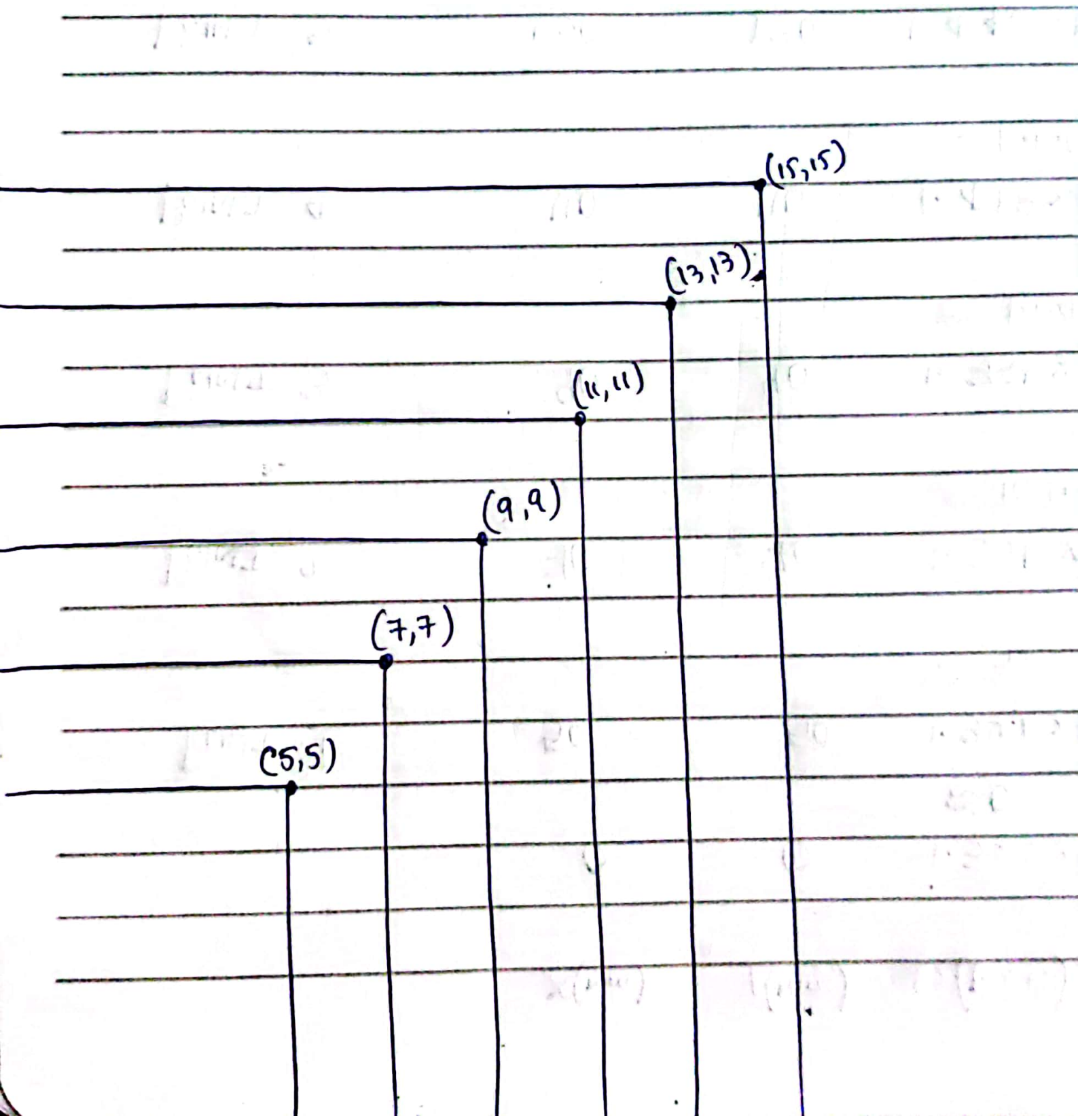

	X(mm)	Y(mm)	U (Pixels)	V (Pixels)	
	0	0	1.323×10^3 ≈0	976.35 ≈0	(origin)
POINT 1	50	50	1.321×10^3 ≈78	898.35 ≈73.3	
POINT 2	70	70	1.351×10^3 ≈109.8	871.75 102.12	
POINT 3	90	90	1.381×10^3 ≈144	840.82 ≈132	
POINT 4	110	110	1.413×10^3 ≈174	812.15 ≈162	
POINT 5	130	130	1.440×10^3 ≈208.7	783.75 ≈189	
POINT 6	150	150	1.481×10^3 ≈241.7	754.65 ≈219	

