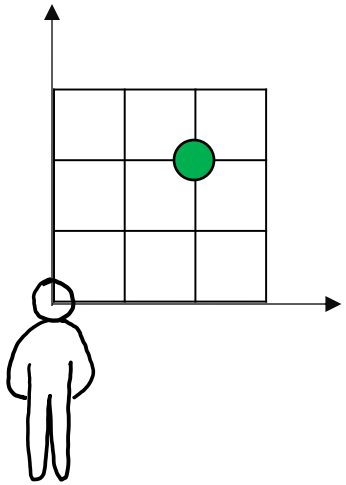
Multiple Coordinate Systems

CSCI 5722 Computer Vision

University of Colorado
Boulder

Same Point in Different Coordinate Systems



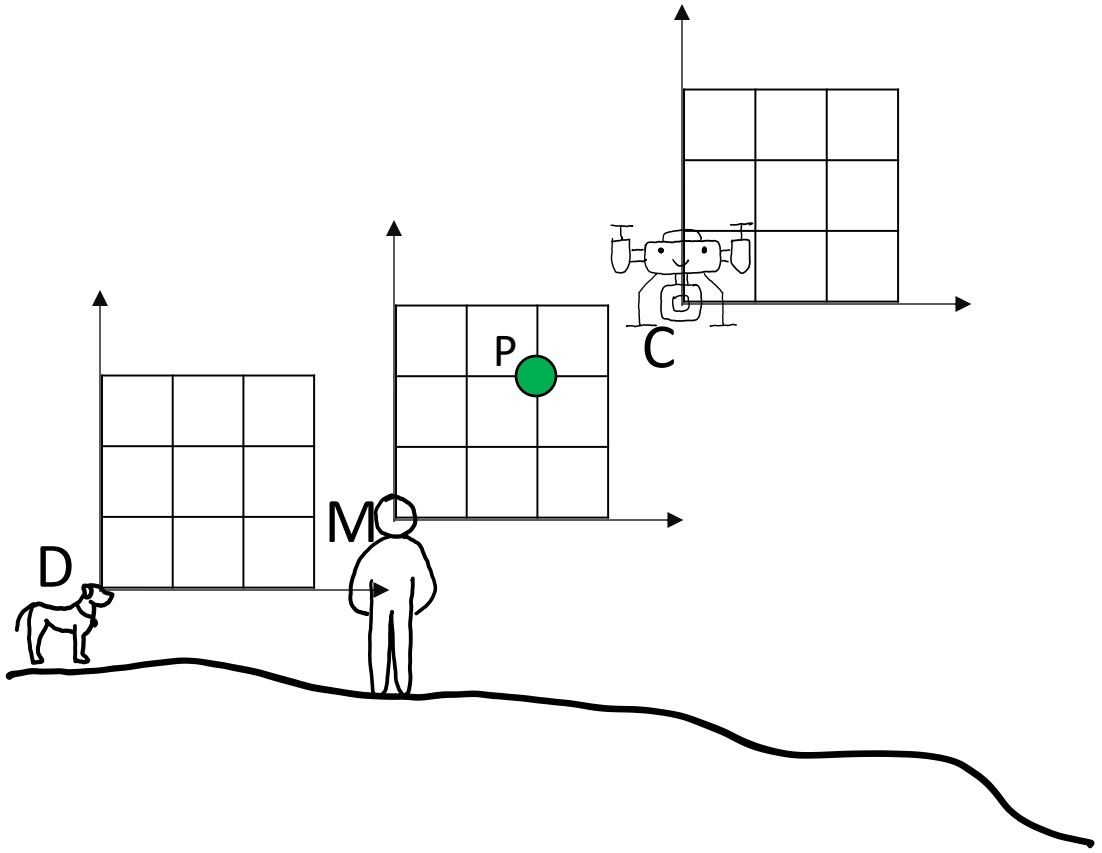


P seen from me = _____

P seen from the drone = _____

$^{M}P_{1}$ $^{R}P_{1}$

Me (M), Dog (D), and Camera (C)



P seen by me:

_____ = [,]

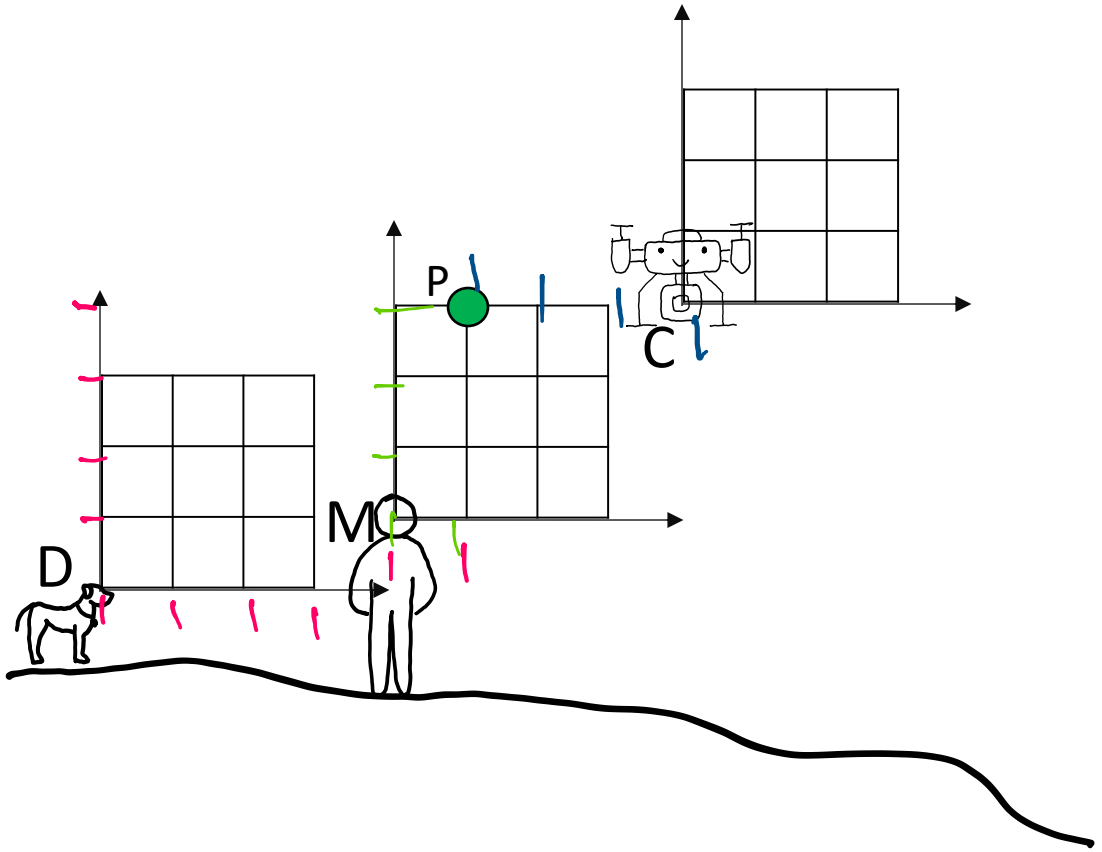
P seen by my dog

_____ = [,]

P seen by the drone camera:

_____ = [,]

Me (M), Dog (D), and Camera (C)



P seen by me:

${}^{M}P = [\ 1\ ,\ 3\ ]$

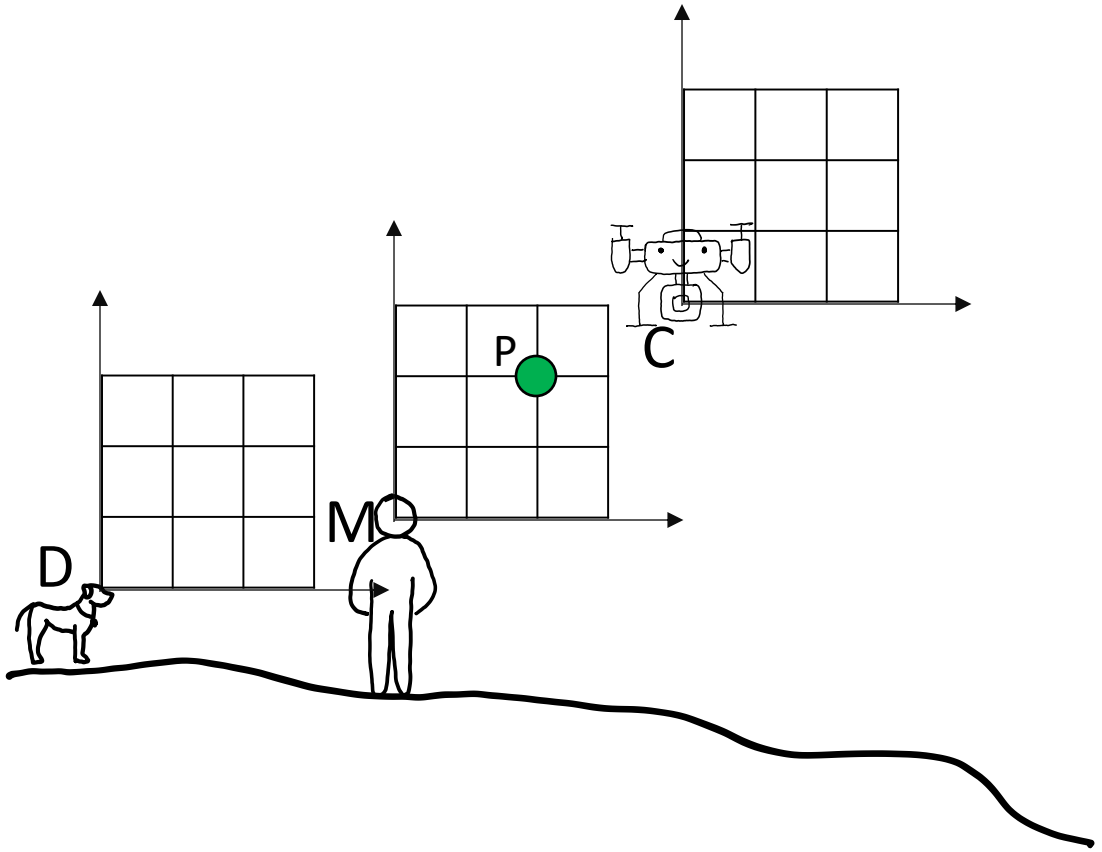
P seen by my dog

${}^{D}P = [\ 5\ ,\ 4\ ]$

P seen by the drone camera:

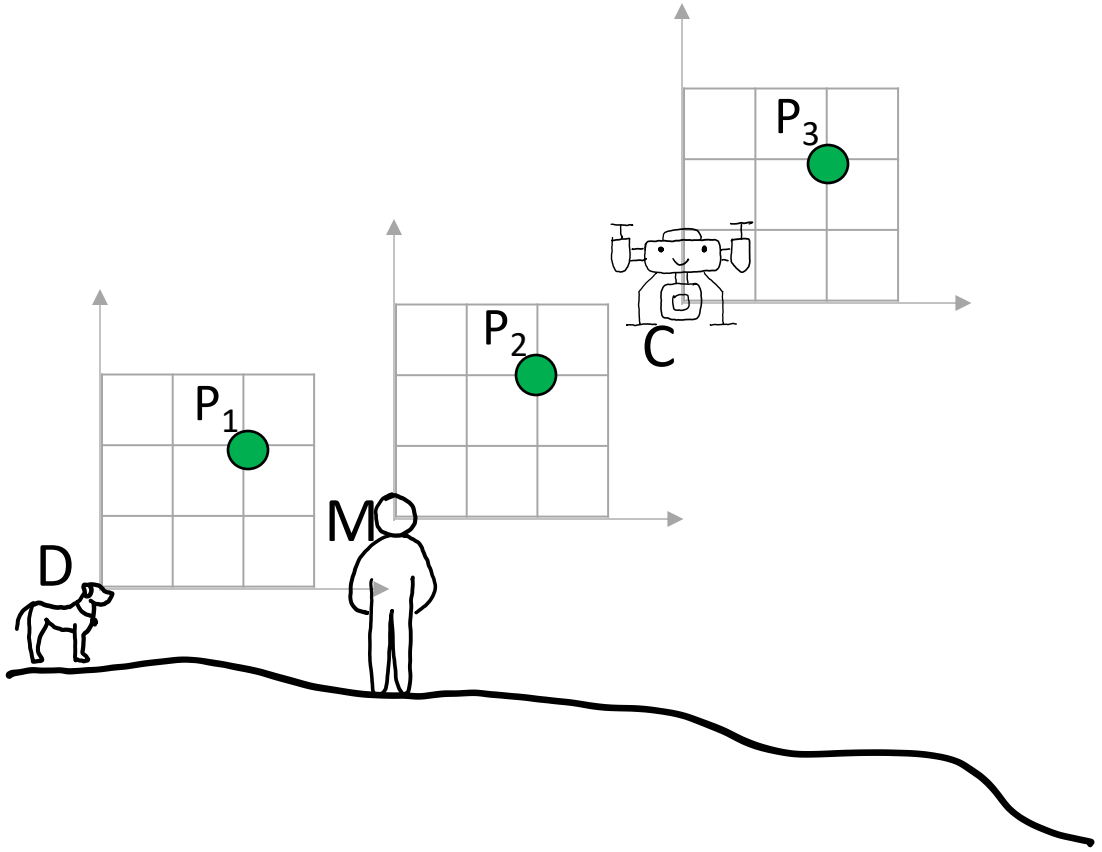
${}^{C}P = [\ -3\ ,\ 0\ ]$

Equal or Not Equal?



^{M}P ___ ^{C}P ___ ^{D}P

Equal or Not Equal?



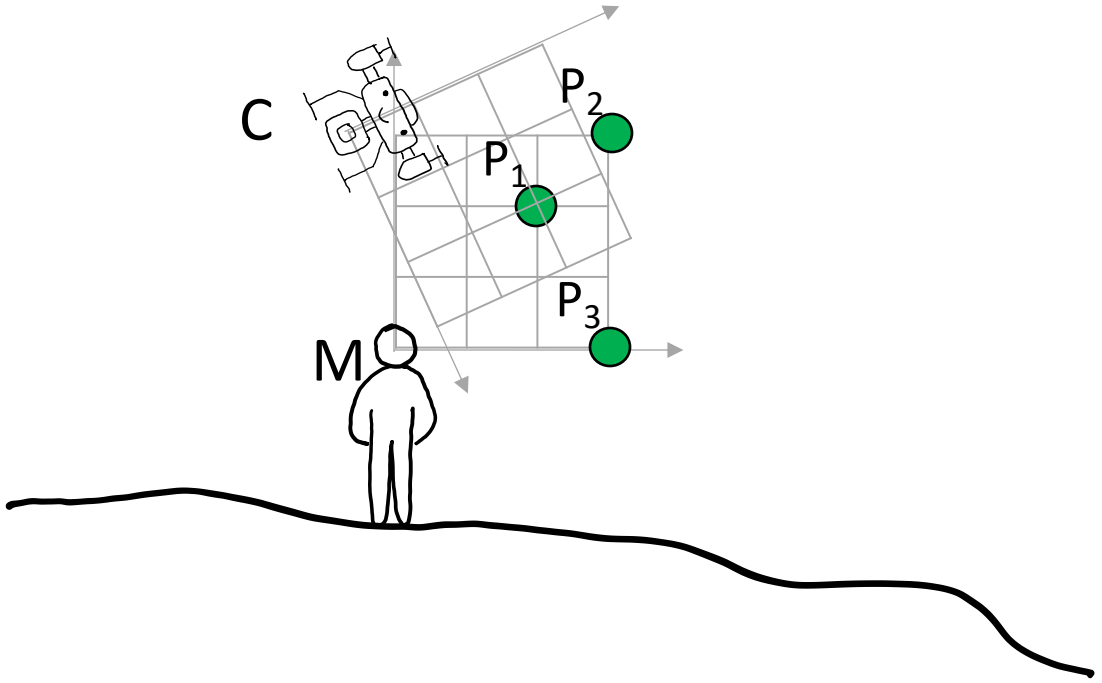
$^{M}P_1$ ____ $^{M}P_2$ ____ $^{M}P_3$

$^{D}P_1$ ____ $^{D}P_2$ ____ $^{D}P_3$

$^{C}P_1$ ____ $^{C}P_2$ ____ $^{C}P_3$

$^{M}P_1$ ____ $^{D}P_2$ ____ $^{C}P_3$

Equal or Not Equal?

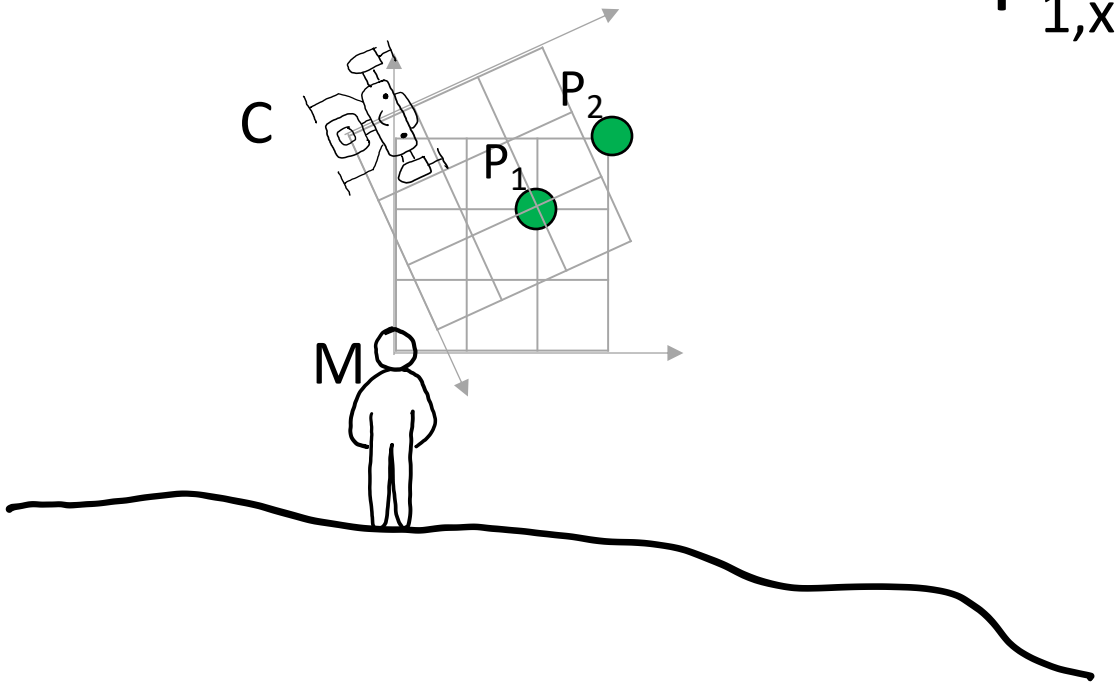


$^{M}P_1$ ___ $^{C}P_1$

$^{M}P_2$ ___ $^{C}P_2$

$^{M}P_3$ ___ $^{C}P_3$

Greater or Less?



