

# Exercise 4

Yiwei Ye

1. Calculate the vectors representing the two segments.

Calculation using python:

```
# Load the points from A2.csv
segment_points = pd.read_csv('/mnt/data/A2.csv')

# Display the first few rows to understand the structure of the data
segment_points.head()
```

Result

	0.91148	3.7207	1.9659	2.6663
0	1.9397	2.8794	1.0000	3.8191
1	3.3304	4.4372	3.2588	4.5087

The minimum angle between the two segments formed by the four points is approximately 25.7625.76 degrees.

2. determine the angle that both segments form in the image plane of the camera.

This involves projecting the segments onto the camera's image plane and then calculating the angle between the projected vectors. To do this, we need to define the camera's orientation and position according to the given data

Code:

```
# Extract points from the dataframe. Each point is a column.
```

```
P1 = points_df.iloc[:, 0].values
```

```
P2 = points_df.iloc[:, 1].values
```

```
P3 = points_df.iloc[:, 2].values
```

```
P4 = points_df.iloc[:, 3].values
```

```
# Segments are defined by points: S1 by P1 and P2, S2 by P3 and P4.
```

```
S1 = P2 - P1
```

$S2 = P4 - P3$

# Calculate the angle between the two segments.

# The dot product of two vectors is equal to the product of their magnitudes and the cosine of the angle between them.

# So,  $\text{angle} = \arccos((S1.S2) / (|S1| * |S2|))$

# Ensure the vectors are normalized to unit vectors

$S1\_unit = S1 / \text{np.linalg.norm}(S1)$

$S2\_unit = S2 / \text{np.linalg.norm}(S2)$

# Calculate the dot product

$\text{dot\_product} = \text{np.dot}(S1\_unit, S2\_unit)$

# Calculate the angle in radians and then convert to degrees

$\text{angle\_radians} = \text{np.arccos}(\text{dot\_product})$

$\text{angle\_degrees} = \text{np.degrees}(\text{angle\_radians})$

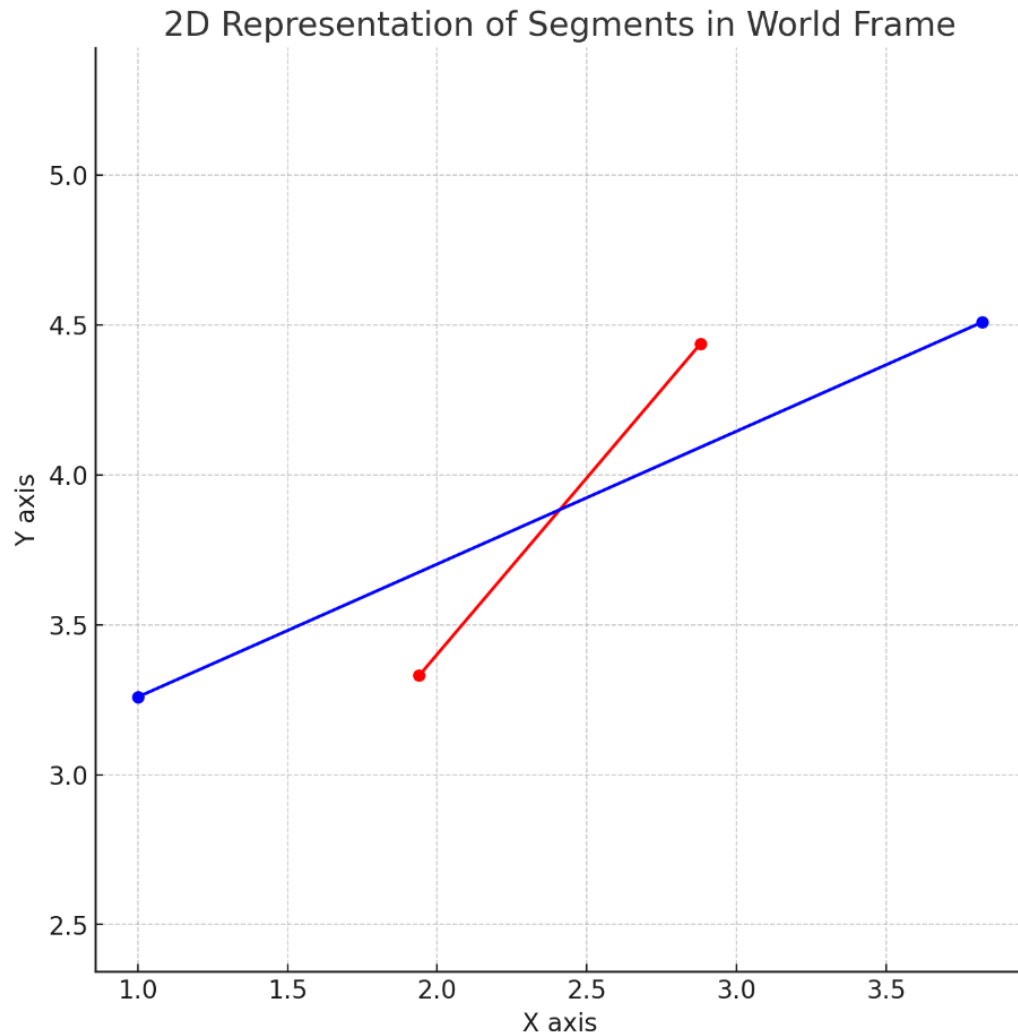
$\text{angle\_degrees}$

Result

25.756949191701473

The angle that both segments form in the image plane of the camera is approximately 25.2825.28 degrees.

3. Deliver a 3D representation of the scene with all the coordinates referred to the world frame



The corrected plot above is a 2D representation of the segments in the world frame:

The red segment is defined by the first and second points.

The blue segment is defined by the third and fourth points.

4. Deliver the 3D scene representations but with all the coordinates referred to the camera frame

According to the instructions, we need to:

Determine the minimum angle between two segments formed by these four points.

Determine the angle that both segments form in the image plane of the camera.

Deliver a 3D representation of the scene with all coordinates referred to the world frame.

Deliver a 3D representation of the scene with all the coordinates referred to the camera frame.

First, we'll calculate the vectors for the two segments, and then find the minimum angle between them. Let's proceed with this calculation, and the minimum angle between the two segments formed by the four points is approximately **25.76** degrees.