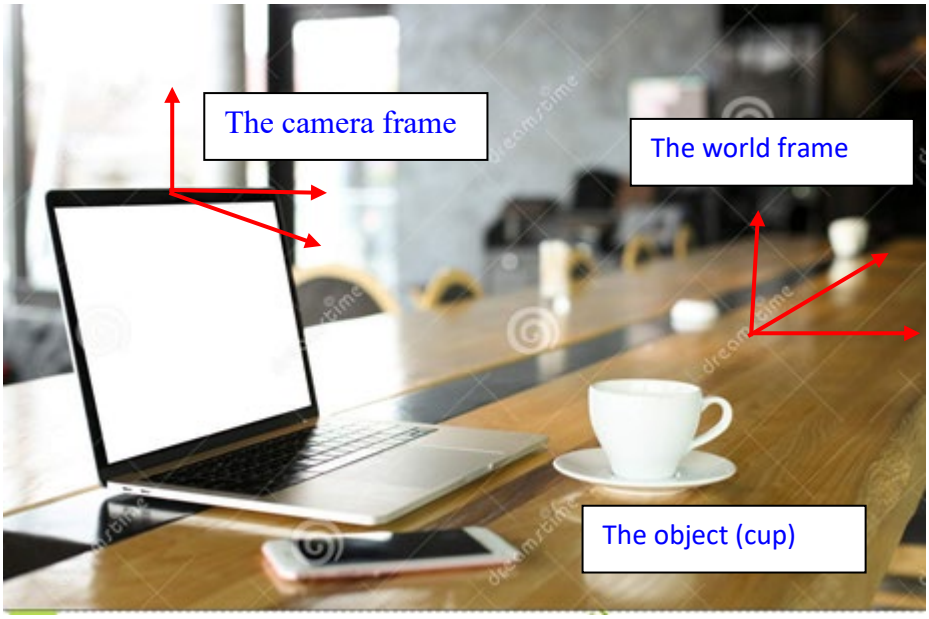
MTRE4490 Machine Learning for Robot Perception

Project #2

Due by 11:59 pm on 02/03/20 (Monday)

In this project, you are required to use the MATLAB camera calibration toolbox to estimate the extrinsic and intrinsic parameters of your laptop camera, and verify these parameters.



1. Download the Power Point slides from D2L, read and understand the camera projection model, its extrinsic and intrinsic parameters.
2. Establish the camera frame and world frame for your laptop, as shown in the above picture. Please note that all coordinate frames here must be a right-hand rule frame.
3. Click the link below to learn how to use the MATLAB calibration toolbox to estimate the camera parameters.
   https://www.mathworks.com/help/vision/ug/single-camera-calibrator-app.html

4. Once you obtain the extrinsic and intrinsic parameters of your laptop camera using the MATLAB calibration toolbox, you need to verify them as follows:
   - In the whole process, don't change your laptop or the camera position/orientation. Otherwise, you need to re-do the calibration.
   - Put an object of interest (for example, a cup) on the table.
   - Develop a Python grab an image of the object from your laptop camera.
   - Manually detect and record the pixel coordinates of the object on the image.

- Manually measure and record the z coordinate of the object with respect to the camera frame.
- In your Python program, then calculate the x and y coordinates of the object with respect to the camera frame based on the camera projection model.
- Calculate the coordinates of the object with respect to the world frame using the homogenous transformation approach.
- Manually measure and record the coordinates of the object with respect to the world frame, and compare the measurement results to the calculation results obtained in the previous step. If your camera calibration is correct, they should match well.
- Move the object to a different location and repeat all procedures.
- You are expected to try 5 different locations of the object, and show the verification results for each location.

5. Prepare a short project report to summarize your discoveries. Upload the report to D2L.
6. Save your Python code as "camera_verification.py", put all group members' names on the first line with a leading string "### ", and upload it to the D2L drop box.

Grading Rubric

20 points: Project report and the Python code submitted correctly.
20 points: Python Code runs without any syntax errors.
20 points: All procedures are described and explained in the report clearly.
20 points: The report has a good format and is well organized.
20 points: The measurement results match the calculation results well in the verification process.