$^{M}P_{1,x}$ ____ $^{M}P_{2,x}$ $^{M}P_{1,y}$ ____ $^{M}P_{2,y}$

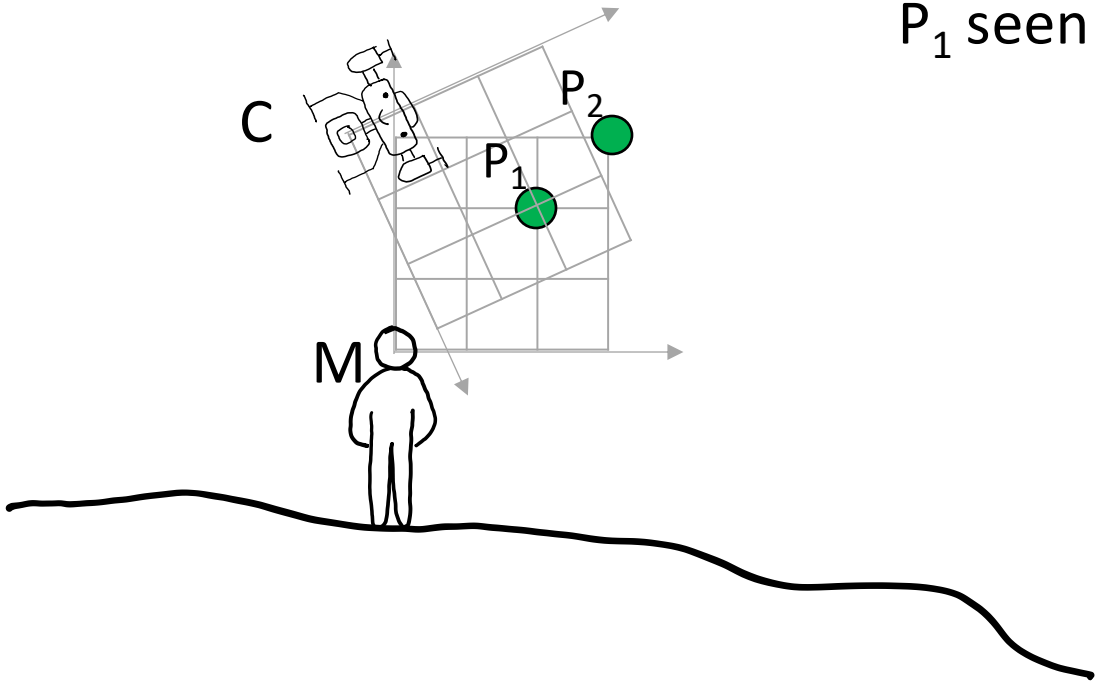
$^{C}P_{1,x}$ ____ $^{C}P_{2,x}$ $^{C}P_{1,y}$ ____ $^{C}P_{2,y}$

Me (M) and Camera (C)

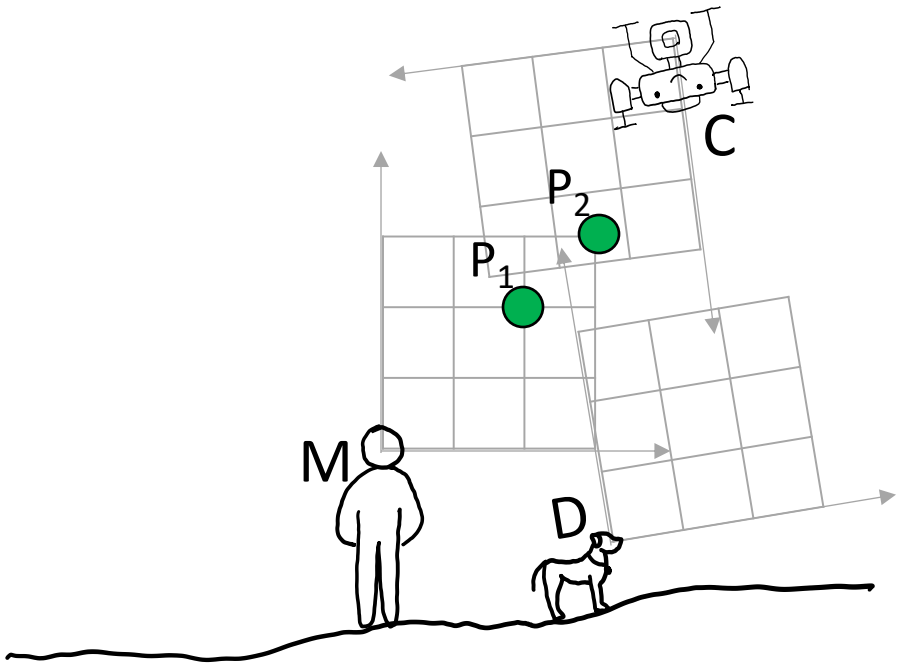
P_1 seen by me: ${}^{M}P_1$ = [2 , 2]

P_2 seen by me: ${}^{M}P_2$ = [3, 3]

P_1 seen by the drone camera: ${}^{C}P_1$ = [2 , 2]



Greater or Less?

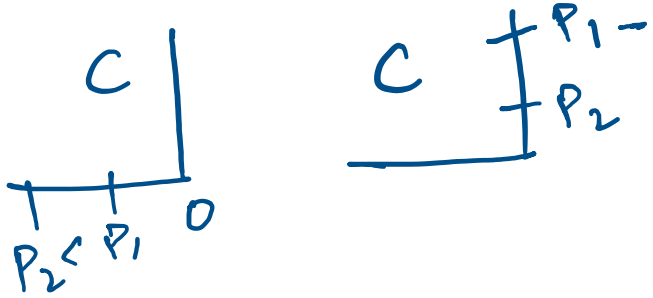


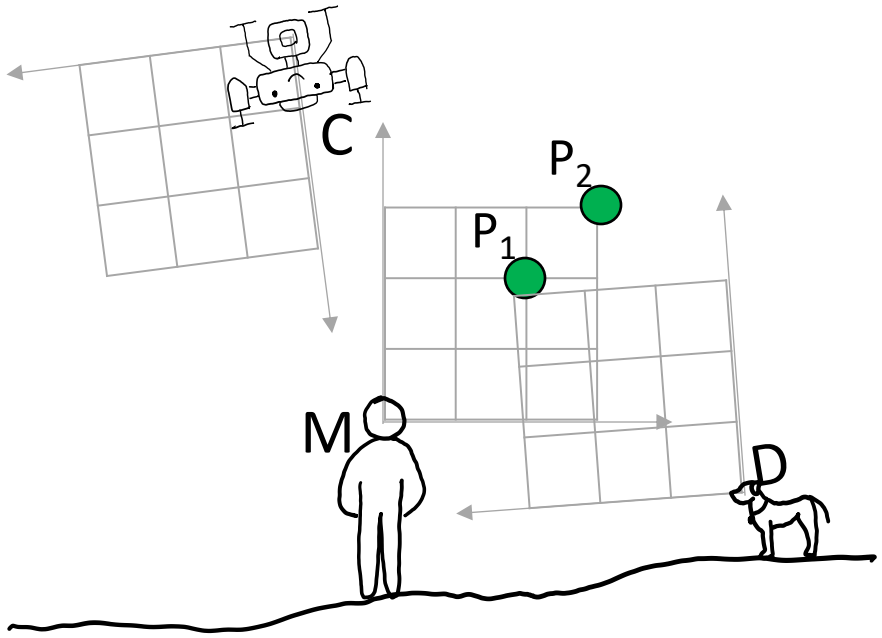
$^{M}P_{1,x}$ $<$ $^{M}P_{2,x}$ $^{M}P_{1,y}$ $<$ $^{M}P_{2,y}$

$^{C}P_{1,x}$ $>$ $^{C}P_{2,x}$ $^{C}P_{1,y}$ $>$ $^{C}P_{2,y}$

$^{D}P_{1,x}$ $<$ $^{D}P_{2,x}$ $^{D}P_{1,y}$ $<$ $^{D}P_{2,y}$

Greater or Less?

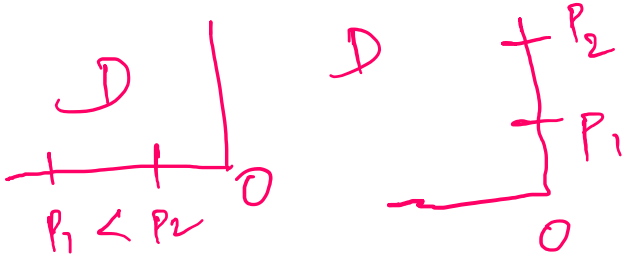




$^{M}P_{1,x} ___ ^{M}P_{2,x}$ $^{M}P_{1,y} ___ ^{M}P_{2,y}$

$^{C}P_{1,x} ___ ^{C}P_{2,x}$ $^{C}P_{1,y} ___ ^{C}P_{2,y}$

$^{D}P_{1,x} ___ ^{D}P_{2,x}$ $^{D}P_{1,y} ___ ^{D}P_{2,y}$



3D Viewing Planes

CSCI 5722 Computer Vision

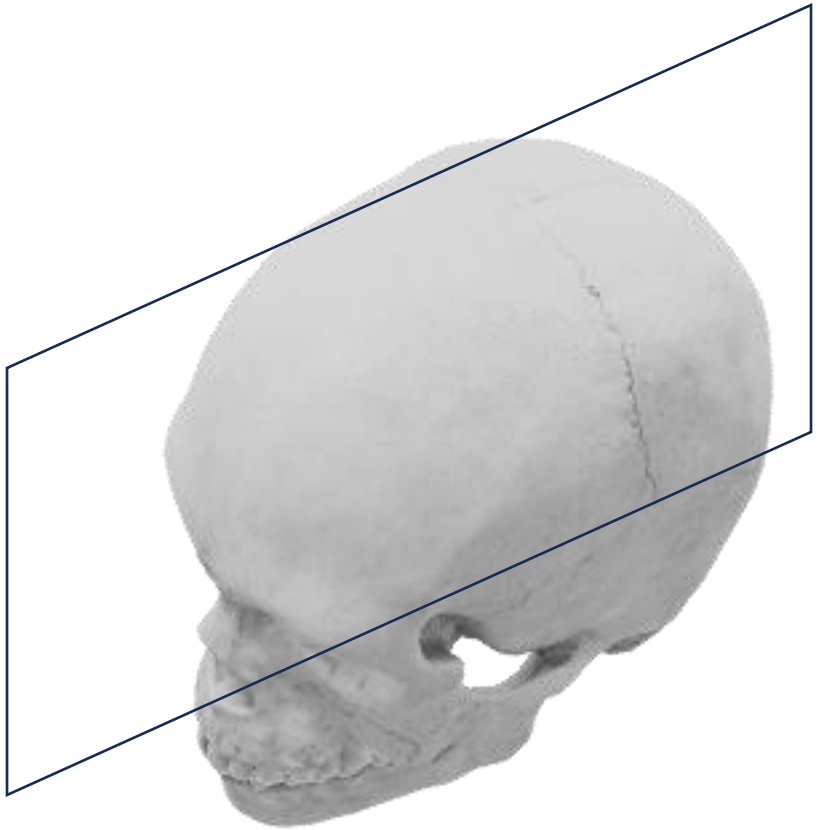
University of Colorado
Boulder

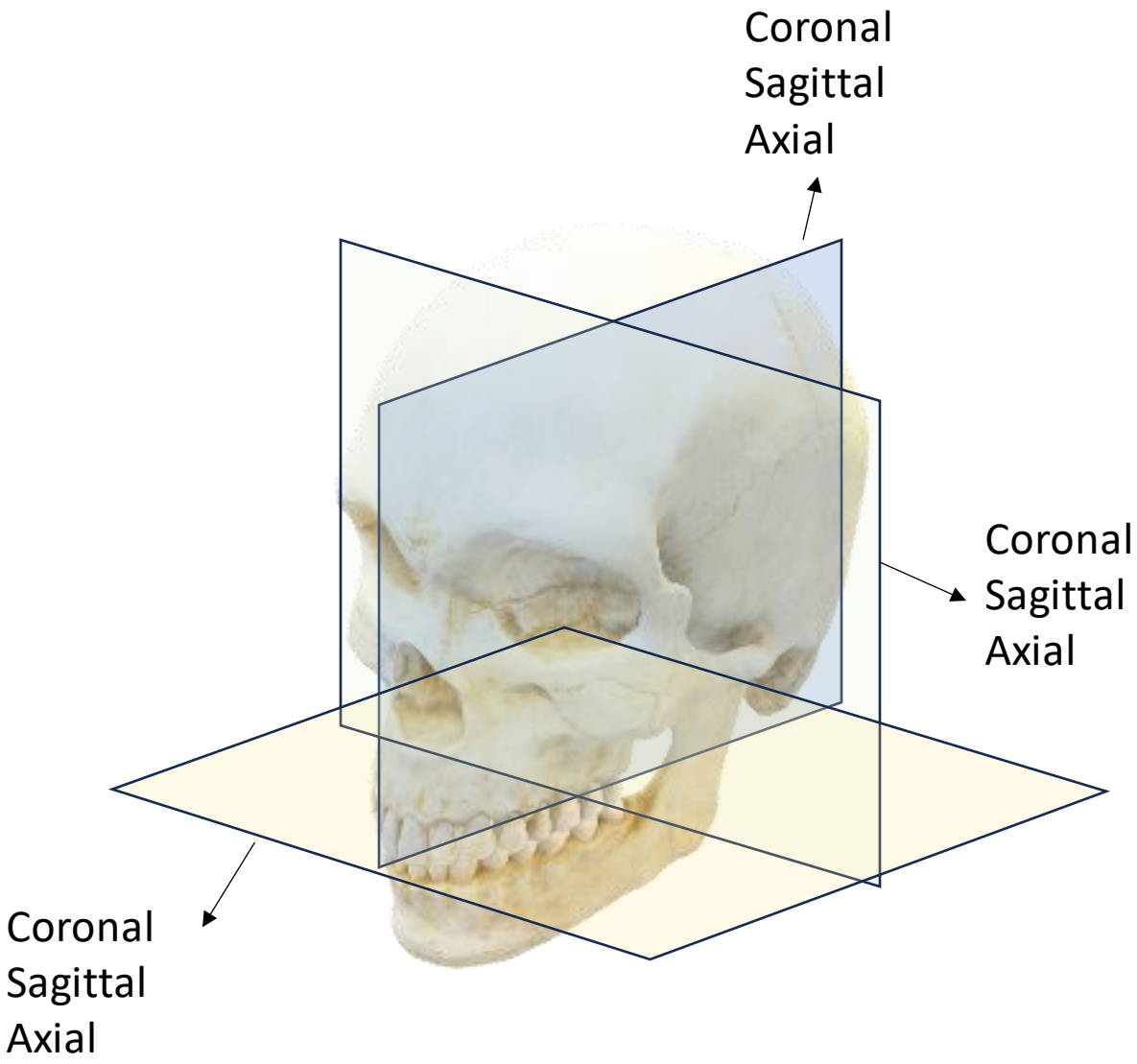
Skull sutures

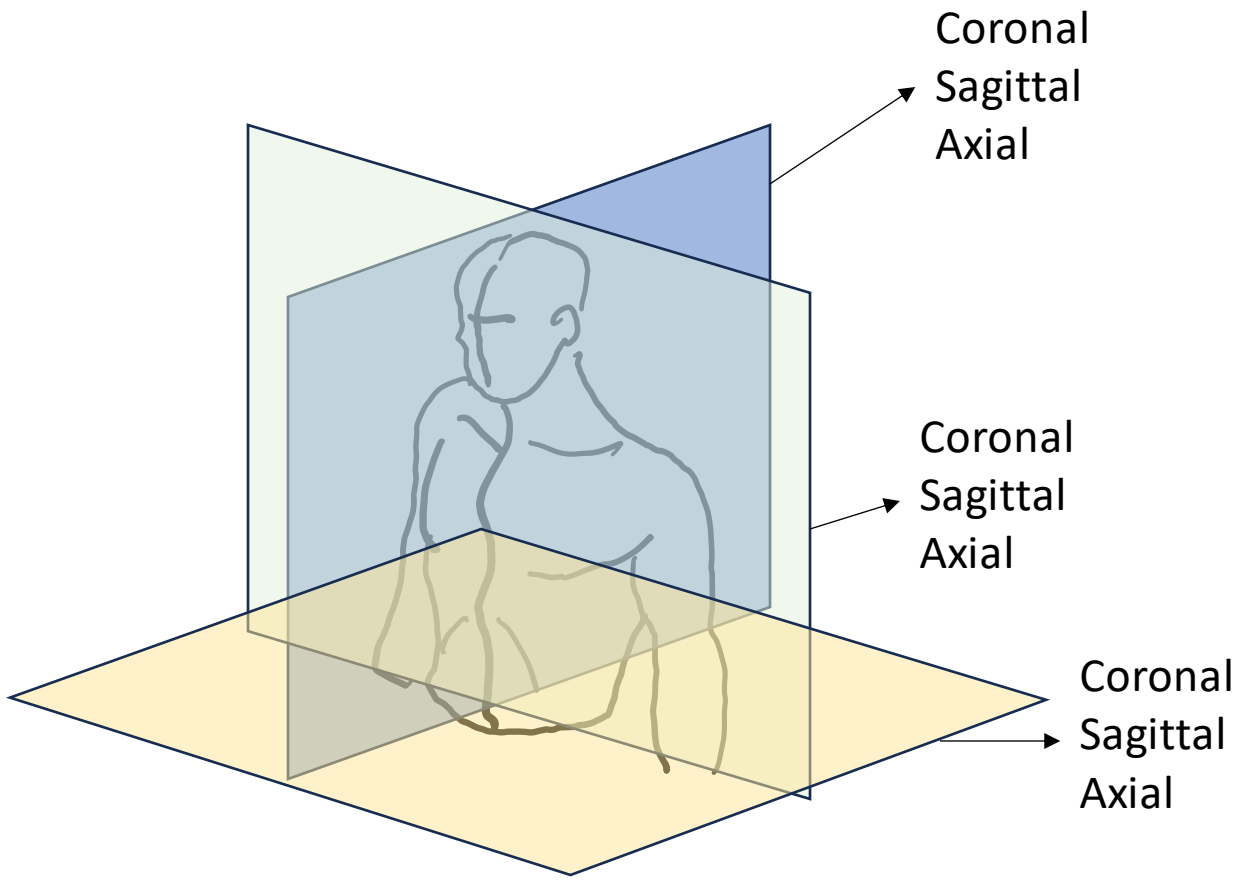
Coronal Plane

XXI
XX
XIX
VULPECULA
ANSER
DELPHINUS
SAGITTA
Pegasus
AQUILA
Albireo
Athair
1670
North

