Camera Model

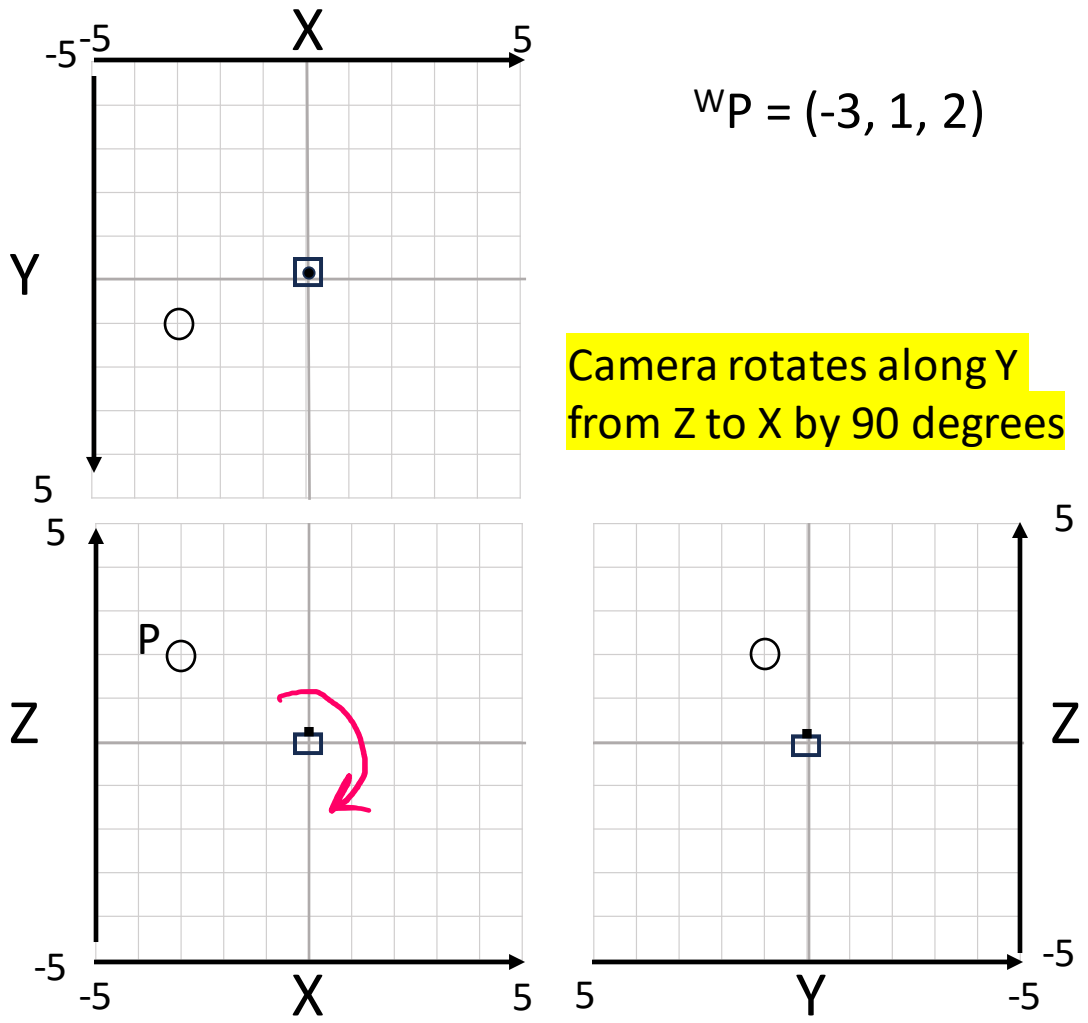
Name	Dharini Baskaran
Identity Key	dhba5060

