

Mid-term

Started: Oct 26 at 4:30pm

Quiz Instructions

Welcome to the mid-term.

A few notes:

- Please read each question and its accompanying choices carefully before selecting your answer.
- Each question has only one correct answer. Choose the most appropriate answer based on your understanding.
- This is an open-book examination. You are allowed to refer to your textbooks, notes, and any other material.
- While you can refer to materials, remember to rely on your own understanding to answer the questions rather than searching for every answer.
- Pay attention to the clock. It's easy to lose track of time when referring to notes or textbooks. Aim to answer each question within the time frame you allocate for yourself.
- Even though this is an open-book exam, all answers should be based on **your own** understanding and interpretation of the materials. While I'm not going to attempt to stop you from communicating with other students, my advice is that you should only trust your own thinking and understanding rather than copying someone else's work.

Good luck!

Question 1

1 pts

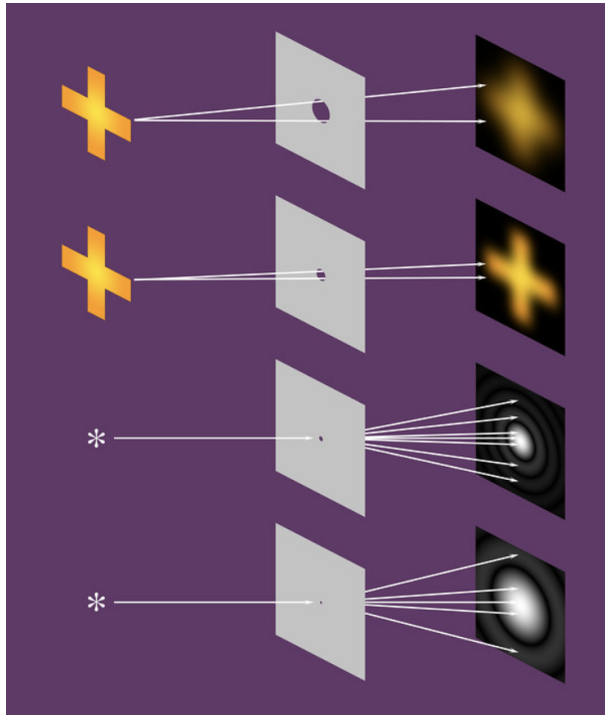
What is one of the primary functions of lenses in image formation?

- ☒ Lenses are used to bend light as it passes through them, aiding in focusing light.
- ☐ Lenses primarily increase the exposure time of the image.
- ☐ Lenses are used to modify the color space of the image.
- ☐ Lenses prevent diffraction in very small pinholes.

Question 2

1 pts

What happens when the pinhole size is very small?



- ☒ It causes diffraction and results in blur.
- ☐ It allows light in multiple paths, resulting in a clearer image.
- ☐ It decreases the exposure time significantly.
- ☐ It eliminates the need for a lens.

Question 3

1 pts

Which of the following best describes the purpose of the pinhole camera model in computer vision?

- ☒ To provide a simplified mathematical model for understanding perspective projection.
- ☐ To simulate the effect of varying focal lengths in digital photography.
- ☐ To analyze the color properties in digital images.
- ☐ To enhance the resolution of images captured by digital cameras.

Question 4**1 pts**

What does the process of sampling in image processing typically involve?

- ☒ Converting analog signals into a digital format by measuring light intensity at various points
- ☐ Enhancing the resolution of images through software algorithms
- ☐ Changing the color space of images to improve their visual appeal
- ☐ Compressing images to reduce their file size

Question 5**1 pts**

What is the primary role of point operators in image processing?

- ☒ To transform the pixels of an image based on their original values independently.
- ☐ To analyze and modify the frequency components of an image.
- ☐ To combine multiple images into a single composite image.
- ☐ To adjust the focal length and aperture of the camera lens post-capture.

Question 6**1 pts**

Filtering in image processing is primarily used for which of the following purposes?