Sagittal Plane

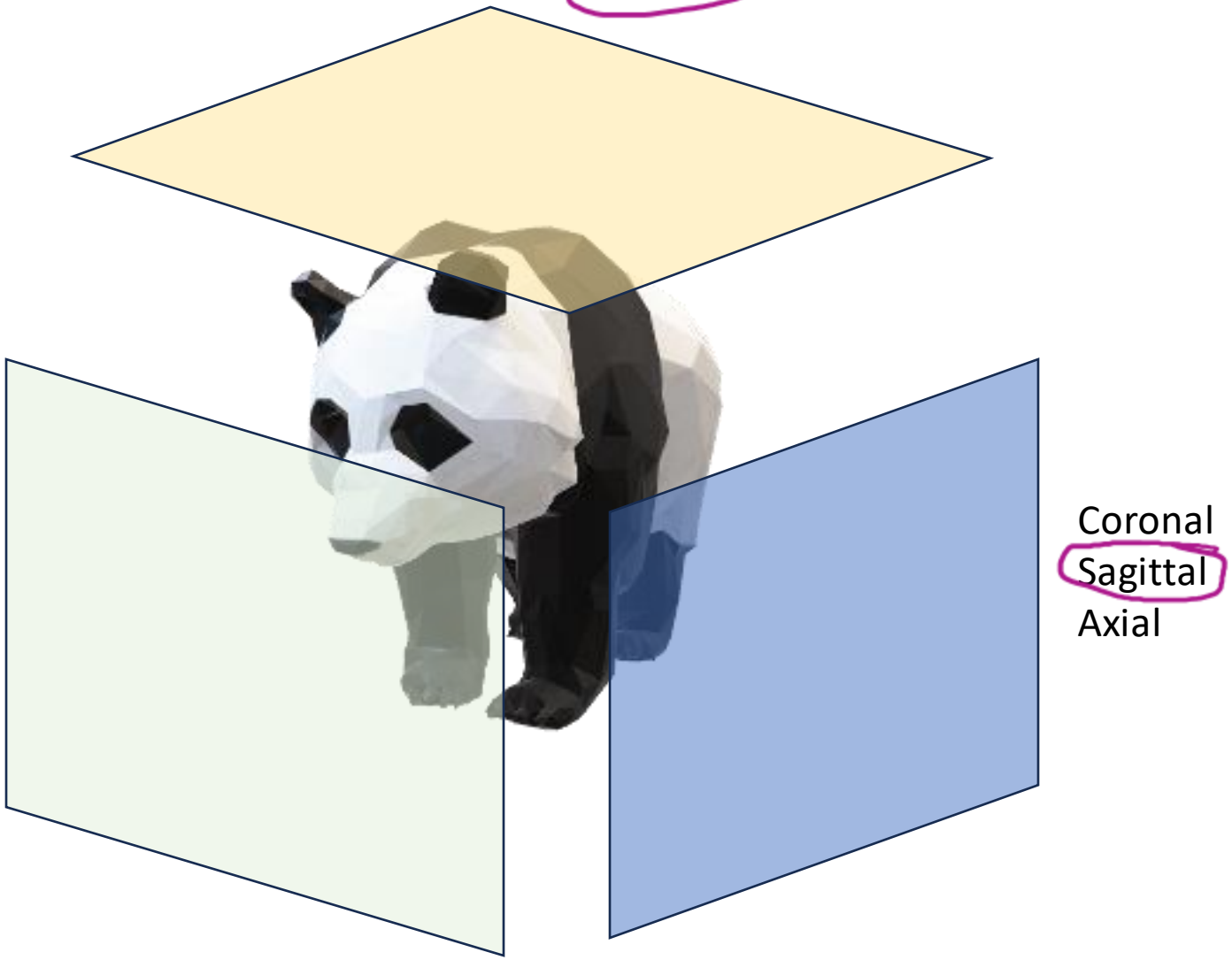



Coronal
Sagittal
Axial
Coronal
Sagittal
Axial
Coronal
Sagittal
Axial


Coronal
Sagittal
Axial
Coronal
Sagittal
Axial
Coronal
Sagittal
Axial

Circle the views

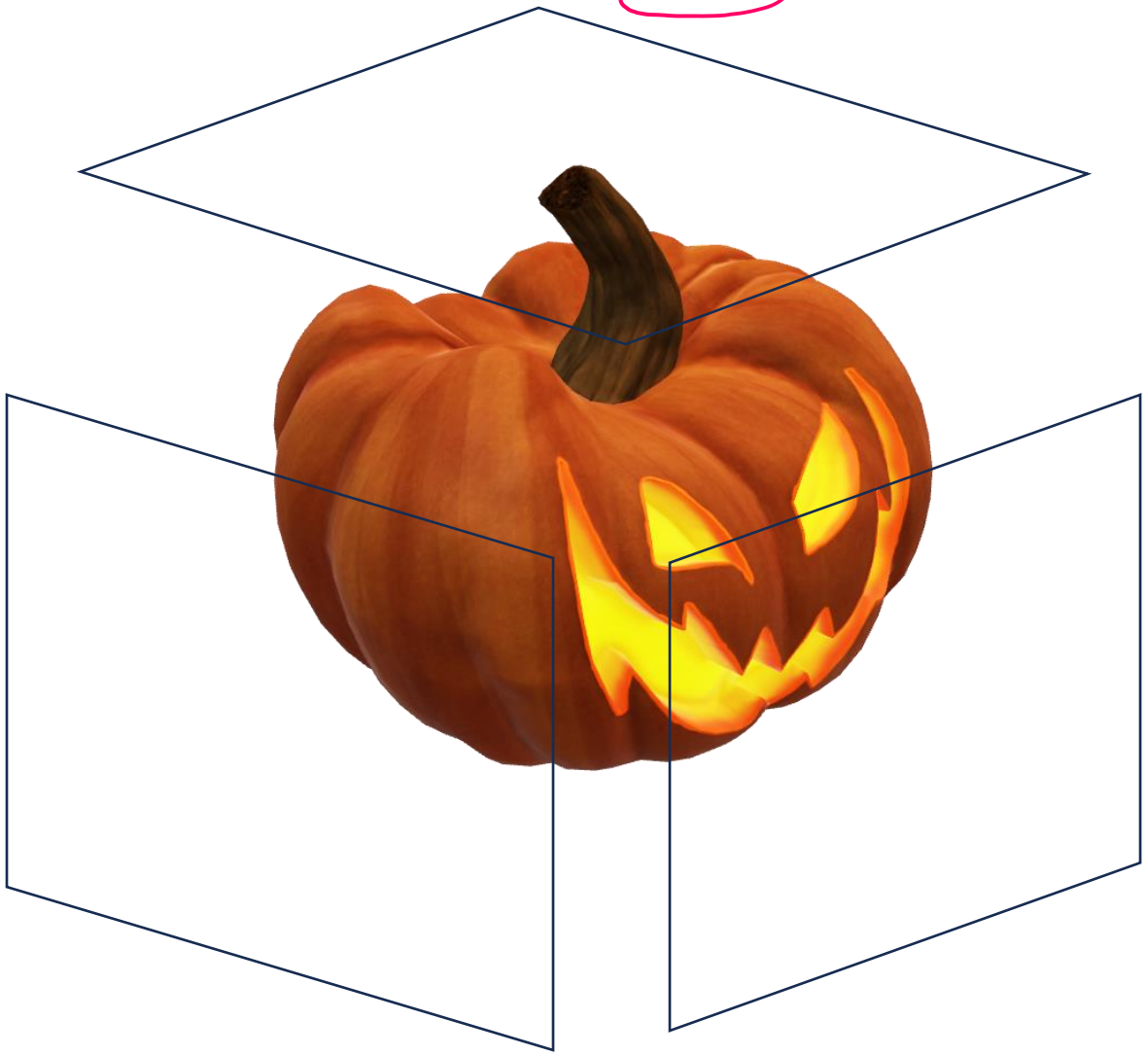
Coronal
Sagittal
Axial



Coronal
Sagittal
Axial

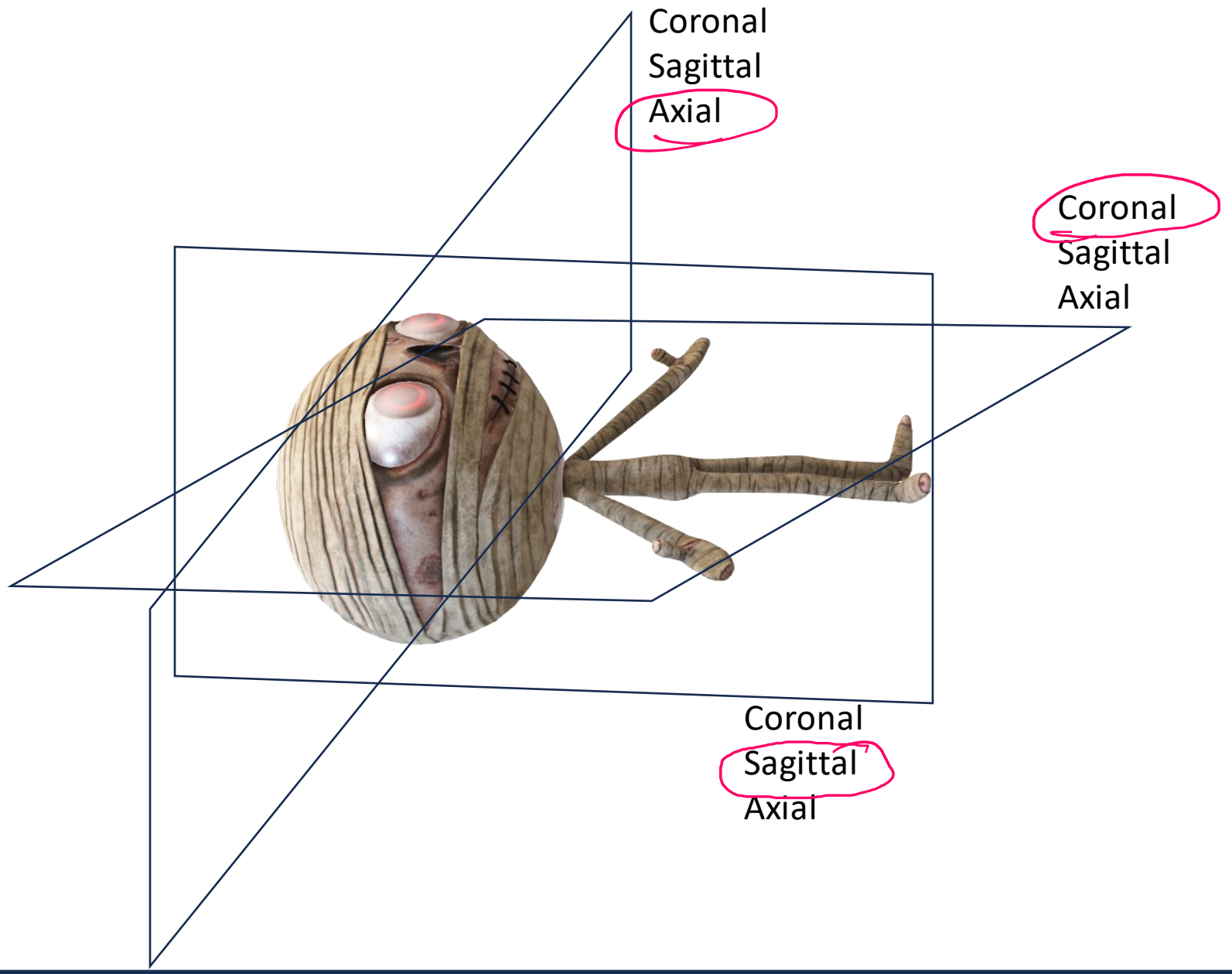
Coronal
Sagittal
Axial

Coronal
Sagittal
Axial



Coronal
Sagittal
Axial

Coronal
Sagittal
Axial


Coronal
Sagittal
Axial
Coronal
Sagittal
Axial
Coronal
Sagittal
Axial

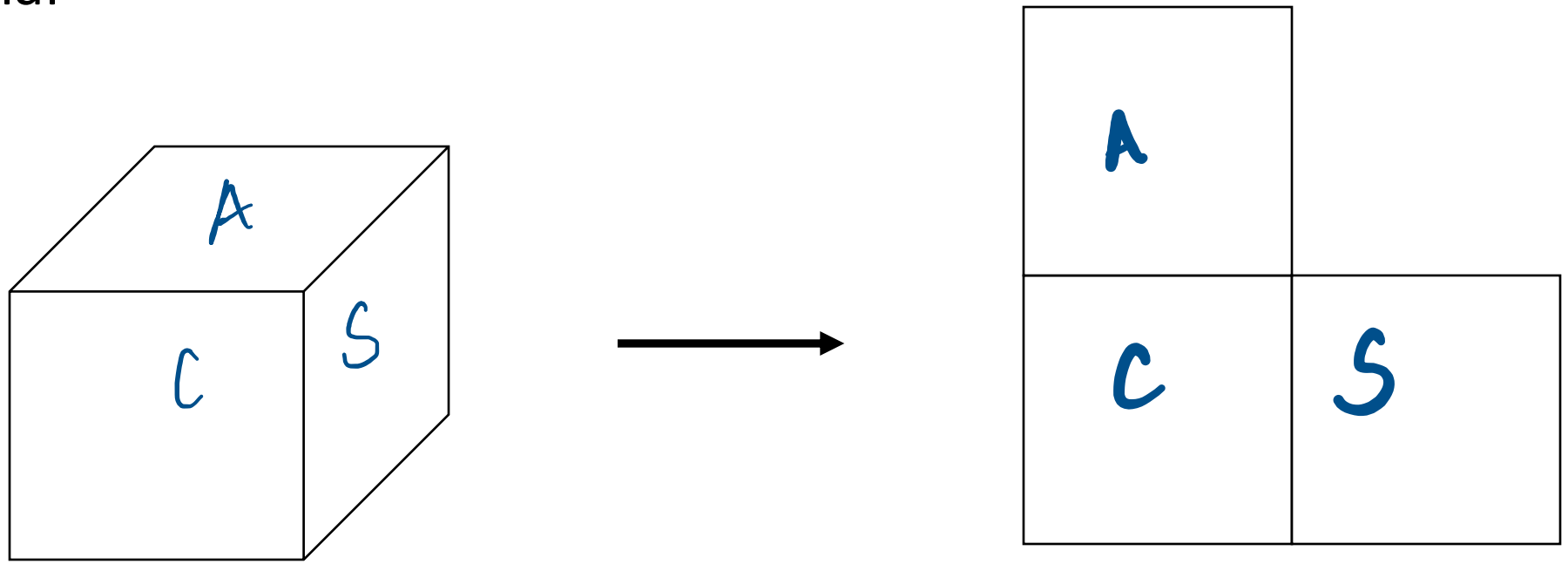
3D Multiview Projection

CSCI 5722 Computer Vision

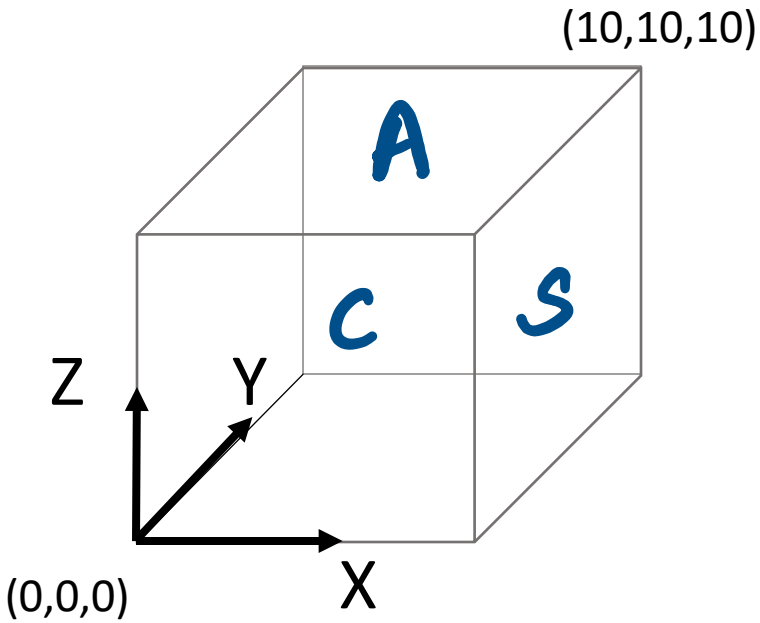
University of Colorado
Boulder

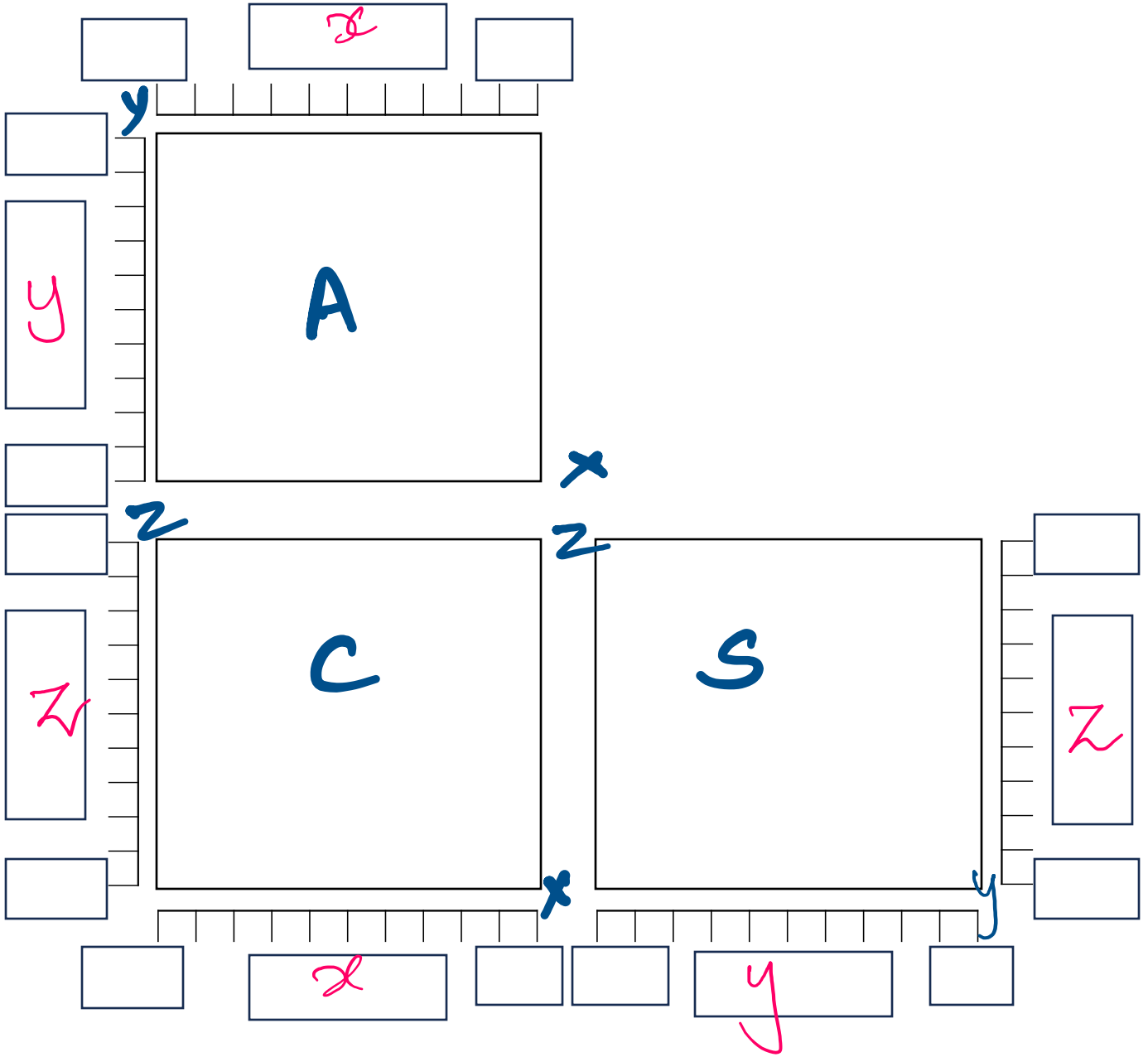
