ROBOTICS WORKSHOP

UMARAH QASEEM

1

POSE

2

POSE

2D
3D

5

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ROTATION MATRIX IN TOOLBOX

Identity rotation

```
ents  ▶  Umarah Qaseem  ▶  Robotics  ▶  li
Command Window
>> rot2(0)

ans =

     1     0
     0     1
```
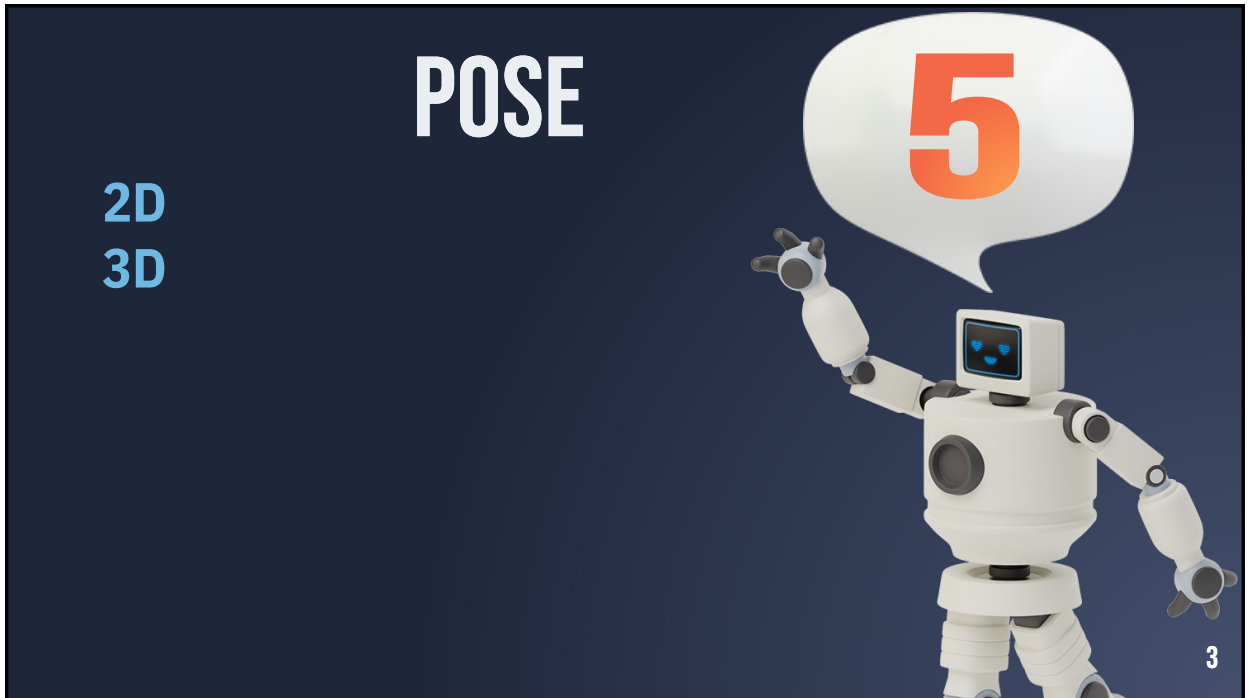
Robotics – Umarah Qaseem
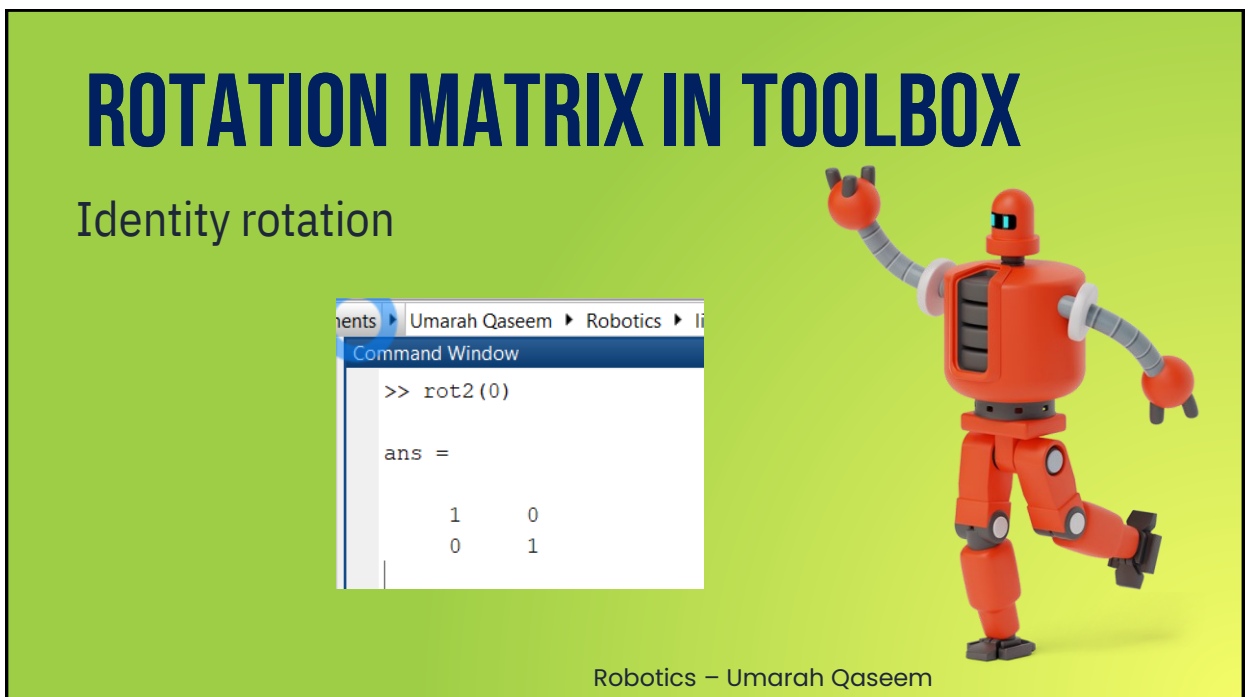
ROTATION IN RADIANS AND DEGREES

```
