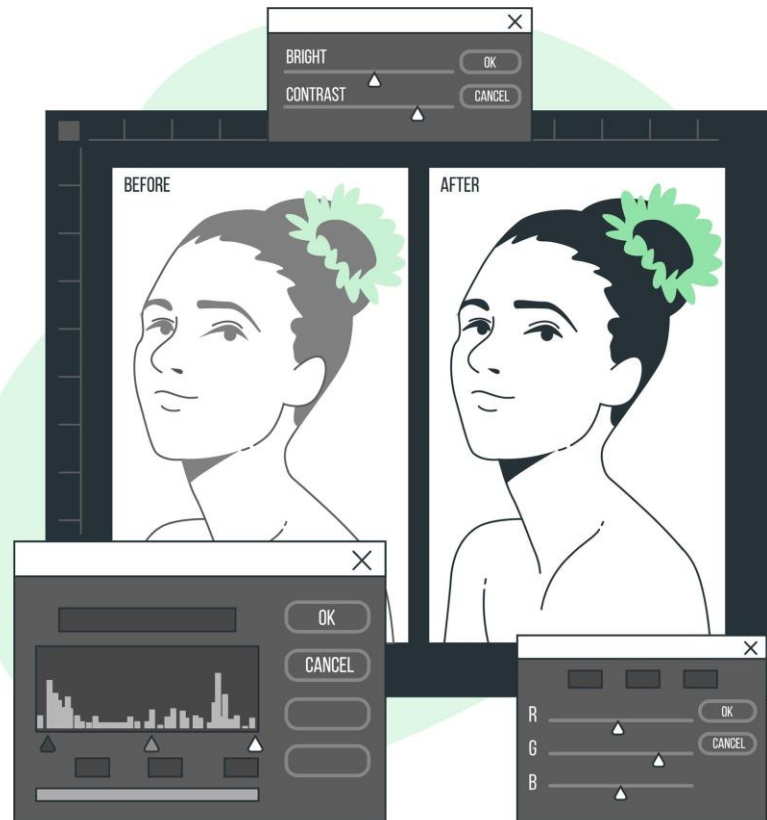


METHODS OF IMAGE MODIFICATION FOR NEURAL NETWORK IMAGE CLASSIFICATION

■
Martina Kuchtová

supervisor: RNDr. Miroslav Opiela, PhD.