Mapping CSA Planes

C: Coronal
S: Sagittal
A: Axial

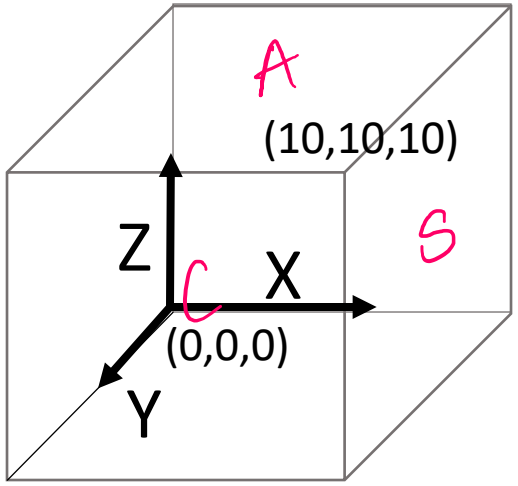


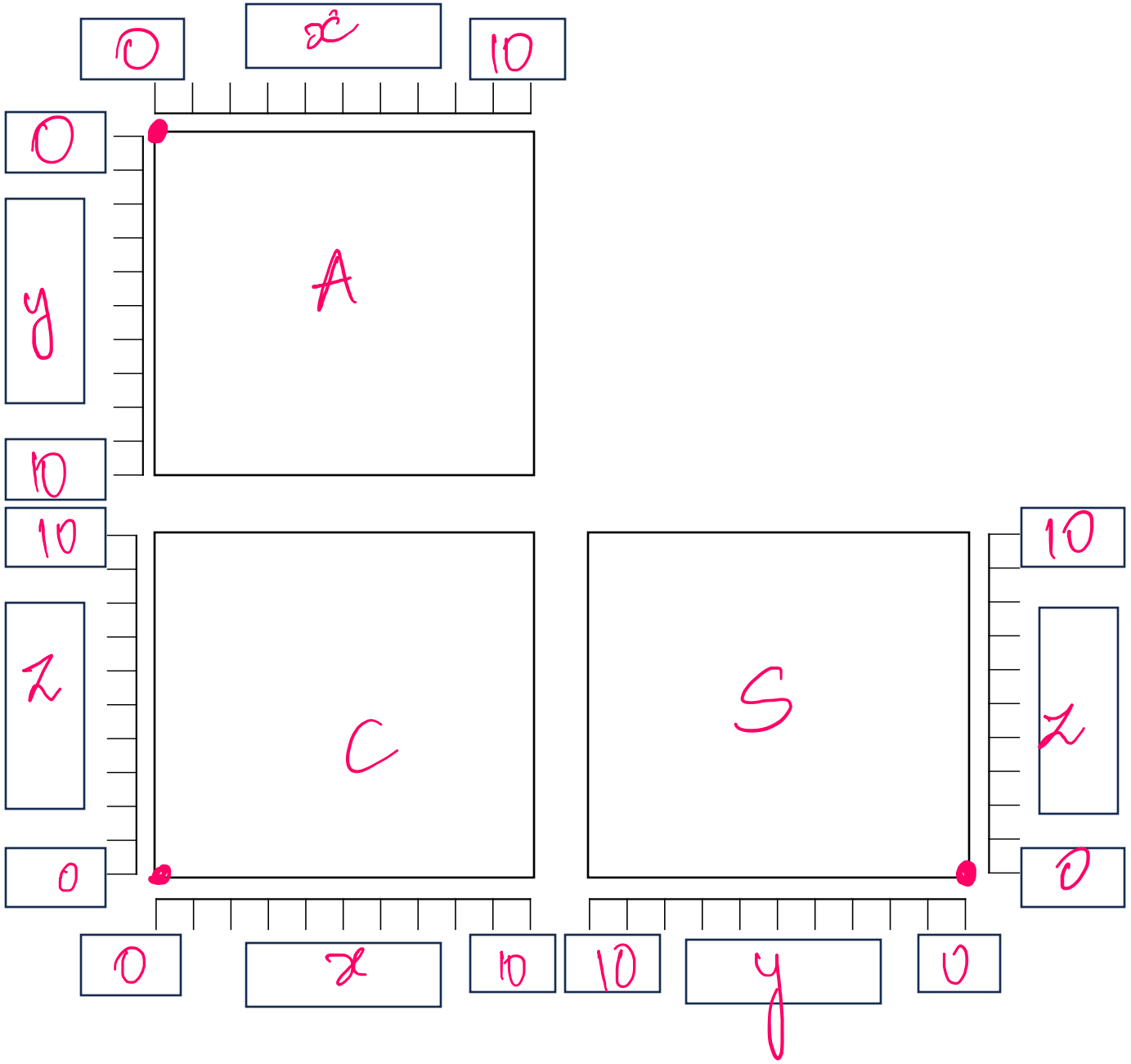
Map the axes



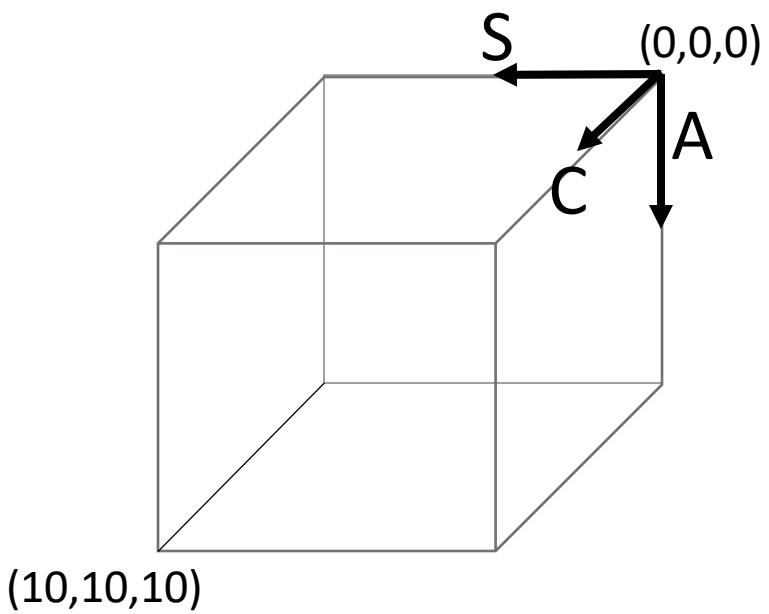


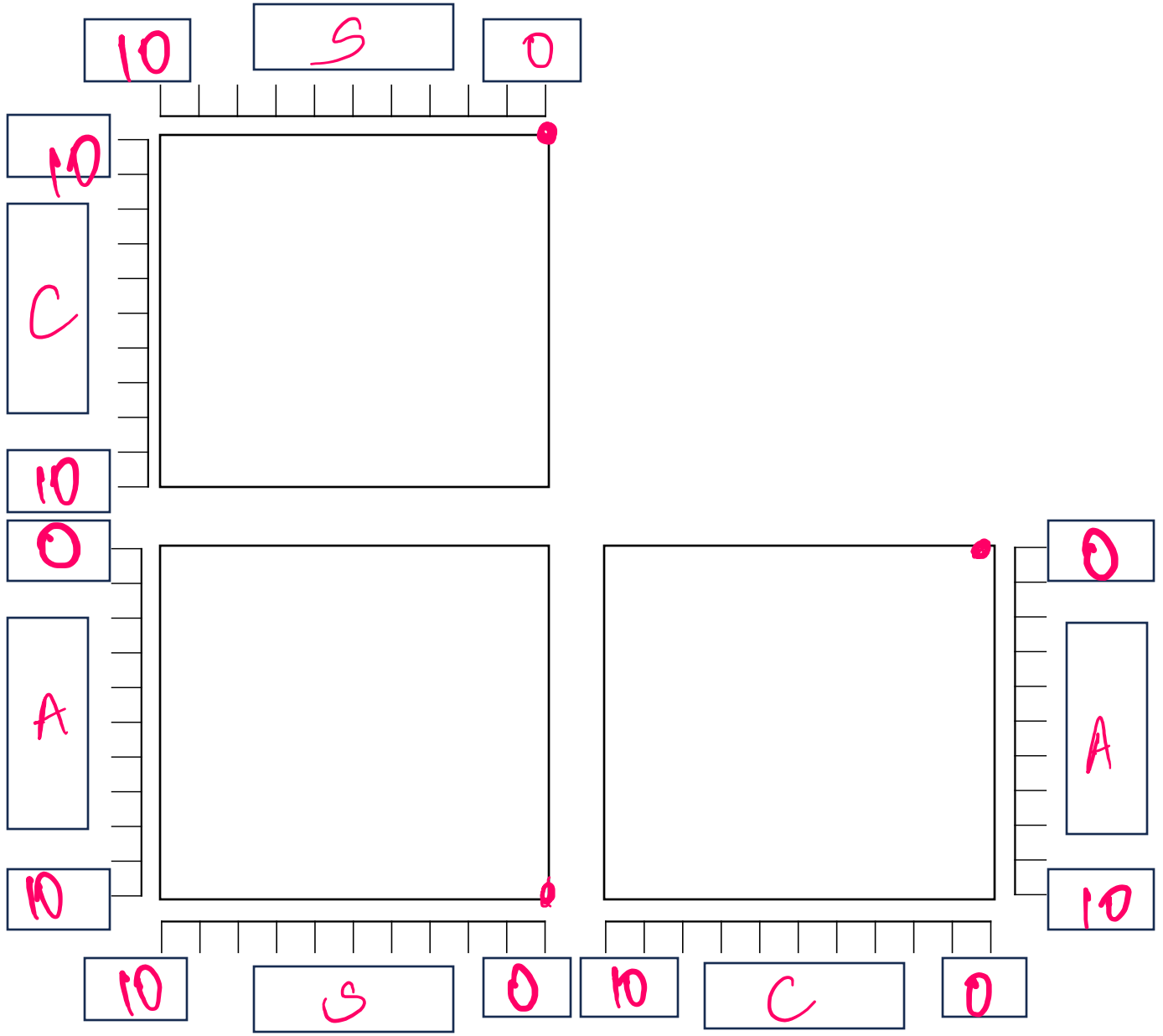
Map the axes



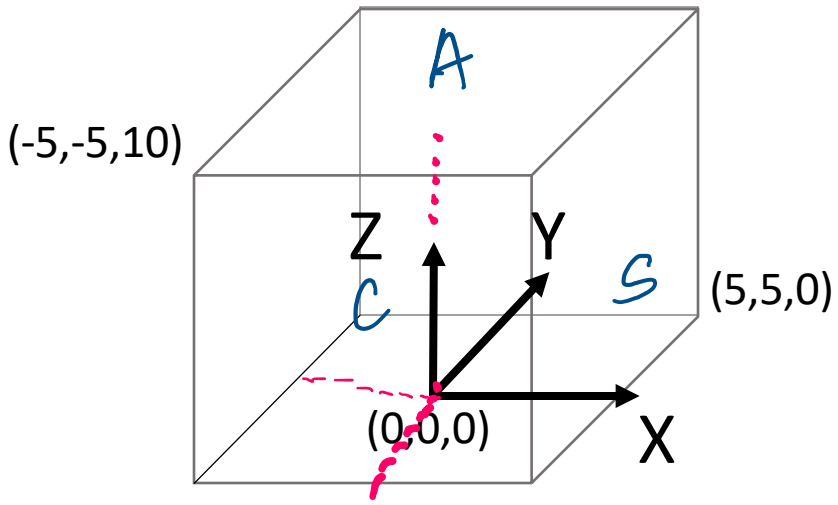


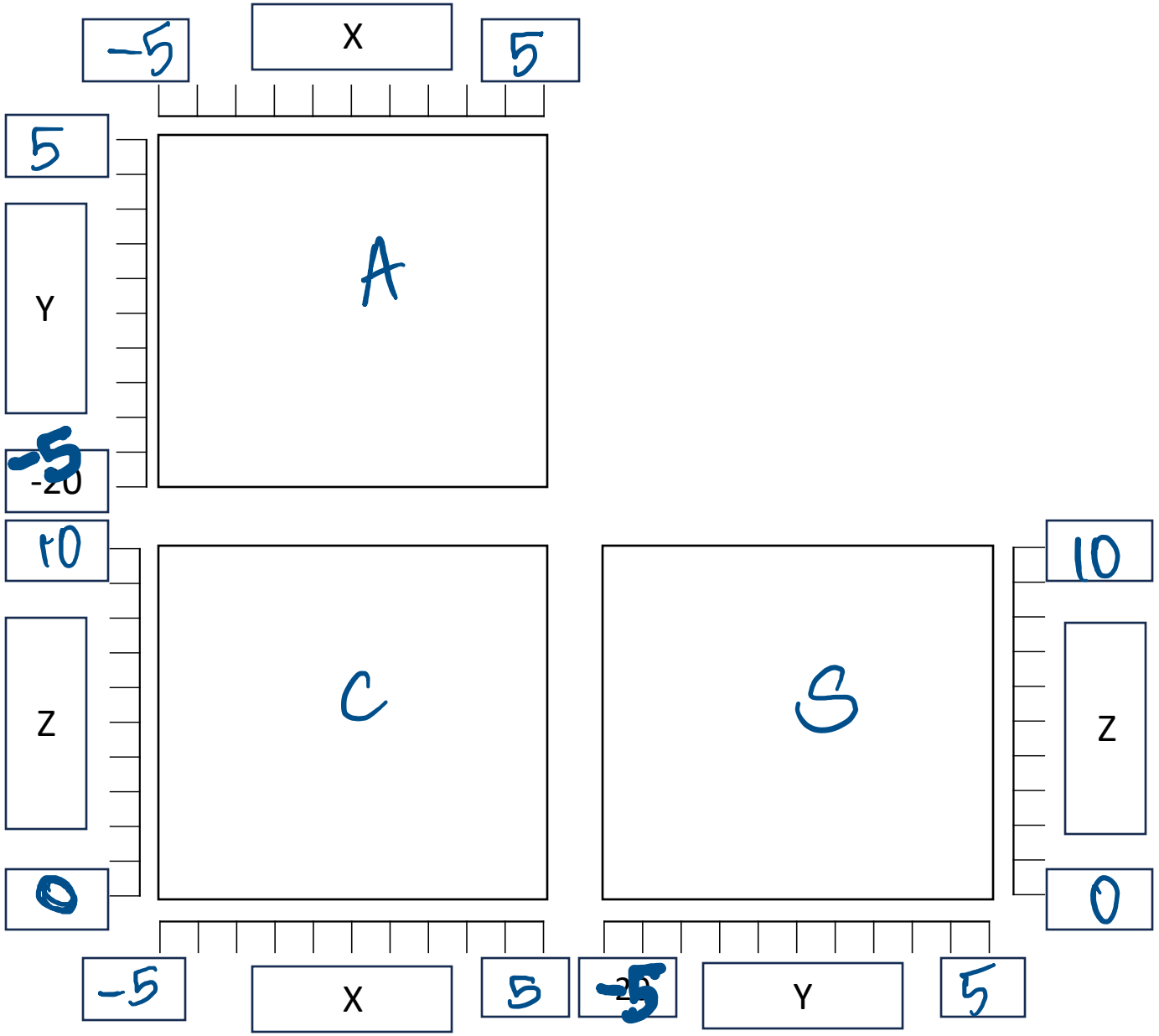
Map the axes



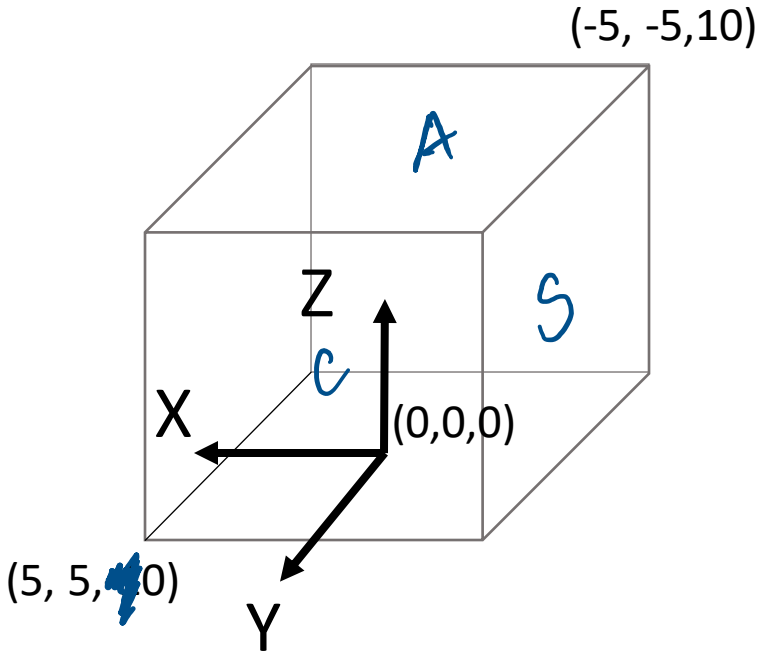


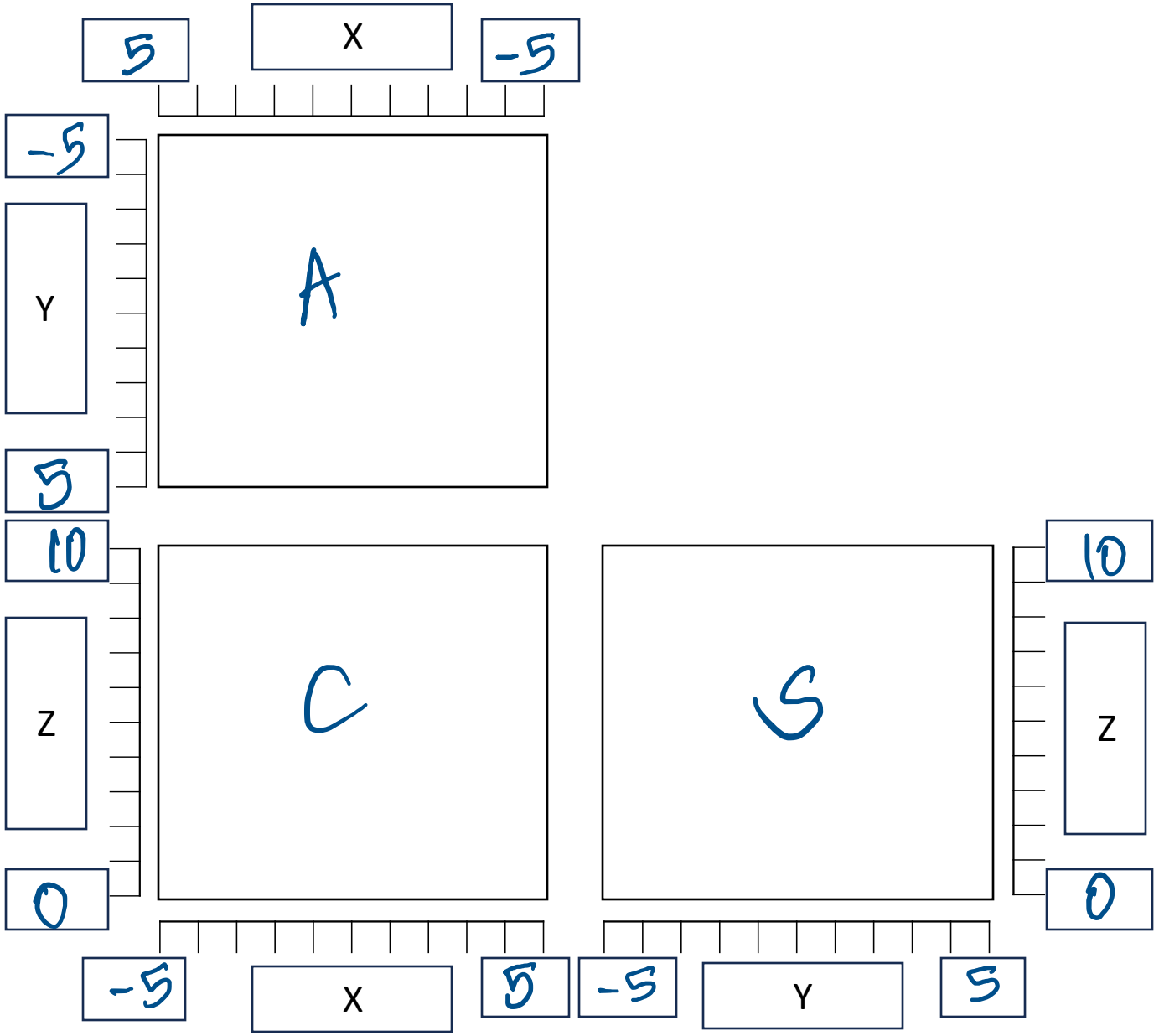
Map the axes



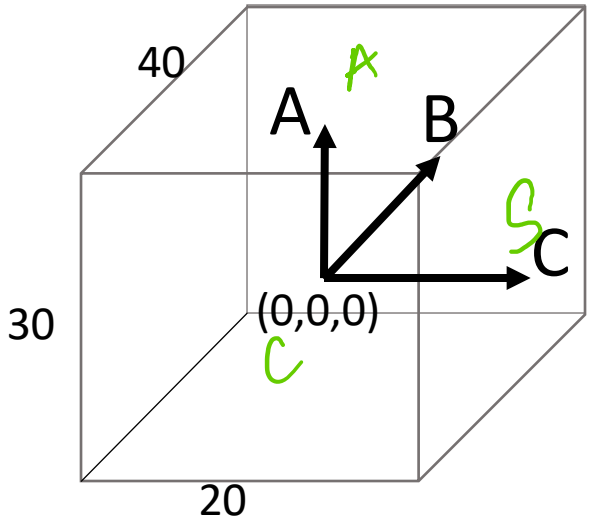


Map the axes

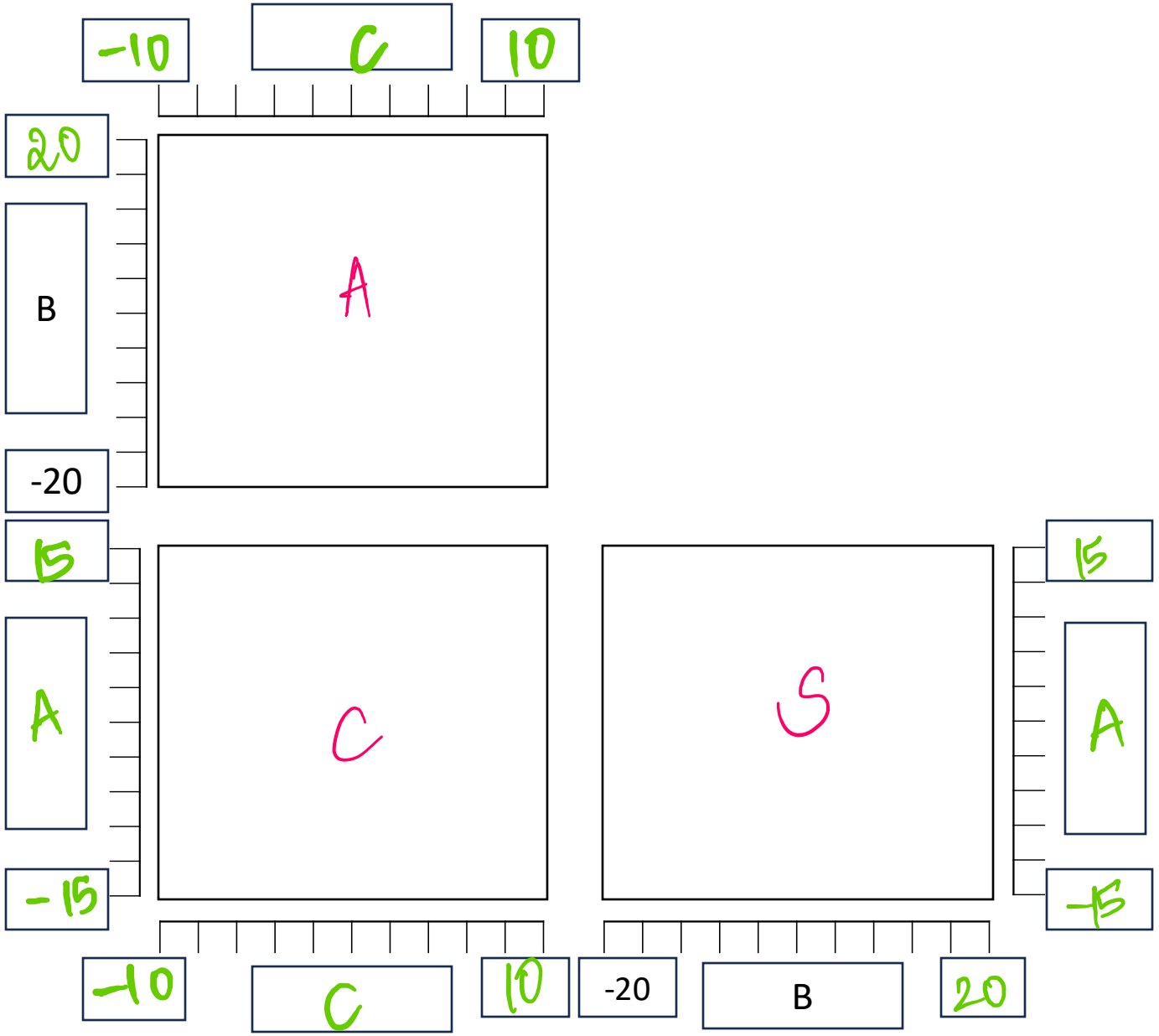




Map the axes

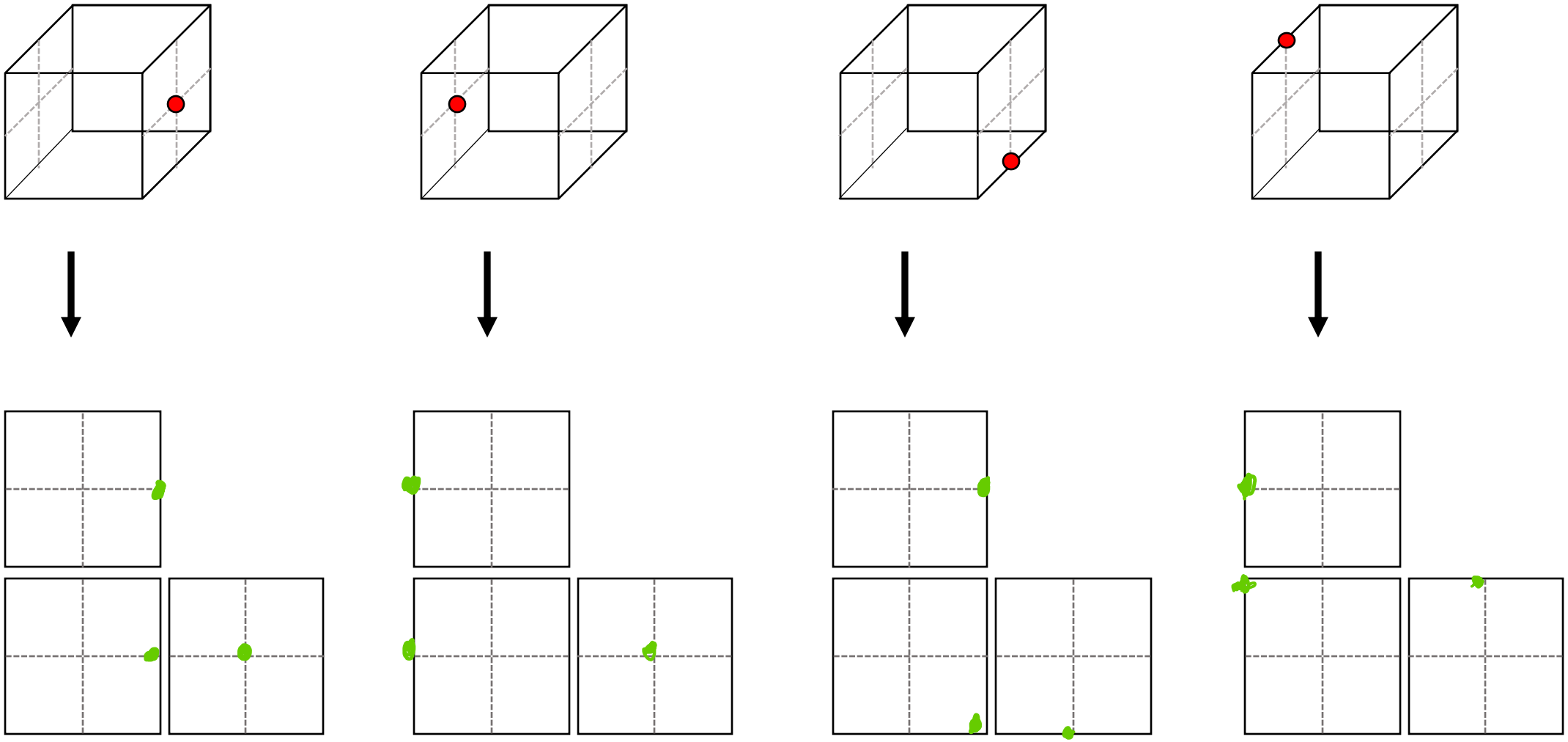


The origin (0,0,0) is in the center of the box. The numbers are the side lengths.