nts ▶ Umarah Qaseem ▶ Robotics ▶
Command Window
  >> rot2(0.6)

  ans =

       0.8253   -0.5646
       0.5646    0.8253
```
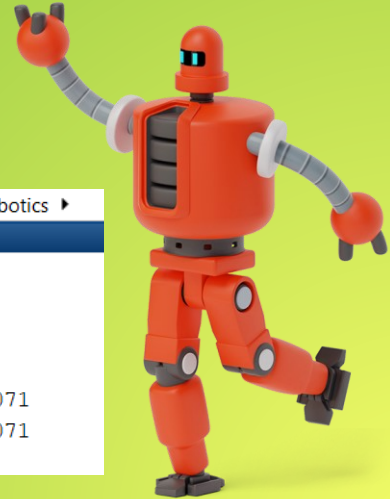
```
ents ▶ Umarah Qaseem ▶ Robotics ▶
Command Window
  >> rot2(45, 'deg')

  ans =

       0.7071   -0.7071
       0.7071    0.7071
```
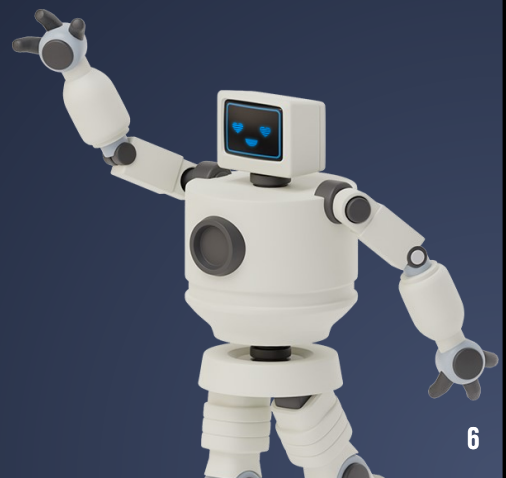
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Some properties of Rotation Matrix