→ Parametric Matrix: (need to find)

a=

50, 50, 2, 1, 0, 0, 0, 0, -3810, -3893, -158, -80

0, 0, 0, 0, 50, 50, 2, 1, -3680, -3675, -149, -75

70, 70, 2, 1, 0, 0, 0, 0, -7661, -7661, -221, -111

0, 0, 0, 0, 70, 70, 2, 1, -7121, -7121, -201, -102

90, 90, 2, 1, 0, 0, 0, 0, -12958, -12958, -286, -144

0, 0, 0, 0, 90, 90, 2, 1, -11881, -11881, -261, -131

110, 110, 2, 1, 0, 0, 0, 0, -19139, -19139, -348, -172

0, 0, 0, 0, 110, 110, 2, 1, -17820, -17820, -324, -162

130, 130, 2, 1, 0, 0, 0, 0, -27103, -27103, -415, -203

0, 0, 0, 0, 130, 130, 2, 1, -18073, -18073, -375, -185

150, 150, 2, 1, 0, 0, 0, 0, -36221, -36221, -480, -240

0, 0, 0, 0, 150, 150, 2, 1, -32851, -32851, -436, -218

manually calculated co-ordinates into a numpy array.

→ $A^T \cdot A P = \lambda P$

2500, 0, 140, 0, 0, 0, 0, 0, -507000, 0, -23400, 0

0, 0, 0, 0, 4500, 0, 220, 0, -477750, 0, -22200, 0

140, 0, 4, 0, 0, 0, 0, 0, -15330, 0, -440, 0

0, 0, 0, 0, 70, 0, 2, 0, -7123, 0, -204, 0

0, 4500, 0, 70, 0, 0, 0, 0, 0, -1684800, 0, -21600

0, 0, 0, 0, 0, 8100, 0, 110, 0, -1544400, 0, -19800

0, 220, 0, 2, 0, 0, 0, 0, 0, -38280, 0, -348

0, 0, 0, 0, 0, 110, 0, 1, 0, -17820, 0, -162

-507000, -477700, -15330, -7123, 0, 0, 0, 0, 734681025, 489787350, 5142050, 6865650

0, 0, 0, 0, -1684800, -1544400, -38280, -17820, 489787300, 366524900, 13693050, 6208650

-23400, -22200, -440, -204, 0, 0, 0, 0, 17142050, 13693050, 234256, 105996

0, 0, 0, 0, -21600, -19800, -348, -162, 6865650, 6208650, 105996, 47961

→ finally, Parametric matrix will be

$$\begin{bmatrix} -507000, & -477750, & -15330, & -7123 \\ -1684800, & -1544400, & -38280, & -17820 \\ -507000, & -1684800, & -23400, & -21600 \end{bmatrix}$$

→ QR factorization: (used online tool to find the values)

$$\begin{bmatrix} +1296075 & -1286187.8 & -213986 \\ -1097816.1 & -1098836. & -182836 \\ -1296075 & -1296075 & -214340 \end{bmatrix}$$

→ Calculate translation matrix.

$$t = k^{-1} \begin{bmatrix} P_{14} \\ P_{24} \\ P_{34} \end{bmatrix}$$

$$K = \begin{bmatrix} 1731140.041349 & 2019863.1402316 & 44987.10506 \\ 0 & -1172315.41259 & -12250.13636 \\ 0 & 0 & -3610.61157 \end{bmatrix}$$

Translation matrix: $k^{-1} \begin{bmatrix} -7123 \\ -17820 \\ -21600 \end{bmatrix}$

→ final extrinsic vector

$$= \begin{bmatrix} -0.11985176 \\ -0.03901874 \\ 6.00790126 \end{bmatrix}$$