	Level	Completed
	Beginner	13
	Intermediate	6
	Advanced	1
	Expert	0

Goal	
4722	16
5722	18
Total Completed	
20	

1 Draw ^{C}P (Geometry only)

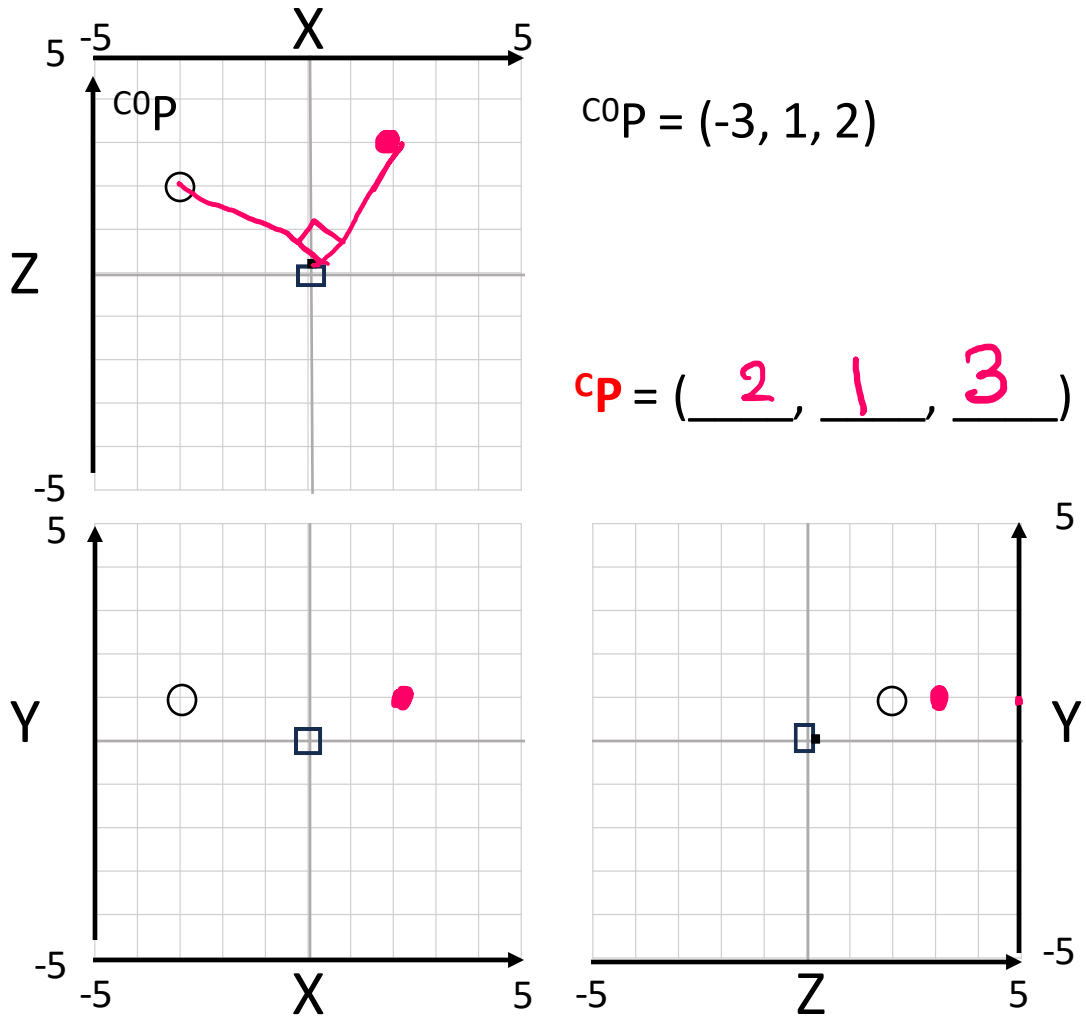
World Coordinate System



$^{W}P = (-3, 1, 2)$

Camera rotates along Y from Z to X by 90 degrees

Camera Coordinate System

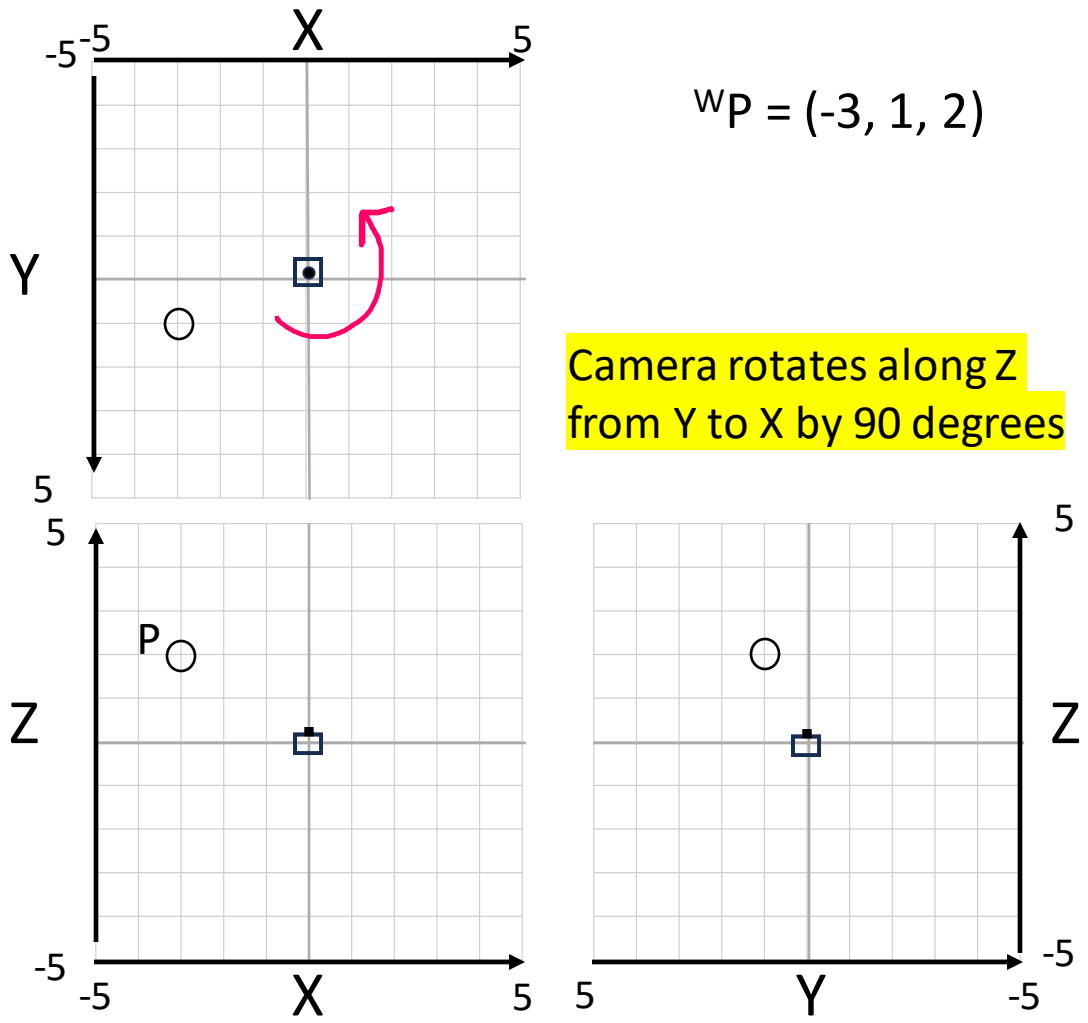


$^{C0}P = (-3, 1, 2)$

$^{C}P = (\underline{2}, \underline{1}, \underline{3})$

2 Draw ^{C}P (Geometry only)

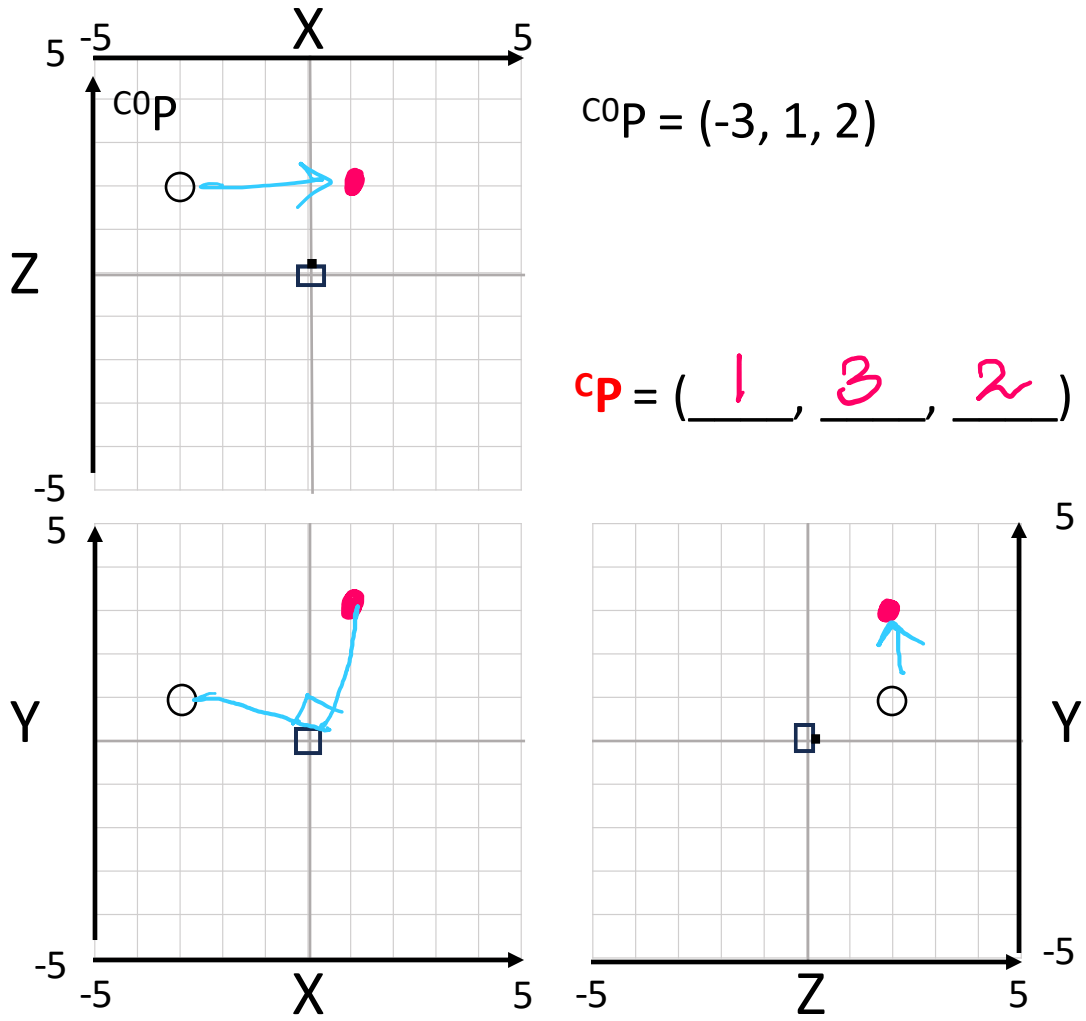
World Coordinate System



$^{W}P = (-3, 1, 2)$

Camera rotates along Z from Y to X by 90 degrees