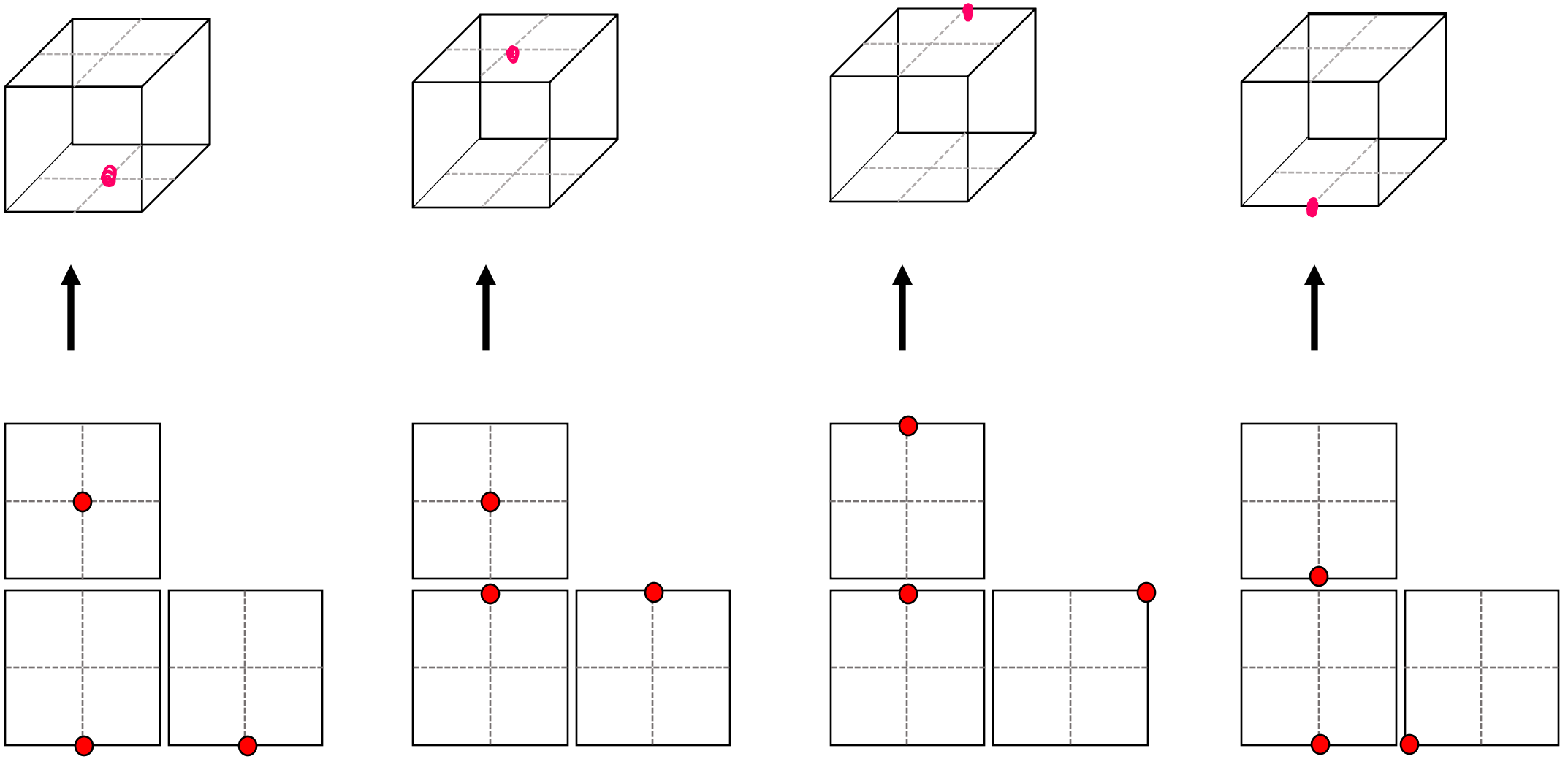


3D Points: Box → Multiview

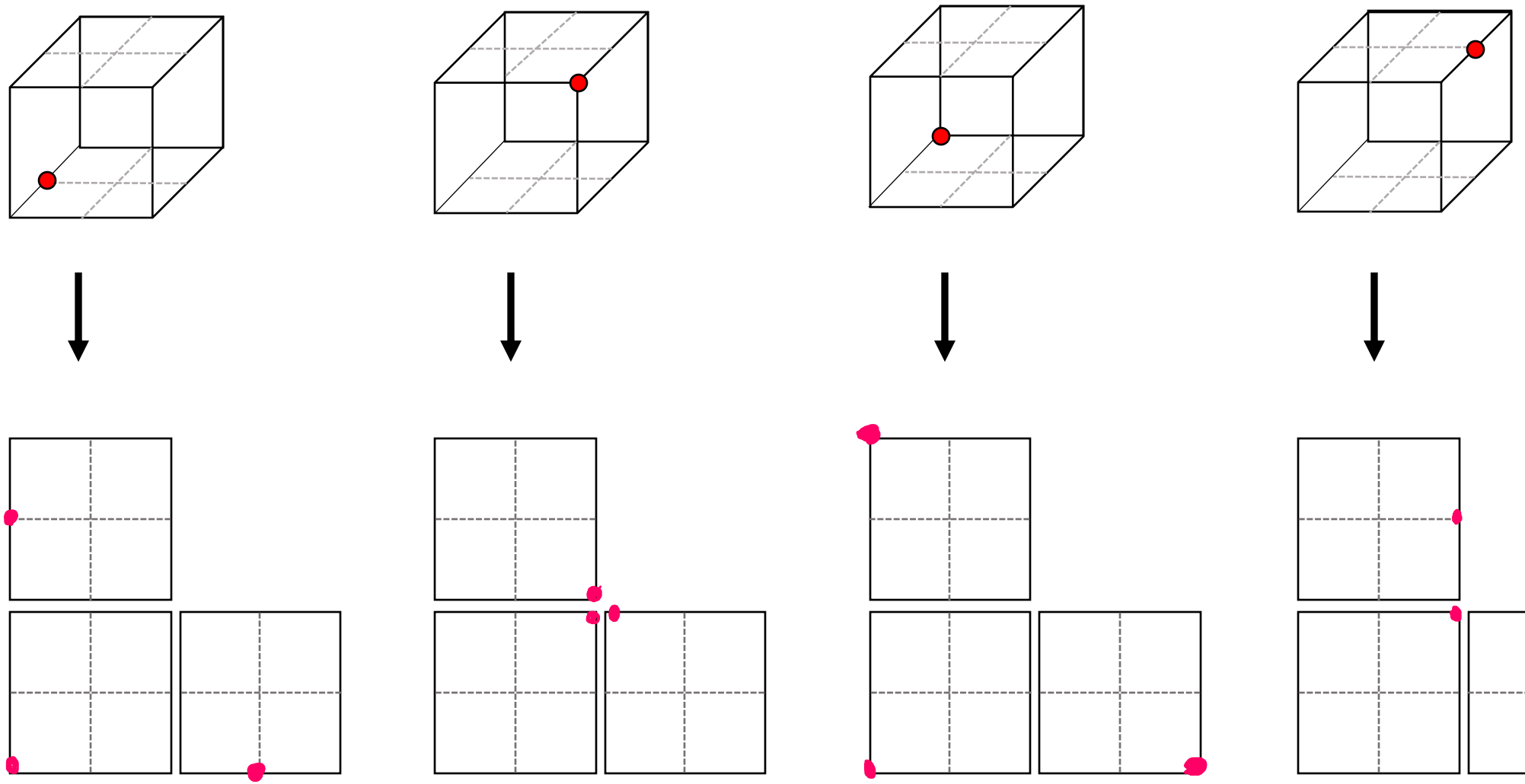
A C S



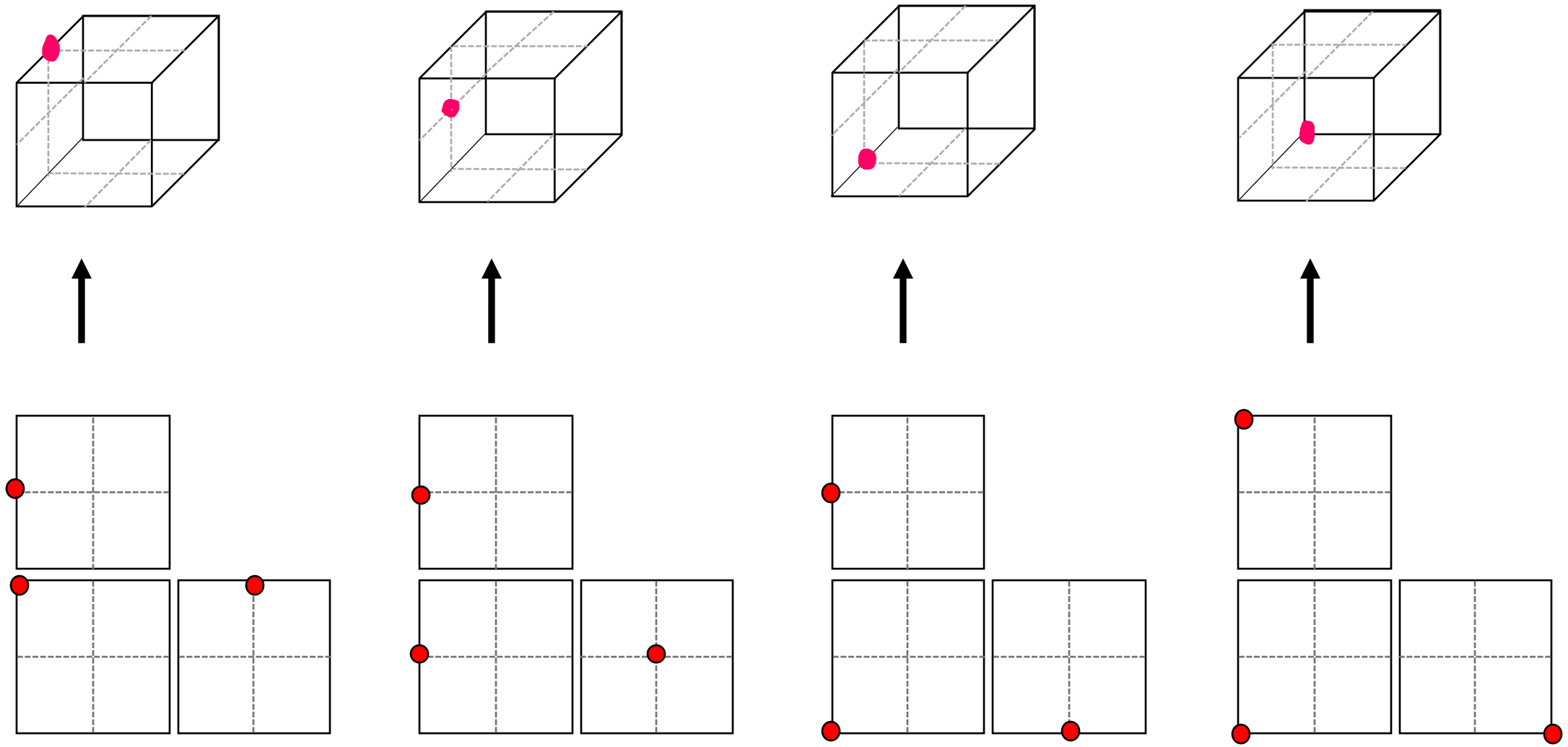
3D Points: Multiview → Box



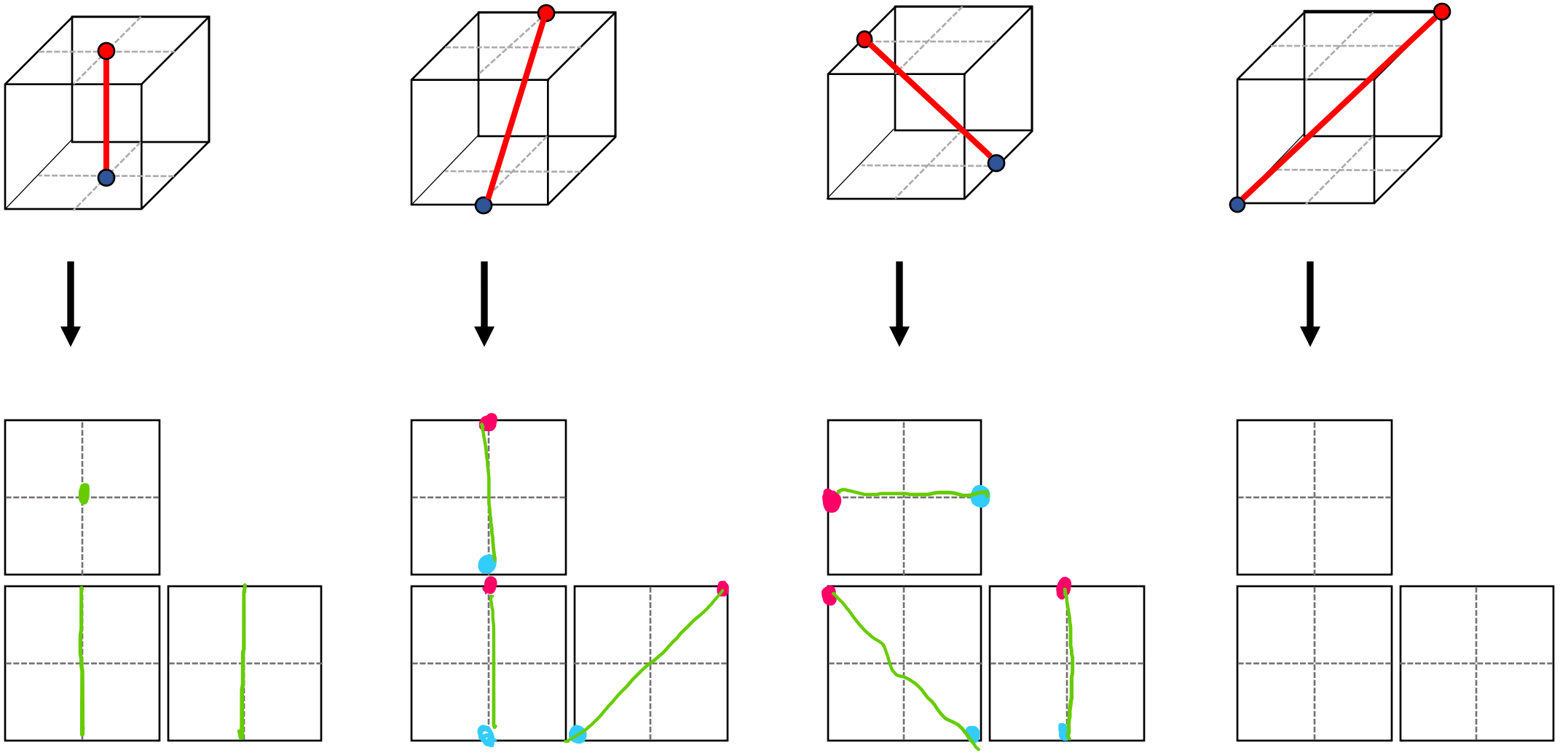
3D Points: Box → Multiview



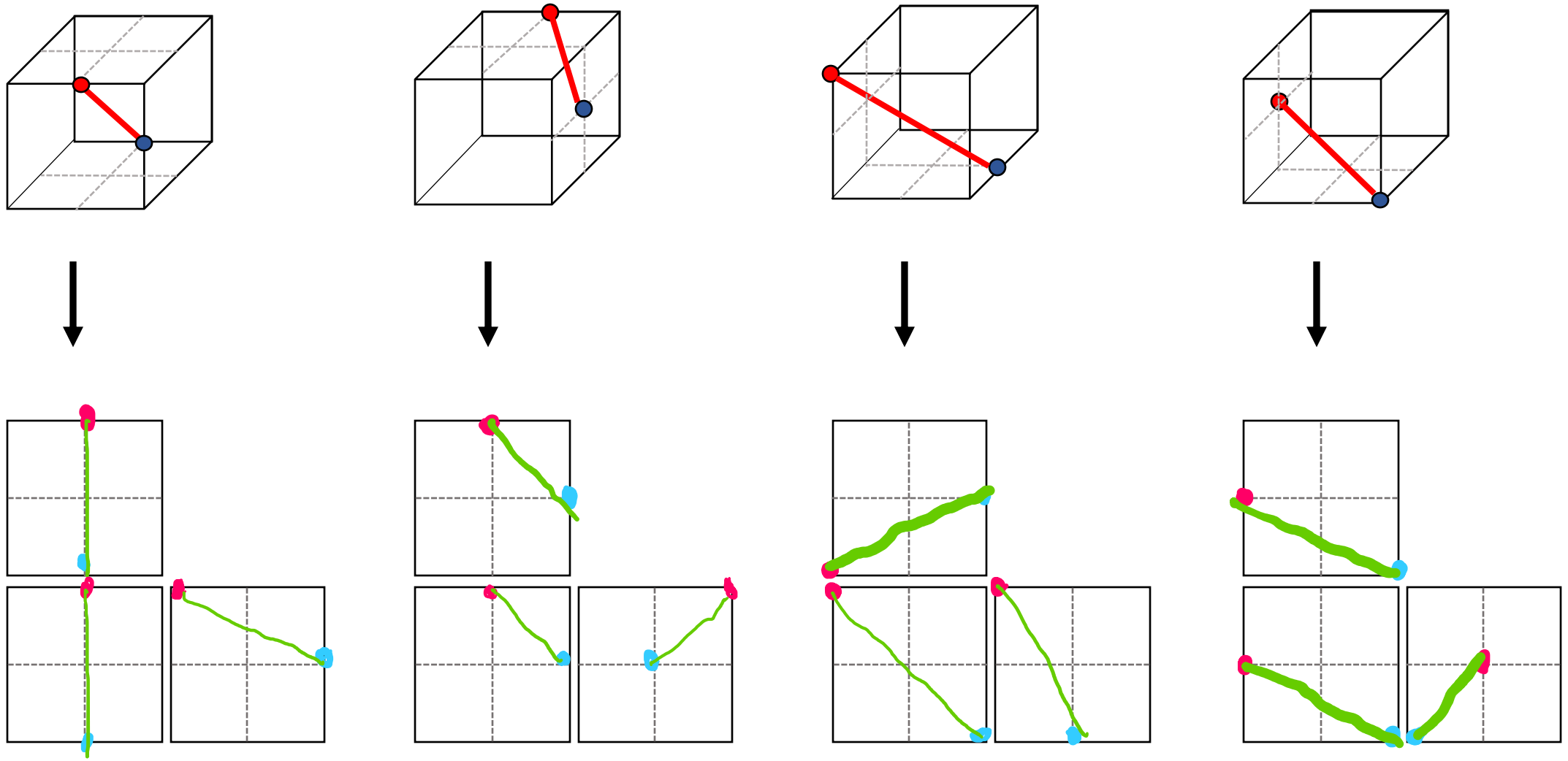
3D Points: Multiview → Box



3D Lines

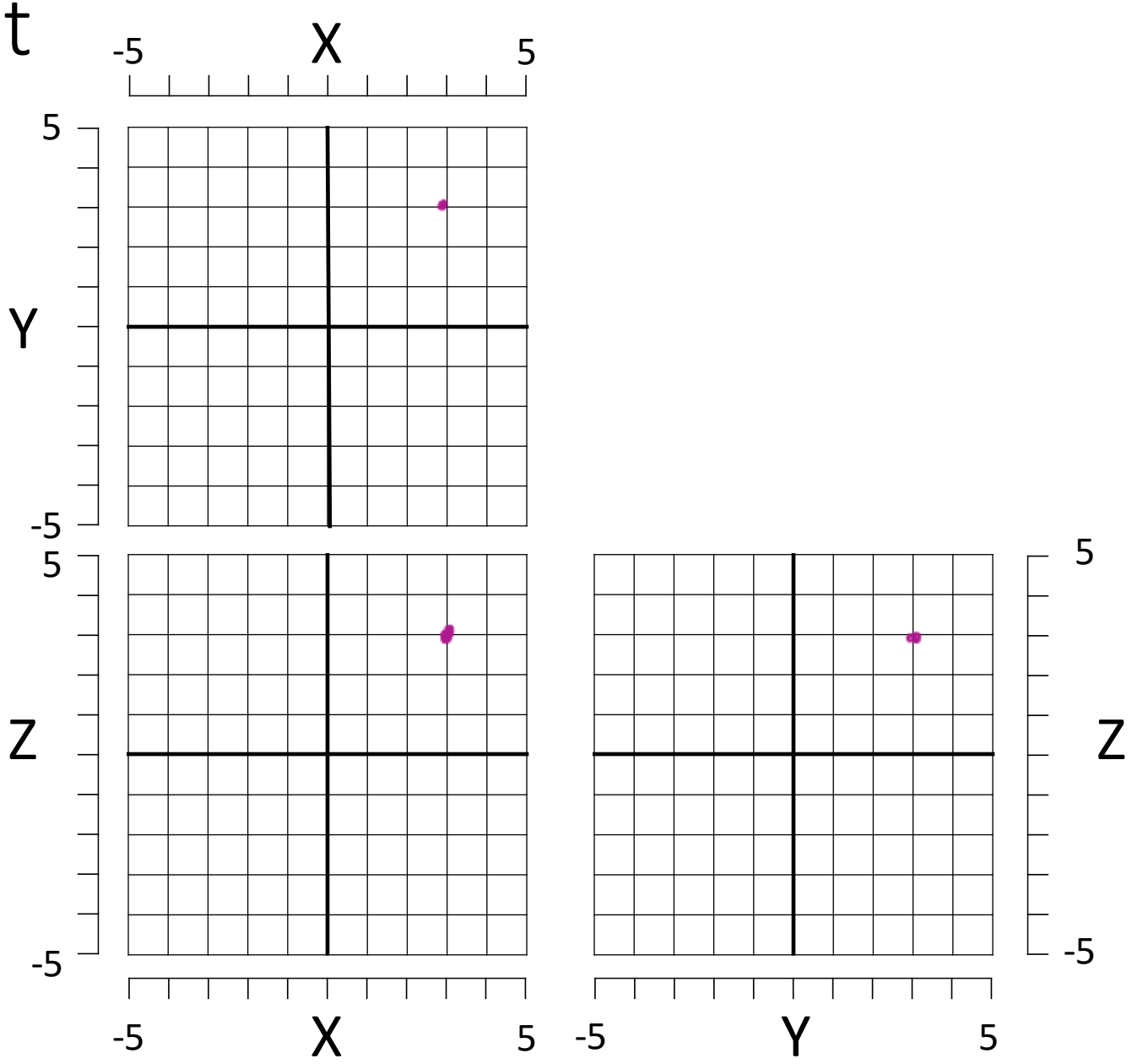