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ORTHOGONAL MATRIX

```
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Command Window
>> R = rot2(35, 'deg')

R =

    0.8192   -0.5736
    0.5736    0.8192

>> c1 = R(:,1)

c1 =

    0.8192
    0.5736

>> c2 = R(:,2)

c2 =

   -0.5736
    0.8192
```

```
>> dot(c1,c2)

ans =

      0

fx >>
```

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DETERMINANT

```
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Command Window
>> det(R)

ans =

      1
```

Determinant is always 1

8

INVERSE AND TRANSPOSE
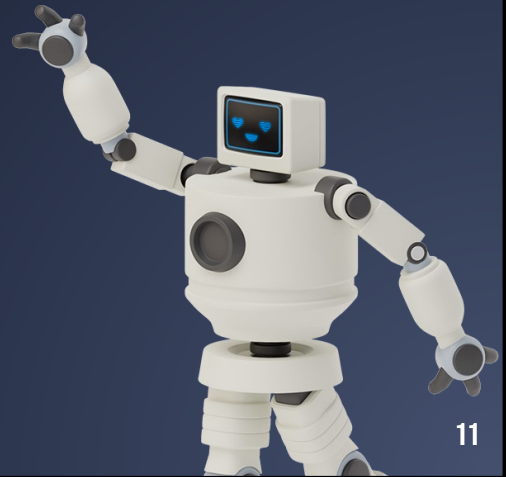

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VISUALIZATION

If it looks weird, write axis equal
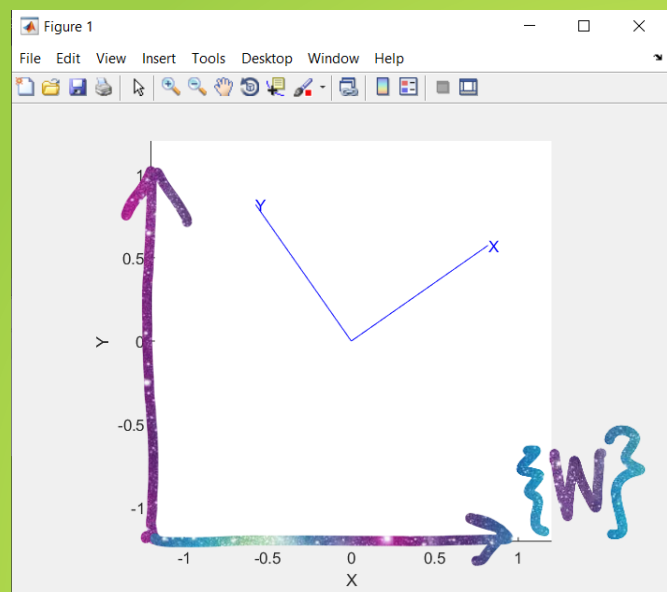
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2D Homogeneous Transformation

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TRANSLATION

Pure translation

```
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Command Window
>> transl2(1,2)

ans =

     1     0     1
     0     1     2
     0     0     1

fx >> |
```

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HOMOGENEOUS TRANSFORMATION


```
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Command Window
  >> trot2(30,'deg')

  ans =

      0.8660   -0.5000        0
      0.5000    0.8660        0
           0         0   1.0000

fx >> |
```

Pure rotation

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HOMOGENEOUS TRANSFORMATION


```
ents ▶ Umarah Qaseem ▶ Robotics ▶
Command Window
  >> transl2(1,2)*trot2(30,'deg')

  ans =

      0.8660   -0.5000    1.0000
      0.5000    0.8660    2.0000
           0         0    1.0000

fx >> |
```

