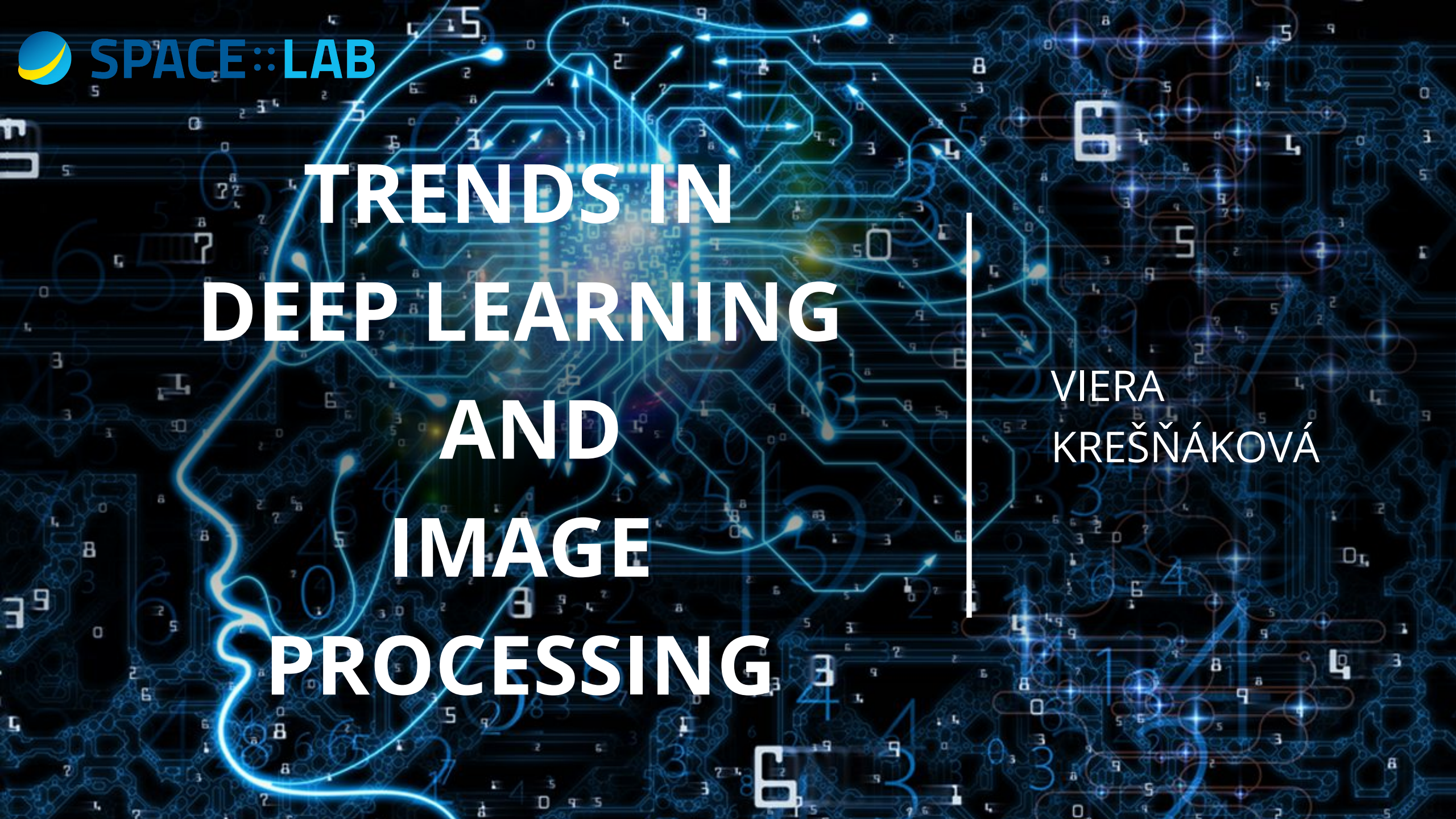
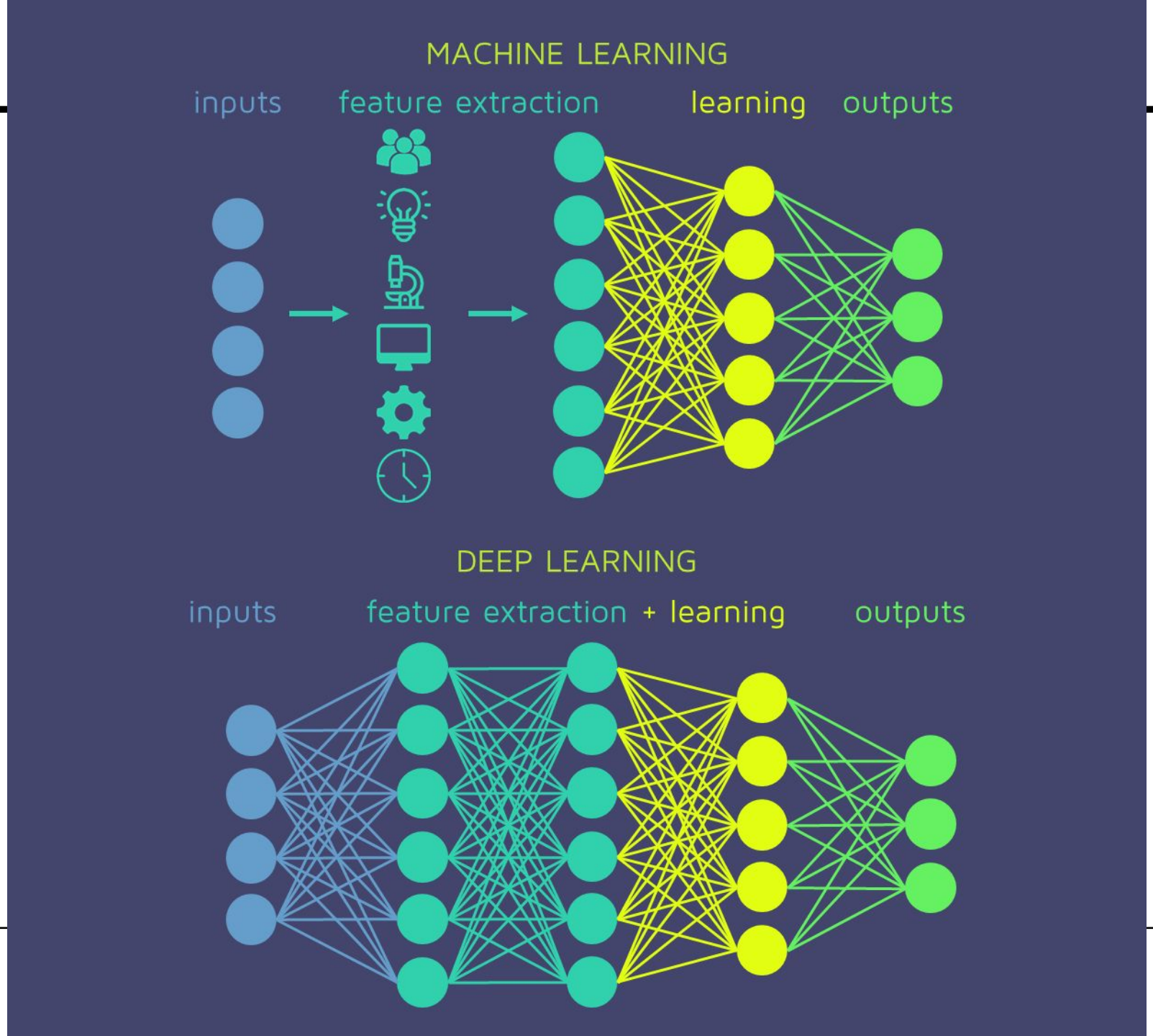
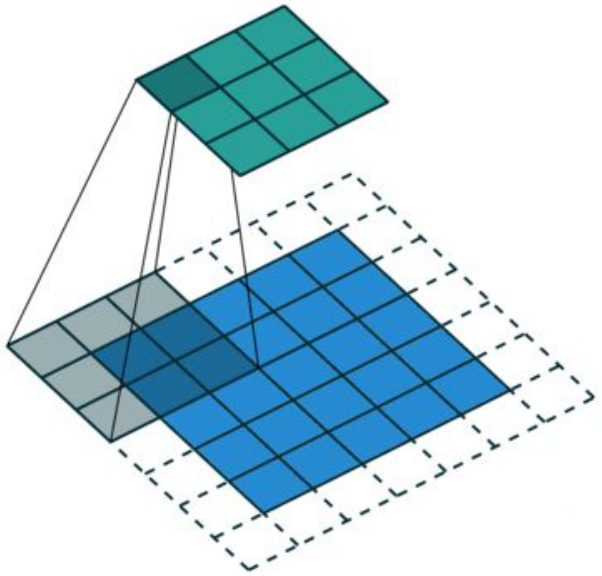

