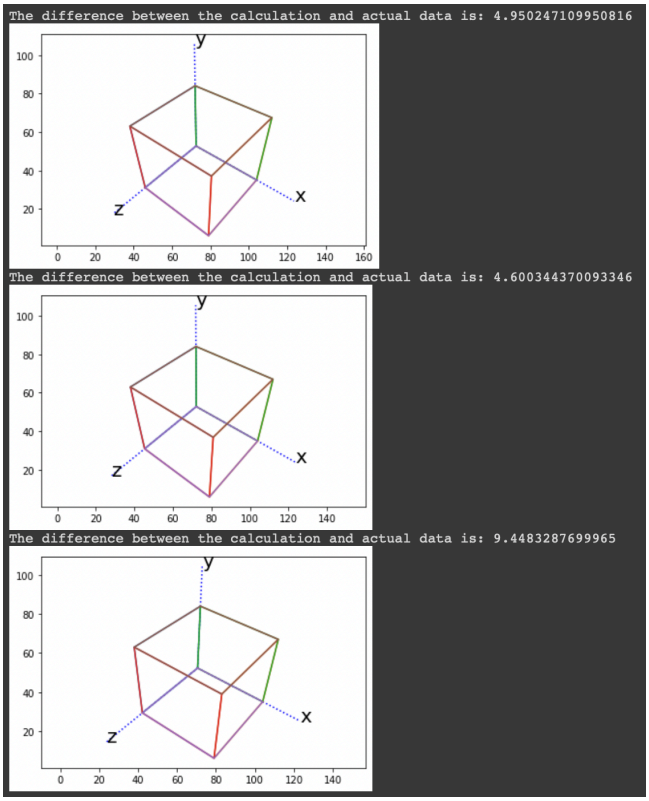
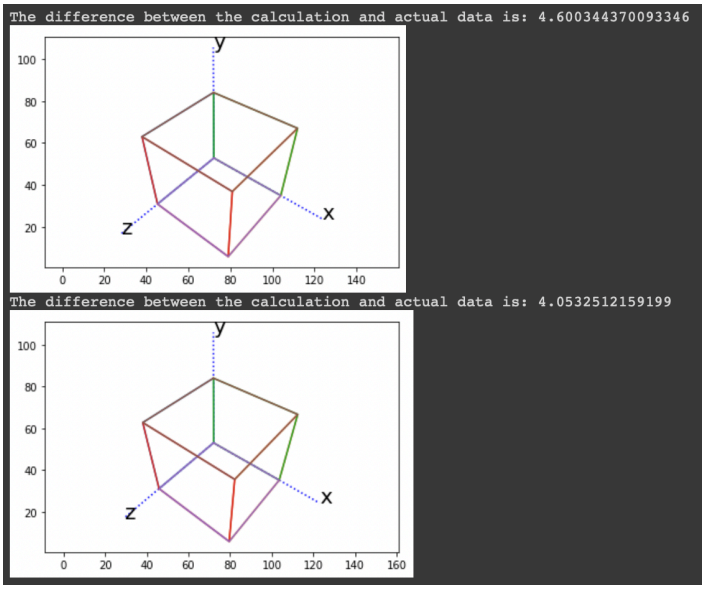
Assignment 2 report 110062120 高小榛

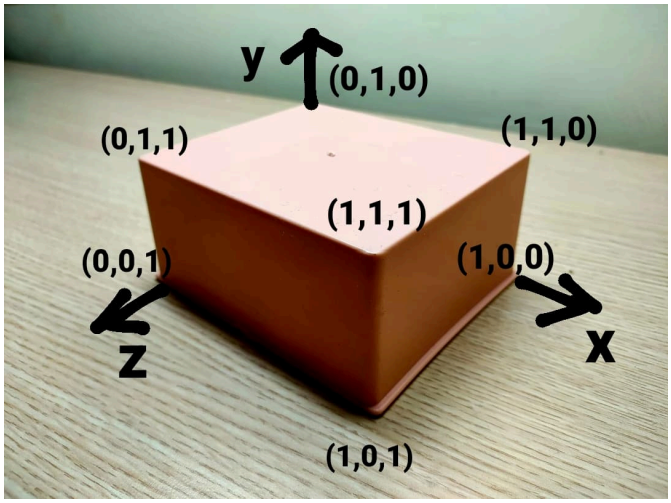
1. In this question, I choose the 1~11 equation for the first cube, and the difference between the calculation and the actual data is 4.95 shown in the screenshot of the result. The second cube is calculate by 2~12 equation, and the difference is 4.60. The third cube is calculate by 3~13 equation, and the difference is 9.45. Therefore, we can find that choosing the 2~12 equation has the less difference between calculation and the actual data, so it give the best result.