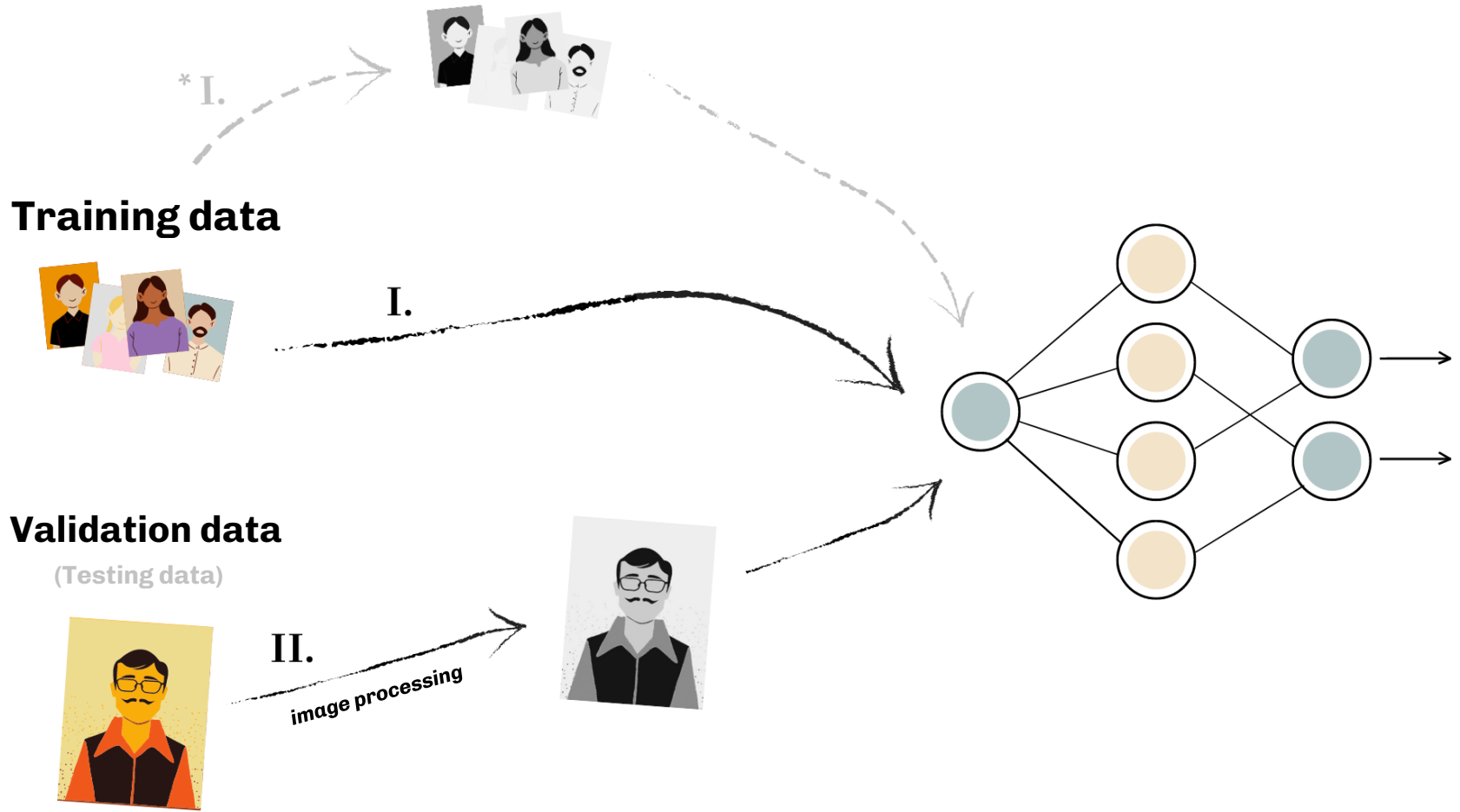
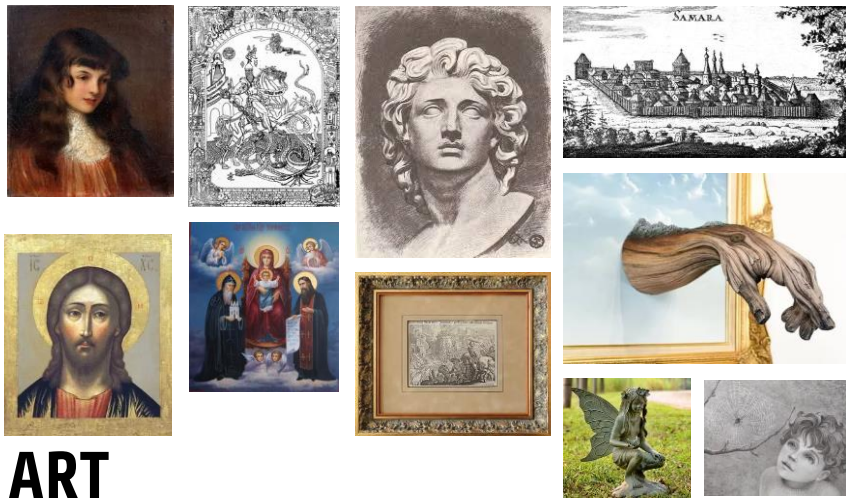


IMAGE DATASETS

Source: <https://www.kaggle.com/datasets/thedownhill/art-images-drawings-painting-sculpture-engraving>,
<https://www.kaggle.com/datasets/abdallahalidev/plantvillage-dataset>



ART

5 classes:

drawing, engraving, iconography, painting, sculpture

Training: 7,000 imgs

Validation: 1,000 imgs



PlantVillage

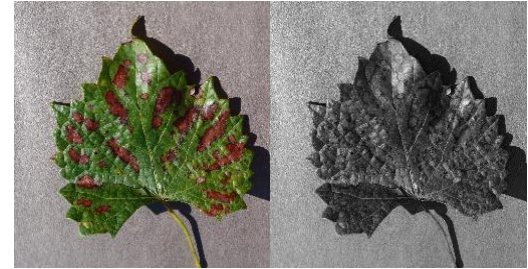
38 classes:

species and diseases

Training: 43,444 imgs

Validation: 10,336 imgs

GRAYSCALE



ART

PlantVillage

original

77.45 %

91.76 %

grayscale

44.47 %

20.80 %

METHODS PERFORMANCE

PlantVillage	
Insect adding	94.01 %
Gaussian blur	93.45 %
Original	91.76 %
Bilateral filter	89.30 %
K-Means (K = 5)	86.84 %
Averaging	76.77 %
Mirroring	59.97 %
Histogram equalization	56.79 %
Background change	26.84 %
Grayscale	20.80 %
Segmented	10.02 %
Background change	8.38 %
Background change	5.65 %