Draw 3D lines



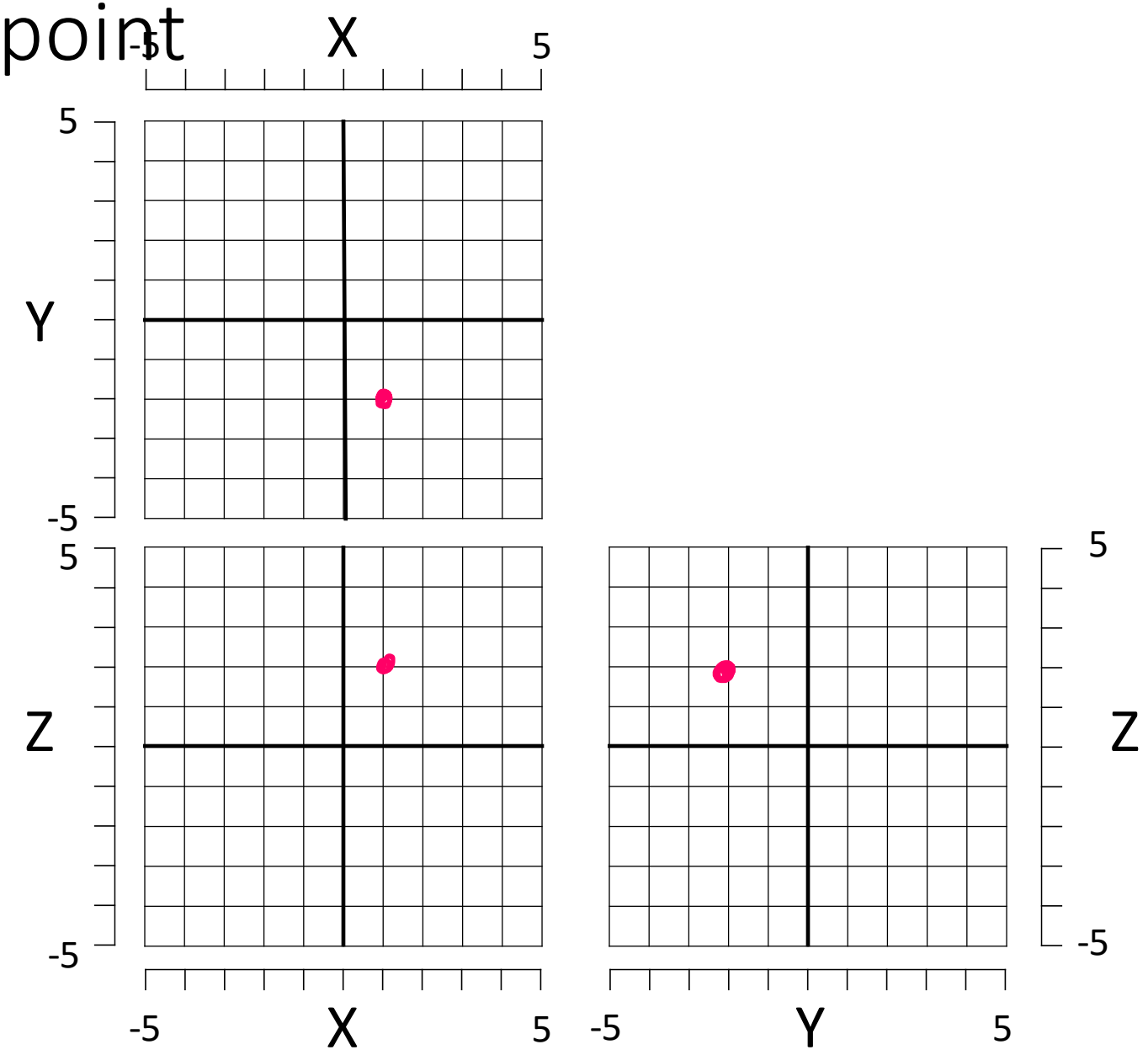
Draw a point

(3, 3, 3)



Draw a point

(1, -2, 2)

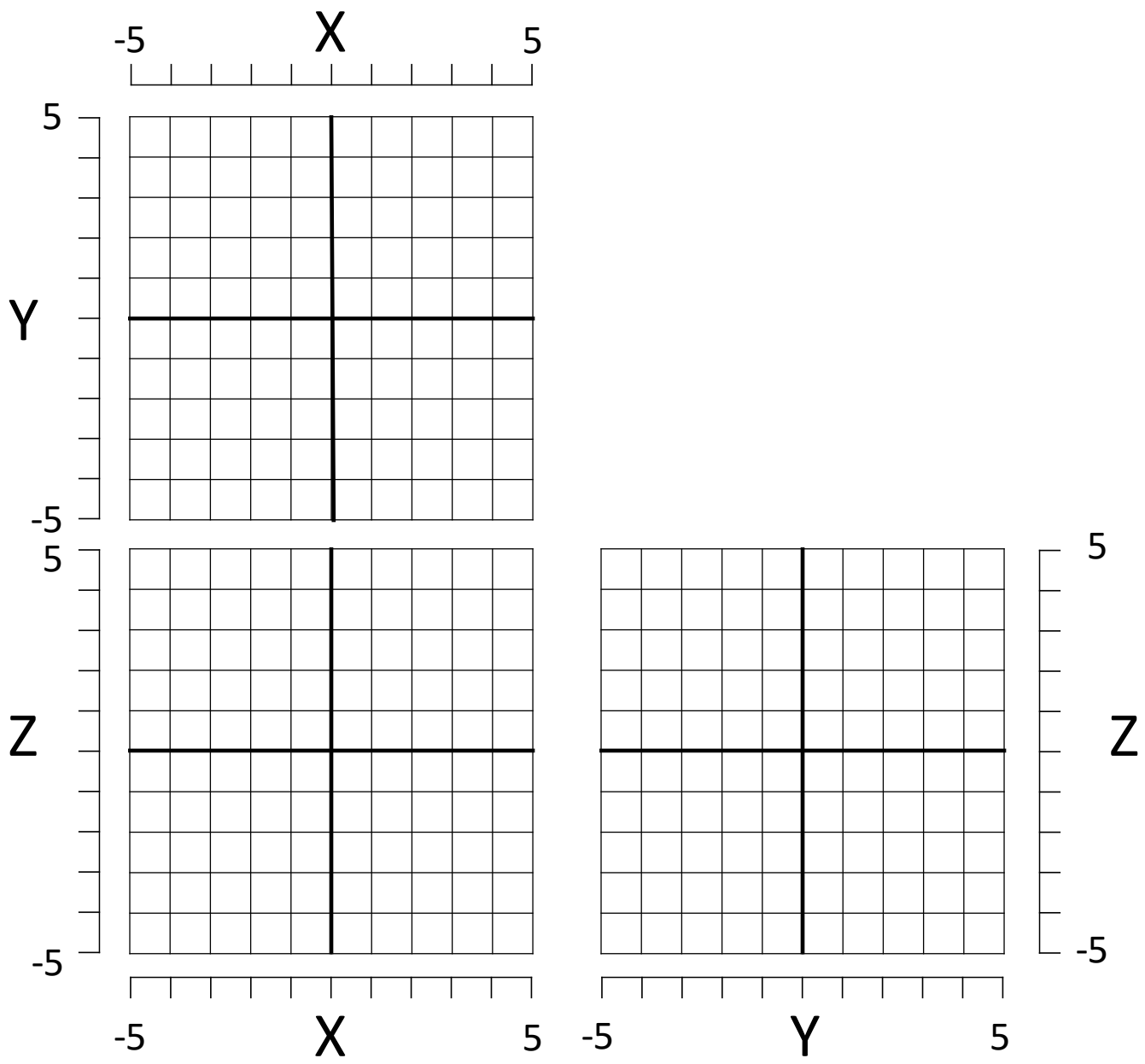


Draw a line

(0, 1, -1)

→

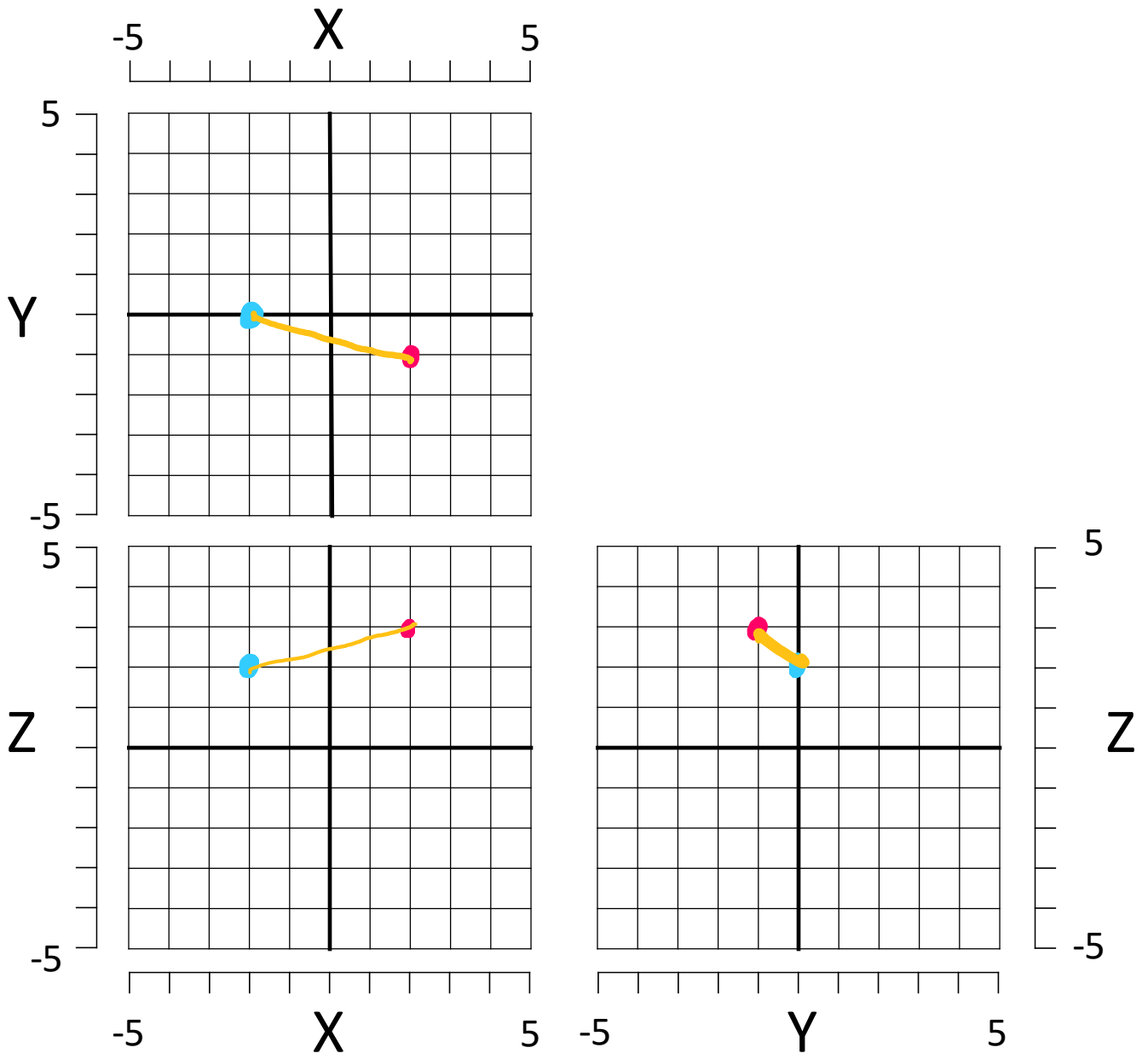
(3, -2, 1)



Draw a line

(2, -1, 3)

(-2, 0, 2)

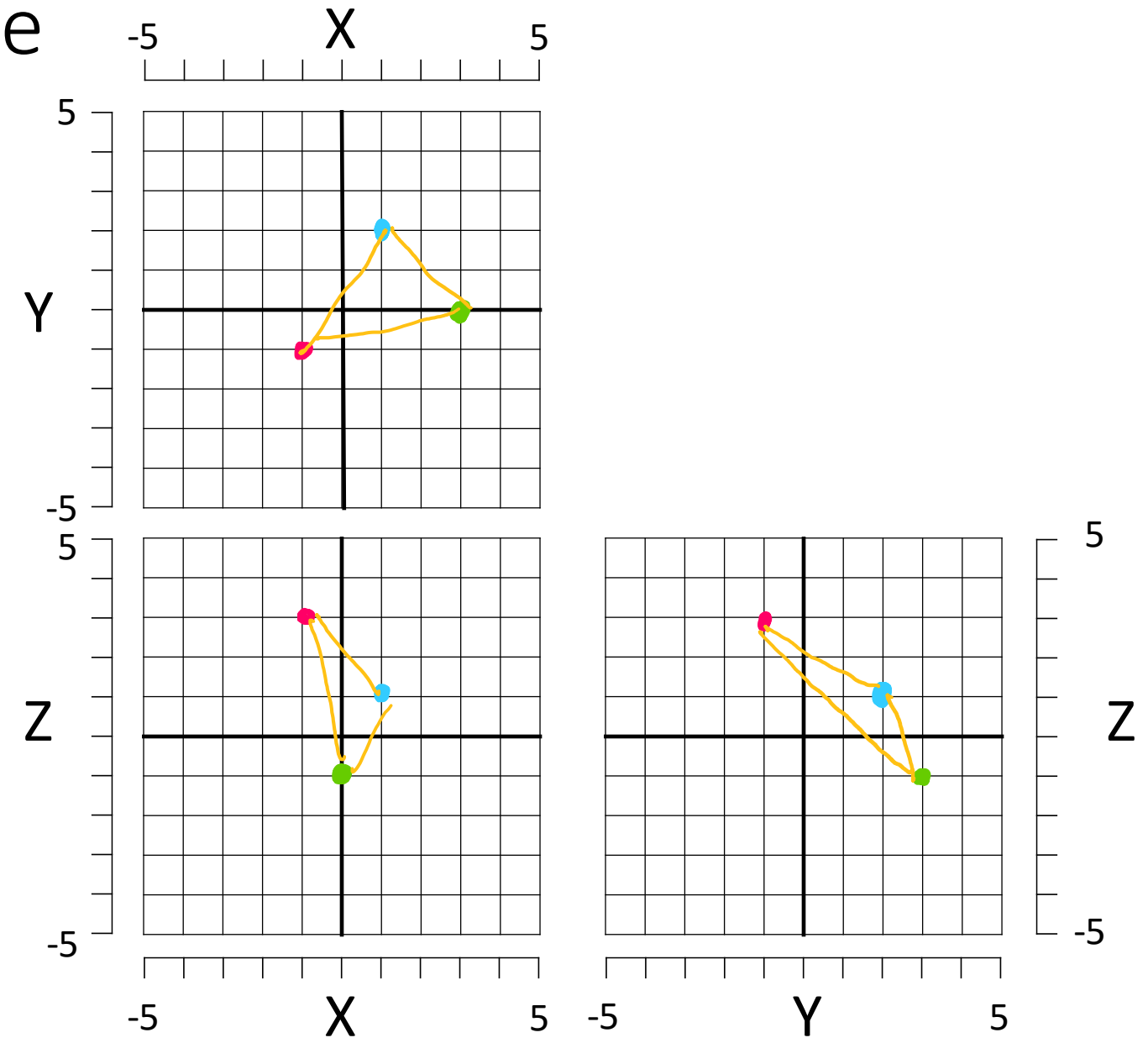


Draw a triangle

(-1, -1, 3)

