mini-Quiz 1

Question 1

Consider a grayscale digital image with 300 rows and 630 columns, where each pixel can take values from 0 up to 1023.

How many bits are required to store such a digitized image?

Answer:

1,890,000 ✓

Question 2

Which of the following statements are **TRUE?**
(you can select more than one, if necessary)

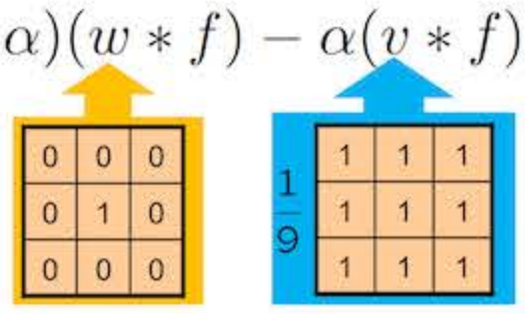
- ✓ ☑ Lines are not good features to track
- ✓ ☐ Kd-Tree performs half of the operations compared to a greedy search.
- ✓ ☐ The SIFT feature descriptor has 64 values
- ✓ ☐ Harris corner detector cannot estimate the orientation of a feature
- ✓ ☑ SIFT features are invariant in scale differences

Question 3

DTU

Sharpening

$$
\begin{aligned}
f_{sharp} &= f + \alpha(f - f_{blur}) \\
&= (1+\alpha)f - \alpha f_{blur} \\
&= (1+\alpha)(w * f) - \alpha(v * f)
\end{aligned}
$$



$$= ((1+\alpha)w - \alpha v) * f$$

DTU Electrical Engineering

We have seen in our lectures that we can implement a sharpening linear filter by a single convolution with an appropriate kernel, as shown in the attached graphic.
Assume that a=0.9 to calculate the sharpening filter kernel.

Which of the following tables is the sharpening kernel in this case:

