

LINEAR ALGEBRA

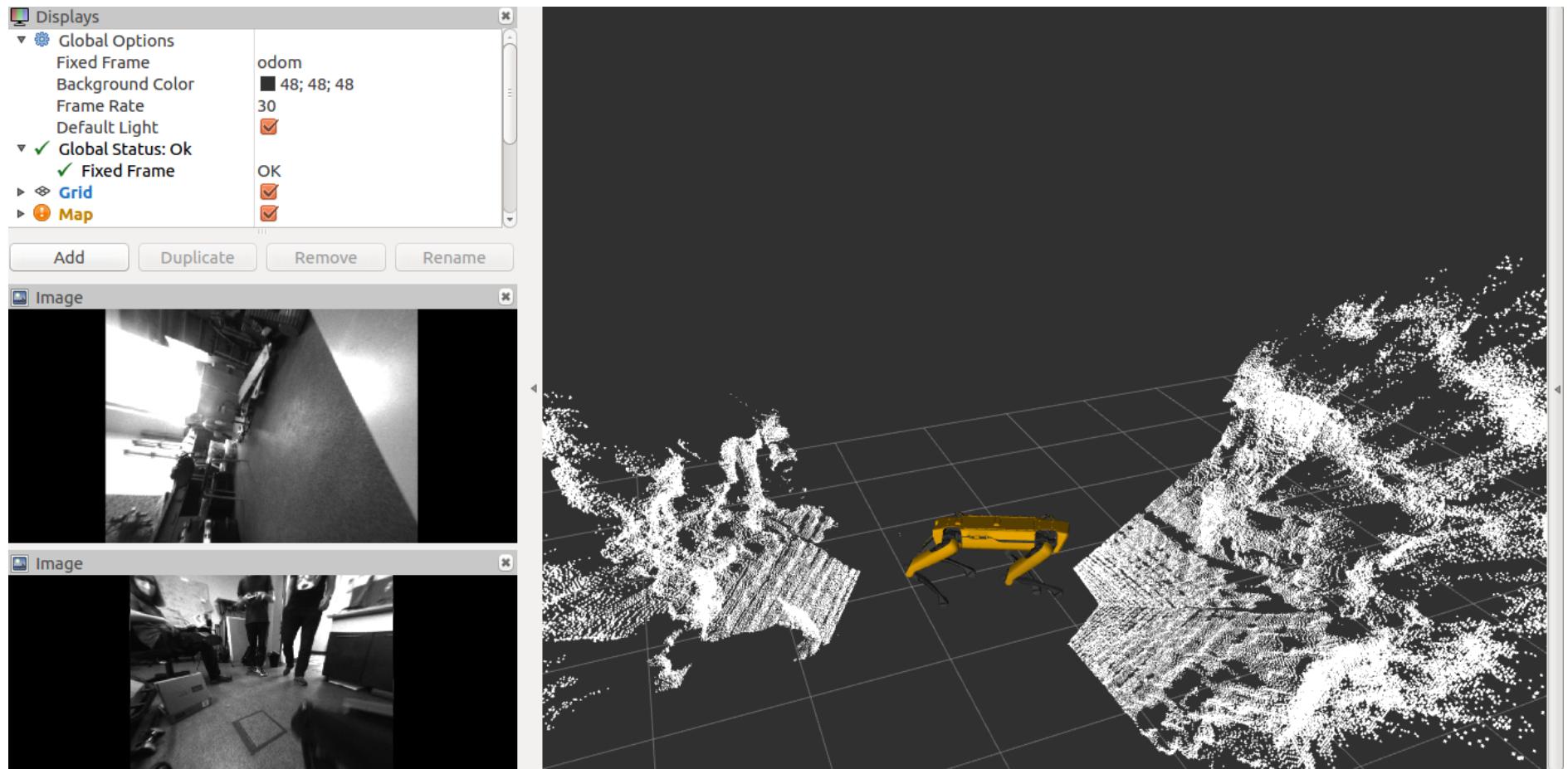
Hochschule Bonn-Rhein-Seig

Michal and Musharraf
Based on the presentation of Divin and Santosh

Where is Linear Algebra applied?

- Robotics
- Data Analysis
- Computer Vision

Motivation



Vectors



y



0
0

x



y



x

0

0



y



x

0
0



5
4

3
-2



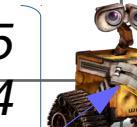
y



θ
 θ

x

5
4



$\theta = -33.7^\circ$
 $\ell = 3.6^\circ$



$\ell \cos(\theta)$
 $\ell \sin (\theta)$

Vector Operations

y



x



y

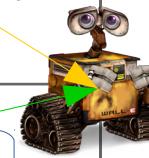
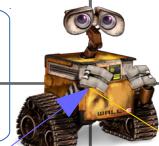


x

0
0

5
4

3
-2
8
2



5
4

3
-2
8
2

y

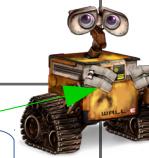


x

0
0

8

2



θ
θ

y

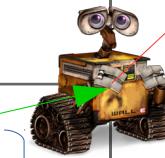


x



y

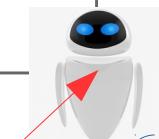
x



8
2

$\ell=5.65$

$\theta=45^\circ$



?

?

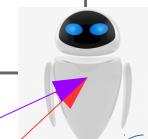
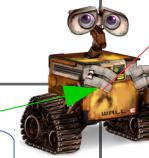
y



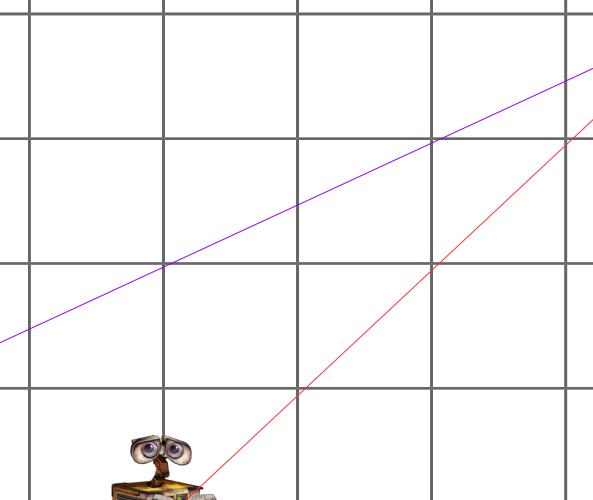
x

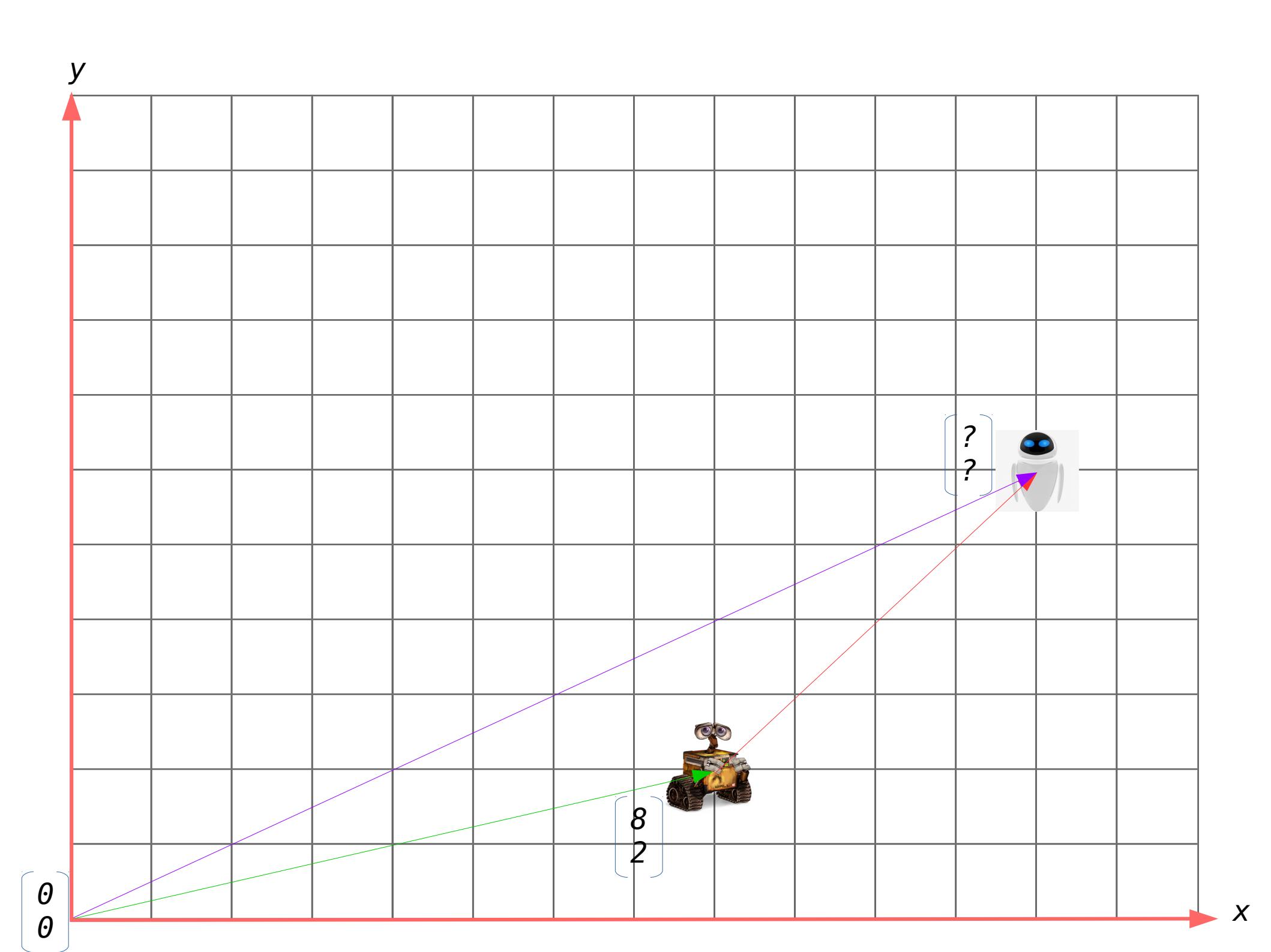
0
0

8
2



?
?