ART	
Scaling-up	77.86 %
Mirroring	77.57 %
Original	77.45 %
K-Means (K = 12)	76.51 %
K-Means (K = 13)	76.16 %
K-Means (K = 9)	75.93 %
Scaling-down	75.58 %
K-Means (K = 15)	75.23 %
Gaussian Blur	75.12 %
Bilateral Filter	75.00 %
Face detection	73.83 %
Brightening	71.14 %
Flipping upside down	70.33 %
K-Means (K = 3)	69.16 %
Darkening	64.25 %
Histogram equalisation	52.80 %
Face detection	51.29 %
Grayscale	44.47 %
Histogram equalisation (grayscale)	42.40 %
Sharpening	40.77 %
Adaptive histogram equalisation	31.77 %
Inverting colours	27.22 %

ART

Scaling-up	77.86 %
Mirroring	77.57 %
Original	77.45 %

PlantVillage

Insect adding	94.01 %
Gaussian blur	93.45 %
Original	91.76 %

ART

Original	77.45 %
K-Means (K = 12)	76.51 %
K-Means (K = 13)	76.16 %
K-Means (K = 9)	75.93 %
Scaling-down	75.58 %
K-Means (K = 15)	75.23 %
Gaussian Blur	75.12 %
Bilateral Filter	75.00 %
Face detection	73.83 %
Brightening	71.14 %
Flipping upside down	70.33 %

PlantVillage

Original	91.76 %
Bilateral filter	89.30 %
K-Means	86.84 %
Gaussian blur	93.45 %

ART

Original	77.45 %
K-Means (K = 3)	69.16 %
Darkening	64.25 %
Histogram equalisation	52.80 %
Face detection	51.29 %
Grayscale	44.47 %
Histogram equalisation (grayscale)	42.40 %
Sharpening	40.77 %

PlantVillage

Original	91.76 %
Bilateral filter	89.30 %
K-Means	86.84 %
Averaging	76.77 %
Mirroring	59.97 %
Histogram equalization	56.79 %

ART

Original	77.45 %
Adaptive histogram equalisation	31.77 %
Inverting colours	27.22 %

PlantVillage

Original	91.76 %
Background change	26.84 %
Grayscale	20.80 %
Segmented	10.02 %
Background change	8.38 %
Background change	5.65 %

COMPRESSION, GEOMETRIC TRANSFORMATIONS



original



mirroring
vertical axis



flipping
horizontal axis

	ART	PlantVillage
original	77.45%	91.76%
scaled-up	77.86% ↑	-
scaled-down	75.58%	-
mirrored	77.57% ↑	59.97%
flipped (upside-down)	70.33%	-

Original

Histogram equalisation

Grayscaled

Histogram equalisation

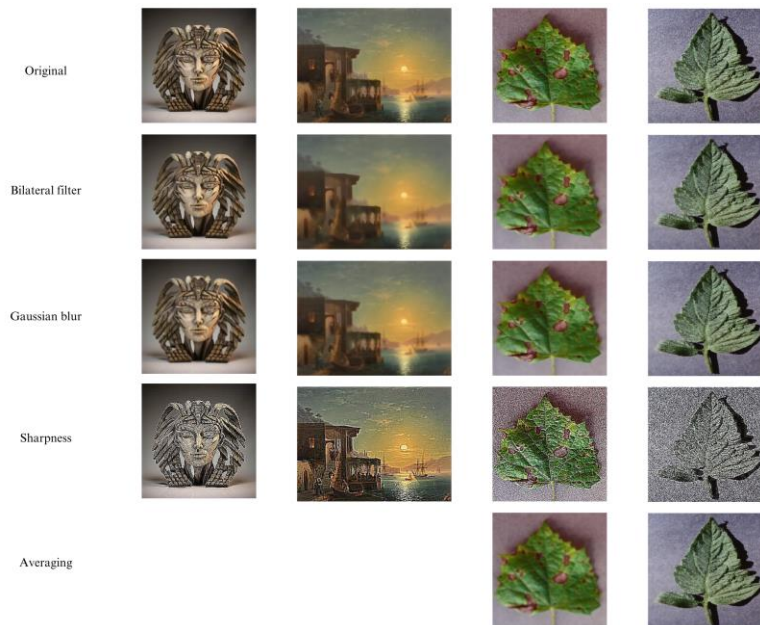
Adaptive histogram
equalisation



HISTOGRAM EQUALISATION

	ART	PlantVillage
original	77.45 %	91.76 %
histogram equalised	52.80 %	56.79 %
grayscale	44.47 %	-
histogram equalised	42.40 %	-
adaptive hist. equalised	31.77 %	-