SPACE::LAB
TRENDS IN DEEP LEARNING AND IMAGE PROCESSING
VIERA KREŠŇÁKOVÁ


MACHINE LEARNING
inputs
feature extraction
learning
outputs
DEEP LEARNING
inputs
feature extraction + learning
outputs

SHORT HISTORY AND DEVELOPMENT OF THESE AREAS

- **1960s**: Initial concepts of neural networks with the **perceptron** model.
- **1980s**: Emergence of the **backpropagation** algorithm, enabling the training of multi-layered neural networks.
- **1990s**: Rise of **Support Vector Machines** (SVMs) and other algorithms that outperformed neural networks in many tasks.
- **2000s**: With increased **data** availability and computational **power**, neural networks began to regain popularity. **Convolutional Neural Networks** (CNNs) began to dominate in image processing tasks.
- **2010s**: A period of rapid growth in deep learning with the introduction of models such as AlexNet, VGG, and ResNet. **GANs** (Generative Adversarial Networks) were introduced in 2014. Deep learning became the **standard** in many image processing and computer vision applications.
- **2020s**: Ongoing development and optimization of models, introduction of **transformer** architectures in image processing, and the combination of deep learning with other technologies such as **augmented reality** and **virtual reality**.

CONVOLUTIONAL NEURAL NETWORK AND TRANSFER LEARNING



0	0	0	0	0	0	0
0	105	102	100	97	96	
0	103	99	103	101	102	1(
0	101	98	104	102	100	1
0	99	101	106	104	99	
0	104	104	104	100	98	1

Image Matrix

Kernel Matrix

0	-1	0
-1	5	-1
0	-1	0

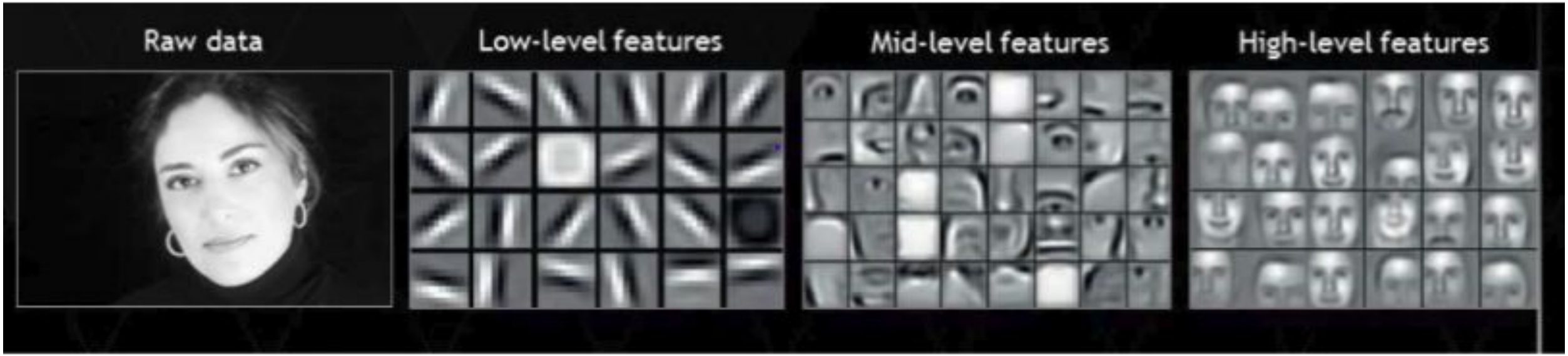
$$0*0+0*-1+0*0$$
$$+0*-1+105*5+102*-1$$
$$+0*0+103*-1+99*0 \quad = 320$$