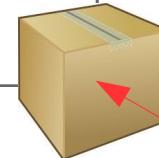


y

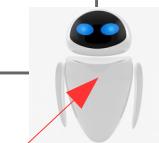
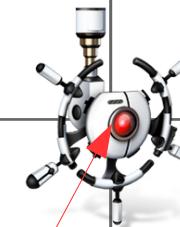
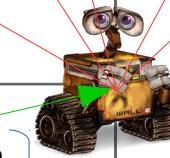


x

0
0



8
2

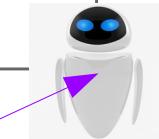
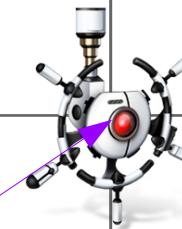
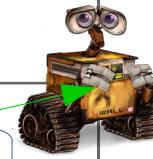
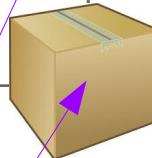


y



x

0
0



8
2

0
0

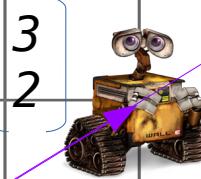
Scaling

y



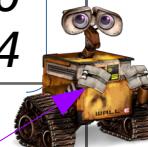
x

θ
 θ



3
2

6
4

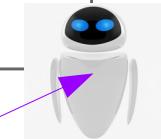
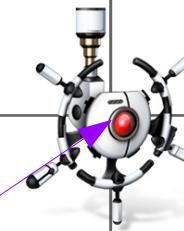
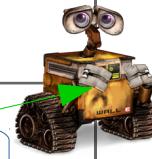
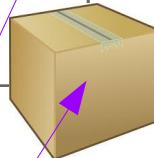