*

-1/9	-1/9	-1/9
-1/9	2 - 1/9	-1/9
-1/9	-1/9	-1/9

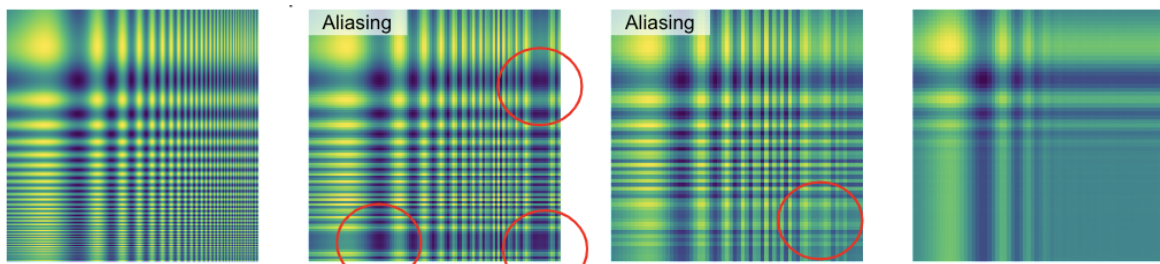
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- ☒ To selectively enhance or suppress certain aspects of the image.
- ☐ To change the format of the image file.
- ☐ To encrypt images for secure transmission.
- ☐ To increase the physical size of the image.

Question 7**1 pts**

How can aliasing, which occurs due to insufficient sampling in image processing, be effectively reduced or overcome?



- ☒ By increasing the sampling rate, often accompanied by anti-aliasing techniques like band limiting.
- ☐ By compressing the image file to reduce its size.
- ☐ By converting the image to a different color space.
- ☐ By applying a high-pass filter to the image.

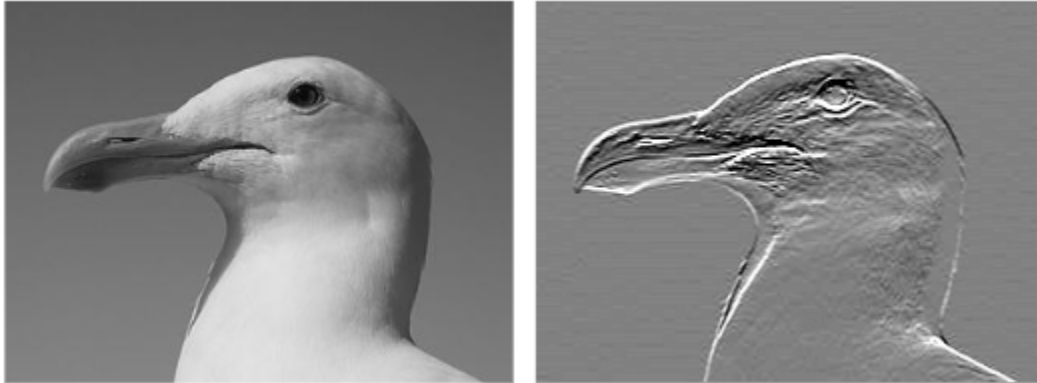
Question 8**1 pts**

In the context of image processing, what is the primary purpose of using the Fourier Transform?

- ☒ To analyze and modify the frequency components of an image.
- ☐ To compress images into smaller file sizes while maintaining quality.
- ☐ To convert images from color to grayscale.
- ☐ To increase the brightness and contrast of the image.

Question 9**1 pts**

Here's an image and a result of filtering it:



What filter was used?