320					

Output Matrix

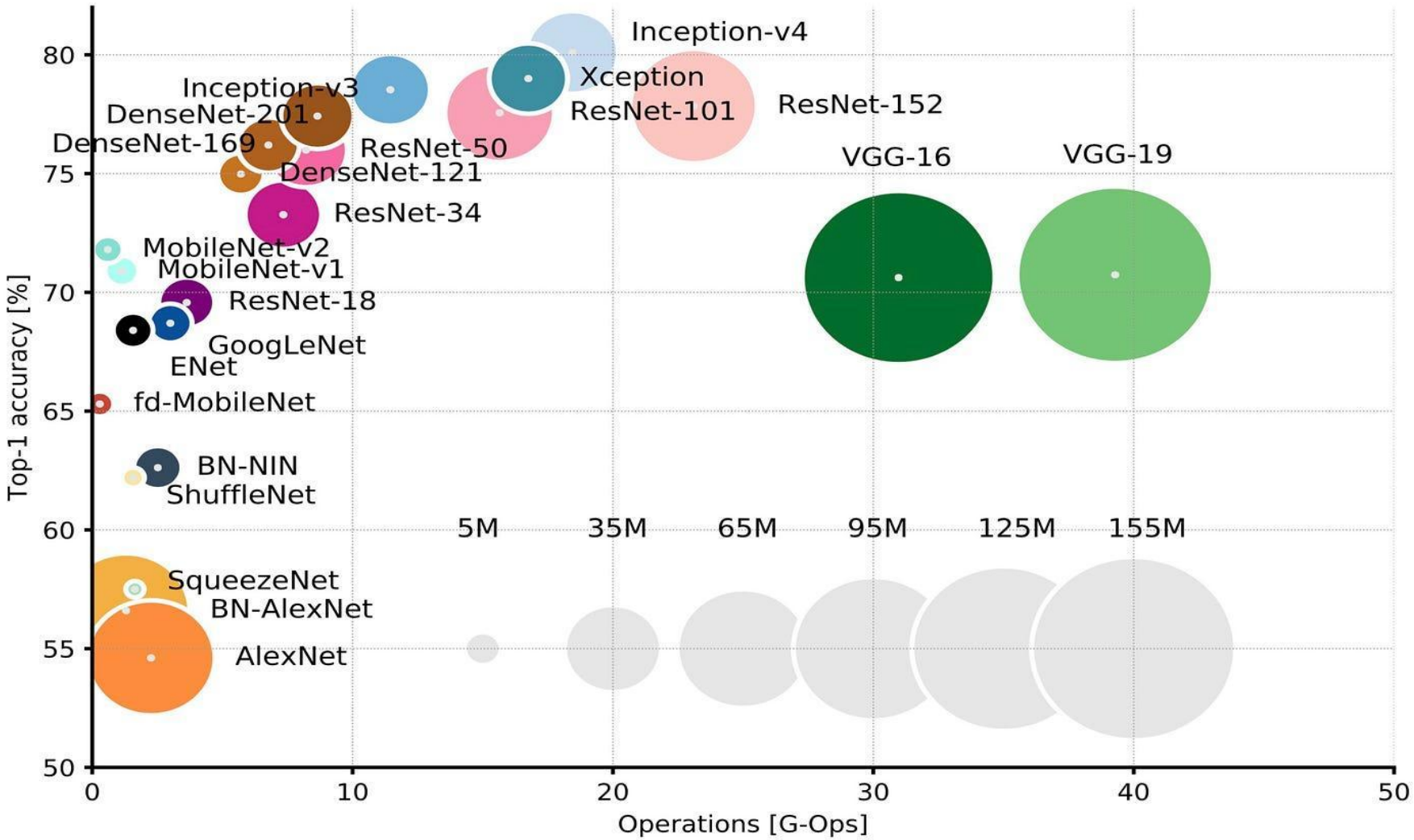
Convolution with horizontal and vertical strides = 2

CONVOLUTIONAL NEURAL NETWORK AND TRANSFER LEARNING



LET'S EXPLORE IT

https://teachablemachine.withgoogle.com/train



Source: Canziani, A., Paszke, A., & Culurciello, E. (2016). An analysis of deep neural network models for practical applications. *arXiv preprint arXiv:1605.07678*.

TRANSFER LEARNING

Pre-trained Models and Their Benefits:

What are pre-trained models: These are models that have already been trained on large datasets like **ImageNet**. These models are often used as a starting point for transfer learning.

Benefits:

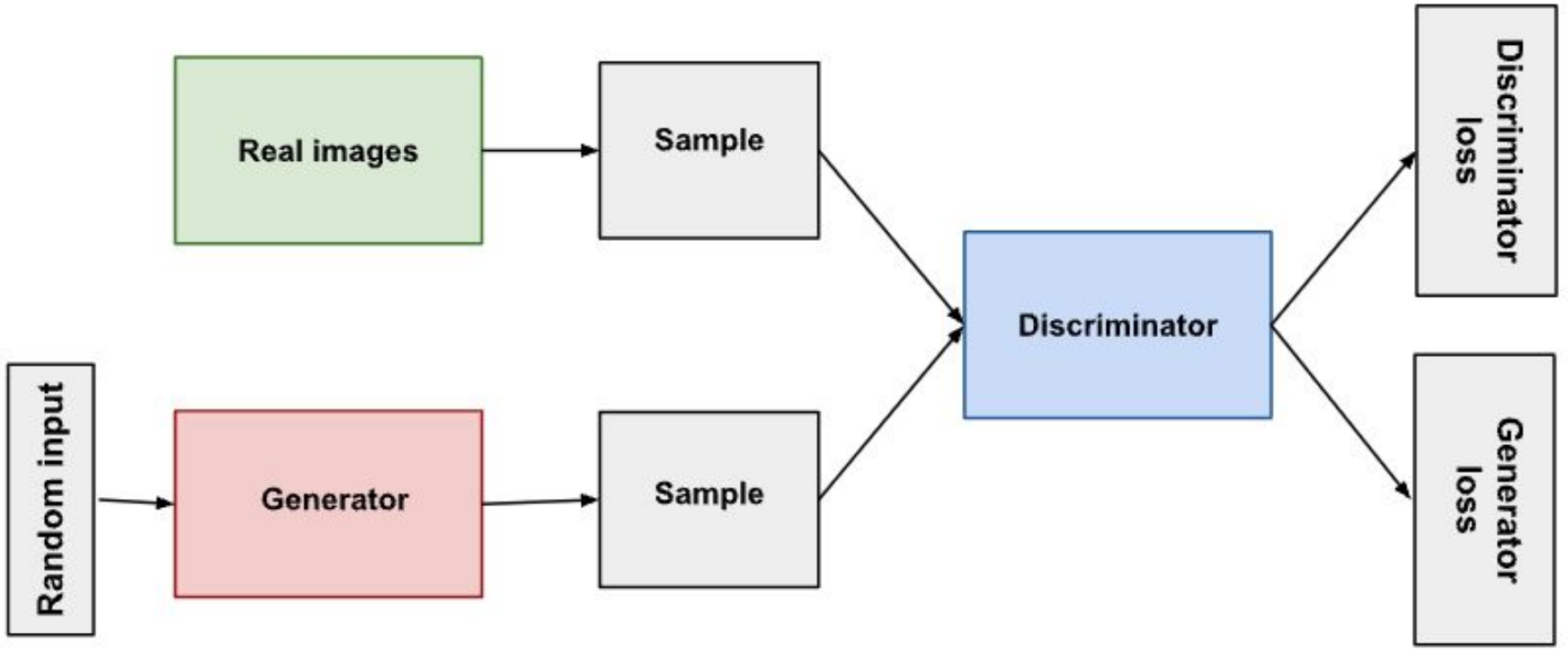
1. **Faster learning:** Since many features are already learned, training on a new dataset can be faster.
2. **Requires less data:** Can reduce the need for large amounts of data for training since the model already understands many general image features.
3. **Improved performance:** Models that use transfer learning often achieve better performance compared to models trained from scratch, especially if there's a limited amount of training data.