y



x

0
0



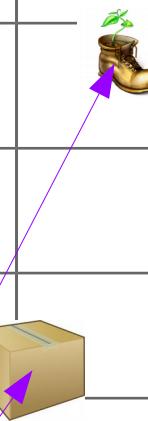
8
2

y



x

0
0



0
0

Basis Vectors

y



x

θ
1

θ
 θ

1
 θ

5
4



5
4

5
4

Linear Combination

y



θ
 θ

x

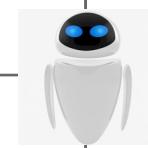
Matrix

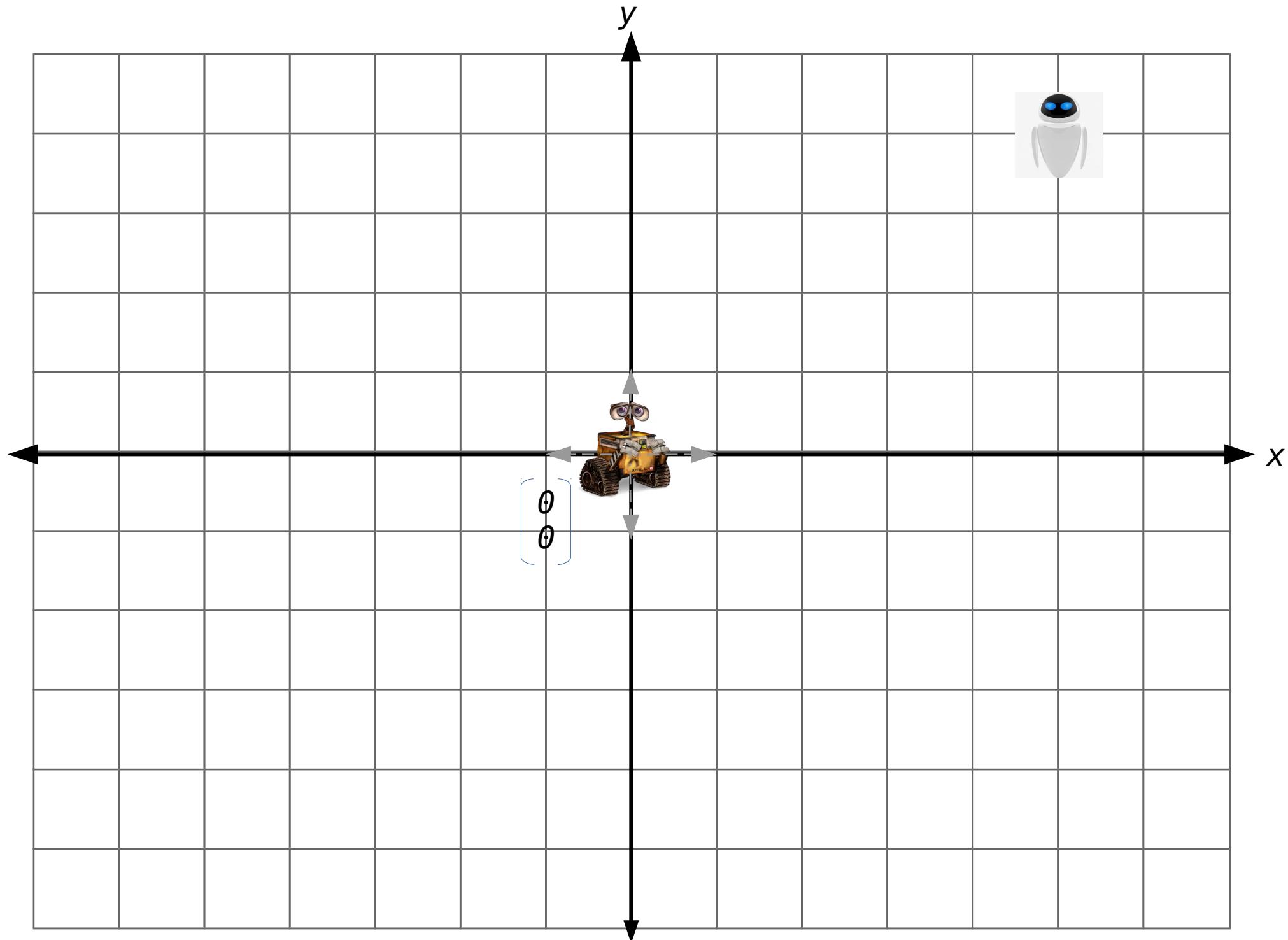
y