- ☒ Edge finding 1st-order filter (e.g. Sobel) in the Y axis
- ☐ Edge finding 1st-order filter (e.g. Sobel) in the X axis
- ☐ Sharpening filter
- ☐ Edge finding 2nd-order filter (e.g. Laplace)

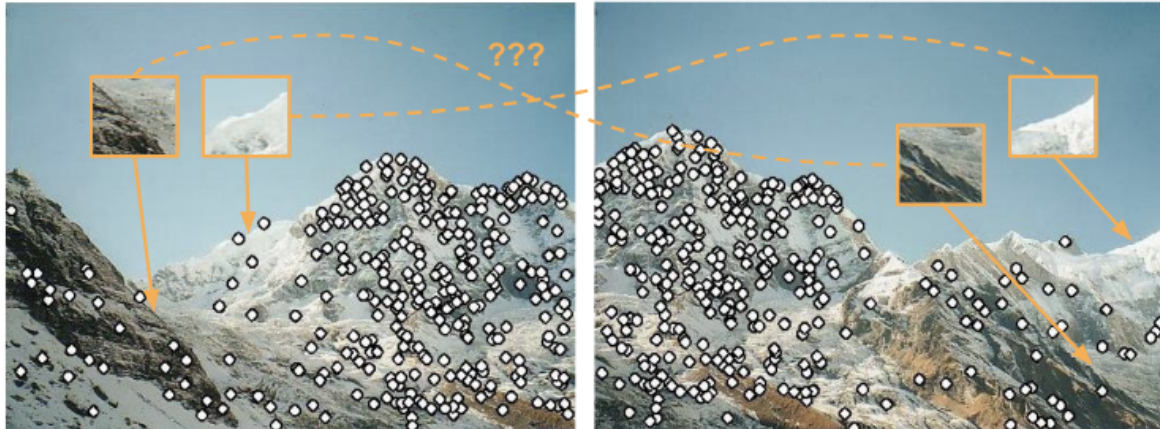
Question 10**1 pts**

Why are interest points important for tasks like matching similar views in different images?

- ☒ They act as distinctive, repeatable features that help in identifying corresponding points across images.
- ☐ They provide a reference for adjusting the color balance between images.
- ☐ They are used exclusively for determining the depth in stereo images.
- ☐ They are only relevant in manual image stitching processes.

Question 11**1 pts**

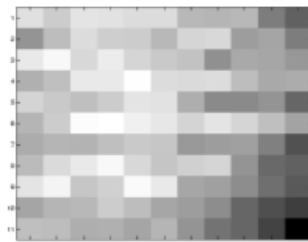
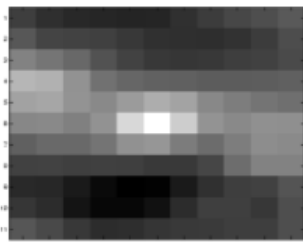
What is a key goal in panorama stitching when identifying interest points in overlapping images?



- ☒ To make sure that the interest points are distinctive and can be matched across images.
- ☐ To change the intensity levels of the interest points for better visibility.
- ☐ To focus solely on the corners of the images for stitching.
- ☐ To ensure that we get as many interest points as possible.

Question 12**1 pts**

Here are three (A, B, C left-to-right) difference-window scans around points in an image:



Which of these correlate to a corner in the image?

- ☒ Only patch A
- ☐ Patches A and B

- ☐ Only patch C
- ☐ Patches A and C

Question 13**1 pts**

What is the main challenge when using simple pixel patches as feature descriptors in image processing?

- ☒ They are not invariant to changes in scale, rotation, and intensity.
- ☐ They require too much computational power to process.
- ☐ They are only effective in grayscale images and not in color images.
- ☐ They tend to increase the file size of the image significantly.

Question 14**1 pts**

What is a naive method for finding the optimal matching of features between two sets in image alignment?

- ☒ Pick the nearest neighbor (NN) and set a threshold on distance.
- ☐ Use a machine learning algorithm to analyze feature sets.
- ☐ Match features based on their color intensity.
- ☐ Align features based on their relative positions in the images.

Question 15**1 pts**

What is a common approach to handle ambiguity during feature matching?

- ☒ Use the Distance-Ratio to discard all ambiguous features.
- ☐ Increase the brightness and contrast of images to reduce ambiguity.
- ☐ Convert the images to grayscale to simplify the matching process.
- ☐ Apply a high-pass filter to enhance the features.