Camera Coordinate System

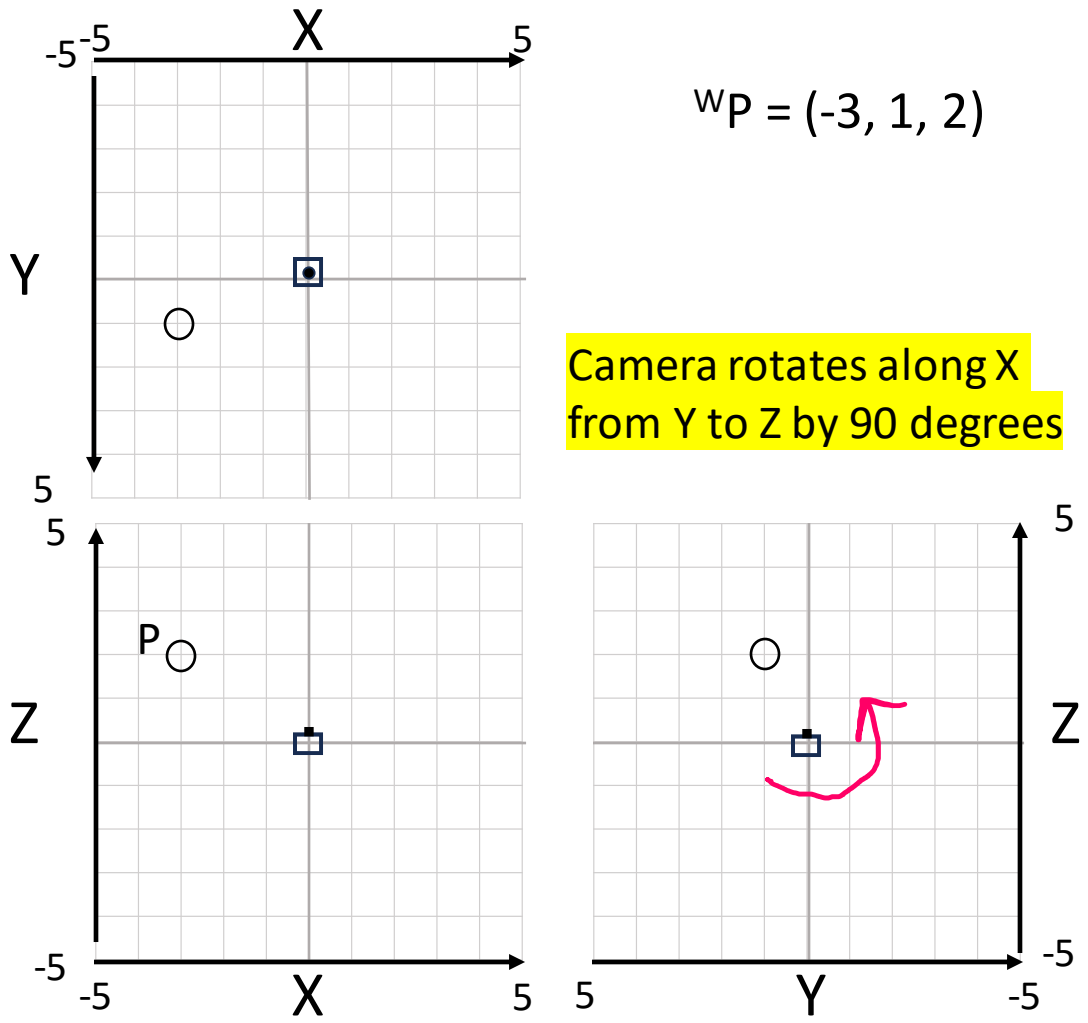


$^{C0}P = (-3, 1, 2)$

$^{C}P = (\underline{1}, \underline{3}, \underline{2})$

3 Draw ^{C}P (Geometry only)

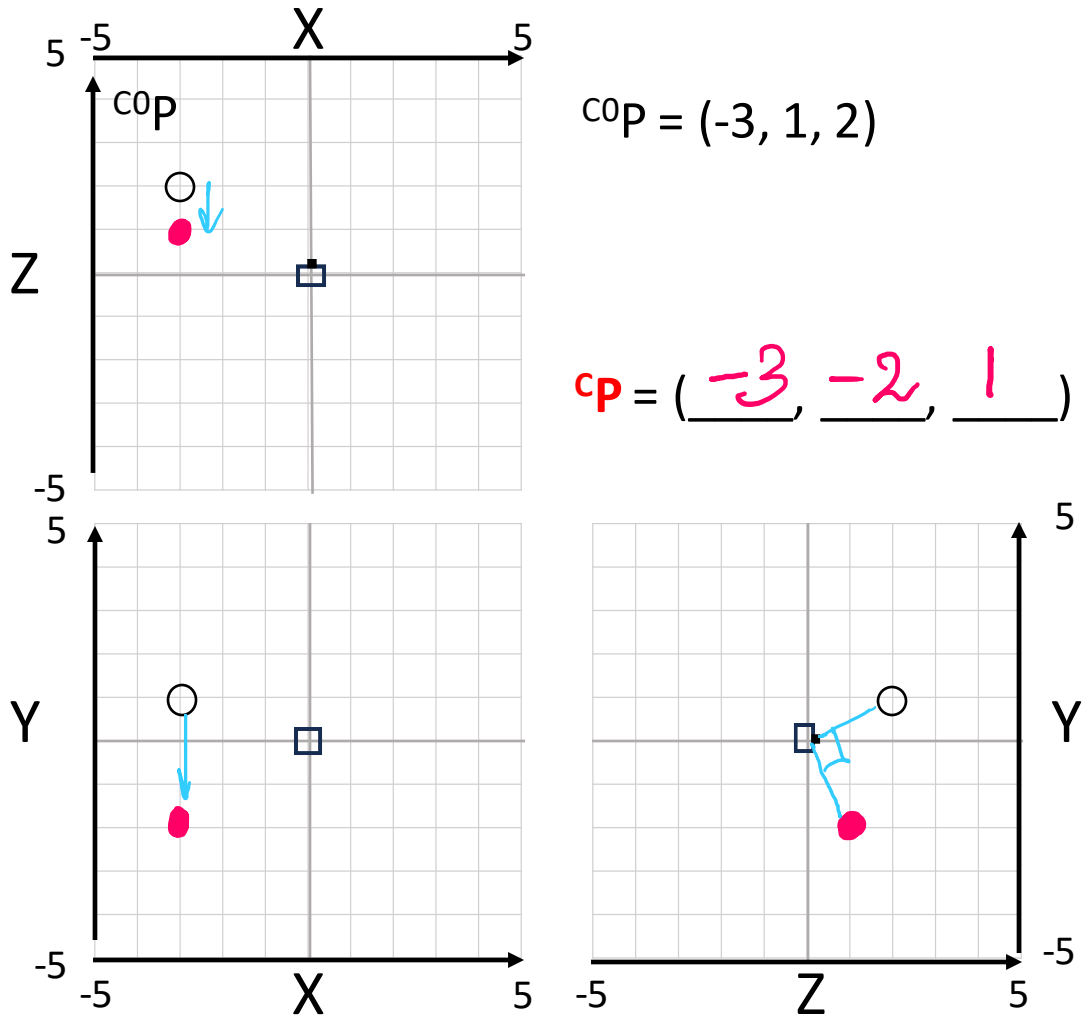
World Coordinate System



$^{W}P = (-3, 1, 2)$

Camera rotates along X from Y to Z by 90 degrees

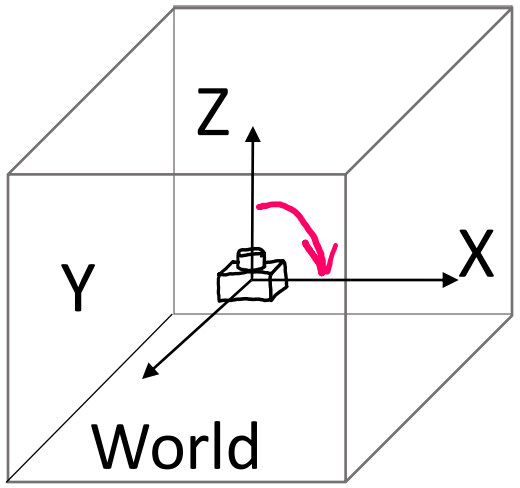
Camera Coordinate System



$^{C0}P = (-3, 1, 2)$

$^{C}P = (\underline{-3}, \underline{-2}, \underline{1})$

4 Convert $^{W}P \rightarrow {}^{C}P$ using a rotation matrix



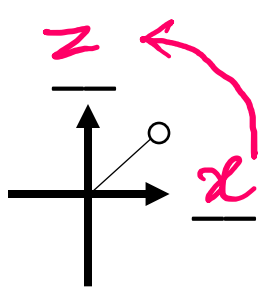
Camera rotates along Y from X to Z by 53 degrees