TRANSFER LEARNING

Quick Adaptation Methods for Specific Image Processing Tasks:

1. **Fine-tuning:** After loading the pre-trained weights, you can further train the model (often with a lower learning rate) on your specific dataset.
2. **Freezing layers:** You can "freeze" the weights of certain layers (often the initial layers) so they don't update during training and only train some layers of the model. This is useful when you want to retain the general features of the model but adapt to the specific characteristics of your dataset.
3. **Using the model as a feature extractor:** You can use the pre-trained model solely for extracting features from images and then train a classifier on these features.

GENERATIVE ADVERSARIAL NETWORKS (GANS)



https://thispersondoesnotexist.com/

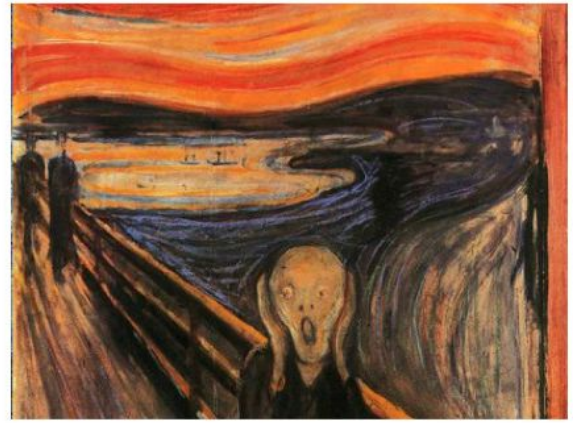
As training progresses, the generator gets closer to producing output that can fool the discriminator:

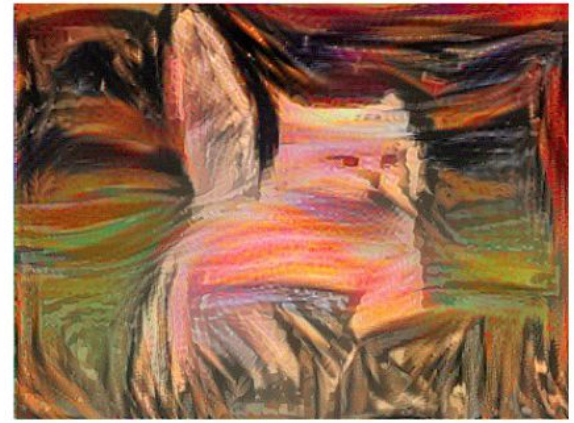
Finally, if generator training goes well, the discriminator gets worse at telling the difference between real and fake. It starts to classify fake data as real, and its accuracy decreases.