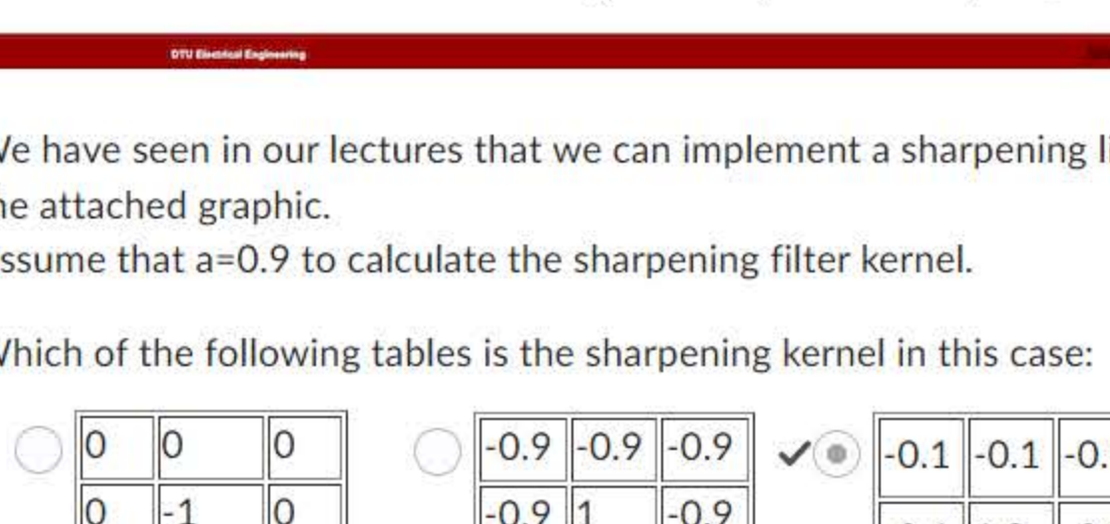
0	0	0
0	-1	0
0	0	0

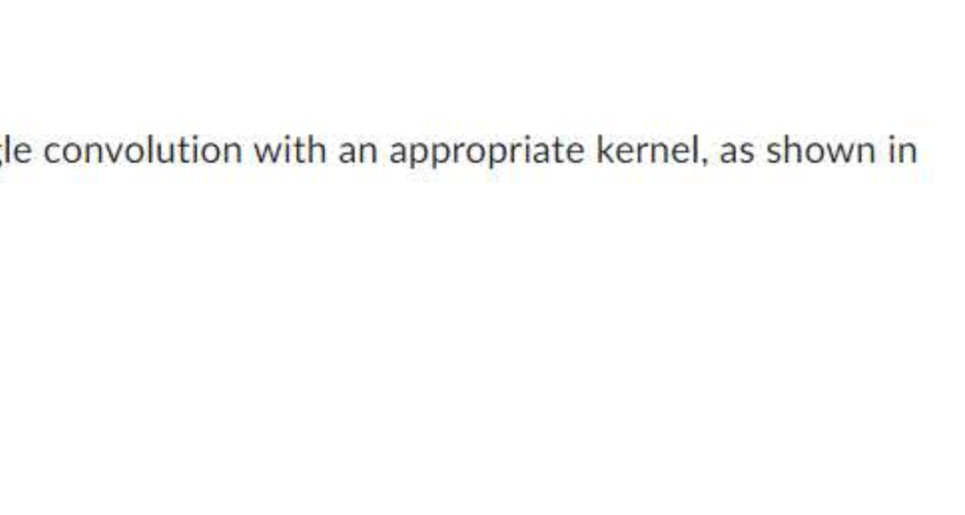
-0.9	-0.9	-0.9
-0.9	1	-0.9
-0.9	-0.9	-0.9

✓

-0.1	-0.1	-0.1
-0.1	1.8	-0.1
-0.1	-0.1	-0.1

Question 4 — 1 / 1 point





In the attached graphic, the left-most image is the original image. To create the middle image, the original was treated with a 9x9 mean filter.

What filter could have been used to produce the right-most image from the original (left-most) image?
(Choose all answers that might apply)

- ✓ ☐ 5x5 median filter
- ✓ ☑ 15x15 mean filter
- ✓ ☐ 9x9 median filter

Question 5 — 1 / 1 point

Which of the following kernels calculates the horizontal gradient?

0	0	0
-1	0	1
0	0	0

0	-1	1
0	-1	1
0	-1	1

-1	0	1
-2	0	2
-1	0	1

✓

0	0	0
0	-1	1
0	0	0

- ◯ None of the above

mini-Quiz 2

Question 1 **1 / 1 point**

What does a low disparity value mean?

- ○ The matching pixels are found far from the same position in both images
- ✓ ● The matching pixels are found near the same position in both images
- ○ Disparity does not tells us about the position of the pixels, but about how similar they are
- ○ There are no matching pixels between the two images

Question 2 **1 / 1 point**

Camera Projection

Assuming a camera at location [X Y Z] = [0, 0, 0] with a pose defined by the following rotation matrix:

[1, 0, 0]
[0, 1, 0]
[0, 0, 1]

given a camera matrix

[725, 0, 631]
[0, 726, 360]
[0, 0, 1]

At which "x **camera coordinate"** would the following 3D point be depicted:
[X, Y, Z] = [1,1,3]

Answer:

872.6 ✓

Question 3 **1 / 1 point**

Assuming this camera matrix please fill in the correct correspondences:

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}$$

- ✓ __4__ c 4. cx
- ✓ __5__ i 5. 1
- ✓ __3__ e 3. fy
- ✓ __2__ f 2. cy
- ✓ __1__ a 1. fx

Question 4 **1 / 1 point**

Choose all the statements below that are true.

- ✓ ☑ The fundamental matrix projects a 3D point in the right camera frame to a 2D point in the left image frame.
- ✓ ☐ The fundamental matrix projects a 3D point in the right camera frame to a 3D point in the left camera frame.
- ✓ ☑ The essential matrix includes the pose of the cameras with respect to each other.
- ✓ ☑ The fundamental matrix projects a point in the right image frame to a point in the left image.

