Assignment #3
Interest Point Detectors

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In this assignment, you will compare different interest point detectors (e.g. Harris, SIFT, SURF) with respect to a measure called 'Repeatibility'. This metric indicates that feature detection should be independent of imaging conditions such as illumination conditions,JPEG compression, homography transformation, etc.

Repeatibility is defined as:

$$r_i(\epsilon) = \frac{|R_i(\epsilon)|}{min(n_i, n_j)}$$

where $R_i(\epsilon)$ denotes a set of point pairs $(\tilde{x_i}, \tilde{x_j})$ laying in an $\epsilon - neigbourhood$:

$$R_i(\epsilon) = \{(\tilde{x_i}, \tilde{x_j}) | dist(\tilde{x_i}, \tilde{x_j}) < \epsilon\}$$

More information on repeatability can be found here:
`https://cs.gmu.edu/~zduric/cs774/Papers/Schmid-Evaluation-IJCV.pdf`

1 Harris Corner Detector

First, implement your own Harris corner detector from scratch.
See the following for further details `http://www.cse.psu.edu/~rtc12/CSE486/lecture06.pdf`
Create a function which would take image as input and give you interest point coordinates as output: myHarrisCornerDetector (Image)

Figure 1: Keypoints detected by Harris Detector

2 Data

You are given a set of images to work on in the following link:
`https://www.dropbox.com/s/jo5i7rok7j5nuyd/Images.zip?dl=0`

You will do the following pre-processing on the kuzey.jpg image:

- **Produce images of different JPEG qualities:**
  JPEG image compression has a quality parameter which ranges between 0 and 100. Generate 6 versions of kuzey.JPG with different qualities. Make sure that you have generated at least one terrible looking image. You can use any tool you find handy for this like Photoshop or use a Python imaging library.
- Generate 6 versions of kuzey.JPG with different levels of Gaussian noise

For the graffiti image set, the homography between the first image and other images are given in the files named H1toNp where N is the image number.

3 Measuring Repeatibility

Implement a function that measures repeatability which was defined above. Your functions signature should be:
measureRepeatability(keyPoints1, keyPoints2, homography1to2, image2size)
which returns the repeatibility rate which takes values between 0 and 1.

Measure the repeatibility of the following keypoint detectors using all three sets of images described above:

- Your Harris Corner Detector
- SIFT detector
- SURF detector

Plot your results, where x axis is the image pairs (1-2, 1-3 ... 1-6) and y-axis is the repeatability rate.

IMPORTANT NOTE: For the SIFT/SURF detectors, you can use OpenCV's functions which come in the contrib modules of this library (they are not included in OpenCV's main modules unfortunately.) Therefore, you need to install the opencv-contrib-python repo which contains all OpenCV functionality. I recommend you do this installation in a virtual environment with pip as shown below:
pip install opencv-contrib-python==3.4.2.16
Check here for more information: `https://www.scivision.co/install-opencv-python-windows/`

4 Deliverables

- Project report (pdf): Describe your methodology. Comment on your results. Dont forget the plots. Also include samples of detected interest points on images.
- Source code files (python)
- Image sets you have generated (don't email the files if can't upload to moodle. upload to dropbox etc. and send the link)

Warning! Submit all files as one zip file. Please send files in correct format. Do not submit .doc files, submit .pdf or .tex for your reports. Use zip or rar for packaging.

Warning! ALL work submitted must be your own. Any instance of plagiarism will result in a negative grade.

The following will be rewarded bonus points:

- Measuring the repeatibility of keypoint detectors under different imaging conditions
- Clean code
- Report written in LaTeX. (Do not forget to include .tex to your submission.)