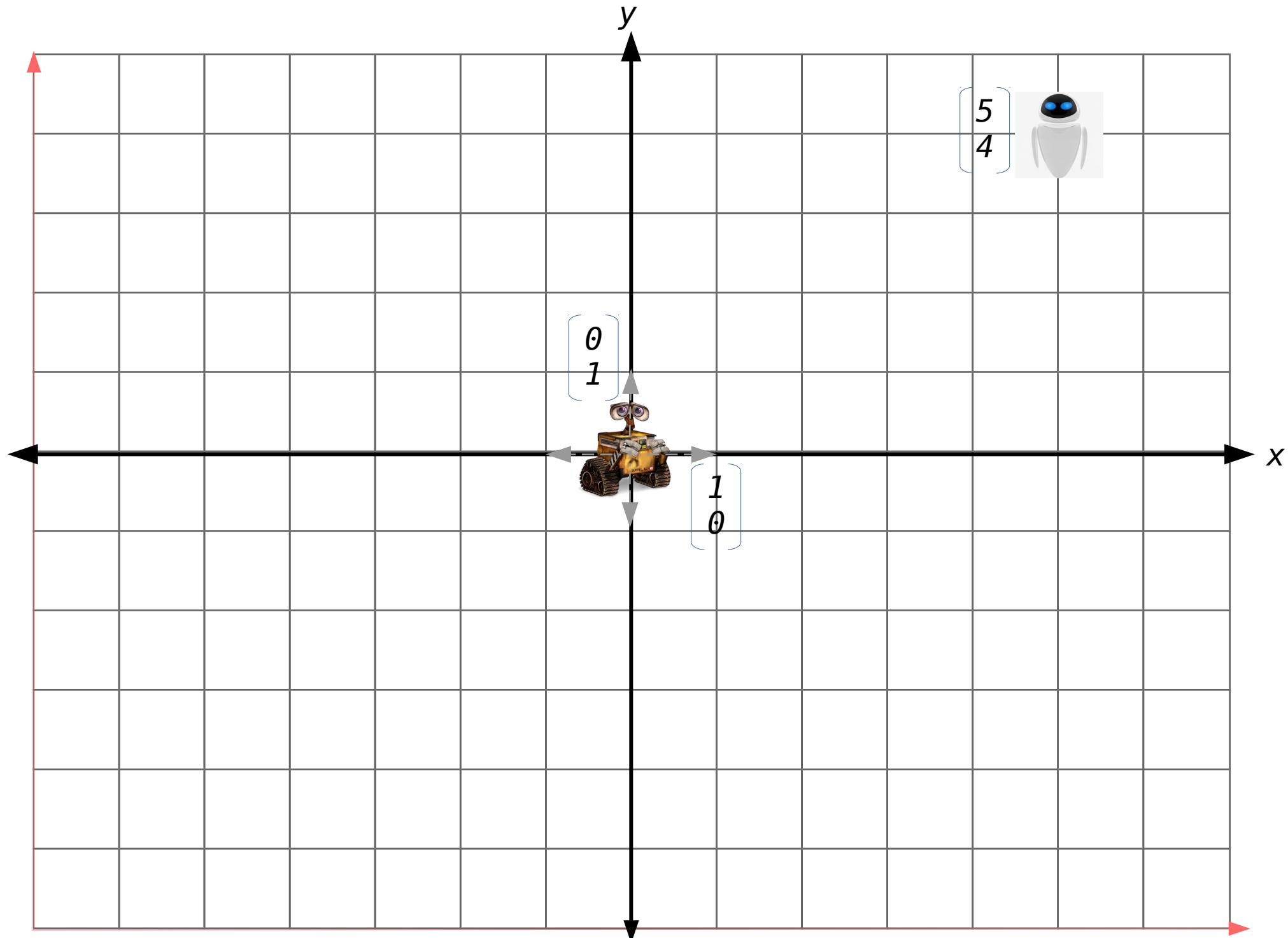


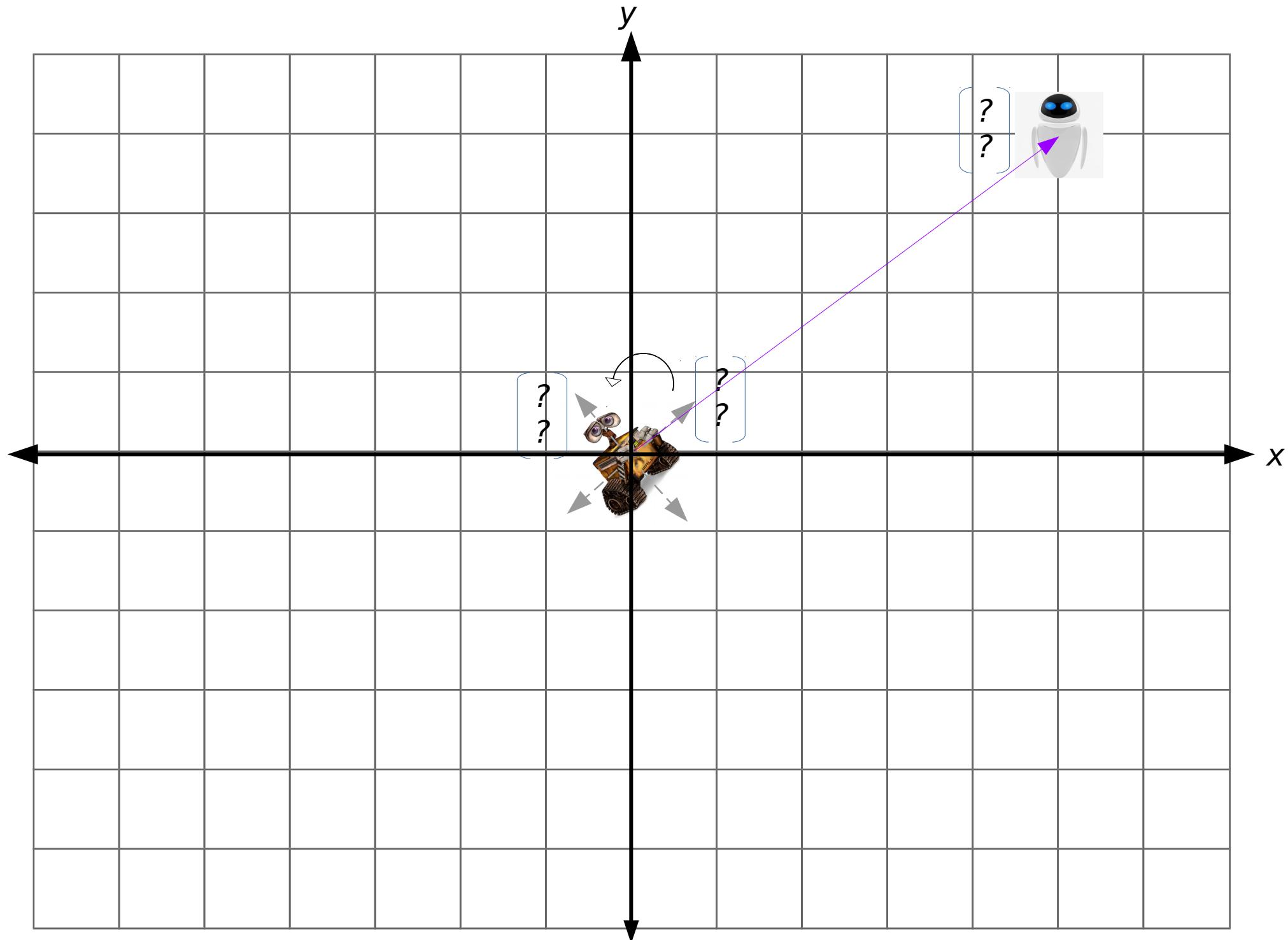
θ
 θ

x

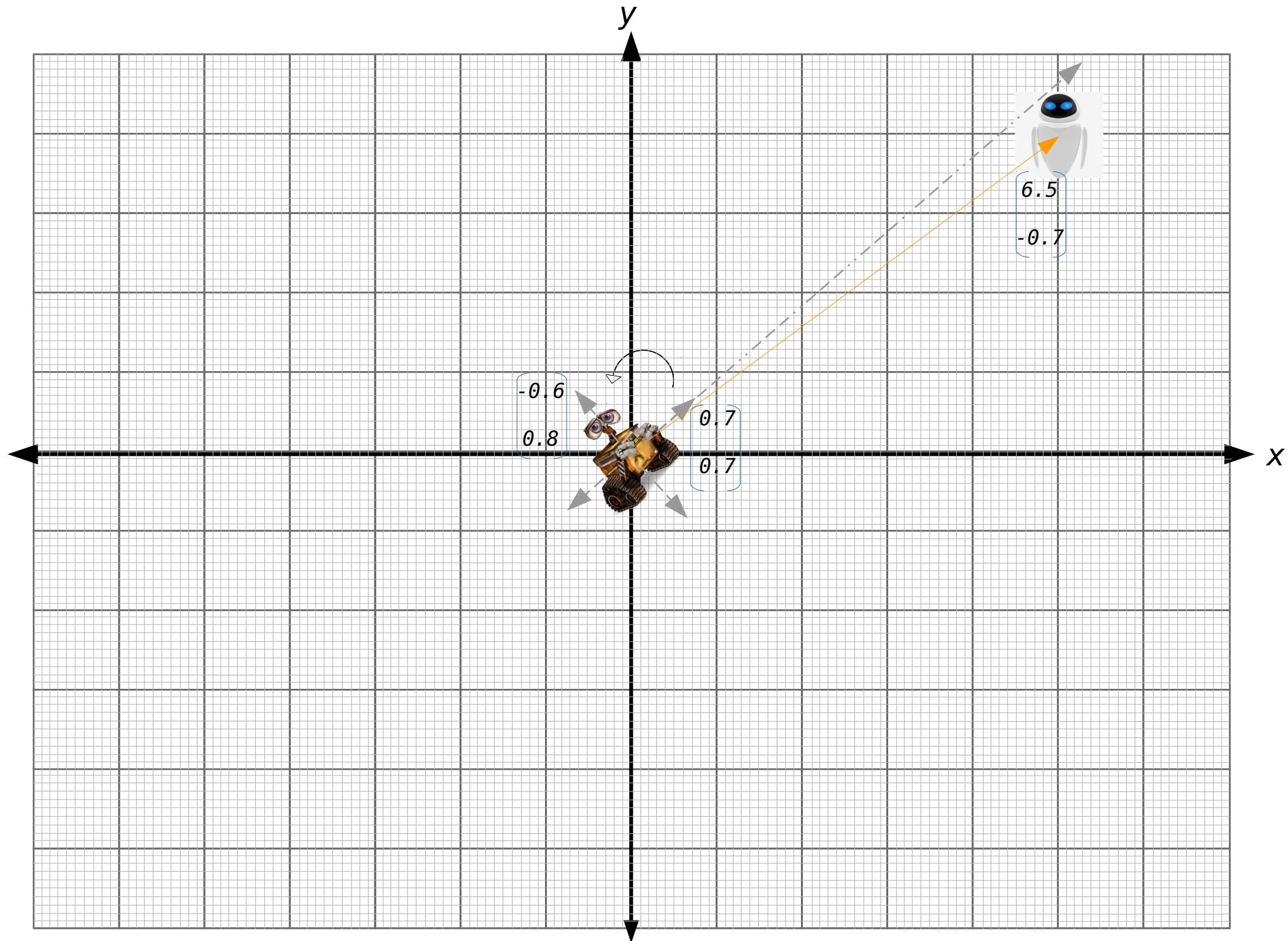




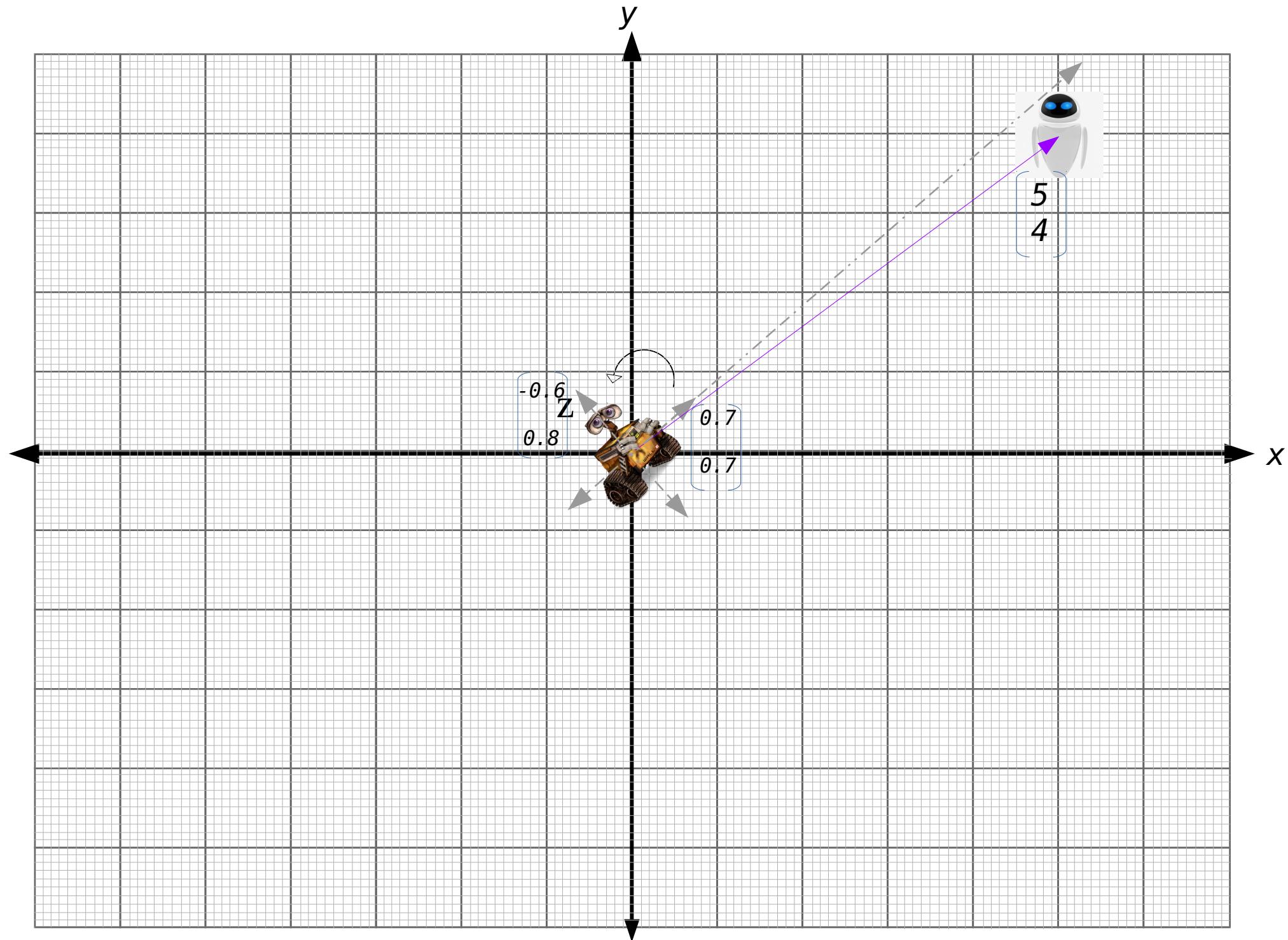




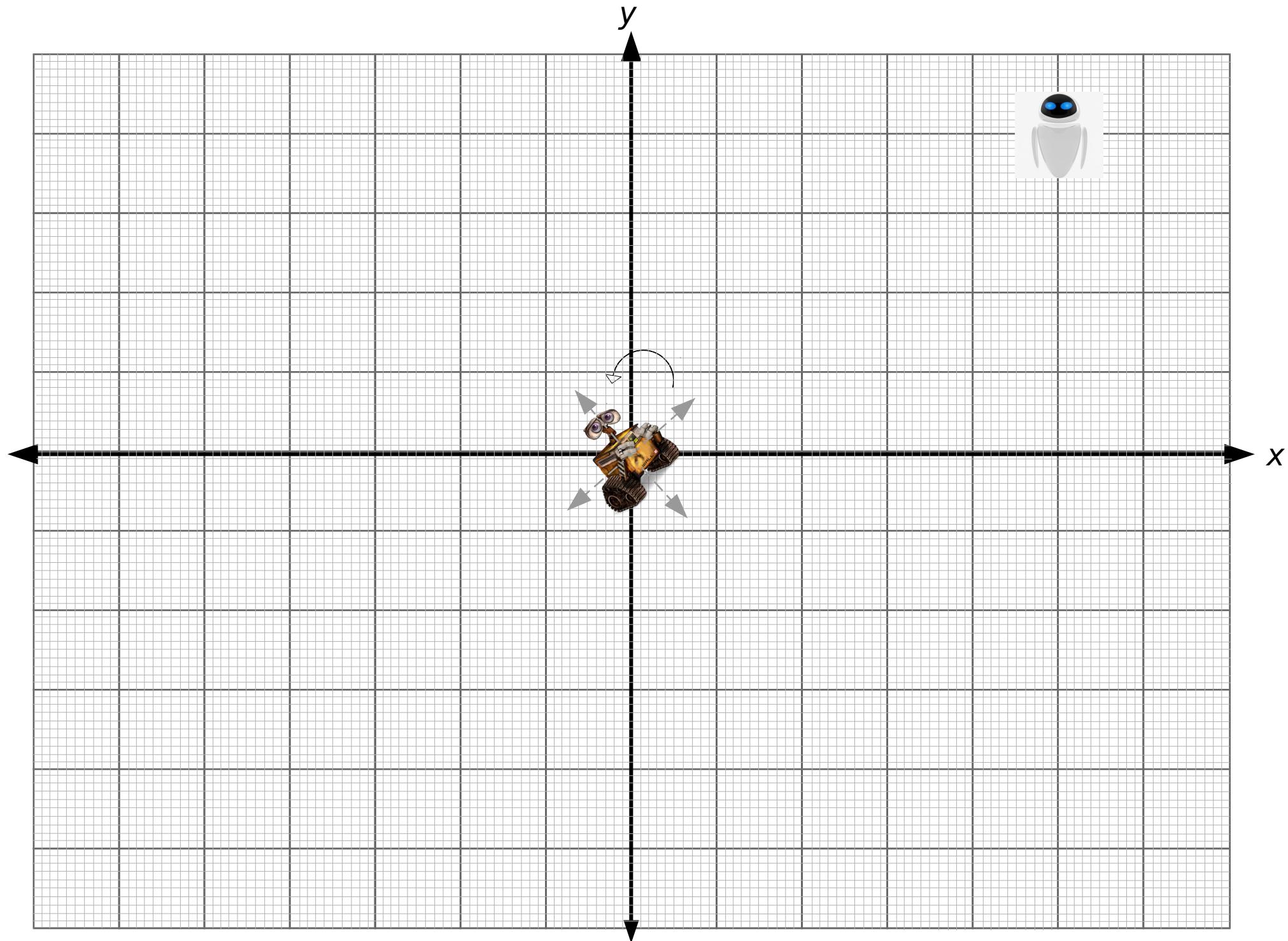
Matrix Multiplication