SHARPNESS, BLUR



	ART	PlantVillage
original	77.45 %	91.76 %
Bilateral filter	75.00 %	89.30 %
Gaussian blur	75.15 %	93.45 % ↑
Averaging	-	76.77 %
Sharpness	40.77 %	-

FILTERING

SHARPNESS



	ART	PlantVillage
original	77.45%	91.76%
Bilateral filter	75.00%	89.30%
Gaussian blur	75.15%	93.45% ↑
Averaging	-	76.77%
Sharpness	40.77%	-



original

colour-based

HSV-based

Graph-cut



original
segmented

SEGMENTATION, BACKGROUND REPLACEMENT

	PlantVillage
original	91.76 %
segmented	10.02 %
bg: hand over grass	8.38 %
bg: hand over gray	26.84 %
bg: dark green leaves	5.65 %



original

colour-based

HSV-based

Graph-cut



original segmented

Graph-cut

SEGMENTATION, BACKGROUND REPLACEMENT

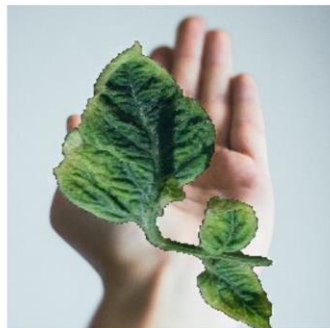
	PlantVillage
original	91.76 %
segmented	10.02 %
bg: hand over grass	8.38 %
bg: hand over gray	26.84 %
bg: dark green leaves	5.65 %

SEGMENTATION, BACKGROUND REPLACEMENT



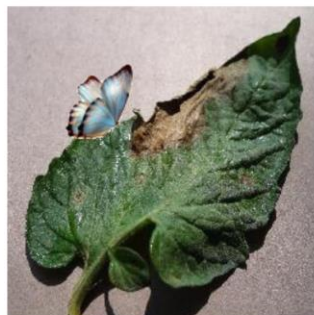
	PlantVillage
original	91.76 %
segmented	10.02 %
bg: hand over grass	8.38 %
bg: hand over gray	26.84 %
Bg: dark green leaves	5.65 %

SEGMENTATION, BACKGROUND REPLACEMENT



	PlantVillage
original	91.76 %
segmented	10.02 %
bg: hand over grass	8.38 %
bg: hand over gray	26.84 %
Bg: dark green leaves	5.65 %

IMAGE OVERLAY



	PlantVillage
original	91.76 %
insect added	94.01 % ↑
hand added	85.28 %

Actual: Pepper_bell__healthy,
Predicted: Corn (maize)__Common_rust_
Confidence: 34.349998474121094%



Actual: Tomato__Target_Spot,
Predicted: Corn (maize)__Common_rust_
Confidence: 36.810001373291016%



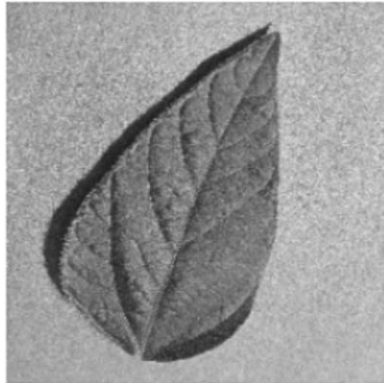
Actual: Tomato__Tomato_Yellow_Leaf_Curl_Virus,
Predicted: Corn (maize)__Common_rust_
Confidence: 20.450000762939453%



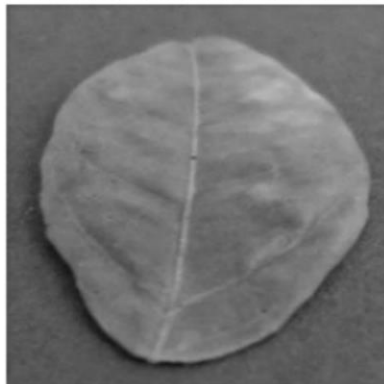
Actual: Potato__Early_blight,
Predicted: Squash__Powdery_mildew.
Confidence: 16.690000534057617%