degrees	37	53	60	90
sin(θ)	3/5	4/5	√3/2	1
cos(θ)	4/5	3/5	1/2	0

^{W}P

3
2
4
1

$^{W}P = (3, 2, 4)$

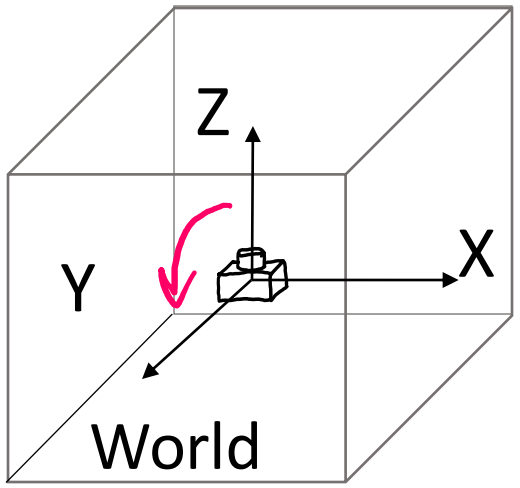


$^{C}P = (\frac{-7}{5}, 2, \frac{24}{5})$

R

				R*P	^{C}P
3/5		-4/5	0	-7/5	$\frac{9}{5} - \frac{16}{5}$
	1		0	2	
4/5		3/5	0	24/5	$\frac{12}{5} + \frac{12}{5}$
			1	1	

5 Convert $^{W}P \rightarrow {}^{C}P$ using a rotation matrix



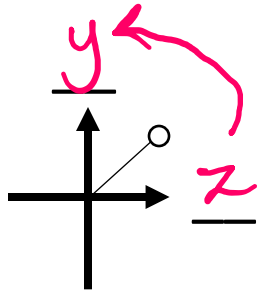
Camera rotates along X from Z to Y by 90 degrees

degrees	37	53	60	90
sin(θ)	3/5	4/5	√3/2	1
cos(θ)	4/5	3/5	1/2	0

^{W}P

4
5
3
1

$^{W}P = (4, 5, 3)$



$^{C}P = (\underline{4}, \underline{3}, \underline{-5})$

R

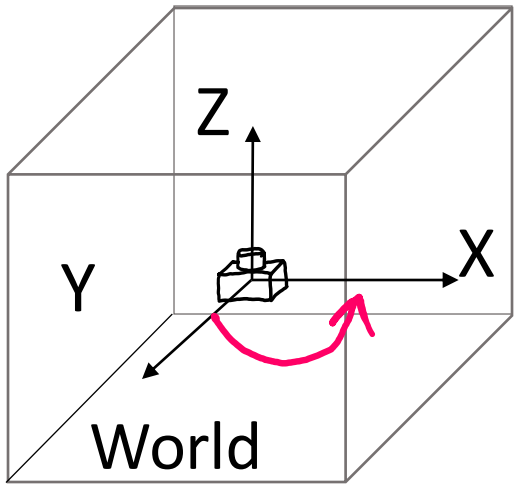
1		s	0
c	0	1	0
	-1	0	0
	-s	c	1

R*P

4
3
-5
1

^{C}P

6 Convert $^{W}P \rightarrow {}^{C}P$ using a rotation matrix



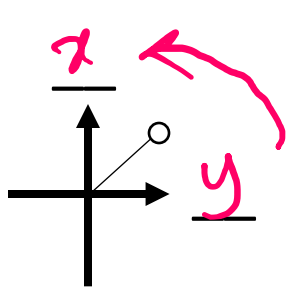
Camera rotates along Z from Y to X by 37 degrees

degrees	37	53	60	90
sin(θ)	3/5	4/5	√3/2	1
cos(θ)	4/5	3/5	1/2	0

^{W}P

4
3
-2
1

$^{W}P = (4, 3, -2)$



$^{C}P = (5, 0, -2)$

R

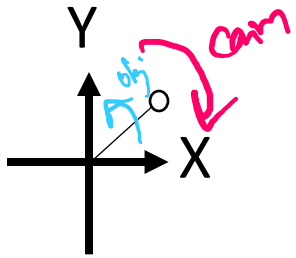
				R*P	^{C}P
4/5	3/5		0	5	$\frac{16}{5}+\frac{9}{5}$
-3/5	4/5		0	0	$-\frac{12}{5}+\frac{12}{5}$
-s	c	1	0	-2	
			1	1	

c (cos), s (sin), y

7 Fill R, T, ^{W}P, ^{C}P

degrees	37	53	60	90
sin(θ)	3/5	4/5	√3/2	1
cos(θ)	4/5	3/5	1/2	0

$^{C0}P = (4, -1, 5)$



Camera rotates from Y to X by 90 degrees

$^{C1}P = (1, 4, 5)$

$^{C2}P = (3, 1, 6)$

P ^{W}P

-4
1
5
1

R z T ^{C}P

0	1		0	1
-1	0		0	4
		1	0	5
			1	1

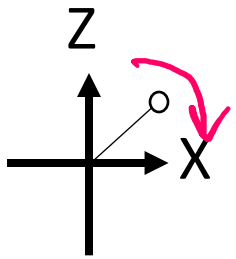
y

8 ☑ ○

Fill R, T, ^{W}P, ^{C}P

degrees	37	53	60	90
sin(θ)	3/5	4/5	√3/2	1
cos(θ)	4/5	3/5	1/2	0

$^{C0}P = (3, 2, -4)$



Camera rotates from Z to X by 53 degrees

$^{C1}P = (5, 2, 0)$

$\frac{3a}{5} + \frac{4c}{5} = 5$

$3a + 4c = 25$

$-\frac{4a}{5} + \frac{3c}{5} = 0$

$4a - 3c = 0$

$16a - 12c = 0$

$9a + 12c = 75$

$25a = 75$

$a = 3$

$^{C2}P = (3, 1, 1)$

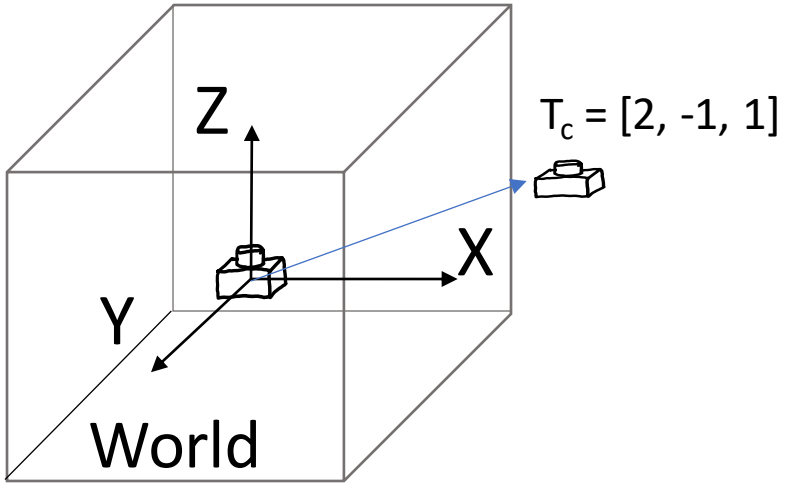
P	^{W}P
	3
	2
	4
	1

R		T		^{C}P
3/5		4/5		5
	1			2
-4/5		3/5		0
			1	1

Z

9 Derive the Extrinsic Matrix

Camera rotates along Y from Z to X by 53 degrees then translates



degrees	30	37	45	53	60	90
sin(θ)	1/2	3/5	√2/2	4/5	√3/2	1
cos(θ)	√3/2	4/5	√2/2	3/5	1/2	0