Content image

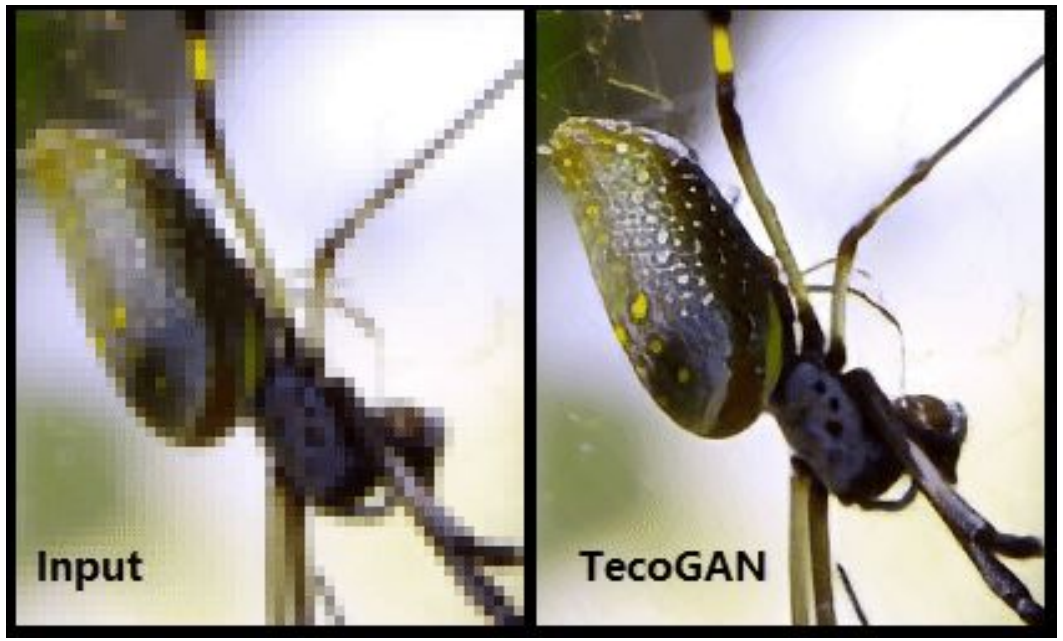
Style image

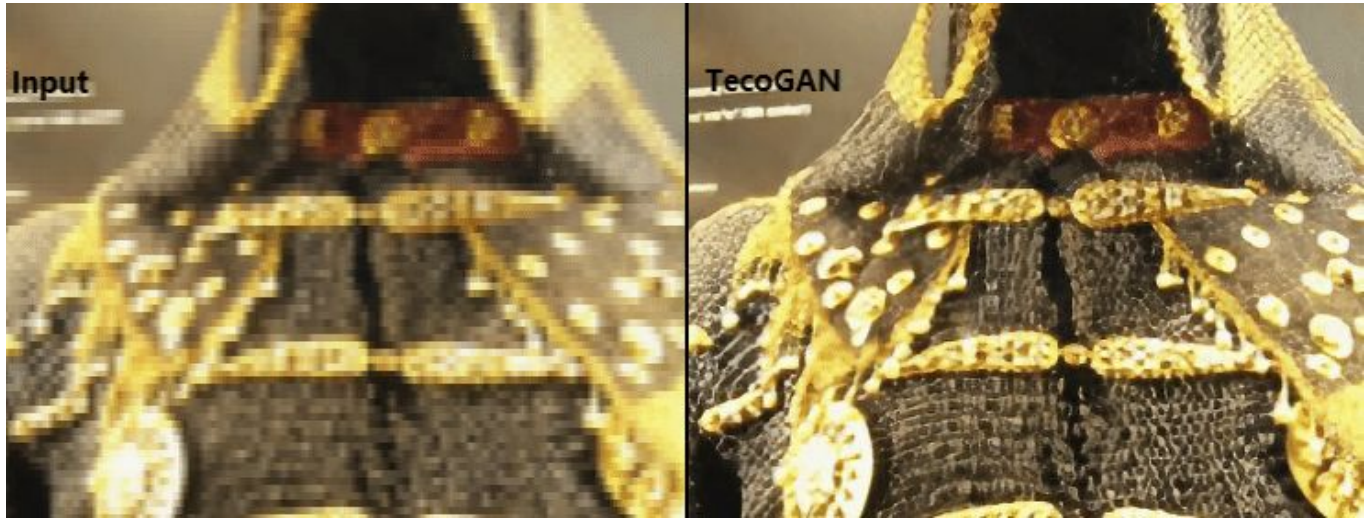
Output image





SUPER-RESOLUTION GAN



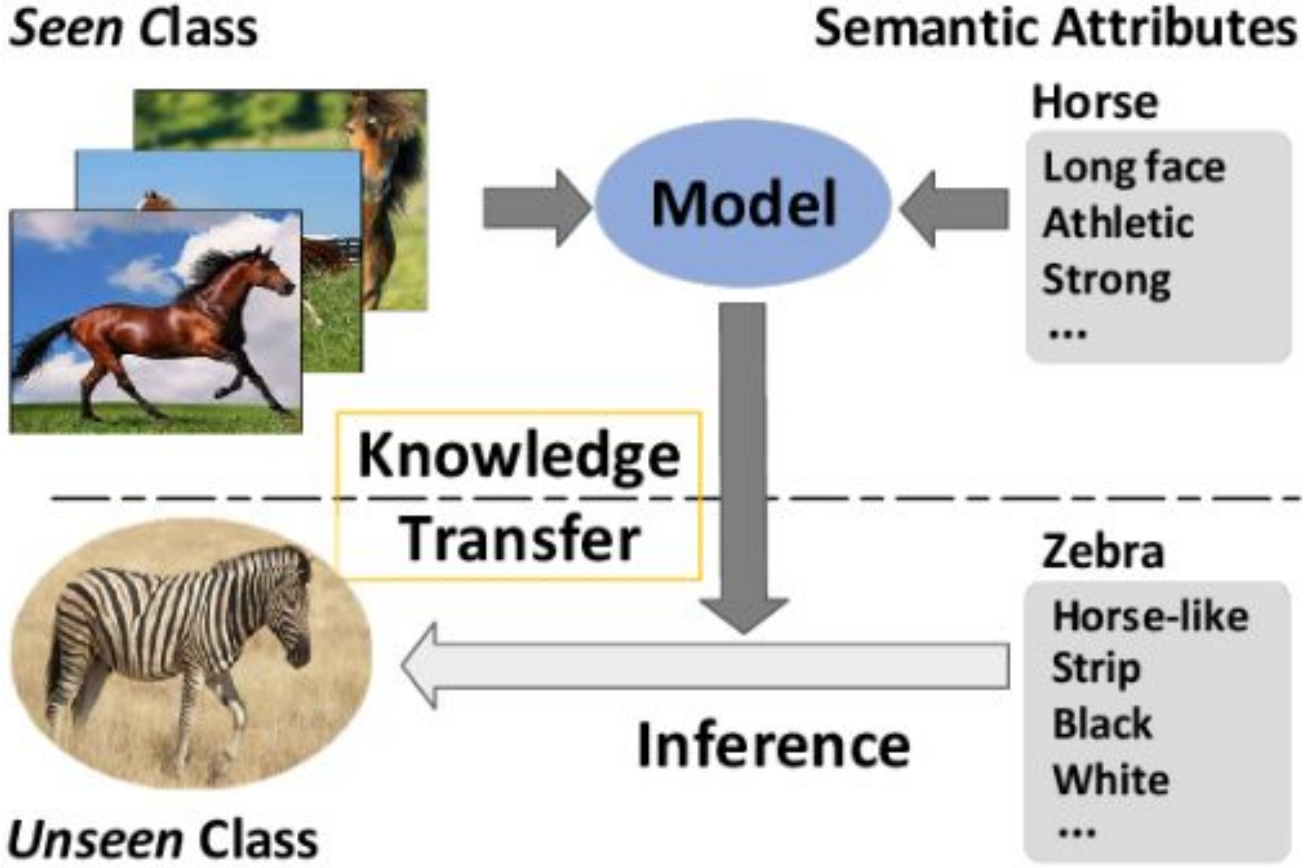


WHAT IS NEW IN OBJECT DETECTION? YOLOV8