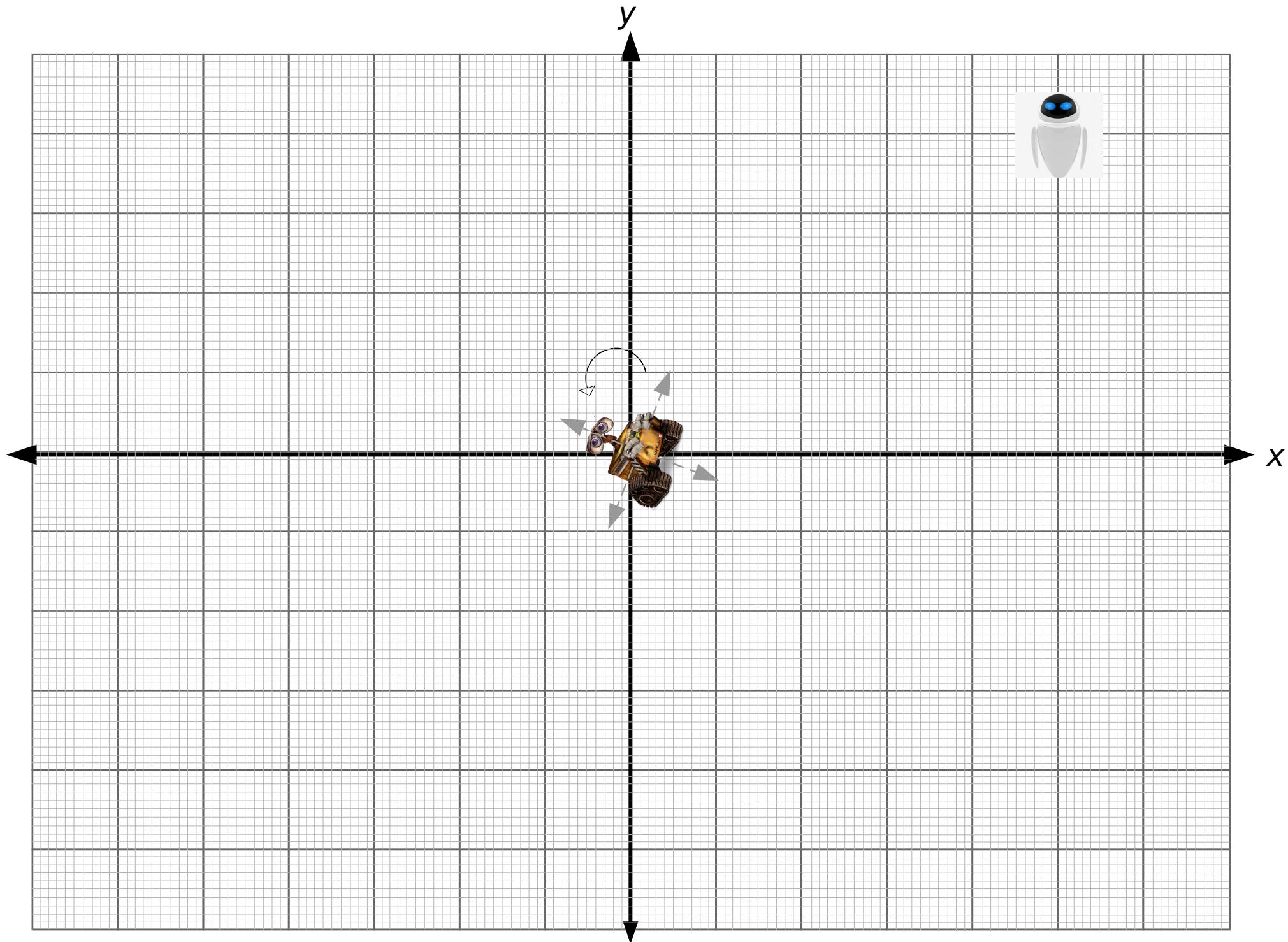


Inverse of a Matrix



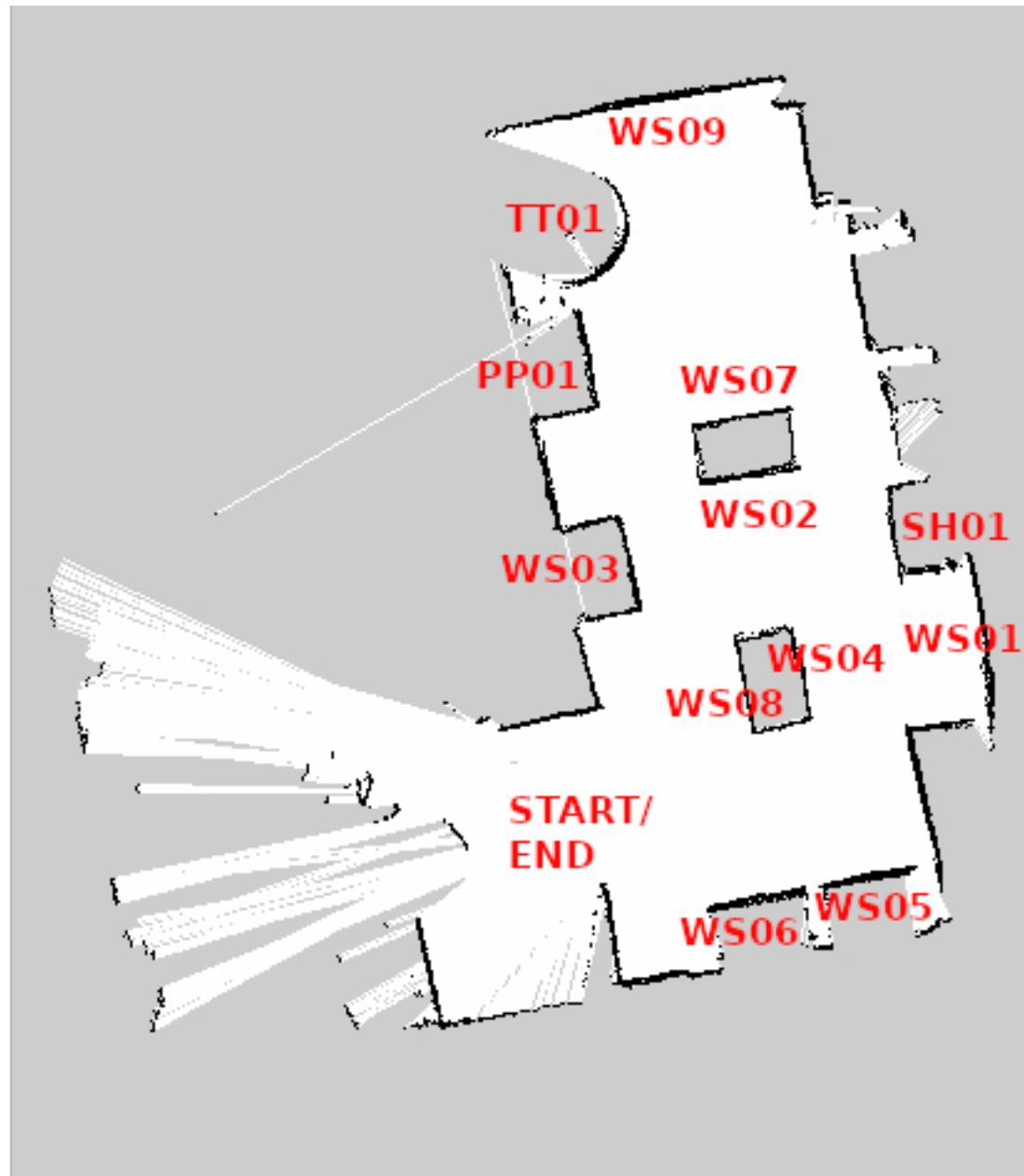
Composition

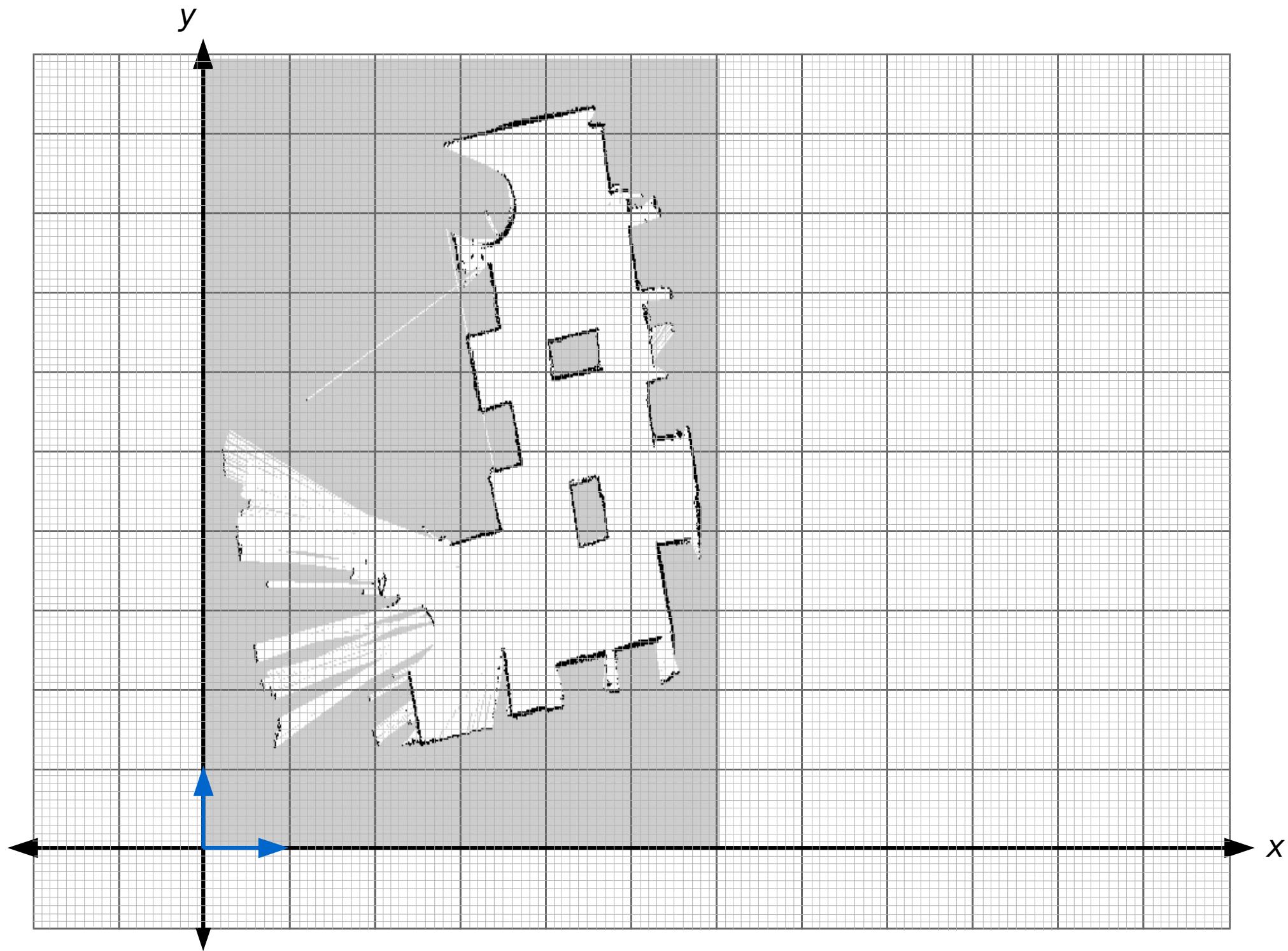




Applications

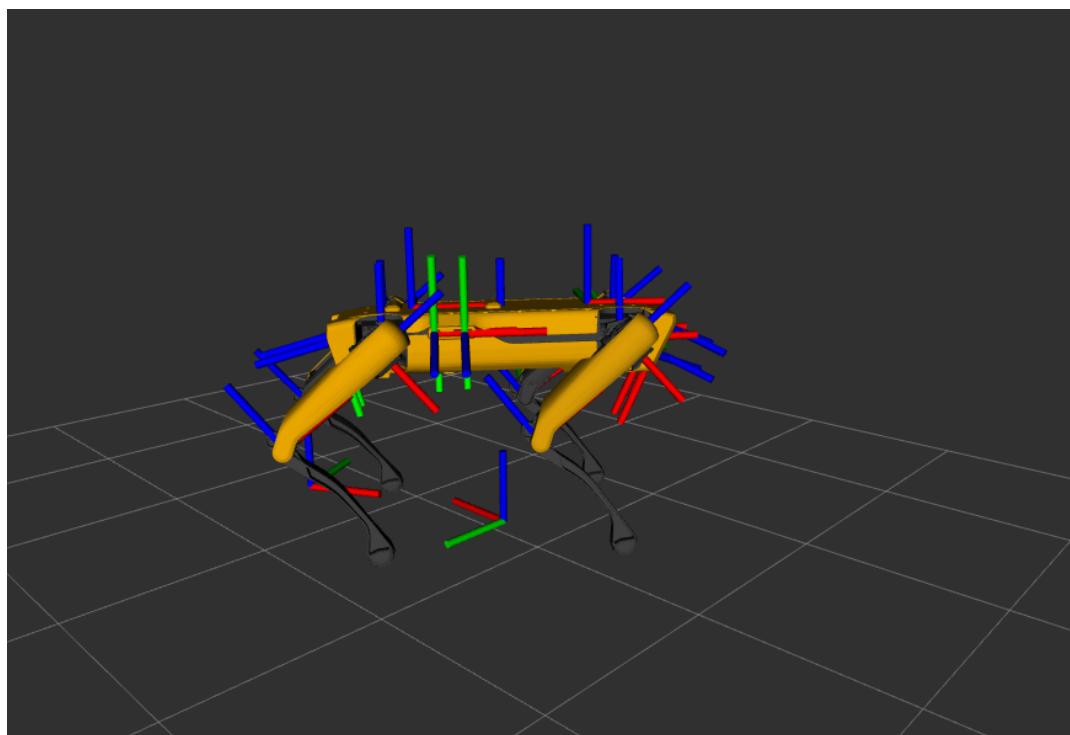
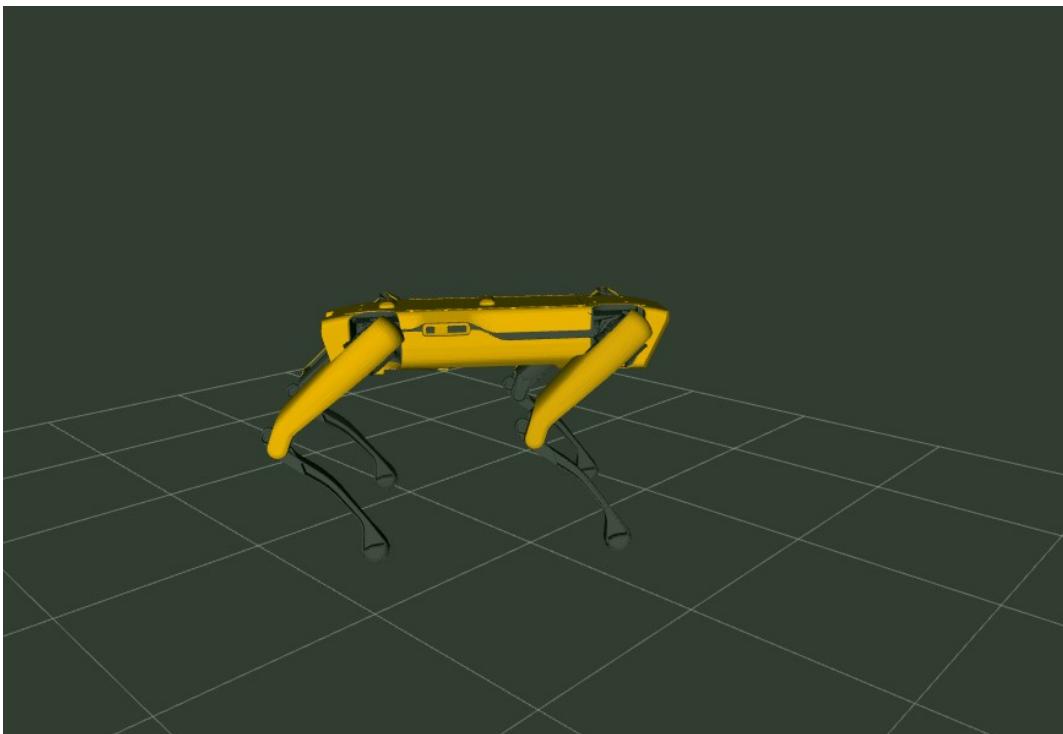
Robotics: Mapping