Question 5 **1 / 1 point**

Consider the following two tables and calculate their dissimilarity using as metric the sum of squared differences.

$$A = \begin{pmatrix} 10 & 15 & 20 \\ 20 & 20 & 25 \\ 10 & 15 & 20 \end{pmatrix} \qquad B = \begin{pmatrix} 15 & 15 & 15 \\ 20 & 20 & 20 \\ 30 & 30 & 30 \end{pmatrix}$$

Answer: 800 ✓

Question 6 **1 / 1 point**

Order the following stereo vision algorithms, according to their typical computational complexity:
(where 1 is LEAST computational demanding, and 3 is MOST computational demanding)

- ✓ __1__ Dense Local Stereo Vision Algorithm
- ✓ __2__ Dense Dynamic Programming-based Stereo Vision Algorithm
- ✓ __3__ Dense Graph Cuts-based Stereo Vision Algorithm

Question 7 **1 / 1 point**

Consider a stereo vision system.
Choose all the statements below that are true.

- ✓ ☐ All epipolar lines meet at the optical center
- ✓ ☐ All epipolar lines are parallel to the optical axis
- ✓ ☑ The epipoles lie on the baseline-containing line
- ✓ ☑ The epipoles can be outside the images
- ✓ ☑ All epipolar lines intersect at the epipoles
- ✓ ☐ The baseline intersects the epipolar plane at the epipoles

mini-Quiz 3

Question 1 — 1 / 1 point

Which of the following algorithms requires as input explicit matches between point pairs from two point clouds BEFORE it starts executing?

- ICP
- FPFH
- Spin Images
- ✓ Kabsch algorithm

Question 2 — 1 / 1 point

Please select the correct among the following statements concerning the Iterative Closest Points (ICP) algorithm:

- ✓ ICP works best if an initial rough estimation of the alignment of 2 point clouds is known.
- ✓ ICP provides a rigid transformation between 2 point clouds
- ✓ ICP provides an affine transformation between 2 point clouds
- ✓ ICP works best if the 2 point clouds are far from each other.
- ✓ ICP is guaranteed to provide the optimal transformation that best aligns 2 point clouds

Question 3 — 1 / 1 point

Which of the following clustering results could have been produced using k-means?
(choose all correct answers)

A:  B:  C:  D:  E: 

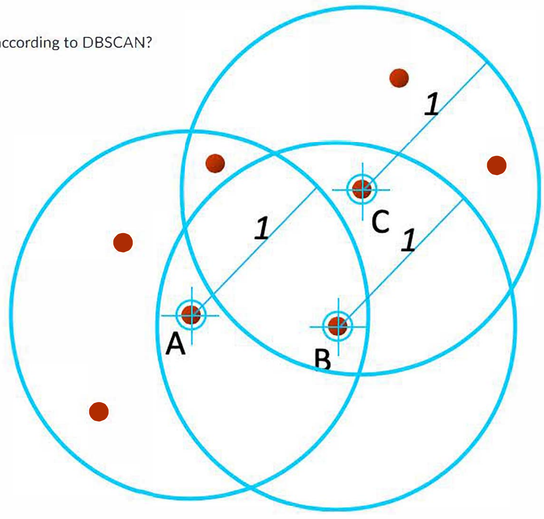
- ✓ A
- ✓ B
- ✓ C
- ✓ D
- ✓ E

Question 4 — 1 / 1 point

Consider the following points.

How would points A, B and C be characterized according to DBSCAN?
(assume ϵ=1 and *MinPts*=4)

- A: noise | B: border | C: noise
- A: core | B: noise | C: core
- A: core | B: border | C: border
- A: noise | B: core | C: noise
- ✓ A: core | B: border | C: core
- A: core | B: core | C: core
- A: border | B: noise | C: border
- A: noise | B: border | C: core



Question 5 — 1 / 1 point

Consider a color image with dimensions 640x480 pixels. We would like to cluster its pixels making full use of both geometric and color information (including intensity/lightness).