https://github.com/ultralytics/ultralytics

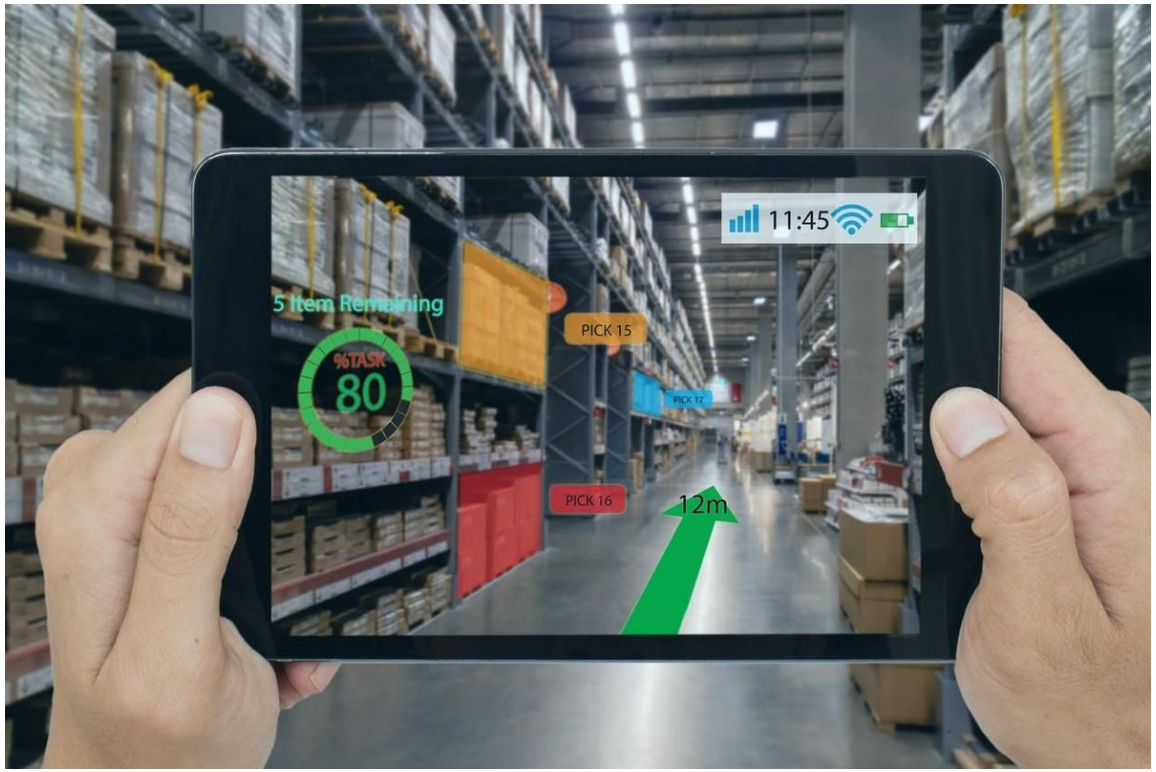
ZERO-SHOT LEARNING

The goal of zero-shot learning is to recognize objects that the model has never seen before