Vision and Perception

First Part of the course on Multiview Geometry

(10 May deadline, 1 pt more for those who do all the exercises)

last name	first name	MATRICOLA

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List of exercises, to be delivered by the 8th of May

1. Compute the degenerate conic, null space and the cross product of two non parallel lines (1 pts)
2. Define a conic with 5 points (1 pts)
3. Removing projective distortion applying DLT algorithm (3 pts)
4. Show the preservation of Geometric Properties after Affine transformation (parallelism and area ratios) (2 pts)
5. Show the preservation of Geometric Properties after applying Homography $\ell^\top \mathbf{x}, \mathbf{x}^\top C\mathbf{x}, \ell = C\mathbf{x}$ (3 pts)
6. Find singular vector matrices U and V of the given matrix A using eigen decomposition of $A^\top A$ and finally computing U. (1 pts)
7. Given a quadric equation, find the projective transformation H and define the type of quadric (2 pts)
8. Given the homogeneous coordinate system, define the pairs of point equations for direction and pair of plane equations for coordinate planes (2 pts)
9. Define the equation of a conic resulting from the intersection of a plane with a quadric in $\mathbb{P}3$ (2 pts)
10. Prove that the definition of $cos(\theta)$ with the absolute conic is valid in any projective coordinate frame. (3 pts)
11. Show that if an Euclidean rotation is applied to the plane at infinity, there are other planes that are fixed by this transformation (2 pts)
12. Given an example of camera P factor it into K, R, t and find the camera centre. (2 pts)
13. Calibration: (3 pts)
    - Implement the example *a simple calibration device*. (2 pts)
    - Take an image, for example like the one I add, and compute 3 pairs of vanishing points. (1 pts)
14. Compute the DLT algorithm for the matrix P using an external calibration object, return P and compare the calibration part (obviously after decomposition into K, R, t) with what you obtain with the absolute conic. Note that to make this comparison you should take an image of three squares not on the same plane, with the same camera you have used for calibration. (3pts)