How many clusters will the Mean Shift algorithm consider initially?
(provide the exact number below)

Answer: 307200 ✓

Question 6 — 1 / 1 point

Consider a color image with dimensions 640x480 pixels. We would like to cluster its pixels making full use of both geometric and color information (including intensity/lightness).

What would be the dimensionality of the problem in this case?

- ✓ 5
- 4
- 3
- 2

Question 7 — 1 / 1 point

Given the dataset 'clusters.txt' (link) that has been read into the variable X, find how many clusters are optimal for this dataset using the elbow method.

Recall you call Kmeans:

```
km = KMeans(n_clusters = n)
km.fit(X)
```

- 2
- 3
- 4
- ✓ 5
- 6
- 7

Question 8 — 1 / 1 point

Apply Linear Regression to the provided data (link1, link2) to obtain a model of the form $y=ax+b$.
Follow the provided guidelines for the implementation.

What are the values of the parameters "{a}" and "{b}" in that model (APPROXIMATELY)?

- a = 0.23, b = 25.60
- ✓ a = 0.55, b = 19.86
- a = 0.82, b = 19.86
- a = 0.55, b = 12.37
- a = 0.23, b = 12.37
- a = 0.82, b = 25.60

mini-Quiz 4

Question 1 **1 / 1 point**

Which of the statements below are correct for PCA?
(choose all that apply)

- ✓ ☑ PCA relies on the calculation of eigenvectors and eigenvalues
- ✓ ☐ the PCA output describes the significance of each of the original features
- ✓ ☐ PCA dictates how many dimensions need to be retained
- ✓ ☑ PCA in a 5-dimensional space can create exactly 5 new features.
- ✓ ☑ PCA is a dimensionality reduction technique

Question 2 **1 / 1 point**

A SVM draws lines, planes or hyper-planes in the features' space. As a result, it can only treat problems that are linearly separable in the original space.

- ○ True
- ✓ ◉ False

Question 3 **1 / 1 point**

Consider a classification problem where there are 2 classes. Class "A" contains 26 unique instances, while class "B" contains 5 unique instances.

What is a suitable value for "*k*" of a *k*-NN classifier that can correctly classify new instances?

- ○ Any value of *k* equal to, or greater than 5 is suitable.
- ○ *k*=5
- ○ *k*=2
- ○ Any value of *k* between 5 and 26 (including 5 and 26) is suitable.
- ✓ ◉ We don't have enough information to define *k*

Question 4 **1 / 1 point**

Please rate the following approaches to Relative Pose Estimation in terms of expected accuracy.

(1 being best and 3 worst)

✓ __2__ 2	**1**. 3D to 3D
✓ __3__ 1	**2**. 3D to 2D
✓ __1__ 3	**3**. 2D to 2D

Question 5 **1 / 1 point**

Concerning Relative Pose Estimation, please match the problem to the solution

✓ __1__ 3D to 3D Relative Pose Estimation	**1**. ICP
✓ __3__ 2D to 2D Relative Pose Estimation	**2**. PnP
✓ __2__ 3D to 2D Relative Pose Estimation	**3**. Essential Matrix

Question 6 **1 / 1 point**

Assume that you just run a PnP solver with:

- some 3D points in World Coordinates and,
- The same points in the Image Coordinate of your current camera pose.

The result was:
rvec = [-0.05, -1.51, -0.00]
tvec = [87.39, -2.25, -24.89]

Assuming that you perform stereo reconstruction on the camera you get an **interest point P** in location X,Y,Z = [-6.71, 0.23, 21.59] in camera coordinates.

What would be the the location of the **interest point P** in world coordinates?

- ○ 96.75, -1.98, 40.71
- ✓ ◉ 40.71, -1.98, 96.75
- ○ 96.75, 40.71, -1.98
- ○ -1.98, 96.75, 40.71