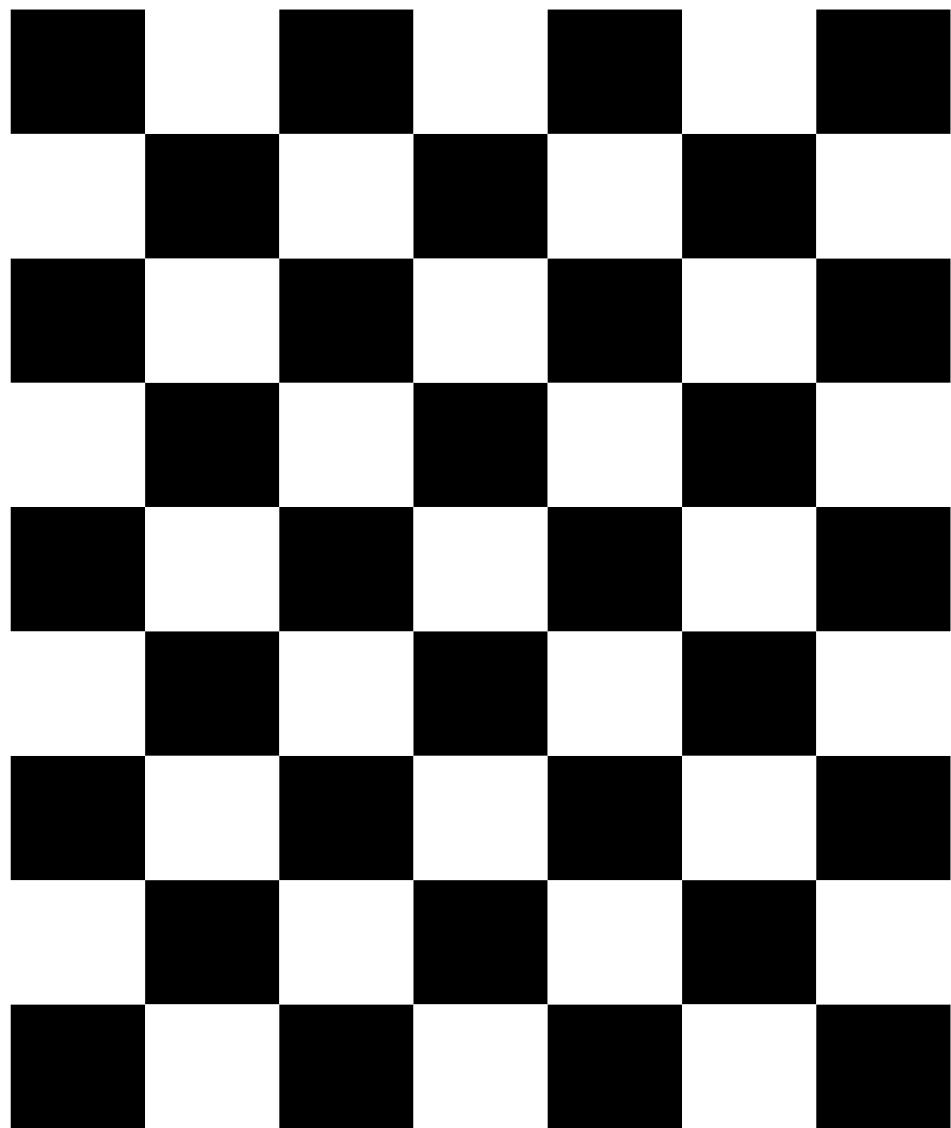
Applications

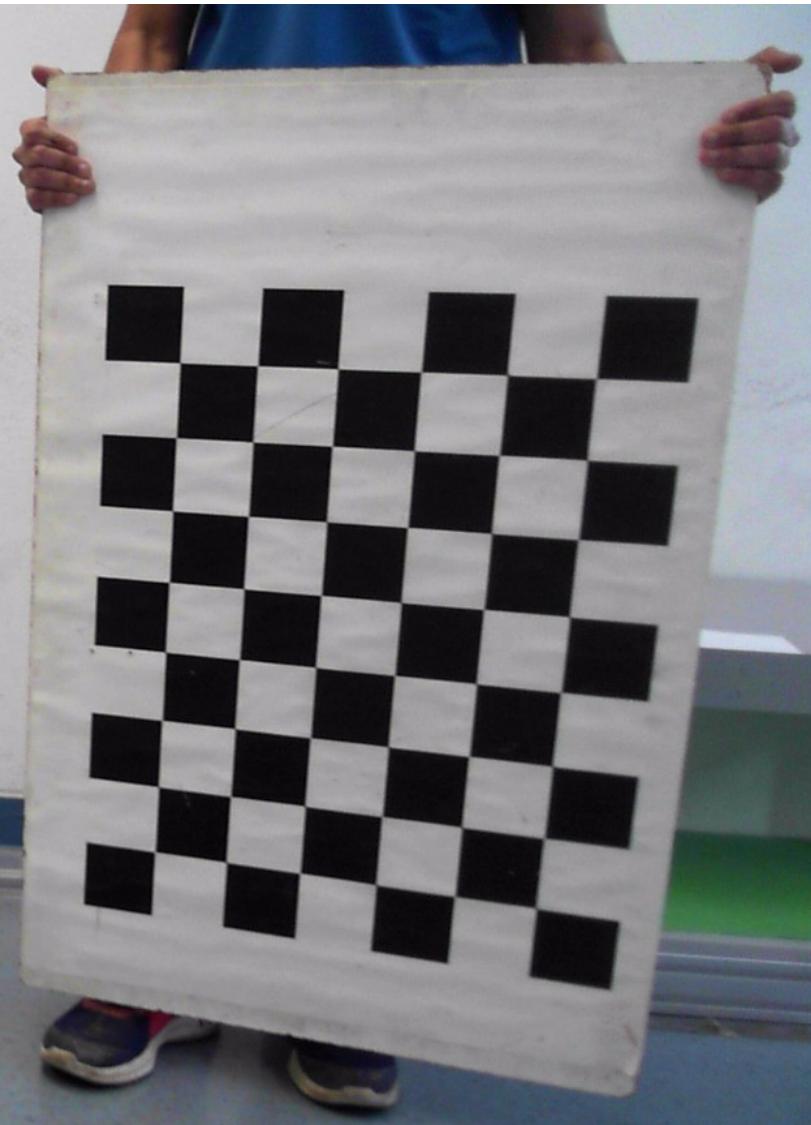
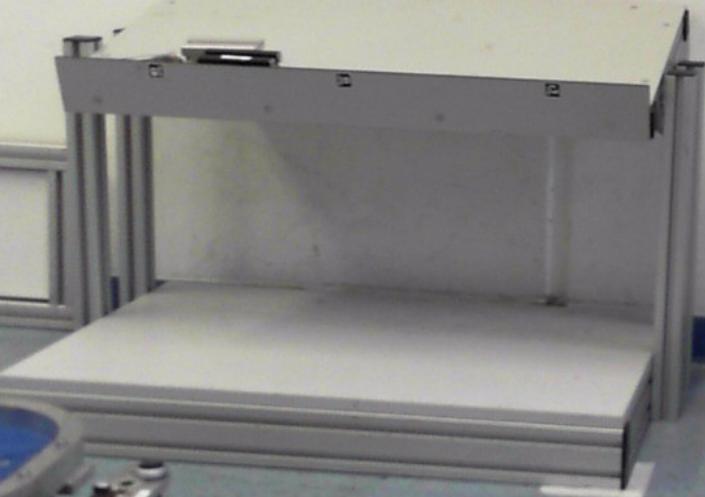
Robotics: Robot Control