M_E

3/5		-4/5	-2
	1		1
4/5		3/5	-1
			1

^wP

3
2
-4
1

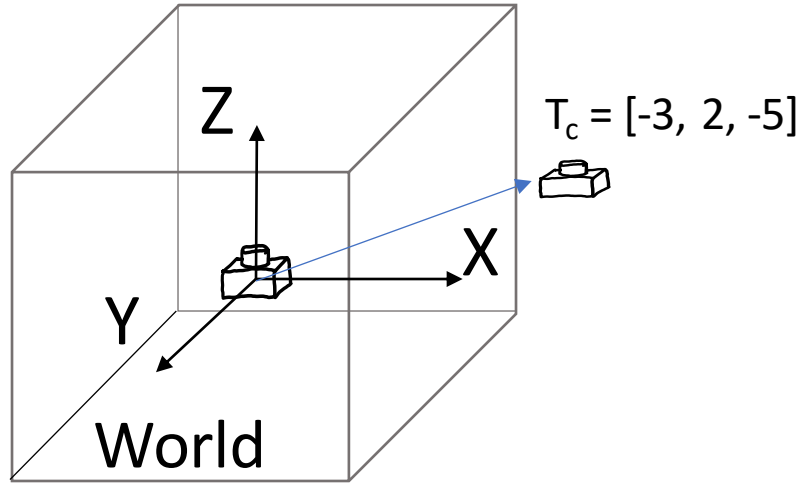
^cP

3
3
-1
1

$\frac{9}{5} + \frac{16}{5} - 2$
$= 5 - 2$
$2 + 1$
$\frac{12}{5} - \frac{12}{5} - 1$
1

10 Derive the Extrinsic Matrix

Camera rotates along X from Y to Z by 90 degrees then translates



degrees	30	37	45	53	60	90
sin(θ)	1/2	3/5	√2/2	4/5	√3/2	1
cos(θ)	√3/2	4/5	√2/2	3/5	1/2	0

