Theory part

Specifications: This inquiries' list contains all the questions for the midterm. They are categorized according to sections of what was covered during this first part of the course.

A) Computer vision and image processing foundations

For this section: choose 6 questions randomly, and answer them thoroughly with examples.

1. Why do we use an RGB-based color system for image processing?

2. Explain the difference between digital and continuous image representations.
3. Why do we include a pre-processing stage for CV-based systems?
4. Explain how our visual system works.
5. Why do we require to enhance an image?

Depending on its use it is good to improve an image, if it is only visual we improve the image, if we use it for CNN in many cases it is better to reduce the resolution of the image to learn better and even the CNN does it autonomously decreasing the resolution of the image

6. Explain what advantages we have when dealing with gray images.

When we are working with a grayscale image we have the advantage of working with just one color channel it's better for calculations and for processing time also it points out the edges and corners of the objects so when you try to detect something in grayscale it's even easier.

7. Why do we want to create binary images?

It is necessary to create binary images when processing them with morphological operations such as erosion, dilation, opening and closing as a result of these morphological operations we can reduce the noise of the Amash the negative side of the Amish but also they posted site.

8. Explain why we require appropriate spatial and temporal sampling when acquiring images.
9. Why don't printers use 30000 DPI?

Because the maximum is 2400 DPI and these have mostly photographic use andblobs are laser colored. In addition, if possible, it would take a long time since the printing would need to be done carefully.

10. Why would you use 32 bits of color depth?

I would use a 32 bit because it can create more convincing gradients, shadows, and transparencies. It has an alpha channel it supports 4294967296 color combination but therefore more memory is required as well if we want to analyze an image of bigger quality.

11. Explain why we don't use 1-bit color-depth images.

we don't use 1-bit color-depth images because they can only have two values 1 or 0. If we are talking about pixels it would be black or white and we wouldn't have the option to analyze the image correctly, because of the data loss, especially if the image was colorful.

12. In uniform quantization, why do we have 256 levels when using 8 bits?

B) Image filtering and processing

For this section: choose 10 questions randomly, and answer them thoroughly with examples.

1. Why would you require to filter an image in the frequency domain?

2. Explain the reason for filtering images.
When you implement the high pass filter the email shows white spaces between the edges in the images. However when we implement a low pass filter when we want to reduce the image frequency and blur the image.
3. Explain the difference between linear and non-linear filters.
The difference between a linear and a non-linear filter, is that the linear filter is the one that can be done with a convolution, which is only the linear sum of values in a sliding window, while a non-linear filter is the one that cannot be done. with convolution of Fourier multiplication.
4. Why does the simple action of sampling an image introduce frequency effects?
5. Explain the intuition behind low and high spatial frequency.
6. Why do we use the FFT algorithm?
FFT(Fast Fourier Transform) is a digital variation of the DFT(Discrete Fourier Transform) algorithm. However, this FFT algorithm it's much faster than the FDA so it is useful because it does not require so much processing time we get images into the frequency domain.
7. Explain the differences between the Median, bilateral, and Gaussian filters.
The main difference between these three types of filters is the application because you can apply. For example, a medium filter to a different kind of noise from a gaussian filter. Additionally, the gaussian filter works better in images with gaussian noise. Also, the kernel is different and the way the algorithm is modified is different, in each case. As a result, every algorithm reduces different kinds of noises and has different results.
8. Explain the intuition behind the Sobel Operator.
It is the reading of a high gradient within the shot of a 3x3 matrix and then this transforms it into white pixels and the others are left in black denoting an image with borders. Where it uses two arrays known as masks that help smooth the image and remove noise.
9. Explain how the Canny Edge detector work.
Canny Edge detection is an algorithm which tries to detect edges on an image. First, the image must be converted into a grayscale image so it's easier to work and process. Then. it is necessary to apply a low pass filter in order to reduce some noise on the image. After that, a high pass filter is applied so the edges of the image are highlighted. Finally, the algorithm applies a binary threshold in order to detect the edges and separate them from the rest of the image in a two-bit space.
10. Why would you rather use the Canny Edge Detector instead of Sobel filters?
Canny edge detection works better than sobel filters because sobel filters are algorithms based on kernels which can be applied on the x-axis or y-axis. However, Canny edge detection works in both directions at the same time because it uses low and high pass filters additionally to a binary threshold. Even if you apply sober filters in both directions it won't be the same result as Canny edge Detection, due to the data loss generated.
11. Why would you rather use HSV instead of RGB?

HSV is better for object detection the HSV color space abstracts color (hue) by separating it from saturation and what so-called illumination. This is practical for several applications and it is also useful for contours detection.

12. Explain the reasons for using different color spaces, e.g. HSV.

13. Explain under what conditions the Hough Transform for Lines method can fail.

The hough transform for lines method can fail if you apply a hough transform in images that have multicolored lines. A human being is able to detect multicolor lines because of past experience that improve the ability of detecting multicolor lines. However a hough transform method bases its detection on frequency. In this case, as the frequency changes so much between colors, the algorithm is not able to recognize lines in that situation. As a result, probable a solution would be apply machine learning so the algorithm could base its detection on colorful lines.

14. Why do we require to improve the Generalized Hough transform method?

15. Explain what goal is a pursuit through the application of morphological transformations.

16. Explain how morphological transformations are related to the creation of binary masks.

17. Explain the expected issues of color-based segmentation.

18. Explain what would be the use of high-frequency pass filters.

The high pass filters are really useful when you're trying to find it just on an image. This is why high pass filters are present in canny edge detection just before binary threshold.