Actual: Soybean__healthy,
Predicted: Apple__healthy.
Confidence: 10.180000305175781%



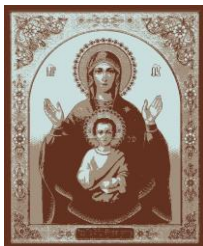
Actual: Orange__Haunglongbing_(Citrus_greening),
Predicted: Corn (maize)__healthy.
Confidence: 9.140000343322754%



K-MEANS



original



K = 3



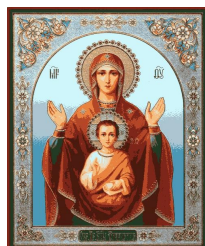
K = 9



K = 12



K = 13



K = 15



original



K = 5

	ART
original	77.45 %
K = 3	69.16 %
K = 9	75.93 %
K = 12	76.51 %
K = 13	76.16 %
K = 15	75.23 %
	PlantVillage
original	91.76 %
K = 5	86.84 %

K-MEANS



original

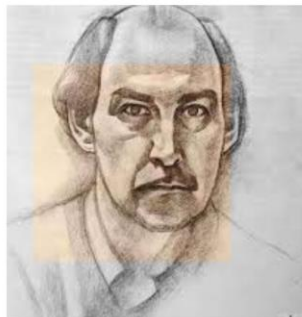
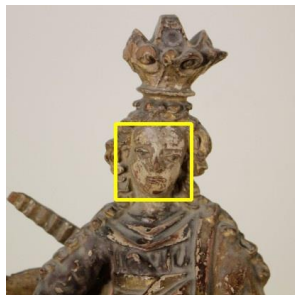
K = 13

K-MEANS



original

K = 5



FACE DETECTION

Haar features
Front + profile view



	ART
Original	77.45 %
Yellow frame	73.83 %
Coloured face	51.29 %

OTHER

Image whitening

Noise addition

Poisson, Salt&Pepper ↑

Gaussian, Quantization

Combining methods



Original



Whitened



Original



Whitened



Original



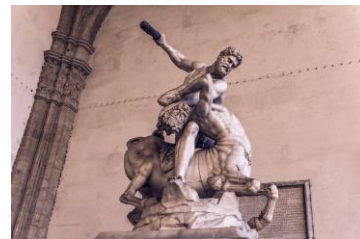
Whitened



Original



Whitened



OTHER

(insufficient)