Rotational + transnational components

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HOMOGENEOUS TRANSFORMATION

```
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Command Window
    >> SE2(1,2,30,'deg')


    ans =
        0.8660    -0.5000        1
        0.5000     0.8660        2
             0          0        1
fx >> |
```
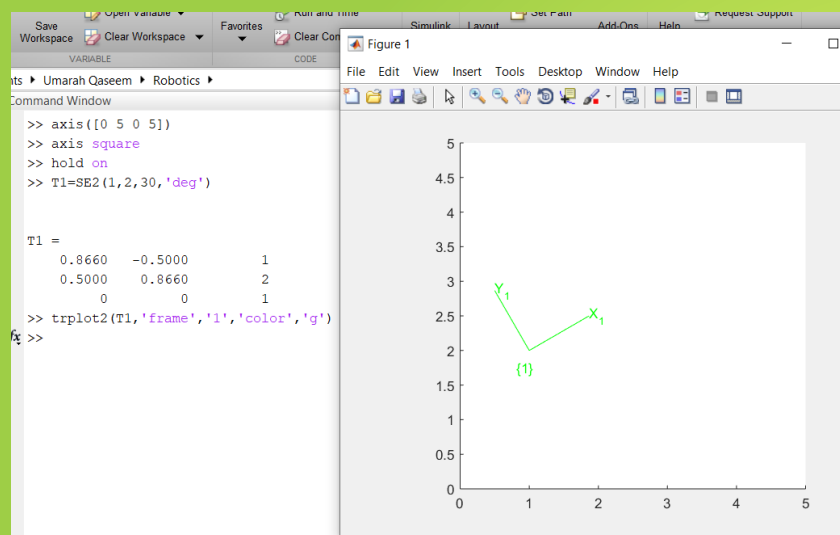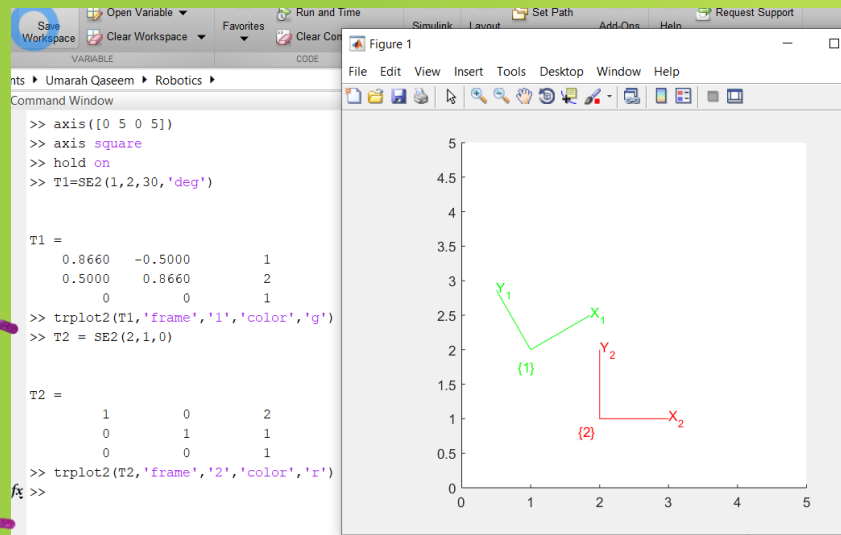
Direct function
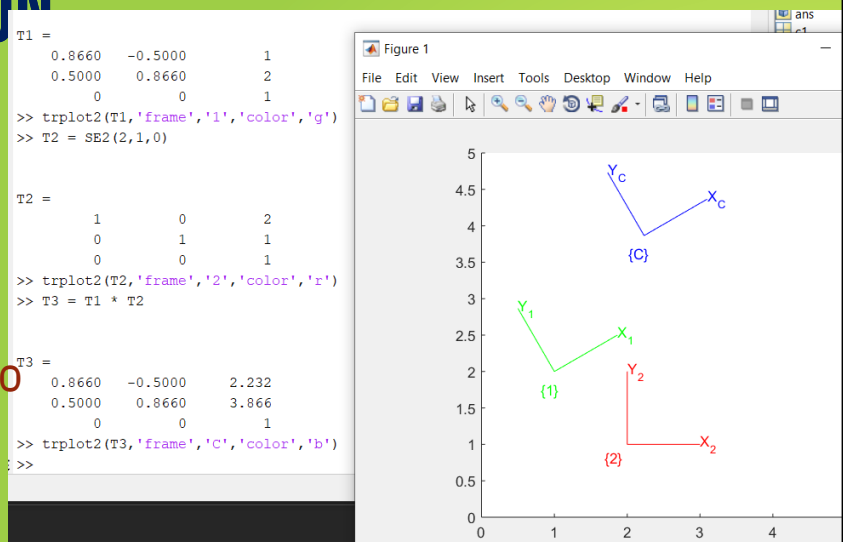
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LET'S VISUALIZE

```
Save        Open Variable ▼          Run and Time              Set Path       Request Support
Workspace   Clear Workspace ▼   Favorites    Clear Co...   Simulink   Layout   Add-Ons   Help
            VARIABLE                      CODE
ts ▶ Umarah Qaseem ▶ Robotics ▶
Command Window
    >> axis([0 5 0 5])
    >> axis square
    >> hold on
    >> T1=SE2(1,2,30,'deg')


    T1 =
        0.8660    -0.5000        1
        0.5000     0.8660        2
             0          0        1
    >> trplot2(T1,'frame','1','color','g')
fx >>
```