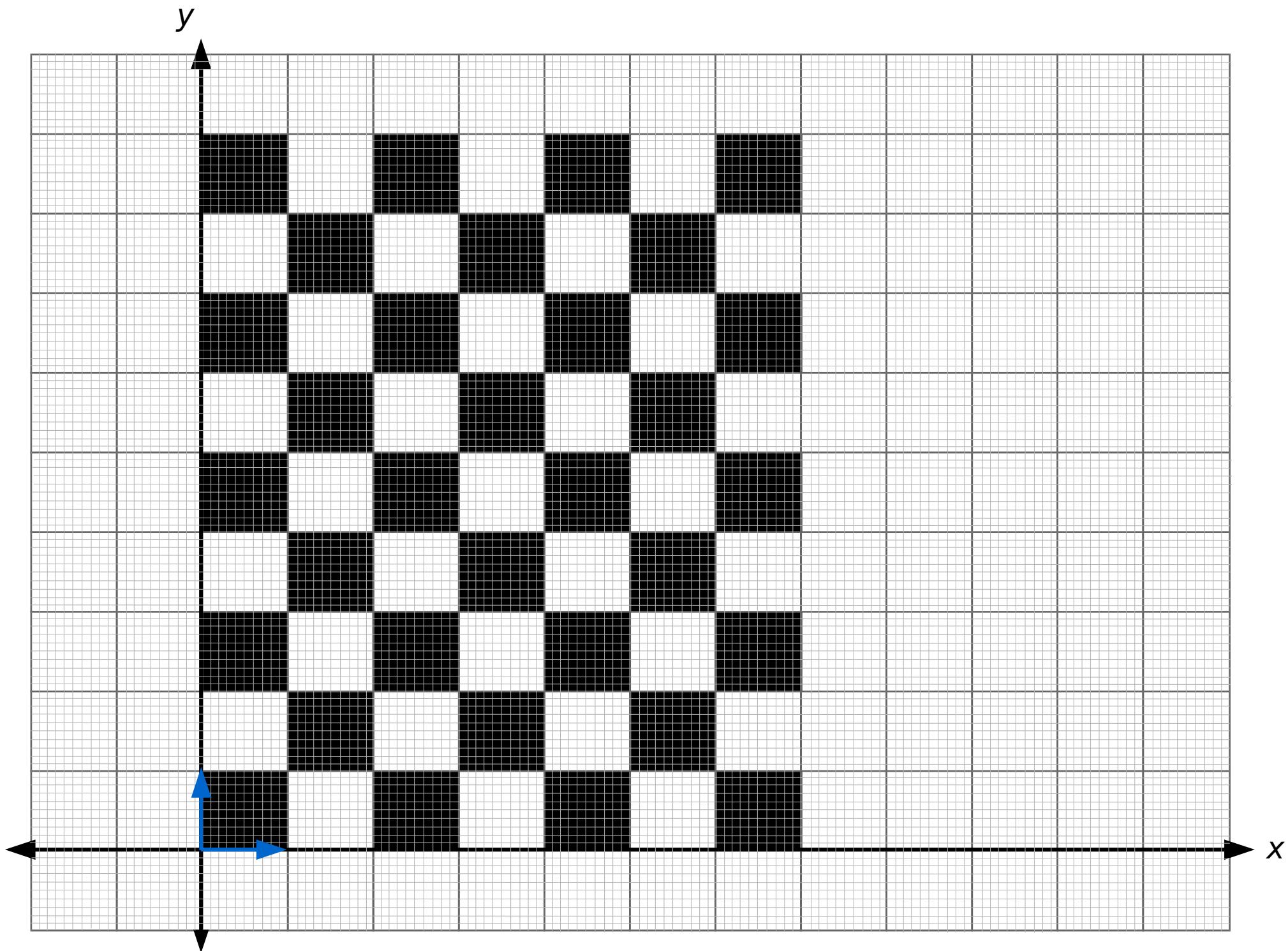


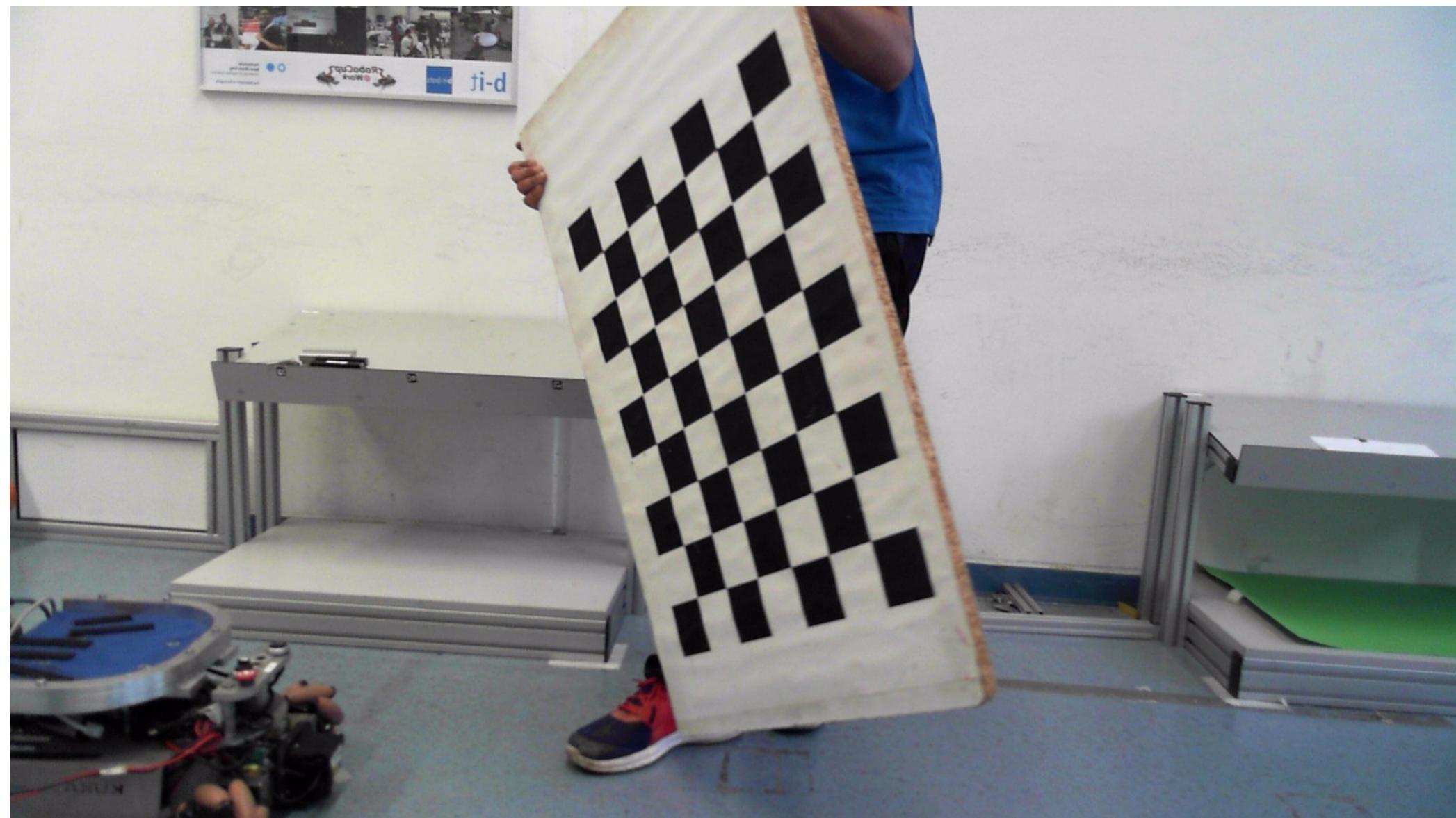
Applications

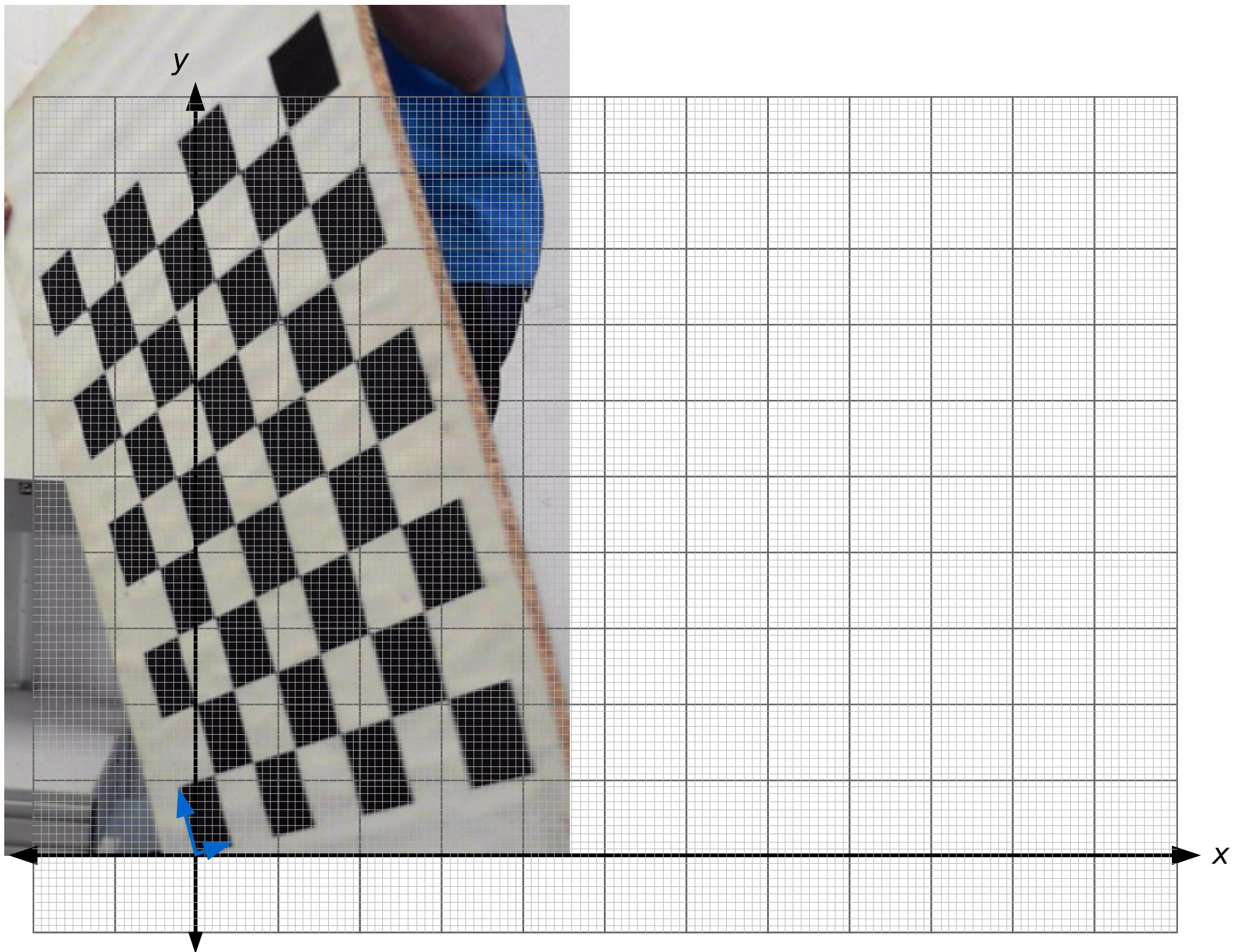
Computer Vision

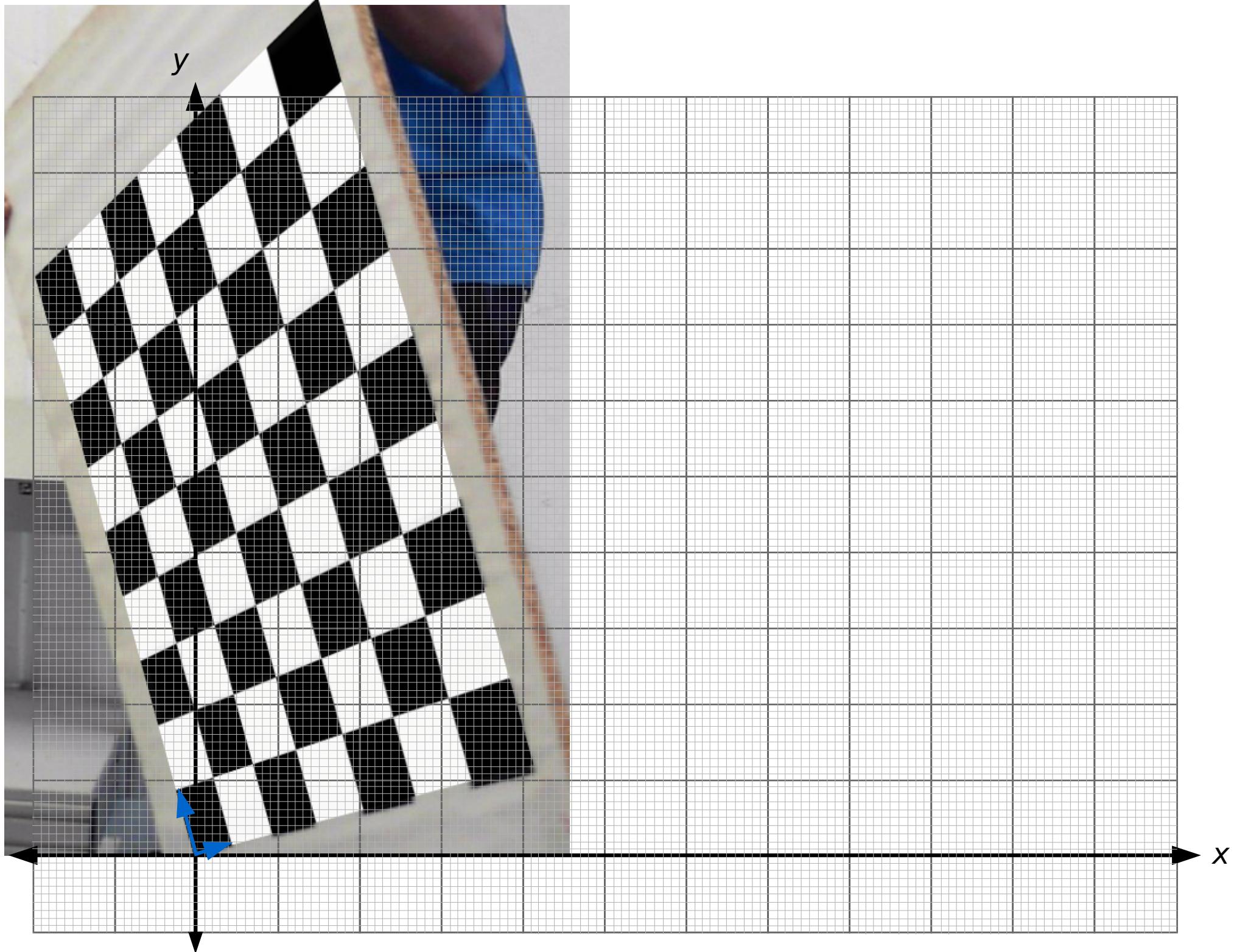