Question 16

1 pts

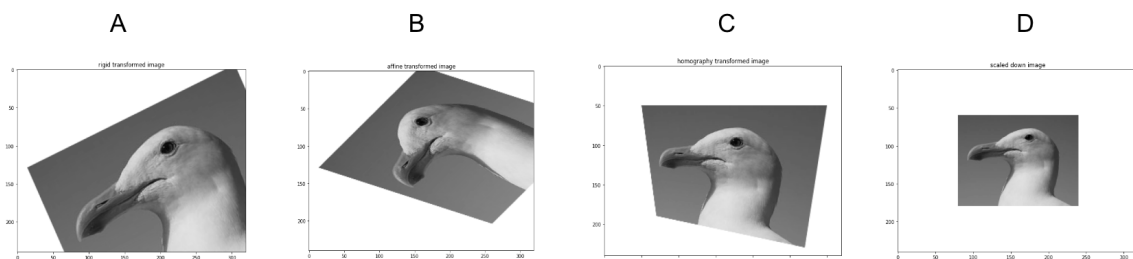
What is one of the main challenges in achieving accurate image alignment?

- ☒ Handling the ambiguity in feature matching due to local features appearing similar across different positions in the target image.
- ☐ Determining the optimal file format for storing aligned images.
- ☐ Converting high-resolution images into lower resolutions for faster processing.
- ☐ Ensuring all feature points are always matched completely with points in the other image.

Question 17

1 pts

Here are 4 transformations of an image:



Name the transformations:

- ☒ A rotation, B affine, C homography, D scale
- ☐ A skew, B homography, C perspective, D scale
- ☐ A translation, B homography, C rigid, D scale
- ☐ A rotation, B rigid, C homography, D rotation

Question 18**1 pts**

What is the primary purpose of using a robust least squares (LLSQ) method?

- ☒ To estimate transformation parameters while mitigating the influence of outliers.
- ☐ To match features between images.
- ☐ To efficiently calculate the difference between images.
- ☐ To apply non-linear methods inside the linear least squares solution.

Question 19**1 pts**

In this panorama stitching



What is one major assumption we make that may be limiting?

- ☒ We assume the scene exists on a plane and we can use homographies as a transformation model. However this fails to create 360 panoramas.
- ☐ We assume the transform model is purely translational, which is easy to calculate, but it introduces strong warping of the image and ambiguity around the poles.
- ☐ We assume the transform model is affine, which is easy to calculate, but it can't model perspective and thus creates inferior stitching.
- ☐ We assume the transform model is spherical, which we can calculate with spherical coordinates, but it fails when there is too much parallax and occlusion.

Question 20

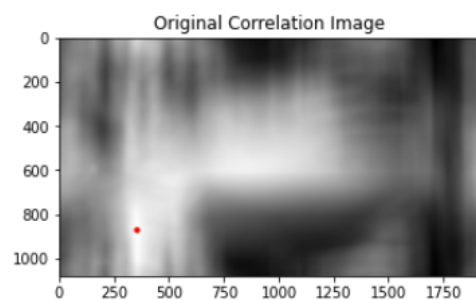
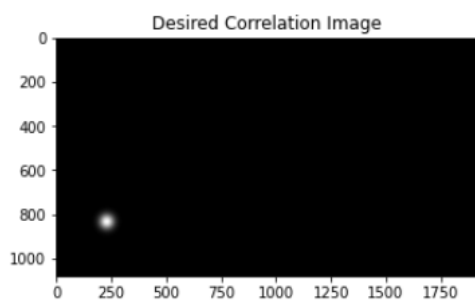
1 pts

What is one way in which Fourier Transform can assist in Template Matching?

- ☒ According to the Convolution Theorem we can use simple and fast multiplication in the frequency domain to calculate e.g. correlation.
- ☐ We can match faster in the FT frequency images.
- ☐ The FT frequency domain is more robust to image noise.
- ☐ We can use the Convolution Theorem to calculate the structural similarity between images even in face of warping like rotation.