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LET'S VISUALIZE

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COMPOSITION

What is the movement?

1- moved to {1}}

2- moved from {1} to 1 step in x direction and 2 step in y

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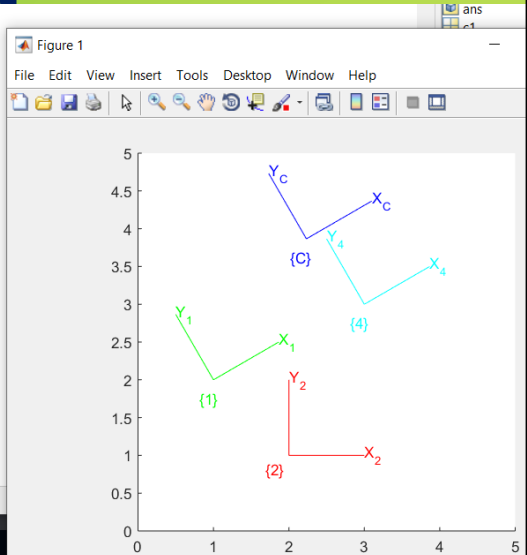
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ORDER OF COMPOSITION

What is the movement

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POINT

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9/13/2024
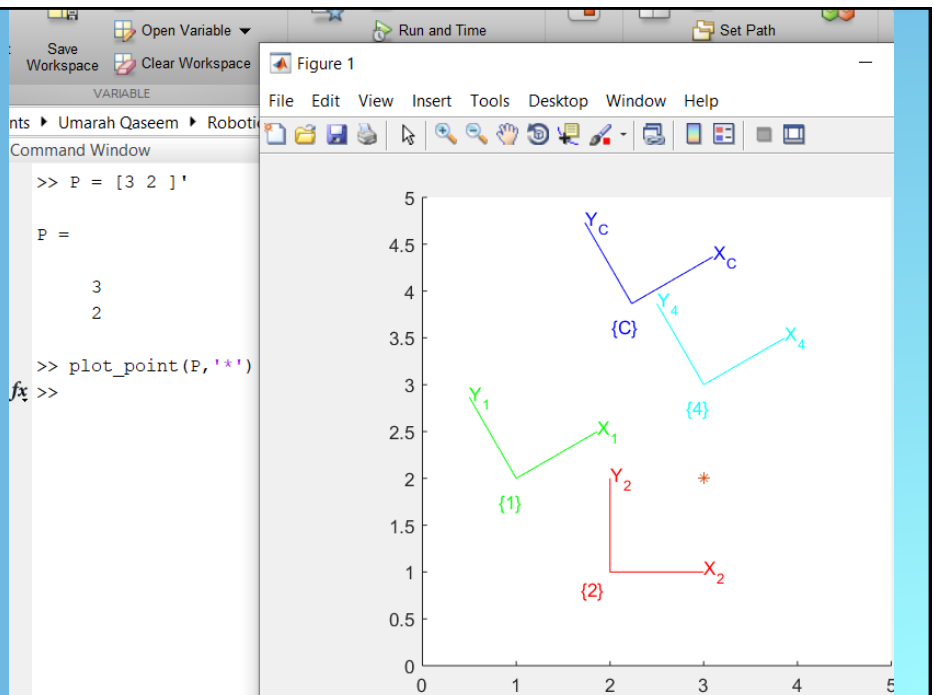
REPRESENTING VECTOR/ POINT WRT A FRAME

```
                                       VARIABLE                    CODE
                        ments ▶ Umarah Qaseem ▶ Robotics ▶
                        Command Window
                            0.5000      0.8000           2
                                0           0            1
                        >> P = [3 2]'

                        P =

                             3
                             2

                        >> P1 = inv(T1) * P

                        P1 =

                            1.7321