C) Visual Information Compression and Analysis

For this section: answer all questions thoroughly with examples.

1. Why are lower dimension images related to fast processing times?

First processing times are related with lower dimension images because lower dimension images require less processing because the operations required for that amount of data are less. As an example when you apply kernels to an image it's easier and faster to apply to an image 600x400 than 1920x1080.

2. Explain the encoder-decoder-called colorful they couple mechanism for compression.

When we compress an image. It is necessary to follow some steps to encode. The three steps are, mapper, quantizer and symbol code. The mapper reduces the spatial or temporal reduced redundancies by grouping similar pixels. After that, we have the Quantizer which reduces the precision of mappers output, this means, reducing the decimal values. Finally, the symbol coder generates variable codes for quantifiers output, as a result, we have an encode format image which is lighter than order image format. If you want the computer to show up the image you have to decode the compressed format so you have to follow the encode steps from the end to the beginning.

3. Why is JPEG commonly used?

Because the image has a lower weight and with better quality. That is to say, at the moment of compressing this image it is reduced to half and still has a good visual resolution.

4. Explain how JPEG can be used to compress without losses.

5. Why do lossless compression techniques not achieve higher compression rates than lossy compression techniques?
6. Explain the low-pass effect that JPEG produces when aiming at very high compression rates.
When you implement a very high compression rate on an image with a low pass effect you can lose a lot of information. In some cases, the image could lose almost all the information,, and even the image could seem to be black.
7. Explain the main differences between JPEG and JPEG2000.
8. Why is compression so important for transmission?
Transporting smaller images is much easier than large ones. This also serves at the time of training images facilitates data transfer
9. Explain the role of features when recognizing objects.
When we are implementing an algorithm for recognizing objects we have to take into consideration three types of features. First, we have the edges which are lines, circles, and complex shapes. Then, we have the corners which are intersections between the edges and this feature is the most important because it gives us more relevant information from the processed image. Finally, we have to consider the blobs which are the least important,, and when we are talking about blobs, we are referring to the textures of the image.
10. Why do we require to use PCA for feature extraction?
PCA is an algorithm that is based on feature extraction and orthogonal projections for data transformation. This algorithm tries to preserve most of the data and it's really useful because when you are applying PCA, you canize the data and work wir and faster.
11. Why can PCA be used as an image denoising algorithm?

12. Explain how PCA is related to the dimensionality reduction task.

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2) Why is JPEG commonly used?

Because the image has a lower weight and with better quality. That is to say, at the moment of compressing this image it is reduced to half and still has a good visual resolution.

3) Explain how is morphological transformations related to the creation of binary masks.

4) Explain under what situations the Automatic Contrast through Histogram Equalization algorithm may fail.

5) Why would you rather use instance segmentation instead of semantic segmentation?

7) Why are there so many variations of Wavelet Transformations?

8) Why do we use the FFT algorithm?

FFT(Fast Fourier Transform) is a digital variation of the DFT(Discrete Fourier Transform) algorithm. However, this FFT algorithm it's much faster than the FDA so it is useful because it does not require so much processing time to get images into the frequency domain.

9) Why PCA can be used as an image denoising algorithm?

10) Why are gradients sensitive to high frequency noise?

11) Why are efficient algorithms related to real-time Computer Vision systems?

12) Explain how do the 4:3, 16:9 aspect relationships work.

13) Why do we use an RGB based color system for image processing?

14) Explain the relationship of STFT with the Uncertainty Principle.

15) Why Wavelets are considered as an improvement over Fourier transformations?

16) Why do we require to improve Otsu's method?

17) Why does the real-time workflow of Computer Vision systems require to consider hardware accelerators?

18) Why do we include a pre-processing stage for CV based systems?

19) Explain how is Cloud Computing related to the real-time workflow of Computer Vision systems?

21) Why can we consider that WebP outperforms JPEG?

22) Explain how we can identify the degradation process.

23) Why should we avoid artifacts?

24) Explain the low-pass effect that JPEG produces when aiming at very high compression rates.

When you implement a very high compression rate on an image with a low pass effect you can lose a lot of information. In some cases, the image could lose almost all the information,, and even the image could seem to be black.

25) Why does the simple action of sampling an image introduce frequency effects?

26) Why do we require to consider adaptivity when designing real-time CV systems?

28) In uniform quantization, why do we have 256 levels when using 8 bits?

29) Explain how does the Canny Edge detector work.

30) Explain the intuition behind low and high spatial frequency.

31) Explain the implications of having a Quantum Efficiency metric equal to 100%.

32) Explain the link between statistical independence and good quality features.

33) Why would you use 32 bits of color-depth?

34) Why would you require to use pseudocolors?

35) Explain what would be the difference between a PCs covariance matrix and the original image matrix covariance?

36) Why is compression so important for transmission?

Transporting smaller images is much easier than large ones. This also serves at the time of training images facilitates data transfer

37) Why do we require to use PCA for feature extraction?

PCA is an algorithm that is based on feature extraction and orthogonal projections for data transformation. This algorithm tries to preserve most of the data and it's really useful because when you are applying PCA, you canize the data and work wir and faster.

38) Explain the reason for filtering images.

When you implement the high pass filter the email shows white spaces between the edges in the images. However when we implement a low pass filter when we want to reduce the image frequency and blur the image.

39) Why do we include zero padding to preserve shapes while using convolution?