Assignment 2
CAP 6419 - 3D Computer Vision

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Part 1. For this question you can take your own test images and work with them.
You are required to write a small Matlab code to perform

1. Affine rectification of an imaged planar surface
2. Metric rectification of an imaged planar surface

Submit your matlab code and results on the test images together with a report in a word document explaining how your program works (i.e. the steps involved). What were the problems that you noticed, if any?

For your convenience, I have also provided some test images and a short Matlab code for fitting a conic to a set of 5 or more points based on the method discussed in the class (page 31 of your textbook).

Grading: 10% data collection (camera pictures, or online images), 20% coding for affine rectification, 20% coding for metric rectification, 30% thorough testing on several images for both rectifications, 20% report. Your report must contain the procedures, input test images, output images after rectification, and your conclusions and reflections on the problem and the results.

Suggestion for taking test images: You may want to take a picture of the main lobby of the student union, with the encircled Pegasus in the middle that can be used for metric rectification. Make sure you can identify parallel lines and/or cross-ratios in your pictures. Also make sure that the pictures have enough projective distortion (i.e. taken at an angle).

Reminder : The intersection of a line $\mathbf{l}$ and a conic $\mathbf{C}$ can be determined as follows: let $\mathbf{m}_1$ and $\mathbf{m}_2$ be two points on the line $\mathbf{l}$, then any arbitrary point $\mathbf{m}$ on the line can be specified parametrically by $\mathbf{m} = \mathbf{m}_1 + \lambda\mathbf{m}_2$. Point $\mathbf{m}$ is on the intersection of the line with the conic $\mathbf{C}$, iff

$$\mathbf{m}^T\mathbf{C}\mathbf{m} = (\mathbf{m}_1 + \lambda\mathbf{m}_2)^T\,\mathbf{C}(\mathbf{m}_1 + \lambda\mathbf{m}_2) = 0.$$

This yields the following quadratic equation in terms of λ

$$\lambda^2\,\mathbf{m}_2{}^T\mathbf{C}\mathbf{m}_2 + 2\lambda\,\mathbf{m}_2{}^T\mathbf{C}\mathbf{m}_1 + \mathbf{m}_1{}^T\mathbf{C}\,\mathbf{m}_1 = 0$$

from which we get the two values λ_1 and λ_2 , and hence the two intersection points $\mathbf{m}_1 + \lambda_1\mathbf{m}_2$ and $\mathbf{m}_1 + \lambda_2\mathbf{m}_2$. Note that in general a line intersects a conic at two points, which may be distinct or not and real or complex.