                           -1.0000

                        >> P1 = [P1 ; 1]

                        P1 =

                            1.7321
                           -1.0000
                            1.0000
```
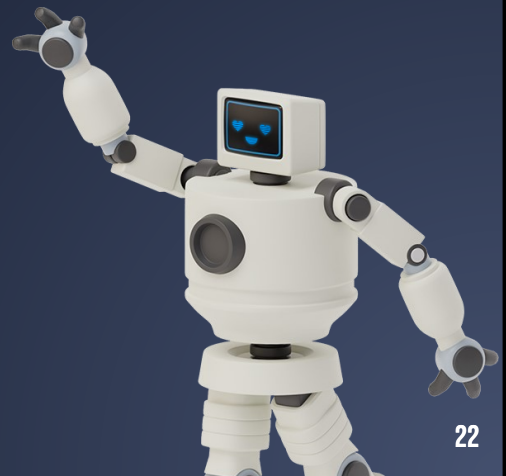
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3D transformation

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3D ROTATION

```
Command Window
>> rotx(0.2)

ans =

    1.0000         0         0
         0    0.9801   -0.1987
         0    0.1987    0.9801

>> rotx(30, 'deg')

ans =

    1.0000         0         0
         0    0.8660   -0.5000
         0    0.5000    0.8660

>> R = ans

R =

    1.0000         0         0
         0    0.8660   -0.5000
         0    0.5000    0.8660
```
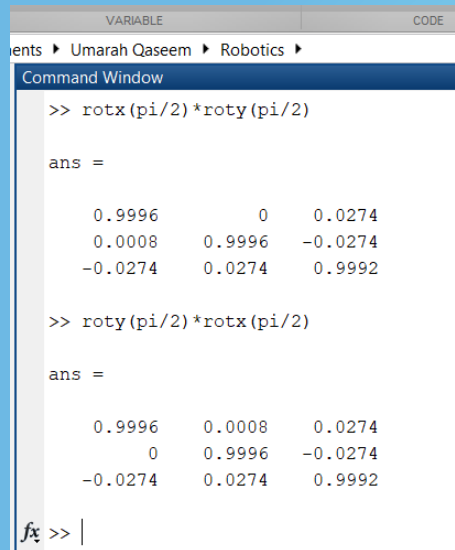
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HOME TASK
- roty
- rotz
- det
- Transpose
- Inverse

- Color, label, arrow head

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NON-COMMUTATIVE

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VISUALIZATION

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