M_E y

1			3
	0	1	-2
	-1	0	5
			1

z

^wP

1
2
-4
1

^cP

4	1+3
-6	-4-2
3	-2+5
1	1

11 ☑ ☐ # Derive M_E^{-1} from M_E

z notation 90

w_P
-4
4
6
1

				c_P
1	0	0	-1	5
0	1	0	-4	0
0	0	1	2	4
0	0	0	1	1

M_E

				c_P
0	-1		1	5
1	0		4	0
		1	-2	4
			1	1

0	1	0	0
-1	0	0	0
0	0	1	0
0	0	0	1

M_E^{-1}

				w_P
0	1		-4	-4
-1	0		1	-5+1
		1	2	4+2
			1	1

12 ☑ ◇

Derive M_E^{-1} from M_E

$-\frac{3}{5}\cdot 50 + \frac{4}{5}\cdot 60 = -30+48 = 18$

$-\frac{4}{5}\cdot 50 - \frac{3}{5}\cdot 60 = -40-36 = -76$

wP
15
5
20
1

$\frac{3}{5}\cdot 75 - \frac{4}{5}\cdot 60 + 18 = 45-48+18 = 15$

$40-40=0$

$\frac{4}{5}\cdot 75 + \frac{3}{5}\cdot 60 - 76 = 60+36-76 = 60-40 = 20$

				cP
1			-50	75
	1		-40	40
		1	-60	60
			1	1

M_E

				cP
3/5		4/5	50	75
	1		40	40
-4/5		3/5	60	60
			1	1

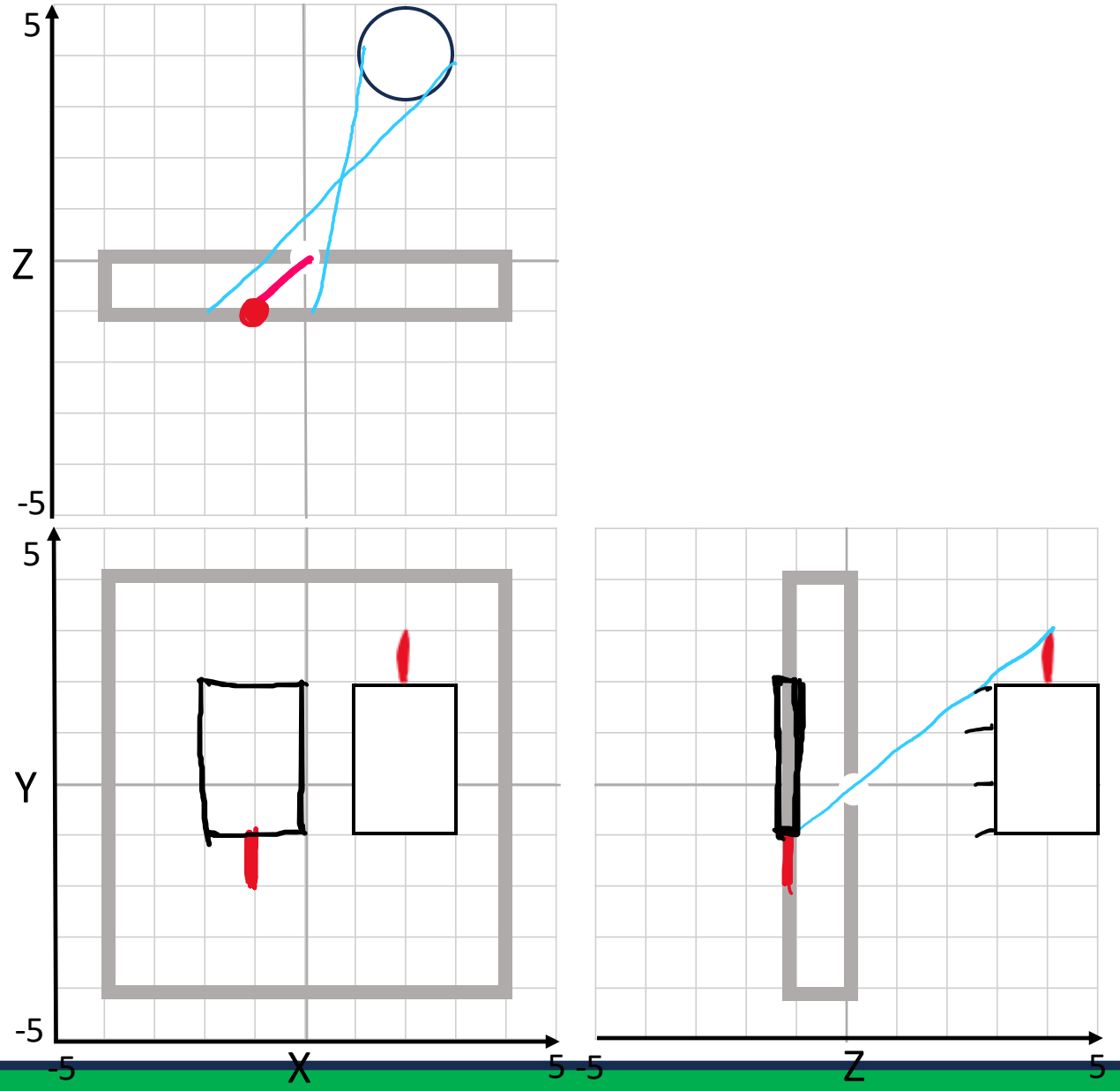
3/5		-4/5	
	1		
4/5		3/5	
			1

M_E^{-1}

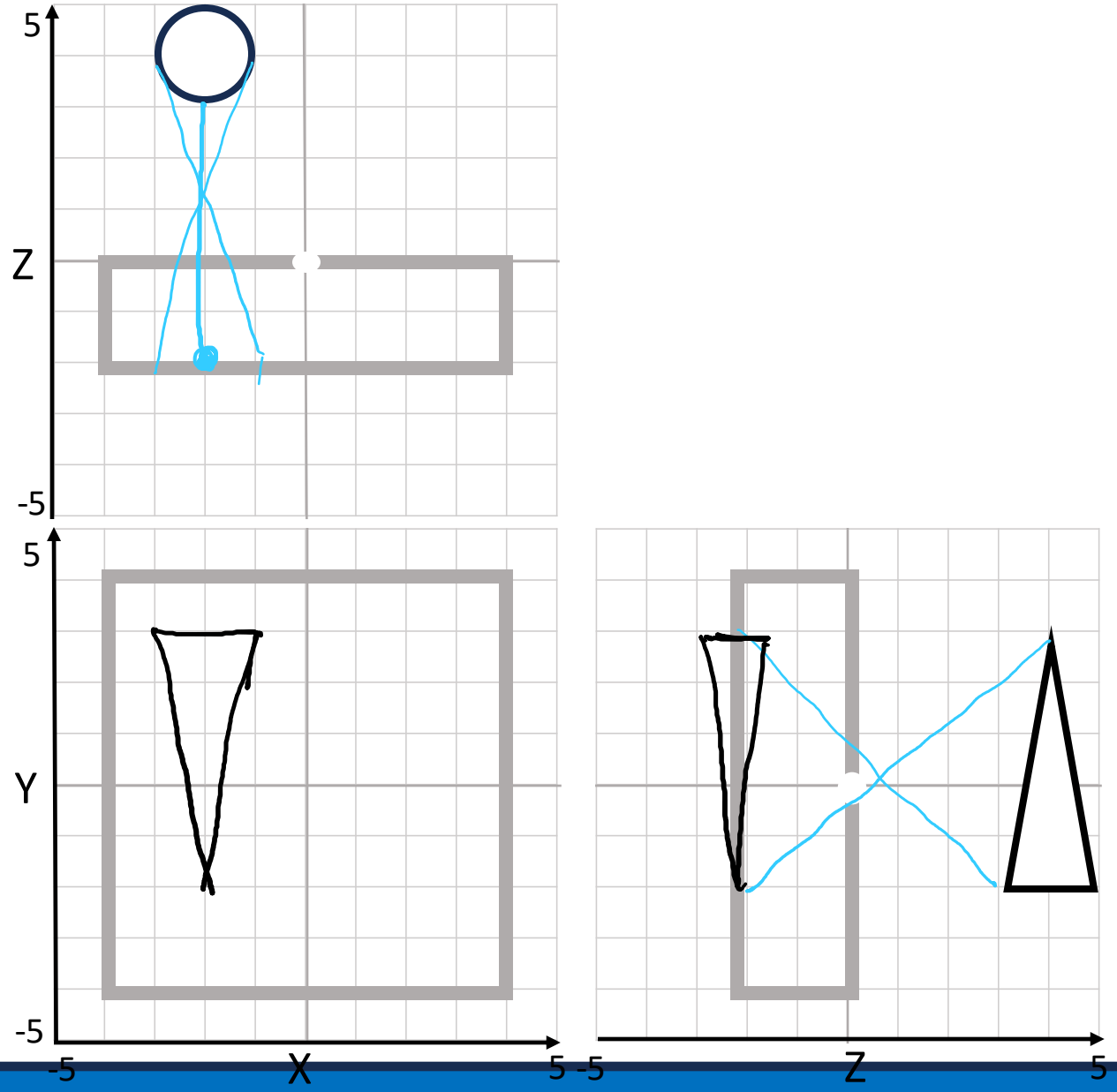
				wP
3/5		-4/5	18	15
	1		-40	5 0
4/5		3/5	-76	20
			1	1