Hough Transform



Line
detection



Circle
detection



USE CASES

Original



Grayscaled



Colorised



IMAGE COLOURISATION

Caffe model

ART accuracy

original

77.45 %

grayscale

44.47 %

colorized

67.76 %



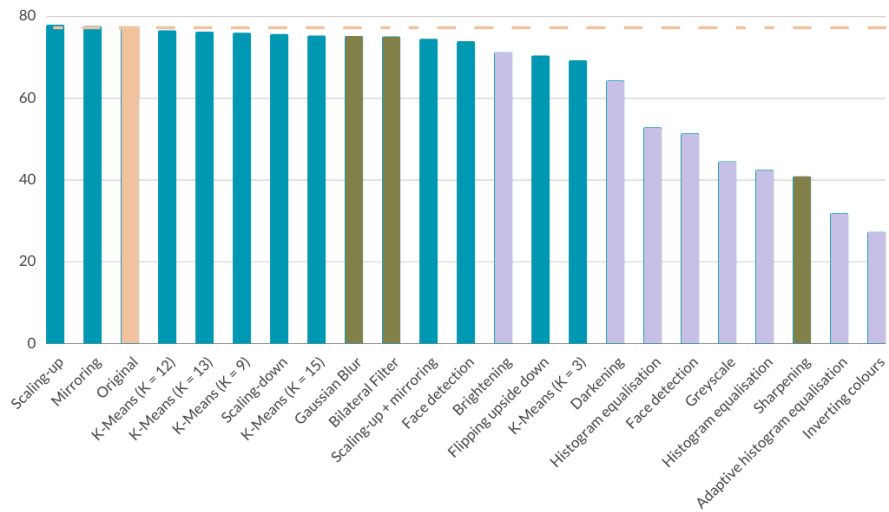
NOISE & DENOISING

Salt&Pepper – Median filter
Poison – Non-local Means

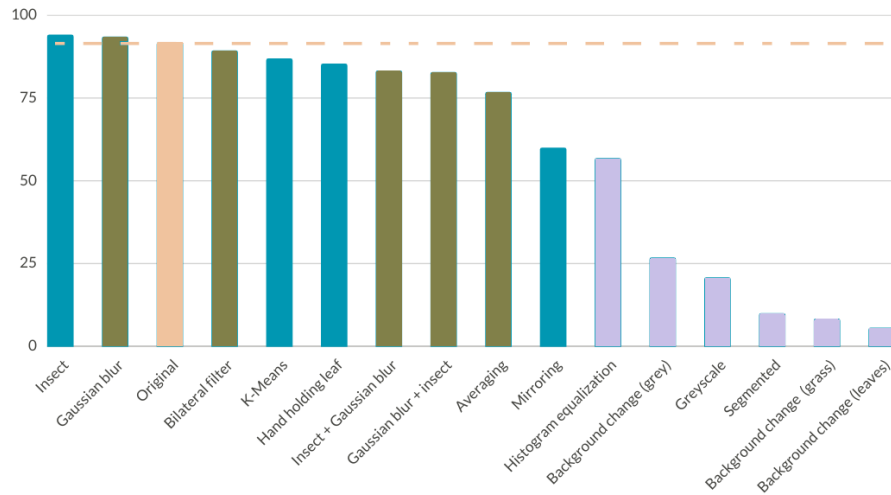


	ART
Original	77.45 %
Salt&Pepper noise	78.27 % ↑
Salt&Pepper denoise	62.01 %
Poisson noise	64.00 %
Poisson denoise	64.23 %

ART



PlantVillage



Filtering

Colour information interfered




NEUTRAL

Brightness adjustment
Filtering – blur
K-Means

NEGATIVE

Grayscale
Sharpness
Histogram equalisation
Operations with colour



CONCLUSION



- unable to find a single method that improves the results for both classification tasks
- some of the methods had no significant effect on classification accuracy
- Hypothesis: *Colour plays an important role in classification tasks utilised.*

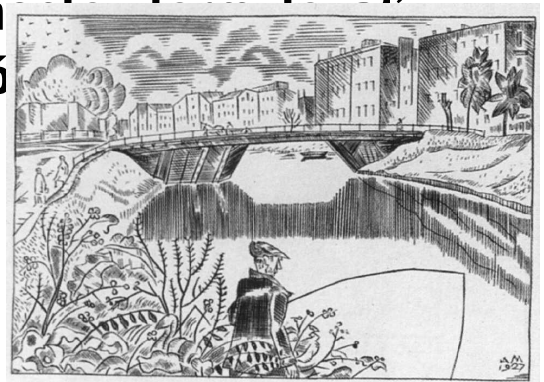
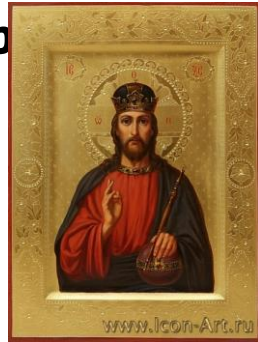
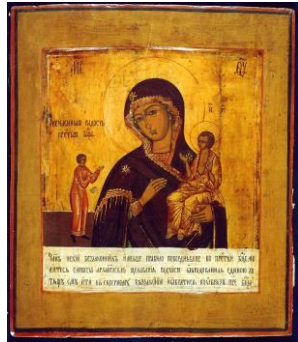
The impact of the methods depends on the dataset and the specific neural network.

Thank you!