2. In this question, I want to compare the best result of question 1 and the result of linear least square method. In the screenshot, we can find that using the method in question 1, we have the difference of 4.6. But by using the linear least square method, we can have the difference 4.05, which is smaller than the method in question1. So it is better to use linear least square method!

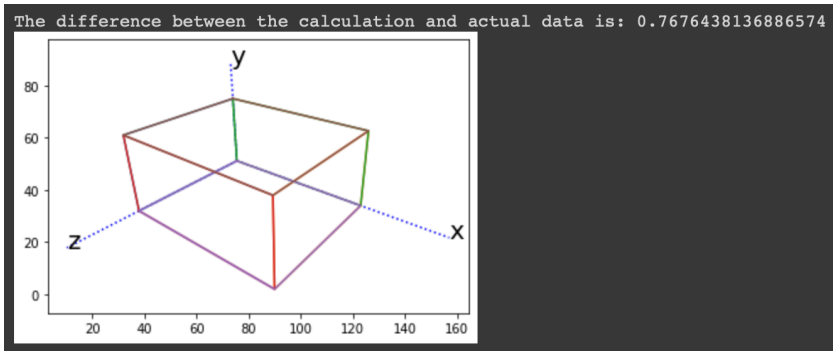


3.



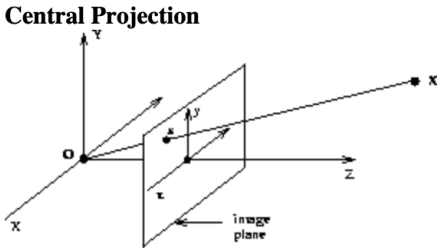
3D	2D
(0,0,1)	(38,68)
(0,1,0)	(74,25)
(0,1,1)	(32,39)
(1,0,0)	(123,66)
(1,0,1)	(90,98)
(1,1,0)	(126,37)
(1,1,1)	(89,62)

In question 3, I use a photo of a rectangular, then calculate by the same algorithm to draw a 3D model. The result of the drawing is in the screenshot.



4.

The idea is to construct a 3D model from a 2D image. And the method we use is “pinhole camera”. This method can make a 3D model to be projection on a 2D plane.



$$\lambda \begin{pmatrix} x \\ y \\ f \end{pmatrix} = \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}$$

$$\frac{x}{f} = \frac{X}{Z} \qquad \frac{y}{f} = \frac{Y}{Z}$$

The matrix P is to transform the 3D coordinate to the 2D coordinate, and it is a rotation transformation matrix.
So we have two step to finish this algorithm.

$$\begin{bmatrix} x_i \\ y_i \\ 1 \end{bmatrix} = \begin{bmatrix} p_{11} & p_{12} & p_{13} & p_{14} \\ p_{21} & p_{22} & p_{23} & p_{24} \\ p_{31} & p_{32} & p_{33} & p_{34} \end{bmatrix} \begin{bmatrix} X_i \\ Y_i \\ Z_i \\ 1 \end{bmatrix}$$

First, we should compute matrix P. We can use the 3D point X and 2D point x to calculate. The equation is on the right.

$$\mathbf{x} = \mathbf{P} \begin{bmatrix} \mathbf{X} \\ 1 \end{bmatrix} \qquad \mathbf{P} = \mathbf{C}[\mathbf{R}|\ \mathbf{T}]$$

Second, we should decompose P into C,R,T, which [R|T] is to change the 3D coordinate to the 2D coordinate, and C is Intrinsic Parameter Matrix, to adjust the image measurement if it is not normalize.

5.

Reference: https://programmerclick.com/article/3734842479/

In this code, we only need to input the original point and length, height, width, then can get a cube.