13

Project with f = 1



Project with f = 2



15

Calculate & Draw ^{I}P

$^{C}P = (4, 2, 4)$

$^{I}P = (\underline{2}, \underline{1})$

$f = \underline{2}$

^{C}P

4
2
4

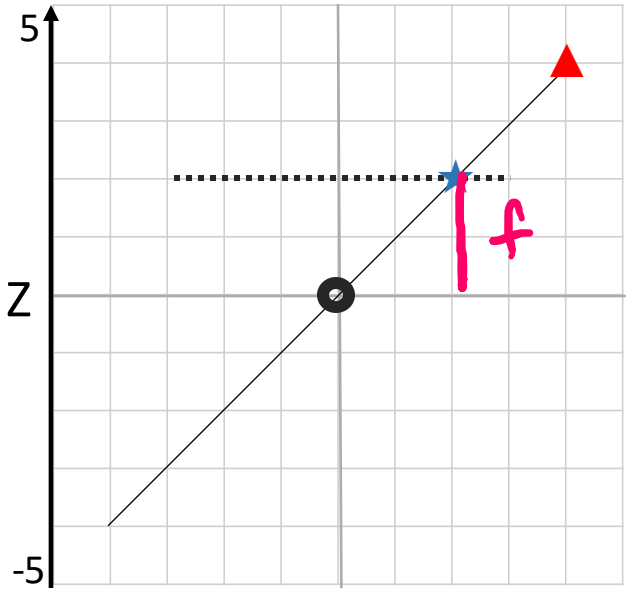
M_I

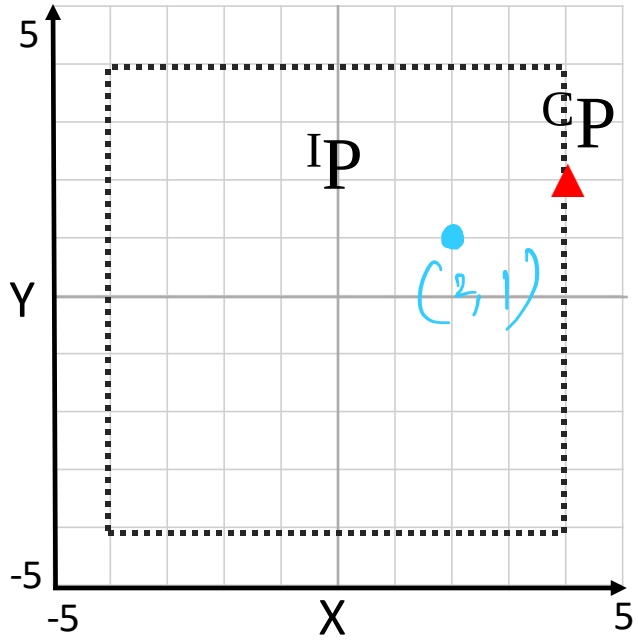
2		
	2	
		1

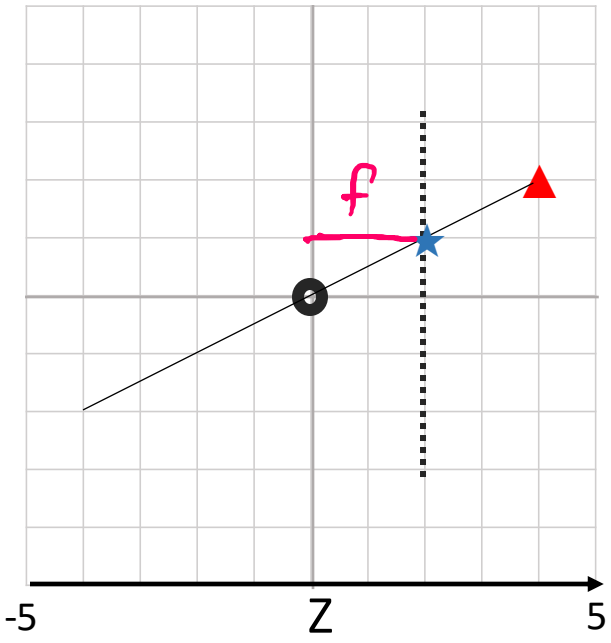
8
4
4

^{I}P

2
1
1







16 ☑ ○ # Calculate & Draw ^{I}P

$^{C}P = (4, 2, 4)$

$^{I}P = (\underline{1}, \underline{.5})$

$f = \underline{1}$

^{C}P

4
2
4

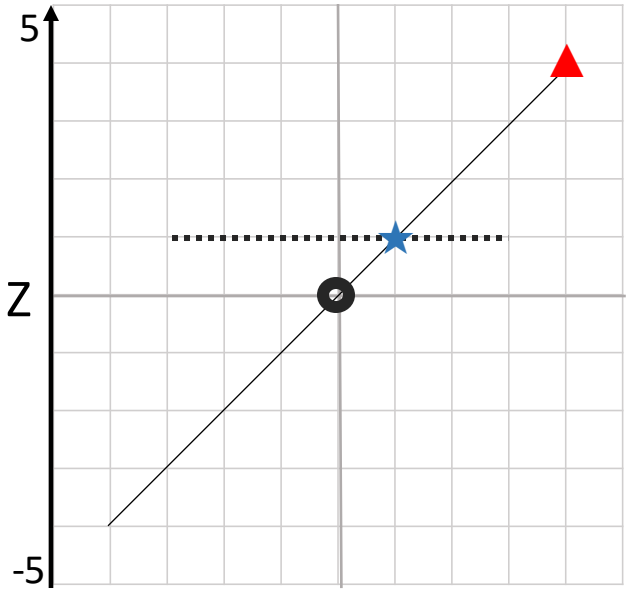
M_I

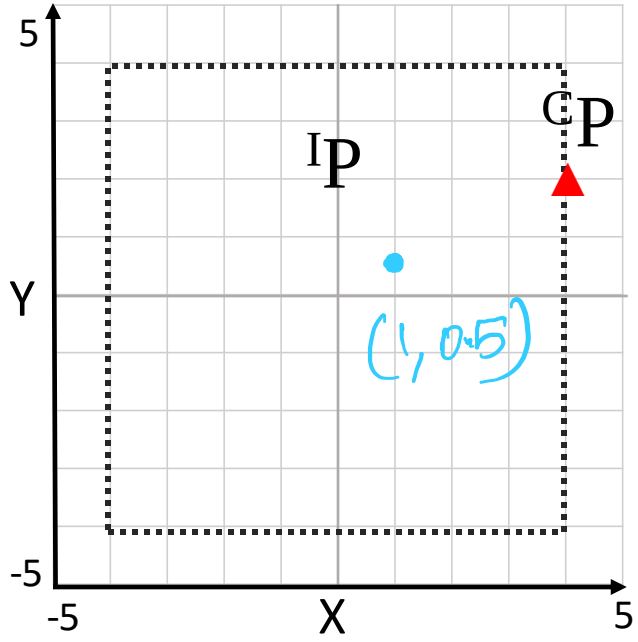
1		
	1	
		1

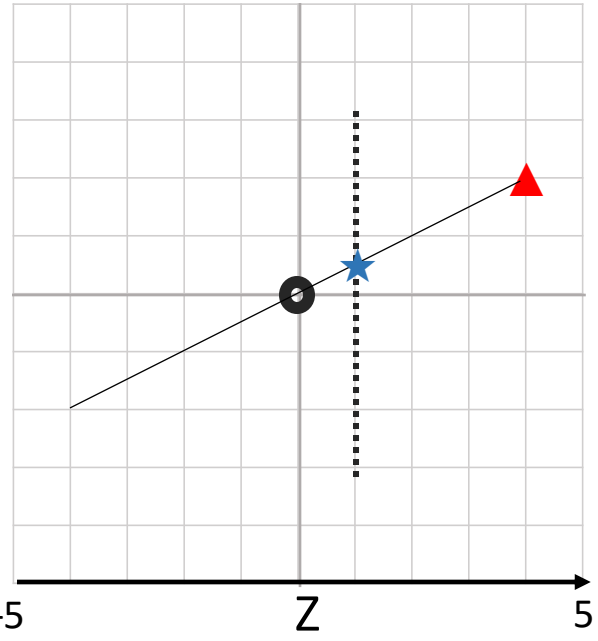
4
2
4

^{I}P

1
0.5
1







17

Calculate & Draw ^{I}P

$^{C}P = (4, 2, 2)$

$^{I}P = (\_\_\_\_\_, \_\_\_\_\_)$

$f = \_\_1\_\_$

^{C}P

4
2
2

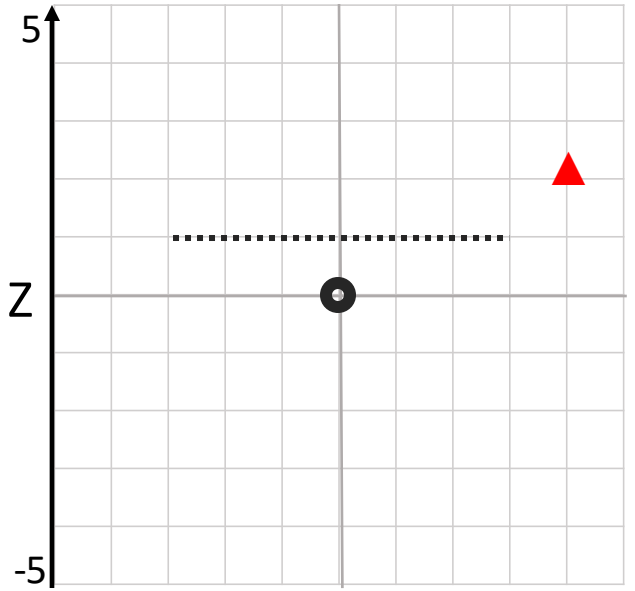
M_I

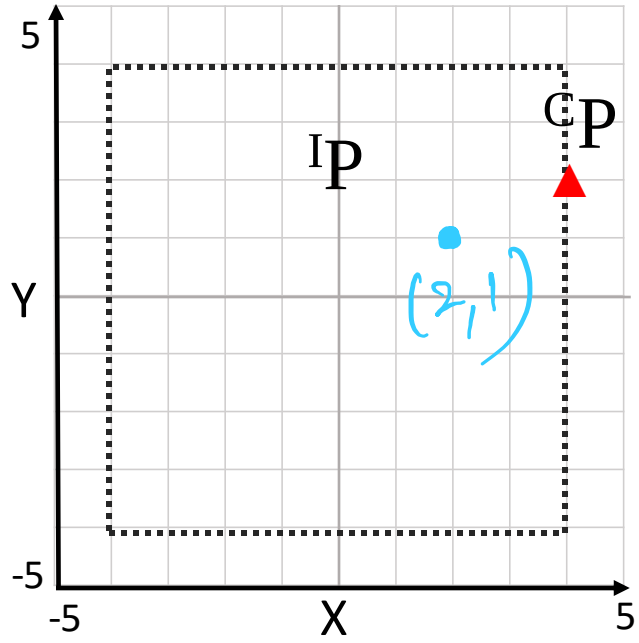