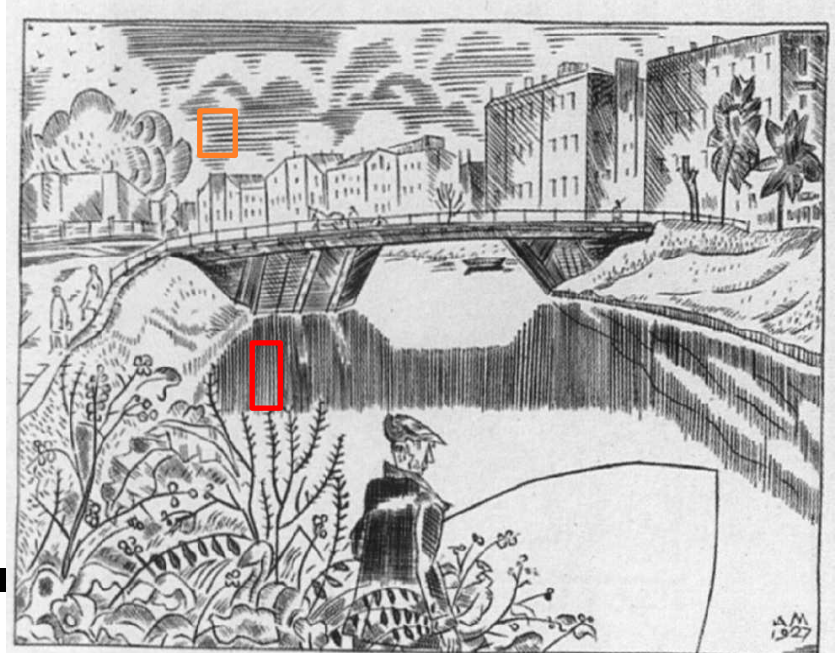
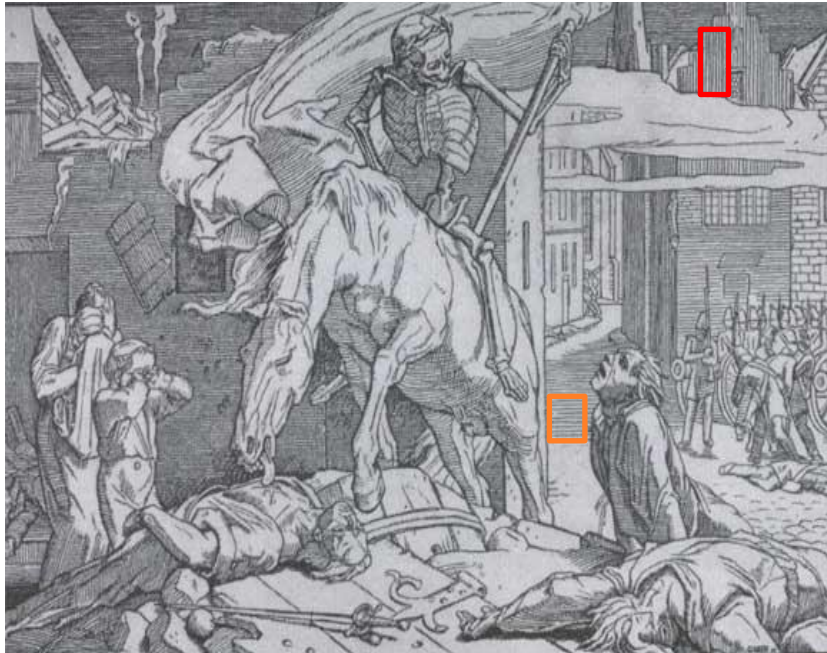
-

QUESTIONS

Je možné na základě rozdílných kompozic „číst“



Je možné na základe realizovaných experimentov formulovať hypotézu, podľa akých kritérií spomínané neurónové siete realizovali klasifikáciu?

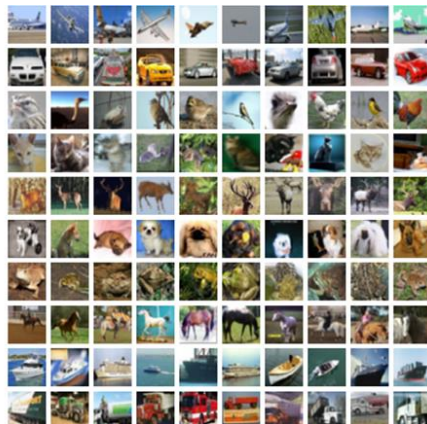


Je možné na základe realizovaných experimentov formulovať hypotézu, podľa akých kritérií spomínané neurónové siete realizovali klasifikáciu?



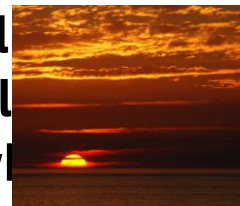
Evaluace
Ak

airplane
automobile
bird
cat
deer
dog
frog
horse
ship
truck



CIFAR-10

Ukážu vám dva
datasety a
připravím
pro vás
rozmanitější výsledky?



