[Fall 2023] ROB-GY 6203 Robot Perception Homework 1

Your name

Submission Deadline (No late submission): NYC Time 11:00 AM, October 04, 2023
Submission URL (must use your NYU account): https://forms.gle/TNrJy7r3smx2t1ed8

1. Please submit the **.pdf** generated by this LaTex file. This .pdf file will be the main document for us to grade your homework. If you wrote any code, please zip all the **code** together and **submit a single .zip file**. Name the code scripts clearly or/and make explicit reference in your written answers. Do NOT submit very large data files along with your code!

2. You don't have to use AprilTag for this homework. You can use OpenCV's Aruco tag if you are more familiar with them.

3. You don't have to physically print out a tag. Put them on some screen like your phone or iPad would work most of the time. Make sure the background of the tag is white. In my experience a tag on a black background is harder to detect.

4. Please typeset your report in LaTex/Overleaf. Learn how to use LaTex/Overleaf before HW deadline, it is easy because we have created this template for you! **Do NOT submit a hand-written report!** If you do, it will be rejected from grading.

5. Do not forget to update the variables "yourName" and "yourNetID".

Contents

Task 1 Sherlock's Message (2pt)

Detective Sherlock left a message for his assistant Dr. Watson while tracking his arch-enemy Professor Moriarty. Could you help Dr. Watson decode this message? The original image itself can be found in the data folder of the overleaf project (https://www.overleaf.com/read/vqxqpvbftyjf), named `for_watson.png`