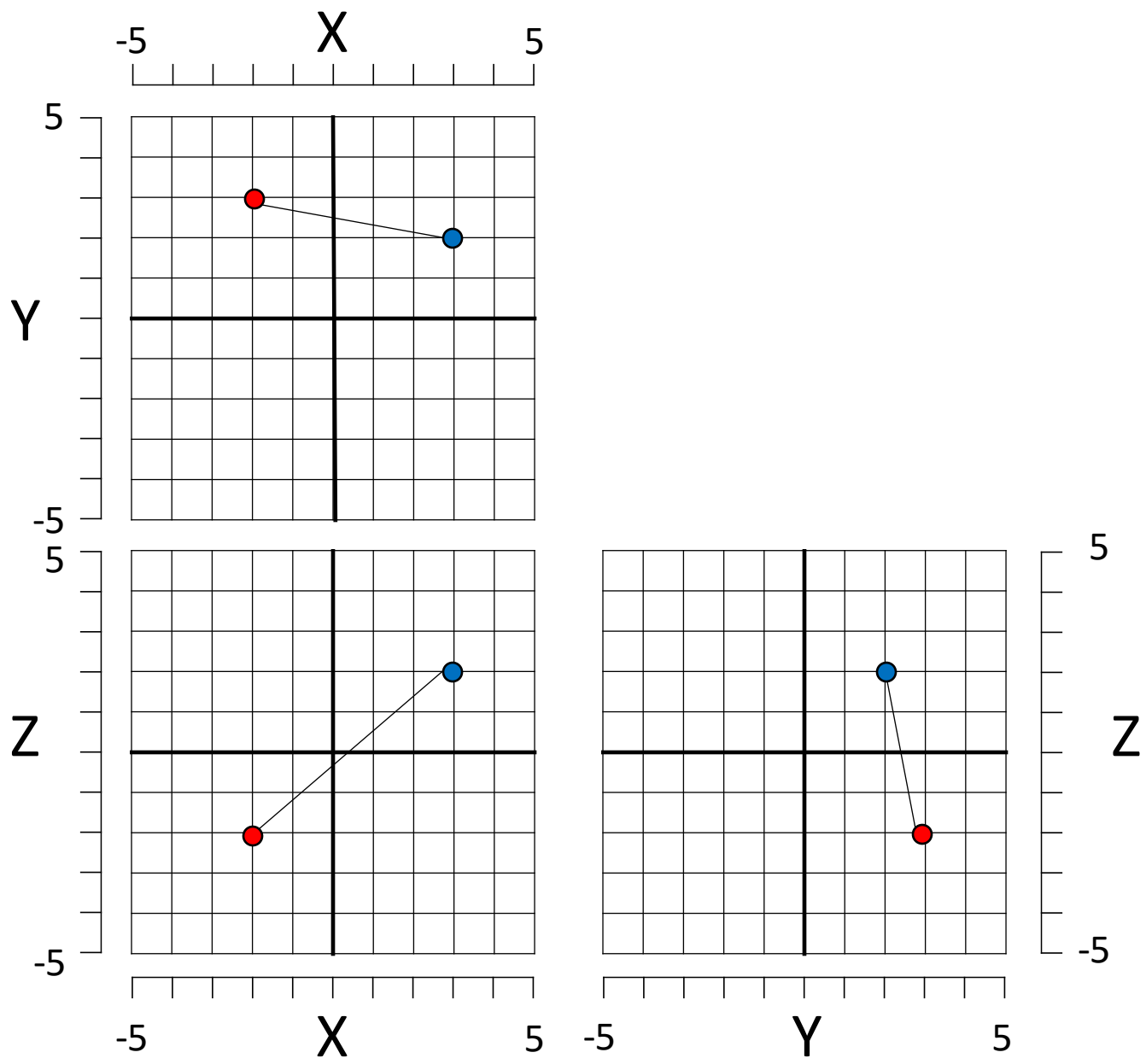
(1, 2, 1)

(0,3,-1,)



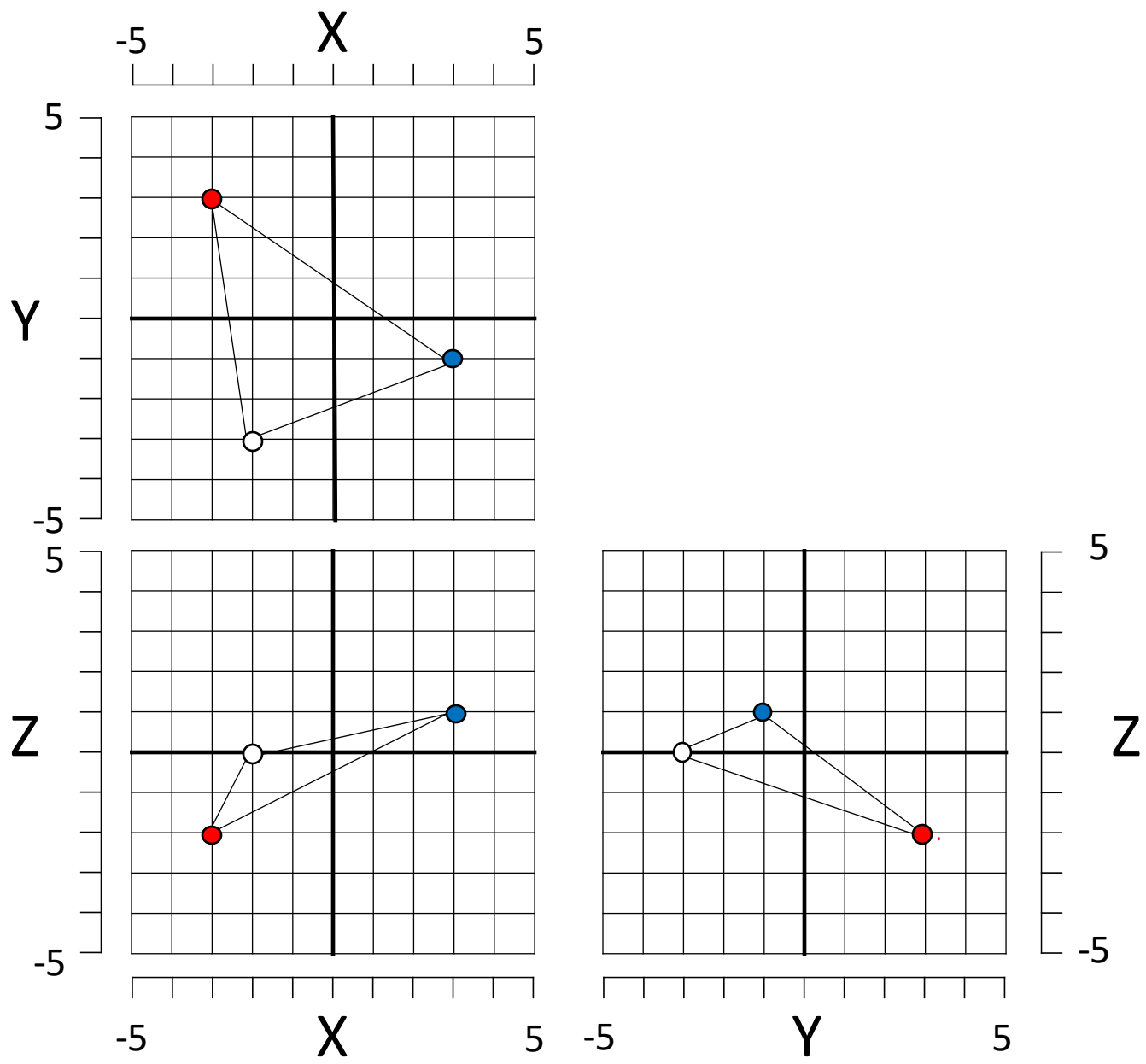
Read a line

- (__, __, __)
- (__, __, __)



Read a triangle

- (-3, 3, -2)
- (3, -1, 1)
- (-2, -3, 0)

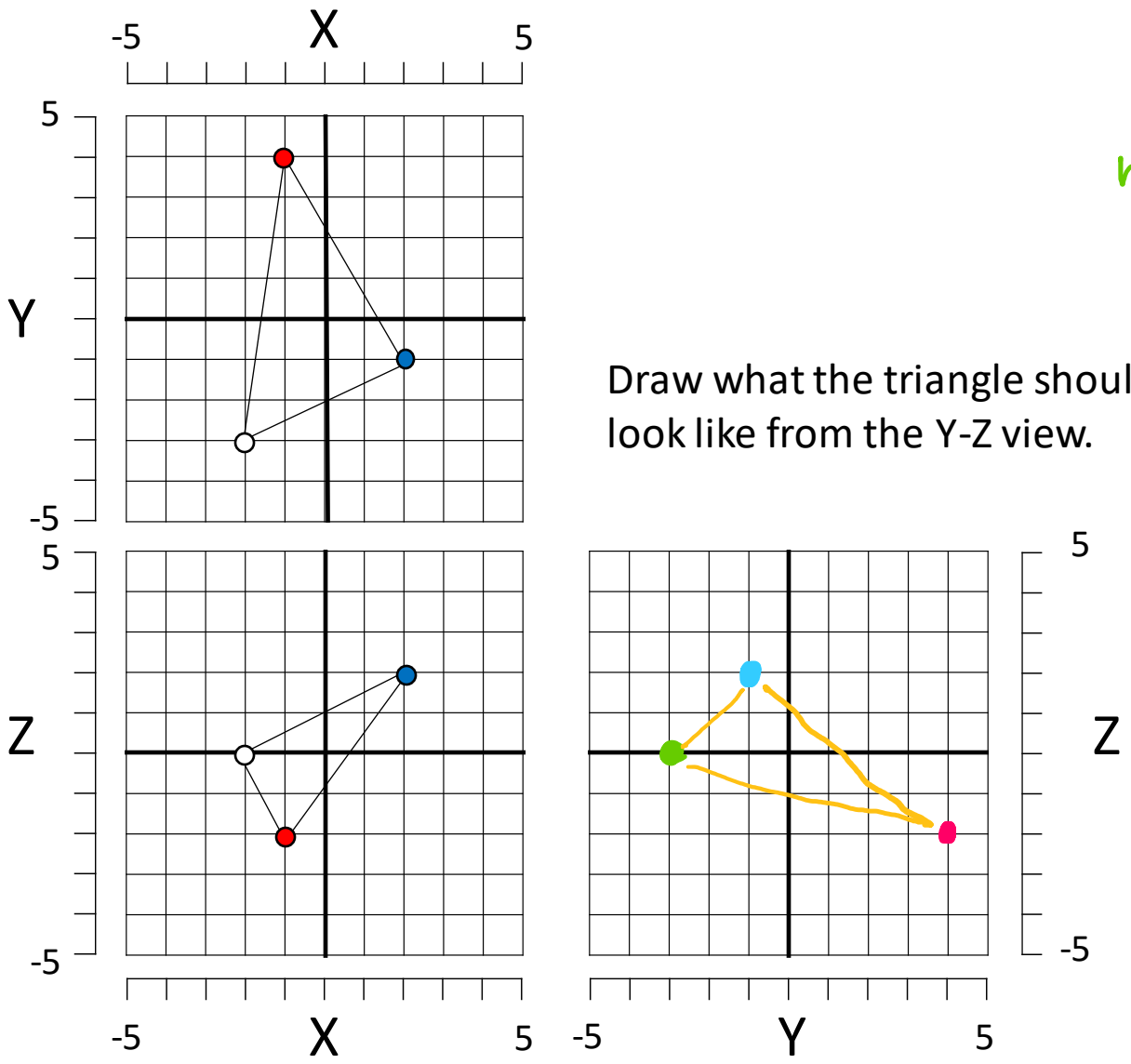


Infer the 3rd view

Red → (-1, 4, -2)

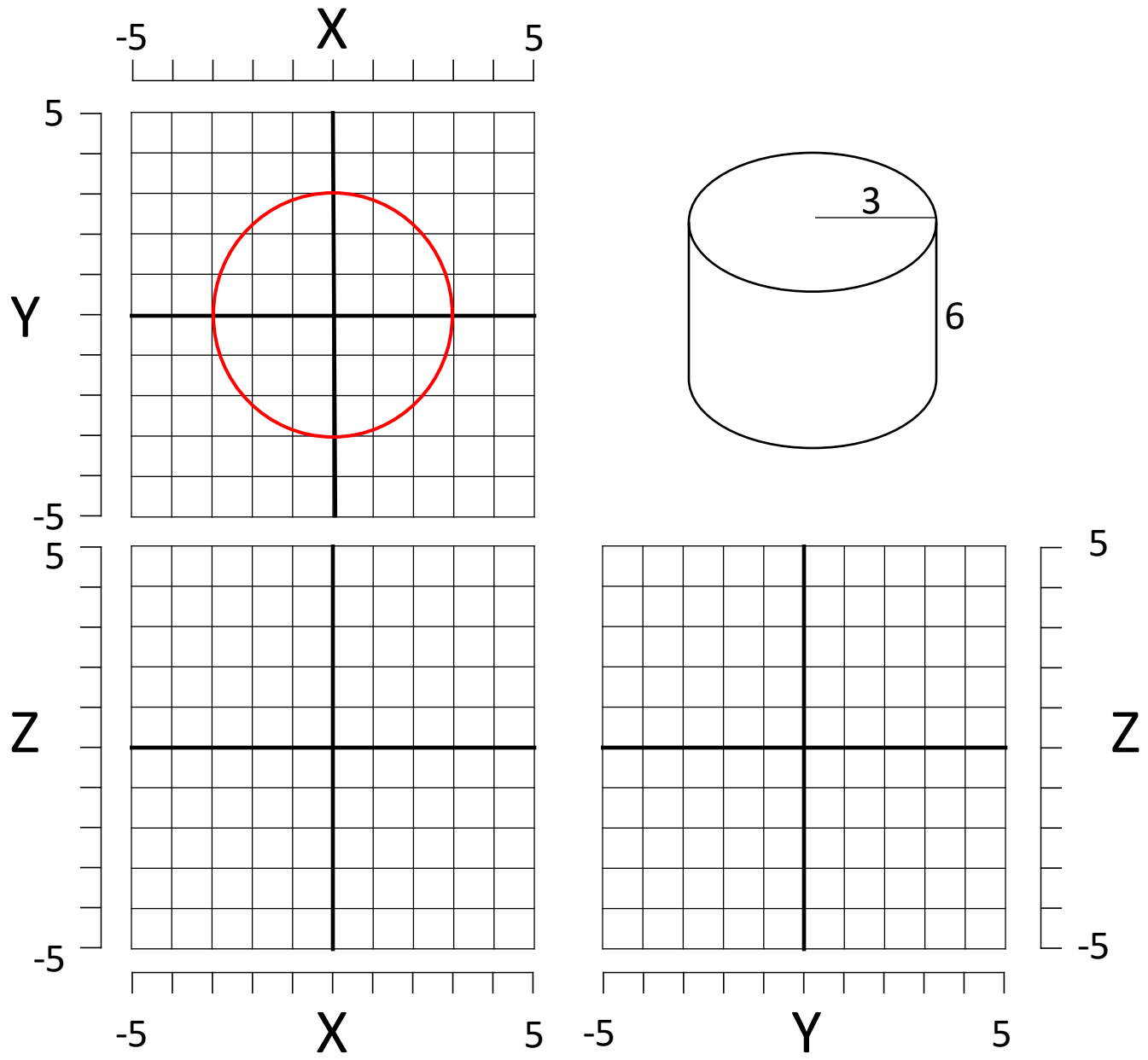
Blue → (2, -1, 2)

White → (-2, -3, 0)

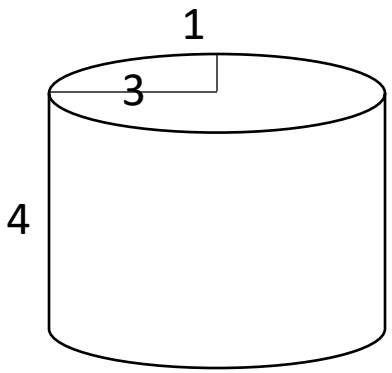


Draw what the triangle should look like from the Y-Z view.

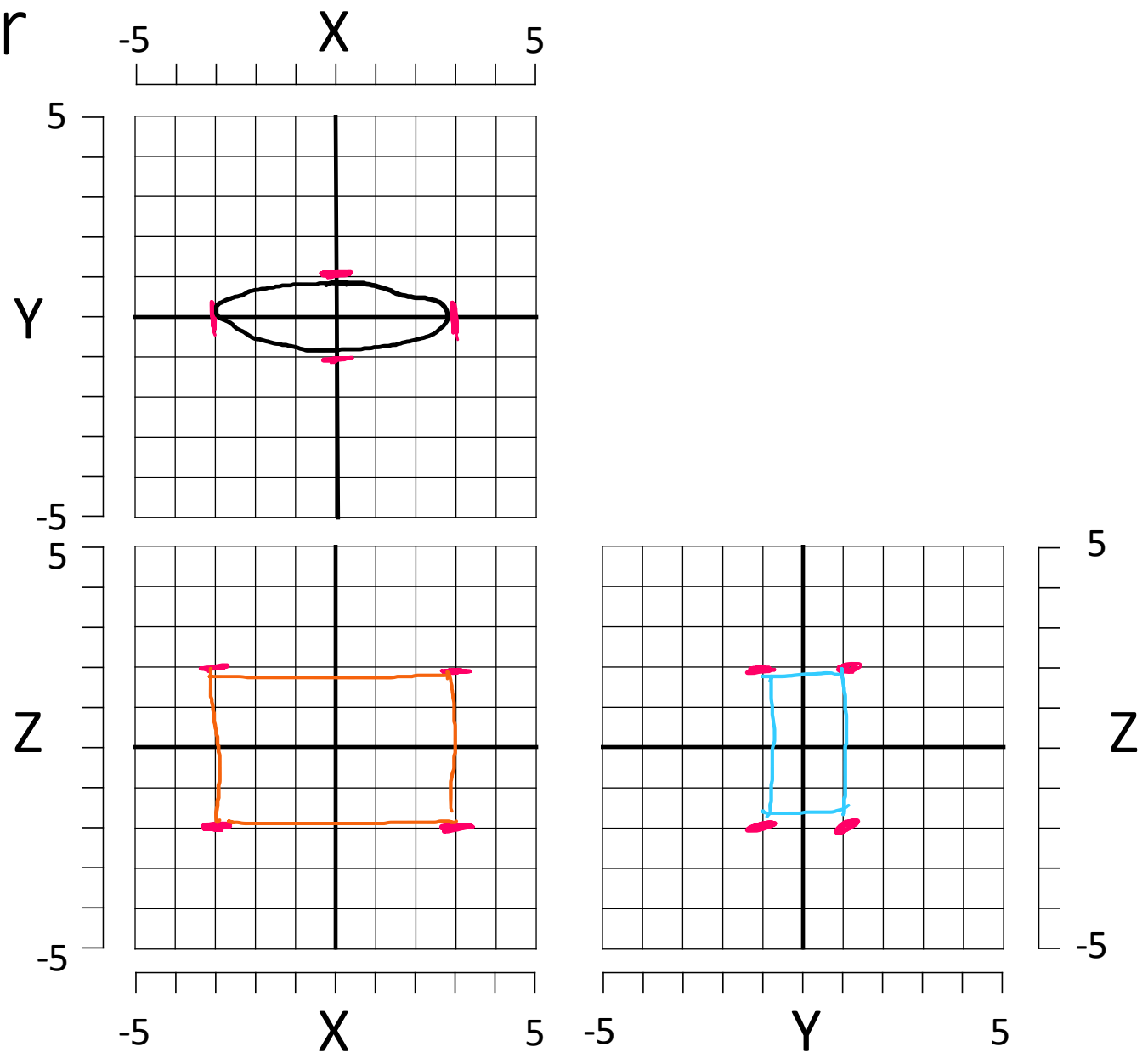
Draw a cylinder



Draw a cylinder

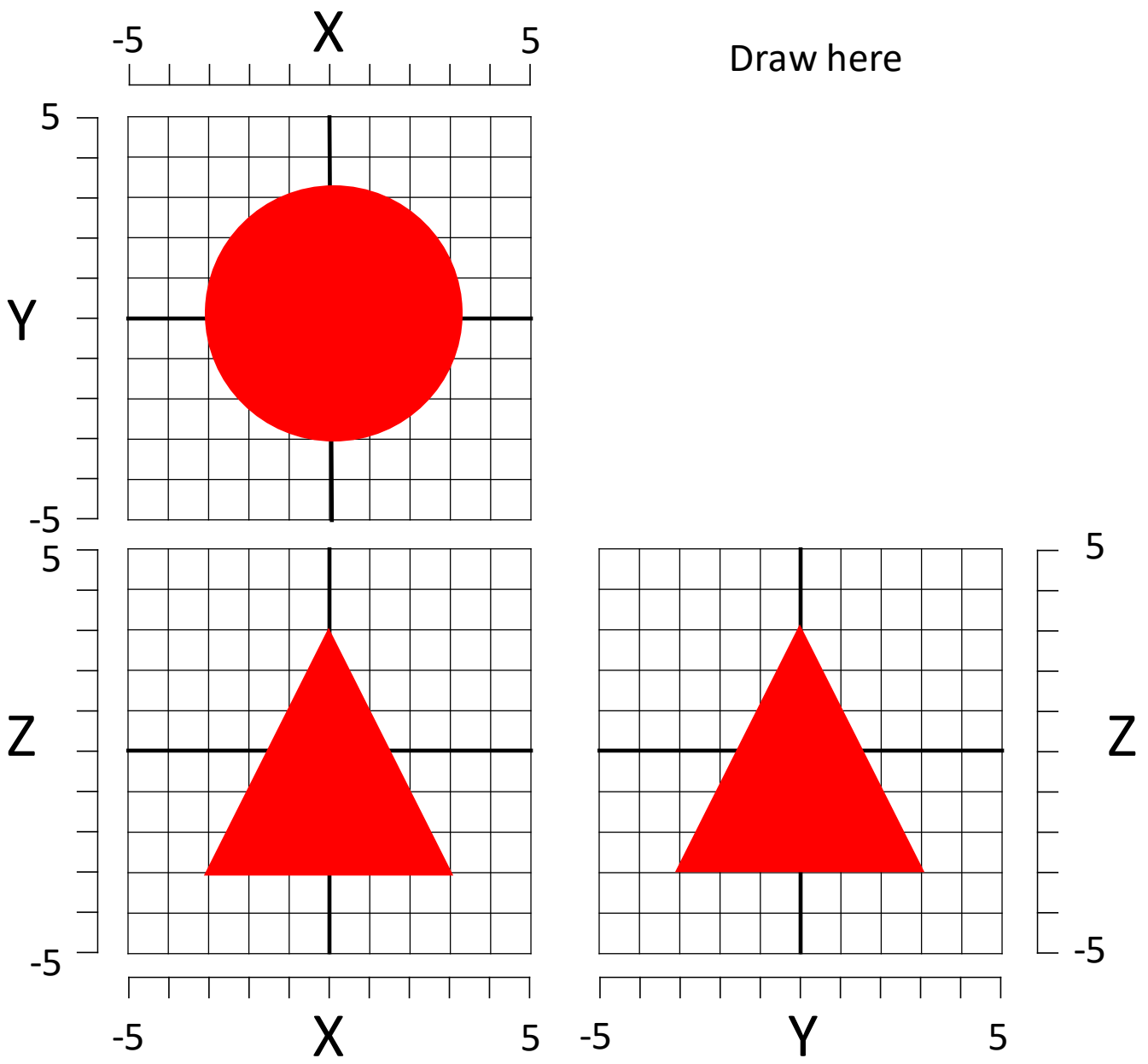


This oval-shaped cylinder is centered at (0,0,0). The short side is parallel to the Y-axis. The long side is parallel to the X-axis.