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9

íset, mode
 la význam
 primárne

well as other
 number of tasks in the book. The p
 nants behaved when they suddenly found
 declaration of war or because of local political
 the British embassy in the Netherlands w
 ing of 1940 from the pages of the memoirs of
 Berridge carefully map
 (pp 36-39). Berridge also points out s
 gored here (pp 36-39). Berridge also points out s
 ected by international law, but also points out s
 consistency with which such requirements are
 consistency with which such requirements are
 the century, international law paid little attention
 are 'foreign nationals', this began to change
 Berridge's book will therefore be of interest
 acy, but he stops short of mapping

69 Mergers/Divisions Documents with CONFIDENTIAL Classification
 1202012
 2 US Government Documents with SECRET Classification
 13 US Government Documents with TOP SECRET Classification
 7 US Government Documents/Photographs without Classification
 69 US Government Documents/Photographs without Classification
 43 Empty Folders with "CLASSIFIED" Stickers
 28 Empty Folders Labeled "Return to Staff Services/Military Mail
 from Office
 Documents/Photographs without Classification

Professor. He had evidently expected some such call, for I found him dressed in his room. His door was ajar, so that he could hear the opening of the door of our room. He came at once; as he passed into the room, he asked Mina if the others might come, too.

"No," she said quite simply, "it will not be necessary. You can tell them just as well. I must go with you on your journey."

Dr. Van Helsing was as startled as I was. After a moment's pause he asked:—

"But why?"
 "You must take me with you. I am safer with you, and you shall be safer, too."

"But why, dear Madam Mina? You know that your safety is one solemn duty. We go into danger, to which you are, or may be, more liable than any of us—from circumstances—things that have been." He passed, embarrassed.

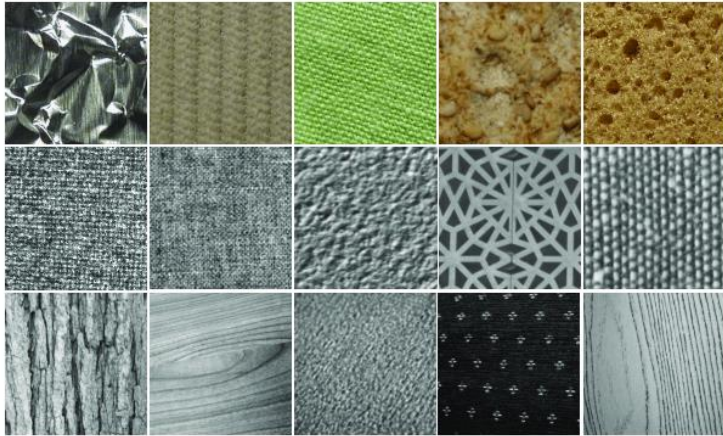
As she replied, she raised her finger and pointed to her forehead:—

"I know. That is why I must go. I can tell you now, whilst the sun is coming up; I may not be able again. I know that when the Count wills me I must go. I know that if he tells me to come in secret, I must come by wile; by any device to hoodwink—even Jonathan." God saw the look that she turned on me as she spoke, and if there be indeed a Recording Angel that look is noted to her everlasting honour. I could only clasp her hand. I could not speak; my emotion was too great for even the relief of tears. She went on:—

"You men are brave and strong. You are strong in your numbers, for you can defy that which would break down the human endurance of one who had to guard alone. Besides, I may be of service, since you can hypnotise me and so learn that which even I myself do not know." Dr. Van Helsing said very gravely:—

"Madam Mina, you are, as always, most wise. You shall with us come; and together we shall do that which we go forth to achieve." When he had spoken, Mina's long spell of silence made me look at her. She had fallen back on her

Existuje klasifikačná úloha (dataset, model), ktorá by po prevode na šedotónový obrázok nevykazovala významné zhoršenie presnosti, t.j., model by neklasifikoval primárne na základe farby?



Ako si autorka vyskúša
metód (7, 1, 1, 1)

nedošlo k zlepšeniu
použitia transformácií:



nejších
upnosti

Original	ART 77.45%
Scale-up	77.86%
Mirror	77.57%
Scale-up + mirror	74.44%



Ako si autorka vysvetľuje, že pri kombinácii dvoch najúspešnejších metód (Tabuľka 6) nedošlo k zlepšeniu? Nie je problém v postupnosti použitia transformácií?

	PlantVillage
Original	91.76 %
Insect	94.01 %
Gaussian blur	93.45 %
Insect + Gaussian blur	83.24 %
Gaussian blur + insect	82.79 %