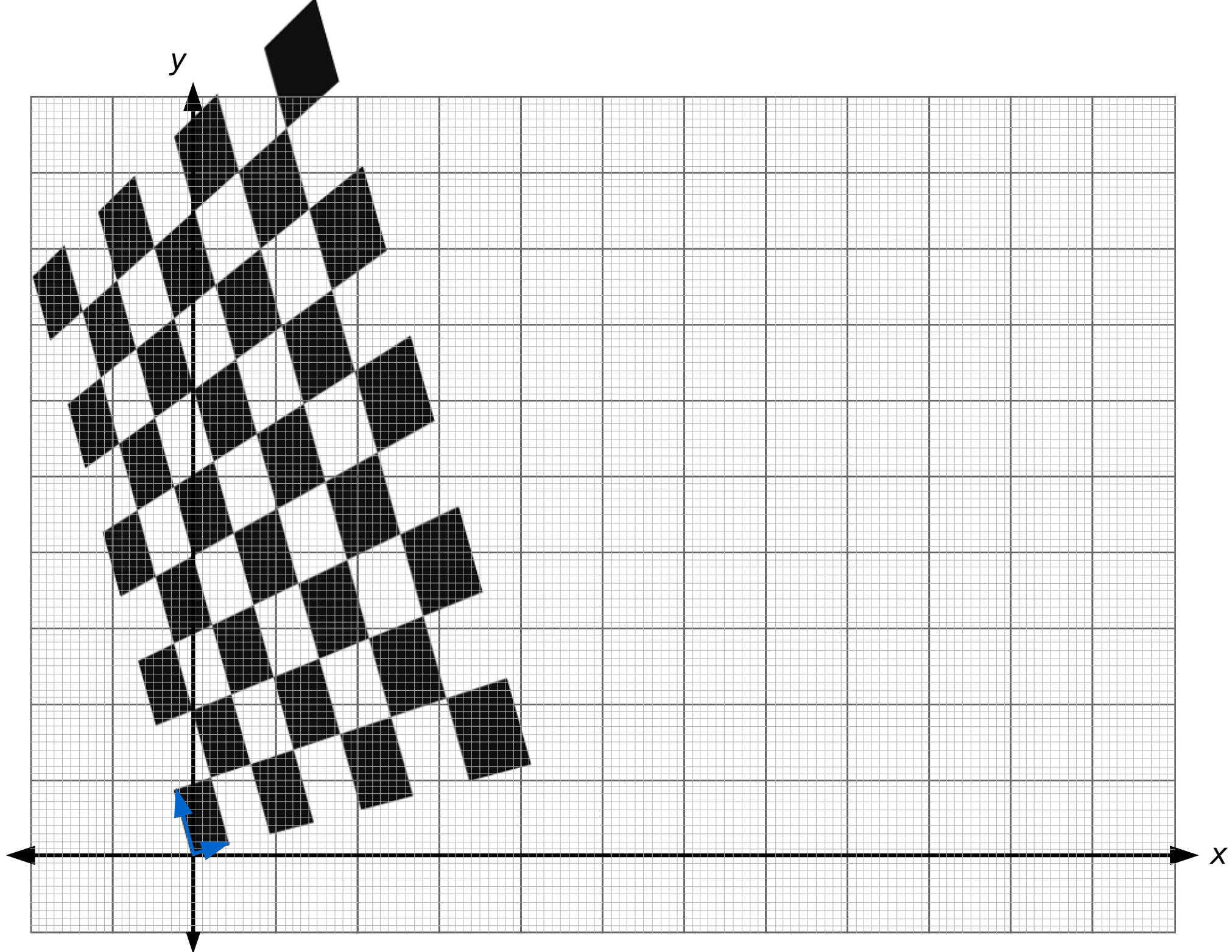






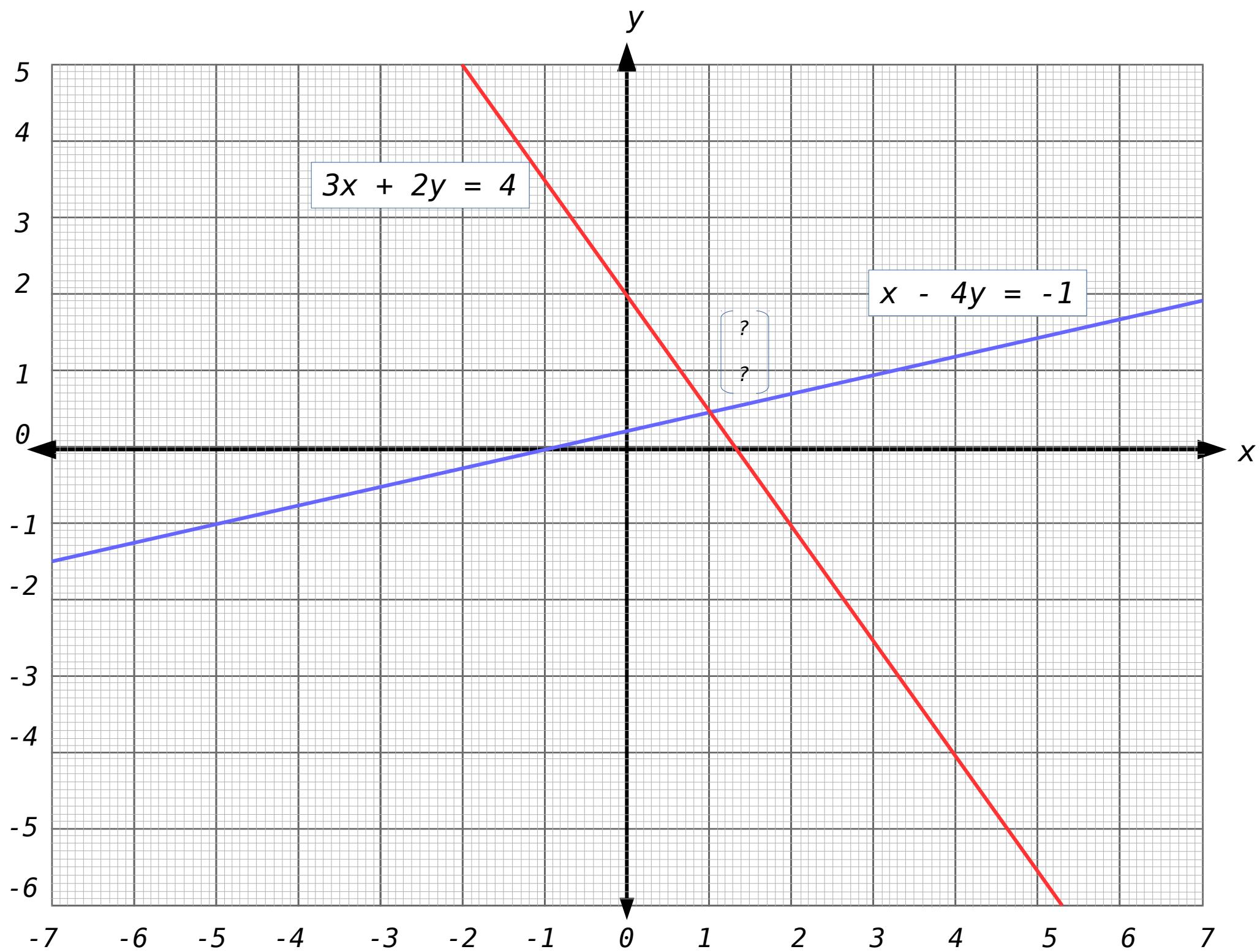






Applications

System of Equations



Determinant

y



θ
 θ

x

Rank of Matrix

y



x

θ

θ

Null and Column Space

y



θ
 θ

x

