

Image Processing

Agenda

- Image Processing Quiz
- Components of an image
- Feature Extraction
- Common filters
- Edge Detection

Let's begin the discussion by answering a few questions.

Image Processing Quiz

What are the three major components of an image?

A

Color, Shape, and Background

B

Size, Color Space, and Channels

C

Pixels, Resolution, and Brightness

D

Contrast, Saturation, and Hue

Image Processing Quiz

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Components of an Image

Size

Represents the height and width of an image

Usually measured by number of pixels

Color

Represents the different possible color spaces (GrayScale, RGB, HSV)

The image of the duck on the right is represented in RGB

Channel

Represents the attributes of a color space

RGB has three color channels: Red, Green and Blue



↑
Height
↓

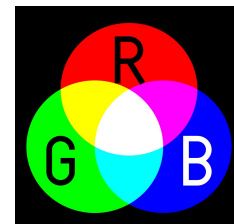
← Width →



Grayscale



RGB



The RGB Color Space

Image Processing Quiz

Why is edge detection important in computer vision?

A

It makes images look more artistic

B

It removes unnecessary parts of an image

C

It helps identify object boundaries and essential structures

D

It increases the brightness of images

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Importance of edges

On the left below, we have a grayscale image of a Ferrari 456 GT, a famous sports car from the nineties.

On the right is another version of the same image, but with purely the edges of the image of the car on the left, and with very little information retained about the background.

Can we still identify the presence of the car despite this loss of information? Yes, we can!
Objects in an image can be identified solely by their edges, without relying on background details.



Image Processing Quiz

Which of the following 3×3 matrices is a vertical edge detection filter?

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

A

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

B

1	0	1
1	0	-1
1	0	-1

C

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

D

Image Processing Quiz

Which of the following 3×3 matrices is a vertical edge detection filter?

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1	0	-1
1	0	-1

B

1	0	1
1	0	-1
1	0	-1

C

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

D

Vertical edge detector



Original image



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

Vertical Edge Detector



Vertical Edge Detector
Output

It has a vertical pattern of pixels (-1s, 0s and 1s) which represent a left-to-right increasing gradient.

Any regions in the input image that have a similar pattern to this would be identified by this filter, and amplified numerically with a higher output value for those regions.

Image Processing Quiz

What made convolution-based feature extraction more effective than SIFT and HOG?

A

It requires no feature engineering and learns from data automatically

B

It manually extracts features faster than SIFT

C

It works only with grayscale images

D

It is the fastest image processing technique available

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Why is Convolution better than SIFT and HOG ?

Convolutional feature detectors are highly trainable and achieve higher accuracy than SIFT and HOG.

They learn low-level features more effectively without the need for hand-coded feature engineering.

Hierarchical convolutions also capture high-level features, e.g., recognizing facial components like eyes, ears, nose, and mouth.

Image Processing Quiz

What is the advantage of using the Laplacian filter over the Sobel and Prewitt filters?

A

It is more robust to noise in images

B

It detects both horizontal and vertical edges with a single kernel

C

It is faster in processing images

D

It is less sensitive to image contrast changes

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Laplacian Filter

A second-order derivative filter that tries to highlight those regions where pixel intensities change abruptly

It only needs one kernel to detect both vertical and horizontal edges, unlike the Prewitt and Sobel Filters, which need a kernel each for the horizontal and vertical directions

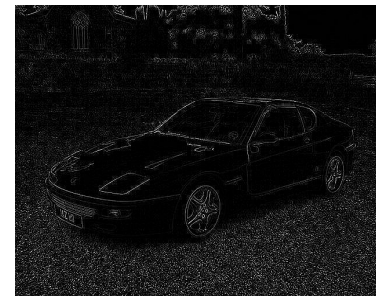


Original image



0	1	0
1	-4	1
0	1	0

Laplacian filter



Laplacian filter output



Power Ahead!