1		
	1	
		1

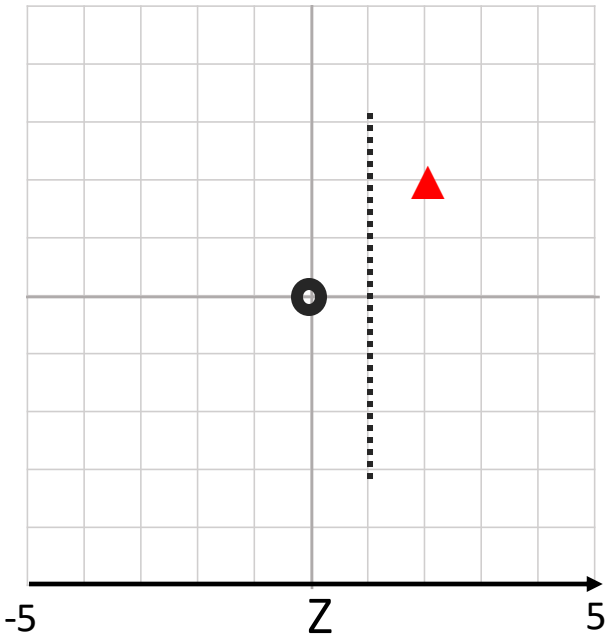
4
2
2

^{I}P

2
1
1







18 ☑ □ Calculate & Draw ^{I}P

$^{C}P = (-1, 3, 4)$

$^{I}P = (\underline{-\frac{1}{2}}, \underline{3/2})$

$f = \underline{2}$

M_I

2		
	2	
		1

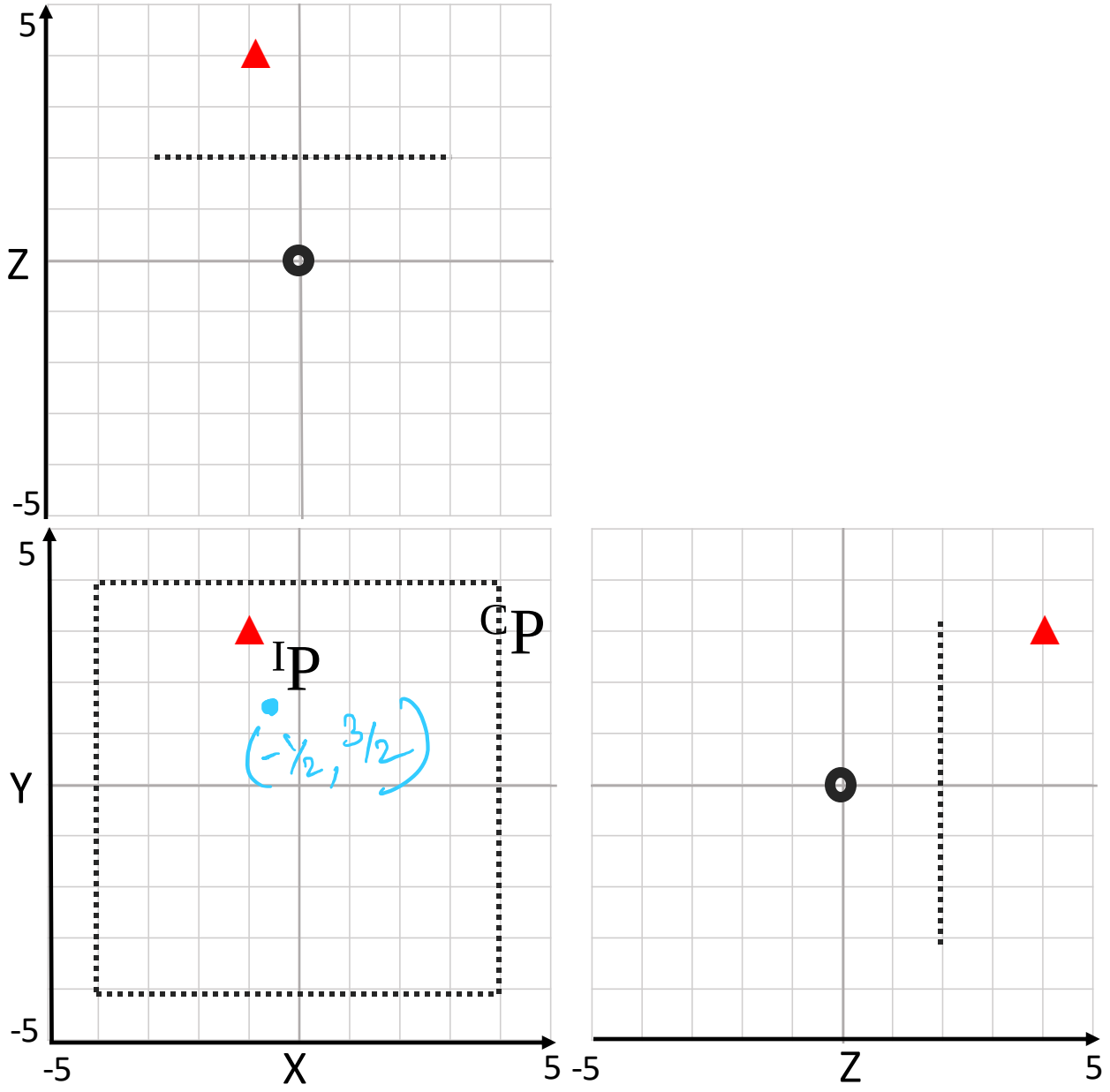
^{C}P

-1
3
4

-2
6
4

^{I}P

-0.5
1.5
1



19

Calculate & Draw ^{I}P

$^{C}P = (-1, 3, 4)$

$^{I}P = (\underline{-1/2}, \underline{3/4})$

$f_x = \underline{2}$

$f_y = \underline{1}$

^{C}P

-1
3
4

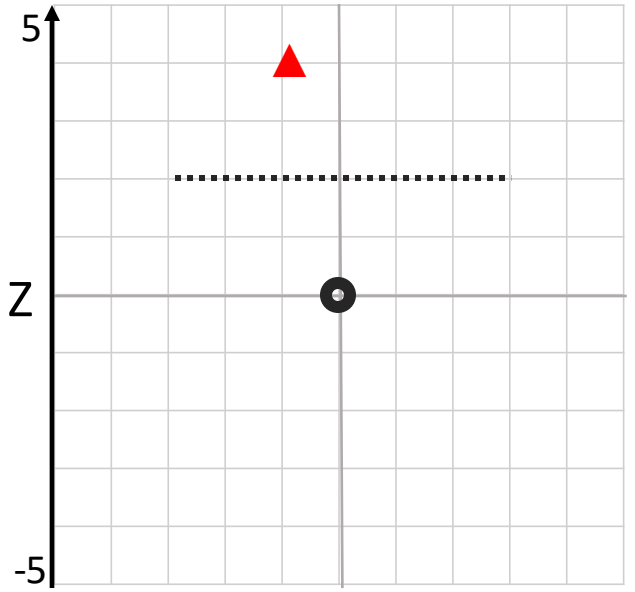
M_I

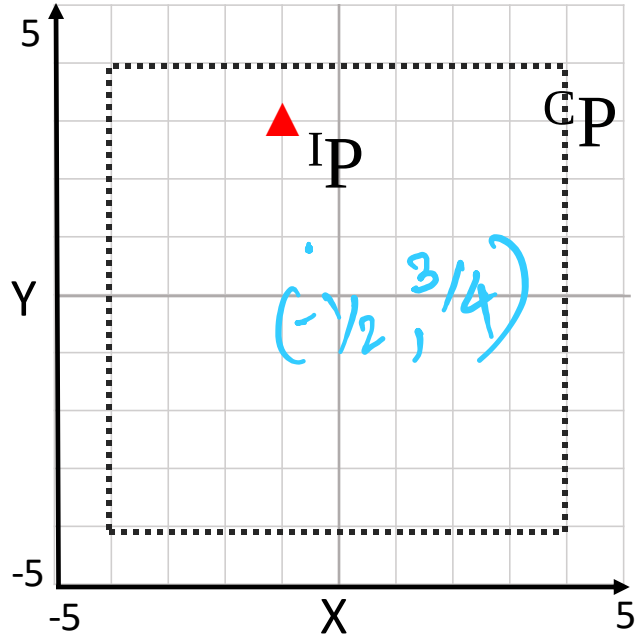
2		
	1	
		1

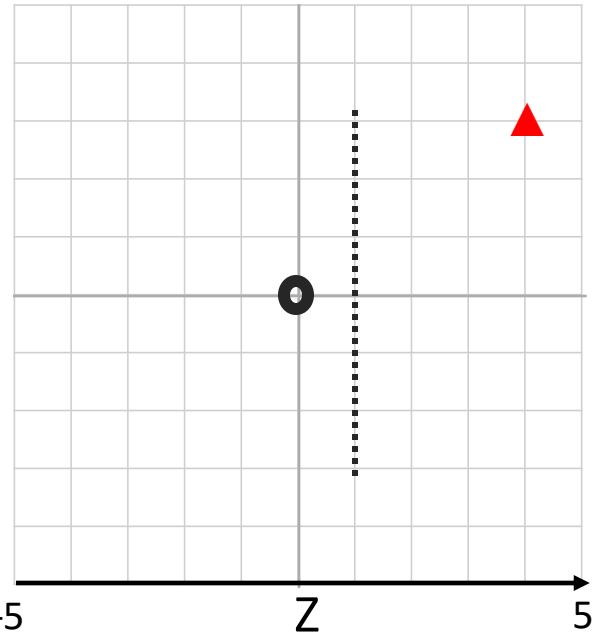
-2
3
4

^{I}P

-0.5
0.75
1







20

Calculate ^{I}P

$^{C}P = (12, -8, 8)$

$^{I}P = (\underline{\quad 6 \quad}, \underline{\quad -4 \quad})$

$f = 4$

^{C}P

12
−8
8

M_I

4		
	4	
		1

48
−32
8

^{I}P

6
−4
1