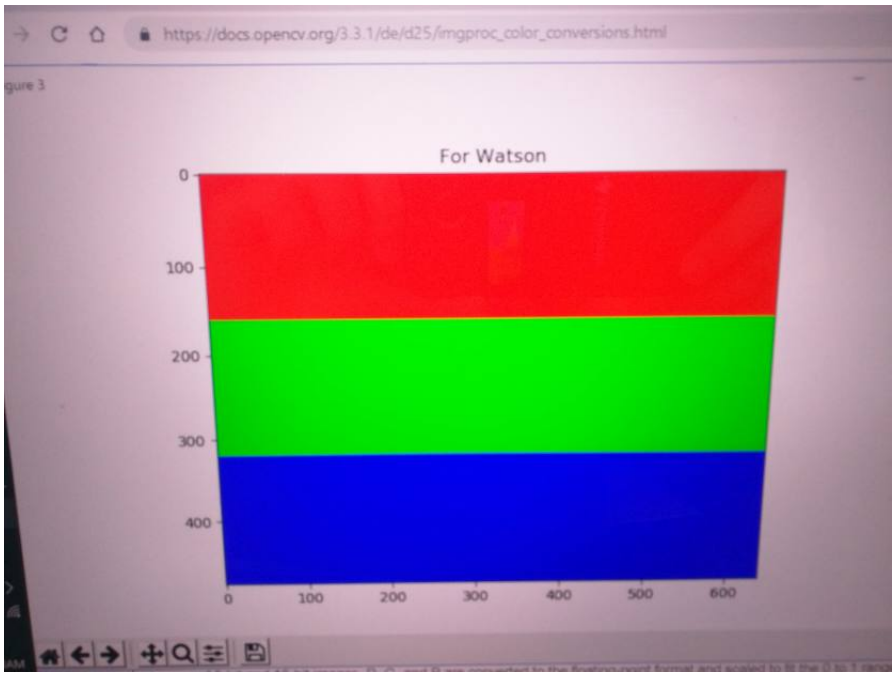


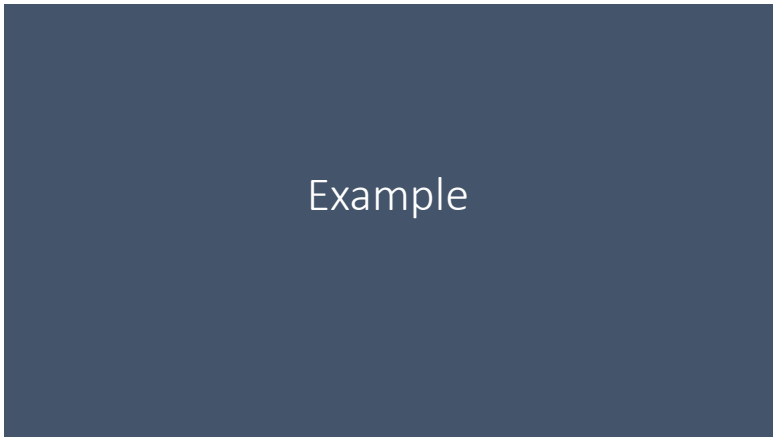
Figure 1: The Secret Message Left by Detective Sherlock

a) (1pt)

Please submit the image(s) after decoding. The image(s) should have the secret message on it(them). Screenshots or images saved by OpenCV is fine.

Answers:

You can use this code snippet to include a picture



b) (1pt)

Please describe what you did with the image with words, and tell us where to find the code you wrote for this question.

Answers:
Type your answer here

Task 2. Low Dimensional Projection (5pt)

Given the Fasion-MNIST dataset, **train** an unsupervised learning neural network that gives you a lower-dimensional representation of the images, after which you could easily use tSNE from `Scikit-Learn` to bring the dimension down to 2. **Visualize** the results of all 10000 images in one single visualization.

Answers:
Type your answer here

Task 3 Camera Calibration (3pt)

Use the pyAprilTag package provided in the class, or other free packages (e.g., OpenCV's camera calibration toolkit) that you may be aware of, to **calibrate** your camera and provide the full K matrix, with the top two distortion parameters k1 and k2.

Answers:
Type your answer here

Task 4 Tag-based Augmented Reality (5pt)

Use the pyAprilTag package to detect an AprilTag in an image (or use OpenCV for an Aruco Tag), for which you should take a photo of a tag. Use the K matrix you obtained above, to draw a 3D cube of the same size of the tag on the image, as if this virtual cube really is on top of the tag. **Document** the methods you use, and **show** your AR results from at least two different perspectives.

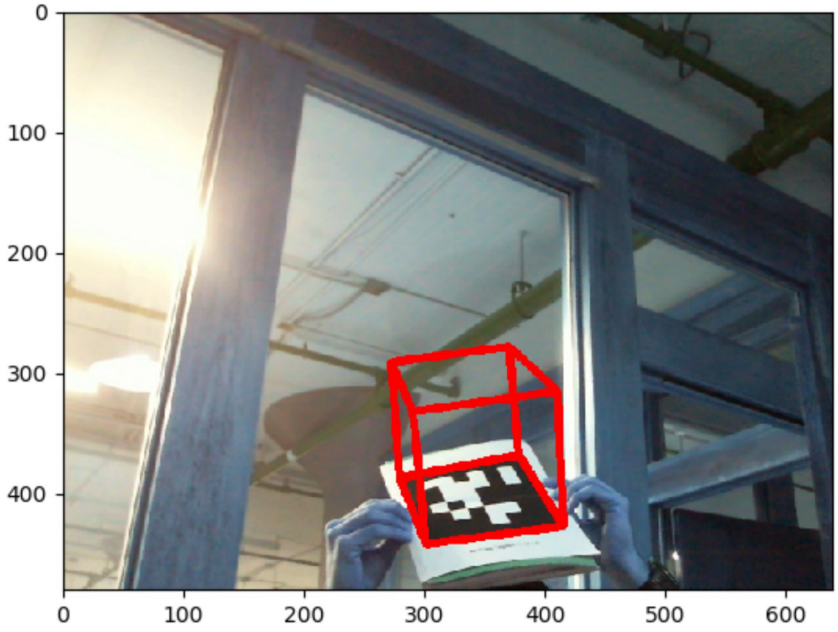


Figure 2: Caption

Tips: There are many ways to do this, but you may find OpenCV's `projectPoints`, `drawContours`, `addWeighted` and `line` methods useful. You don't have to use all these methods.

Answers:
Type your answer here