Question 21

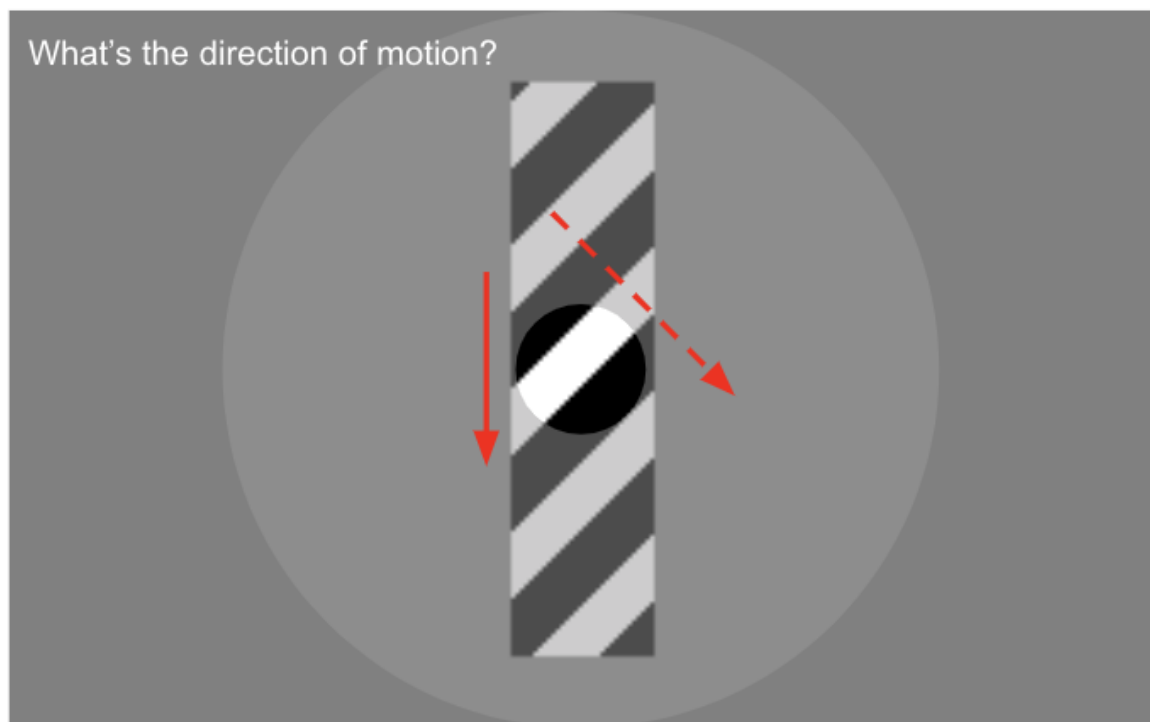
1 pts



Given that our correlation image is $G = F \odot H$ a convolution of the patch with the image.

How might we reconstruct the "perfect patch" given a desired G' and the frame F ?

- ☒ Divide G' by F in the frequency (FT) domain
- ☐ Multiply G' by F in the frequency (FT) domain
- ☐ Threshold G' / F and pick the patch with highest score
- ☐ Divide F by G in the spatial domain and then take the FT of the result

Question 22**1 pts**

What does the barbershop pole illusion tell us about tracking?

- ☒ We can't measure motion parallel to an edge through a pinhole
- ☐ We can't perceive motion at all through a pinhole
- ☐ We can estimate motion through a pinhole only if the pinhole is square
- ☐ We can only measure motion if it's axis aligned (X or Y)

Question 23**1 pts**

Who is one famous contemporary American singer that we have seen in class and what's the connection to our work?



Taylor series.



Rihannian manifolds.

☐

The Knowles-Shur matrix factorizaion.

☐

Eilish-Graham decomposition.

No new data to save. Last checked at 4:45pm

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