**Linear Algebra**

Contents

[1. Linear/Affine Transformation – TRS (part 1) 2](#_Toc129621251)

[1.1. Translation 2](#_Toc129621252)

[1.1.1. 2D, 3D 2](#_Toc129621253)

[1.2. Scaling 2](#_Toc129621254)

[1.2.1. 2D, 3D 2](#_Toc129621255)

[1.3. Rotate 2](#_Toc129621256)

[1.3.1. 2D 2](#_Toc129621257)

[2. Coordinates System 3](#_Toc129621258)

[2.1. Example 1 4](#_Toc129621259)

[2.1.1. Given a point , what is the coordinate in system A? 4](#_Toc129621260)

[2.1.2. Given a point , what is the coordinate in system B? 5](#_Toc129621261)

[3. Lines 7](#_Toc129621262)

[3.1.1. Parametric Form 7](#_Toc129621263)

[3.1.2. Point-Normal Form 7](#_Toc129621264)

[3.1.3. Implicit Form 7](#_Toc129621265)

# Linear/Affine Transformation – TRS (part 1)

## Translation

### 2D, 3D

## Scaling

### 2D, 3D

## Rotate

### 2D

3D rotation is more complicated, look up for computer graphic, 3D rotation topics

# Coordinates System

* Local to Global, Global to Local, Local to Local etc…

Technically, **you do not need to care whether it is from local to global or vice versa etc…;** it’s just **mapping from one coordinate system to another coordinate system**. There are no such things as “local” or “global” system, it is literally just a naming to represent the coordinates system.

But in other topics such as Computer Graphics, you will learn lots of named system such as “Model Space”, etc…, to represent different coordinate system.

* A coordinate system consists of
  + An origin (translation)
  + Axis Vector(s) (scaling)
    - 2 vectors (in 2D space)
    - 3 vectors (in 3D space)

Be default, a **UNIT coordinate system** is defined as:

* + An origin of
  + Axis Vectors (scaling)
    - In 2D = 2 vectors

**Change of coordinates system formulae:**

Some tips and notes:  
The equation of yields the coordinate of A, i.e. from system B to system A.

The transformation of can be seen as LOCAL to GLOBAL and then back to LOCAL system.

As seen from below example, **if the coordinates System A is a Unit coordinate system**, the computation only needs **,** to yields the coordinate of A.

The transformation of **,** is commonly refer to as LOCAL to GLOBAL transformation, or, MODEL to WORLD transformation in computer graphic.

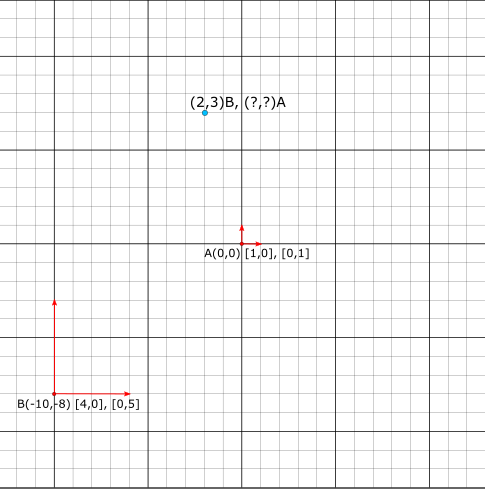
Example see below.

## Example 1

A coordinate system A by the point of origin at

A coordinate system B by the point of origin at

### Given a point , what is the coordinate in system A?

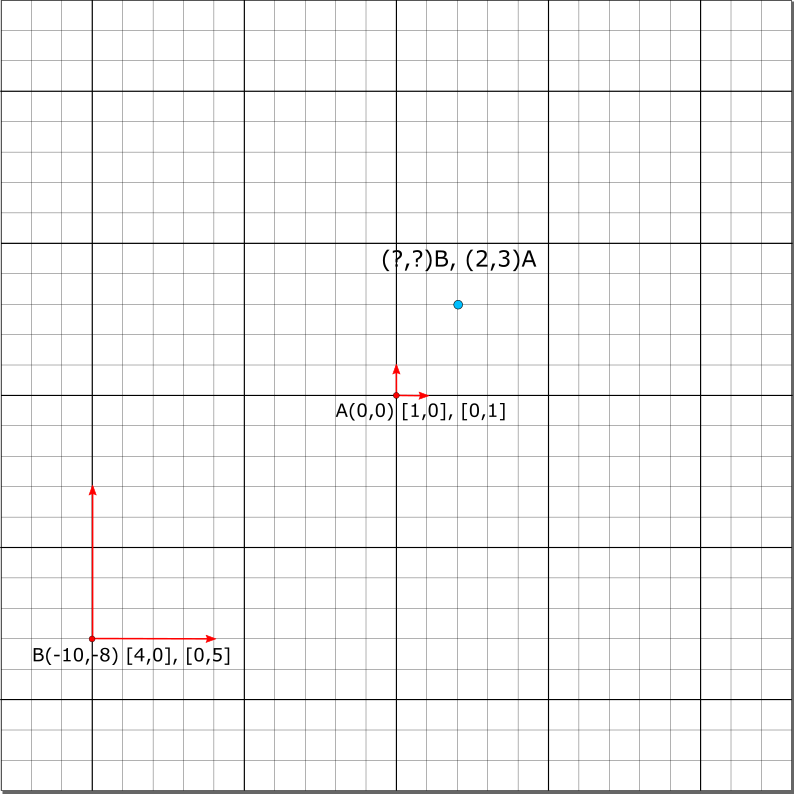


* + - * **Step 1: Form the coordinates system matrix**

Find unknown v, A, B, u is known

* + - * **Step 2: Find the Inverse Matrix**
      * In this example A, the inverse matrix of A is itself since it is an ***identity matrix***
      * **Step 3: Solve the Matrix Multiplication**

### Given a point , what is the coordinate in system B?

****

* + - * **Step 1: Form the coordinates system matrix**

Find unknown v, A, B, u is known

* + - * **Step 2: Find the Inverse Matrix**
      * **Step 2.5: Find the Inverse Matrix using Gauss Jordon**

1st row divide by 4:

3rd row multiply \* then plus 1st row:

2nd row divide by 5:

3rd row multiply \* then plus 2nd row:

Check:

* + - * **Step 3: Solve the Matrix Multiplication**

# Lines

### Parametric Form

### Point-Normal Form

### Implicit Form