# Computer Vision 1 (Total 90 points) ~ 120min

## Part 1. Explain concepts (4 general questions)

1. What's the main idea of non-maximum suppression?
    a.
    b. Non-maximum suppression is often used along with edge detection algorithms. The image is scanned along the image gradient direction, and if pixels are not part of the local maxima they are set to zero. This has the effect of suppressing all image information that is not part of local maxima...
2. Why use a lens instead of a pinhole?
    a. Depth of field control
    b. Zooming capabilities
    c. Sharper images
    d. More light
3. What is the use of  Reduction in Object Recognition? (or something like that)
    a. Data reduction, increasing efficiency of algorithms, variation of data still persist in lower dimensions

## Part 2. Image formation

1. 2 characteristics of camera impact Field of View
    a. Focal length
    b. Sensor size
2. Given distance from object to lens l1 2.5 cm, distance between lens and image plane is 1 cm, focal length is 0.5cm. Is the point in focus? -> apply Thin Lens Formula
    a. 1.4 is unequal 2, so object is not in focus
3. Moiré effect: basically explain what it is and how to prevent it
    a. Generating new patterns that are not there in real world by discrete sampling
    b. Possible solution: blurring before sampling
4. Bayer grid and draw it on a sensor
5.

## Part 3. Filter

1. Given a matrix ⅛*[[1,0,-1],[1,0,-1],[1,0,-1]], what's this filter name and explain 2 operations of it. <- Pretty sure that was the sobel filter instead of the differences
2. Name a pyramid, and why we use it
    a. Gaussian pyramid: motivation is to improve search algorithms
    b. Laplacian pyramid: can be used for sharpening

3. Name a non-linear filter and explain what can it be used for?
    a. Median Filter: smoothing (especially useful for binary images to get rid of grain)
4. Given a matrix, apply 2 padding methods on the matrix.
   e.g.

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | 1 | 3 | | |
| | | 2 | 4 | | |
| | | | | | |
| | | | | | |

# Part 4. PCA

1. Draw a 2 dimensional dataset where PCA doesn't work
2. Which formula PCA optimises? And given a dataset X, how PCA represents it.
3. List 2 advantages of using low-dimensional data
4. Assuming the mean of data is subtracted, how to compute PCA via SVD?

# Part 5. Interest points

1. How to make harris detector more generalised? - (3d harris for mri images)
2. What's the pros and cons of Harris detector?
3. How to determine if two interest points are in different matches?
4. How does the Harris detector work?
5.

# Part 6. Single/two view geometry

1. [Something about why we should use conditioning and how.]
2. How does RANSAC work?

# Part 7. Stereo

1. Why do we use image rectification?
2. How many correspondences does the essential matrix need? Explain

3. How are the fundamental matrix and the essential matrix related? (+what do you still need to go e.g. from fundamental to essentia matrices)
4.

## Part 8. Motion

1. What's the difference between a motion field and an optical flow field?
2. How to solve aperture problem [under some condition] ?

## Part 9. BoW model

1. Explain how Bayers theorem is applied for BoW representation in classification task
2. What's pros and cons of colour histogram?

## Part 10 Deep learning

1. Assuming you are designing a 5 layers neural network. Which 2 layers would you like to stack to the top of the network (first two layers), 2 fully-connected layers or 2 convolutional layers? Why?
2. Draw the network (2 input, 3 hidden 1 output) and give a formula for hidden layers(h1,h2,h3) and y for the forward pass using the weights w11, w12,..., v1, v2, v3, the activation function is sigmoid (4points)
3. Define machine learning and classification/regression. <- i think this was task 9 (but the question is valid)
4. Briefly explain deep learning. What's advantages of using DL compared to traditional computer vision methods? + 2 Applications of DL for CV