Identify the solid

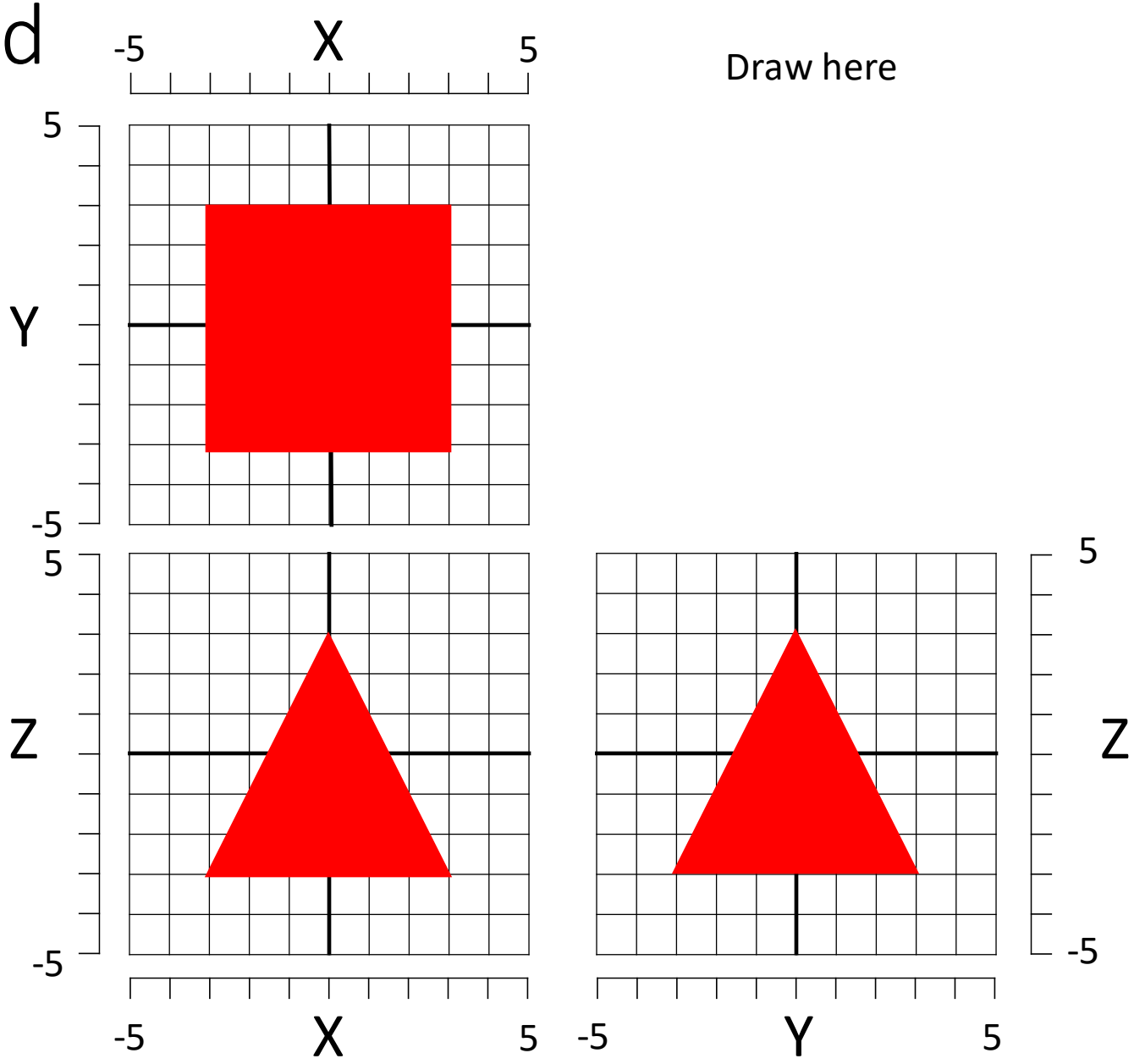
It is a _____.



Draw here

Identify the solid

It is a PYRAMID.



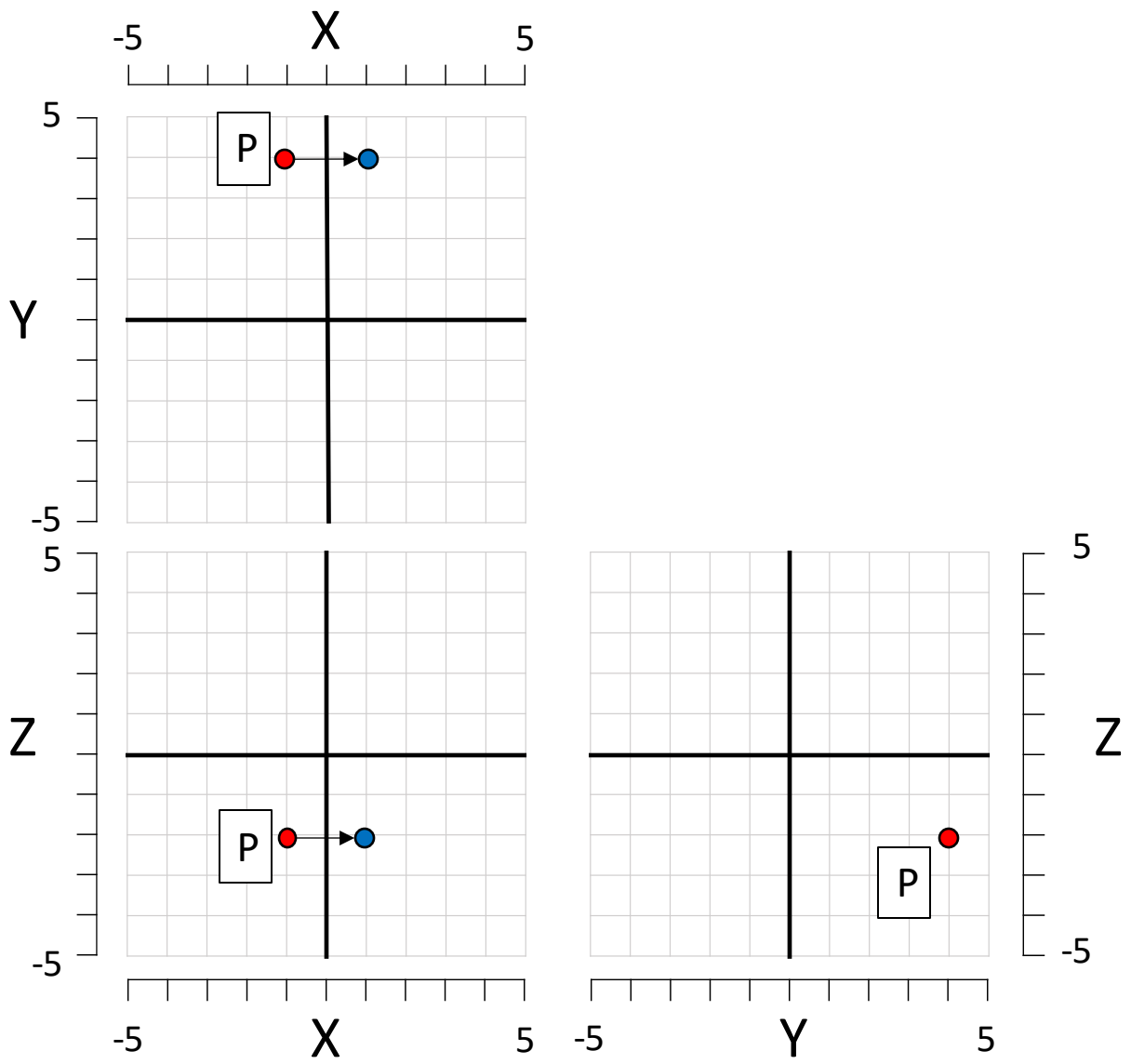
Draw here

3D Translation

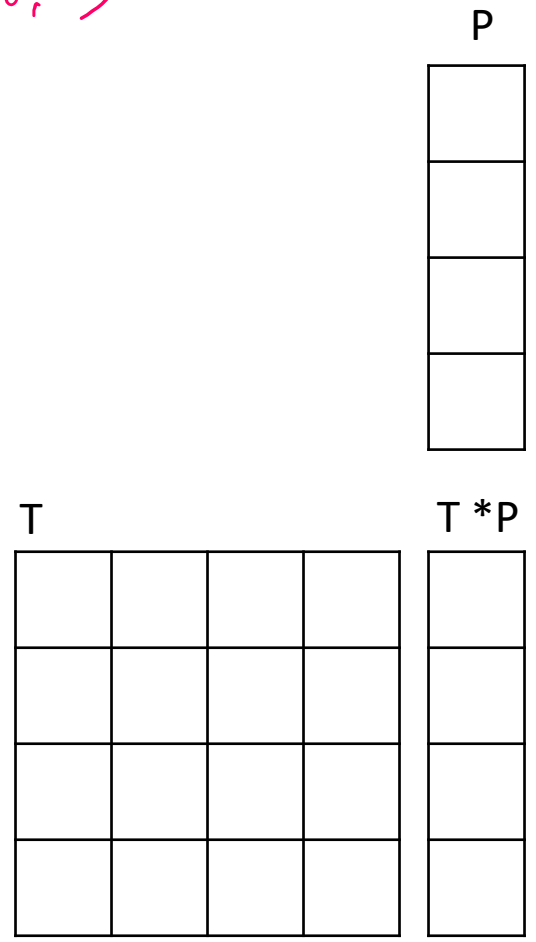
CSCI 5722 Computer Vision

University of Colorado
Boulder

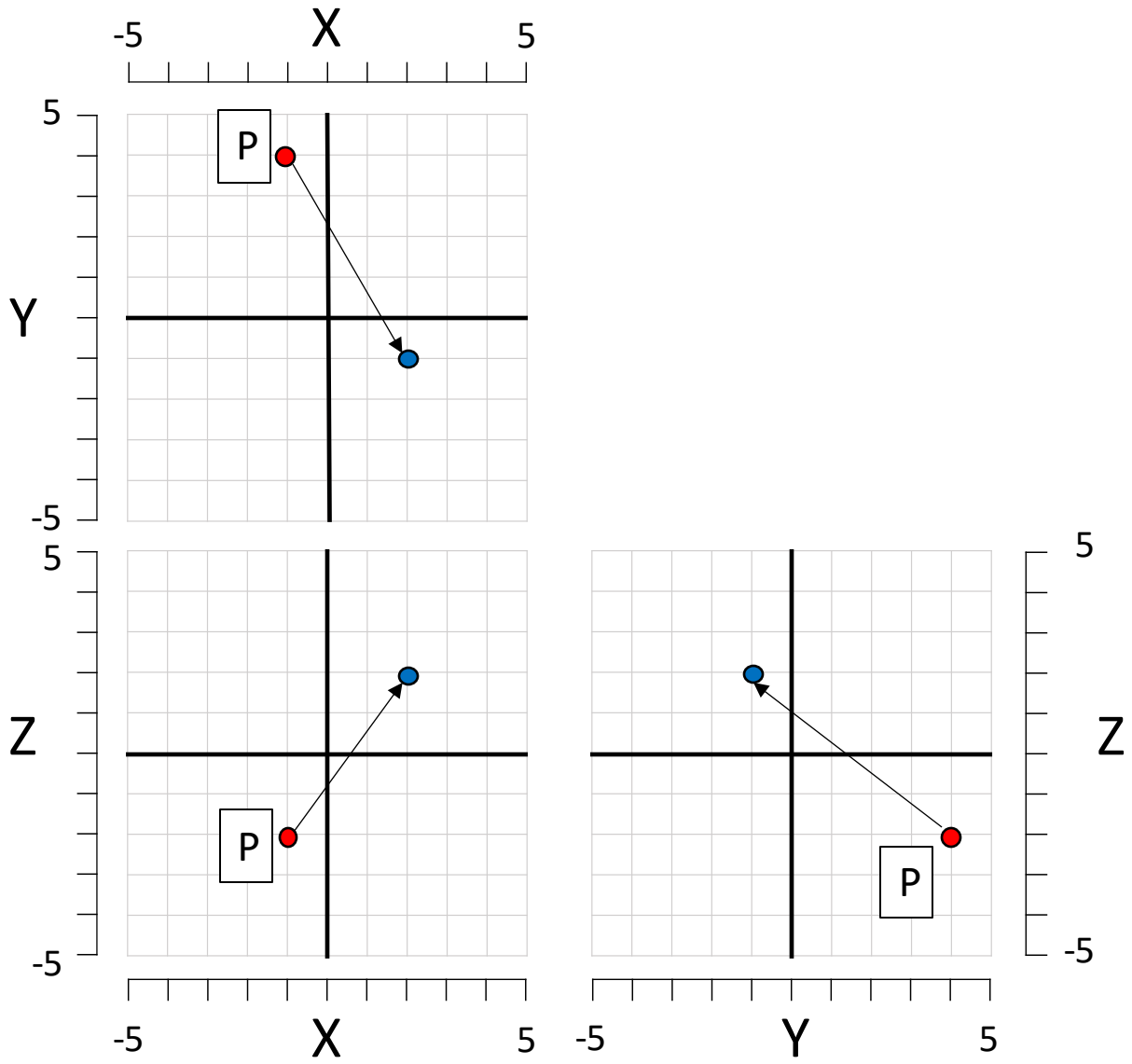
Translate in 3D by matrix multiplication

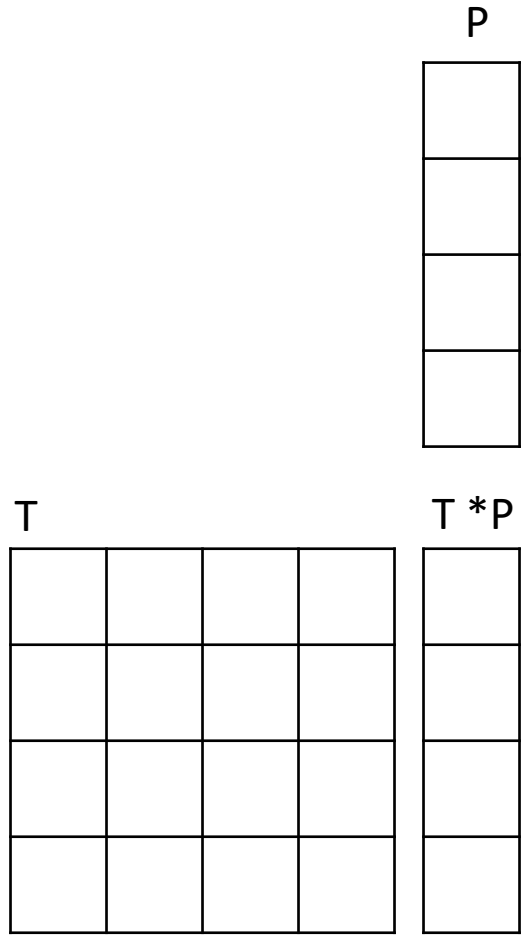


$\Delta = (2, 0, 0)$

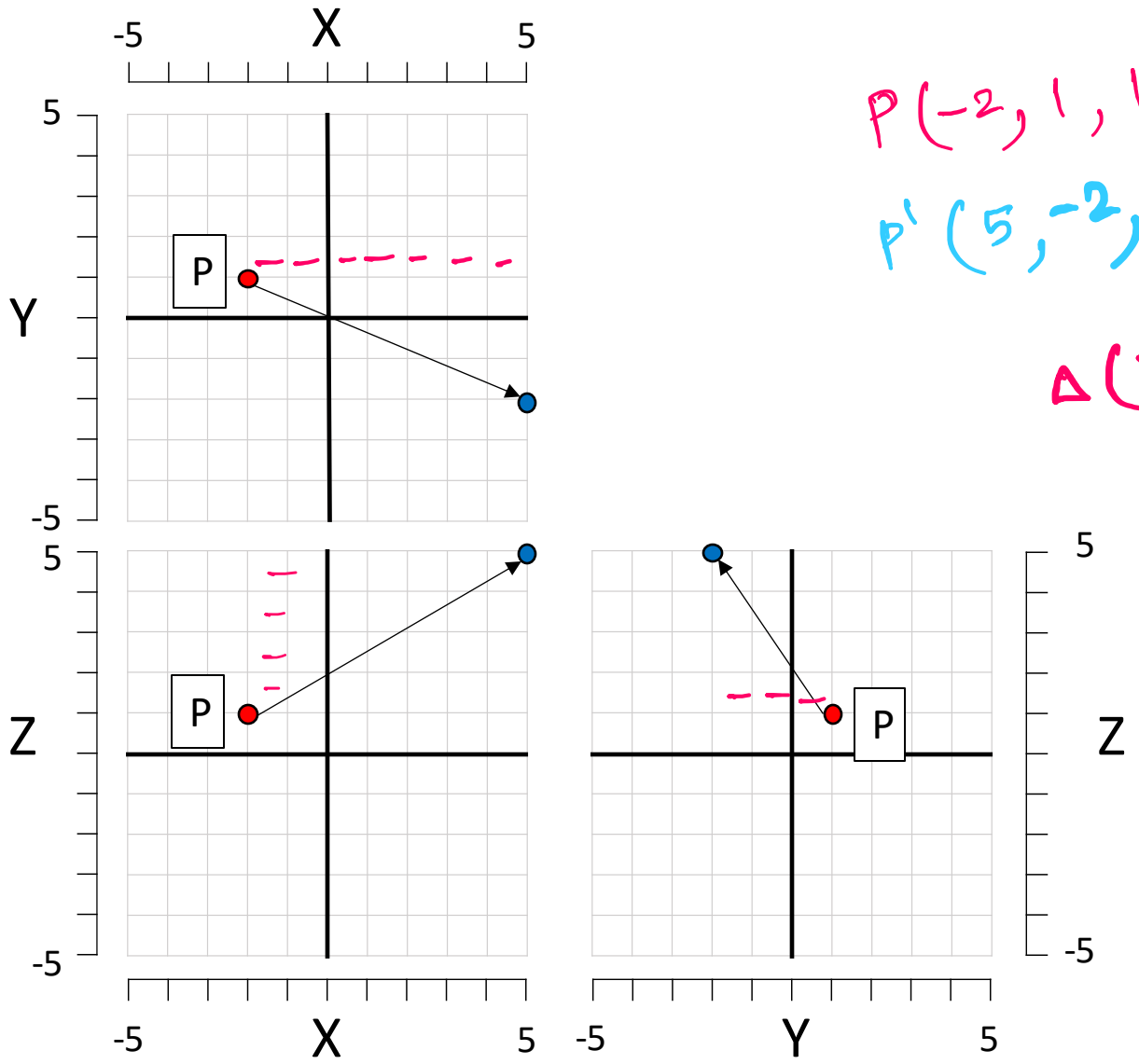


Translate in 3D by matrix multiplication





Translate in 3D by matrix multiplication



P(-2, 1, 1)

P'(5, -2, 5)

Δ(7, -3, 4)

P

-2
1
1
1

T

1			7
	1		-3
		1	4
			1

T *P

5
-2
5
1