in the training data. This is achieved by using knowledge from the categories on which the model was trained to classify unseen categories.



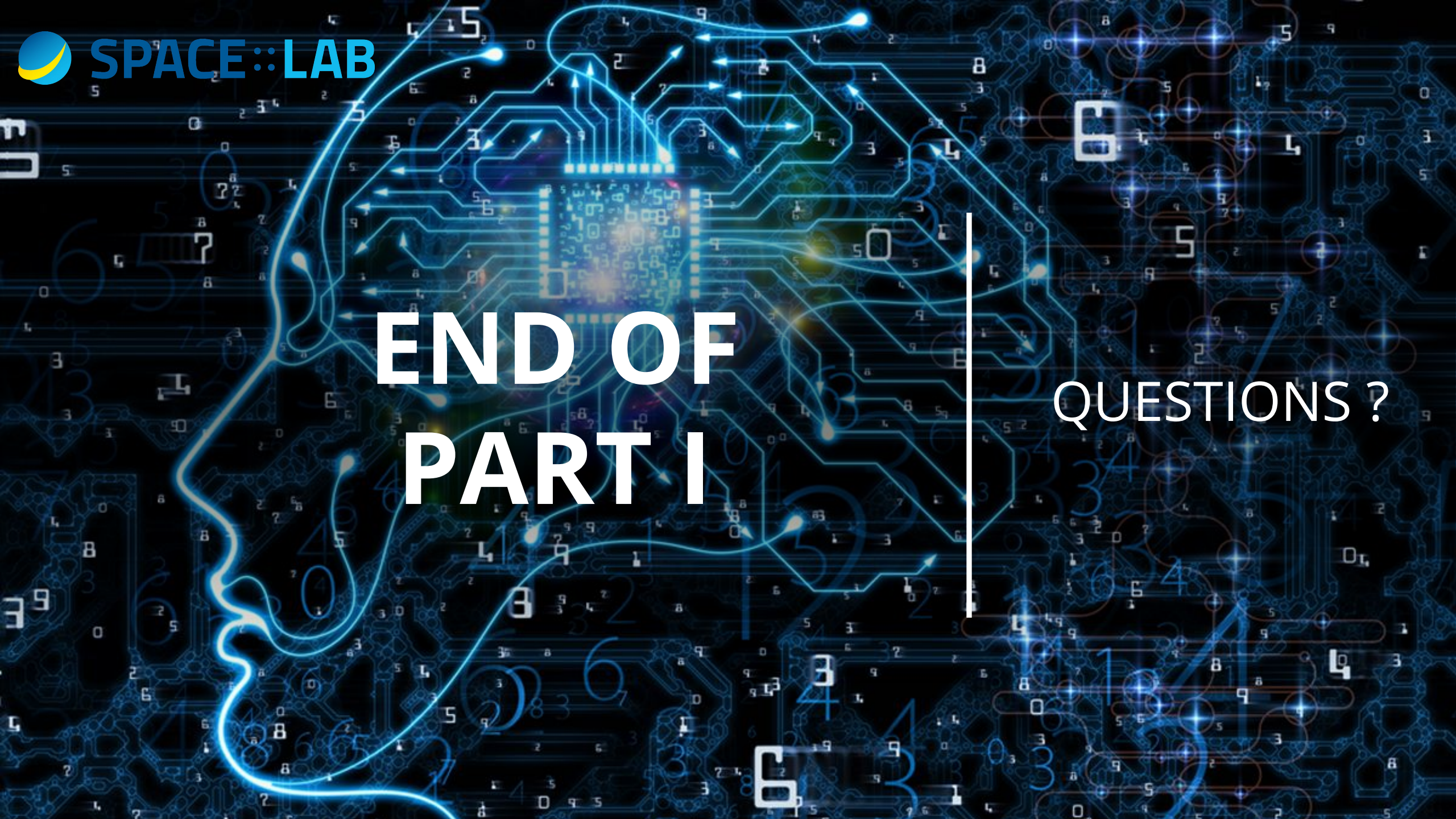
AUGMENTED AND VIRTUAL REALITY

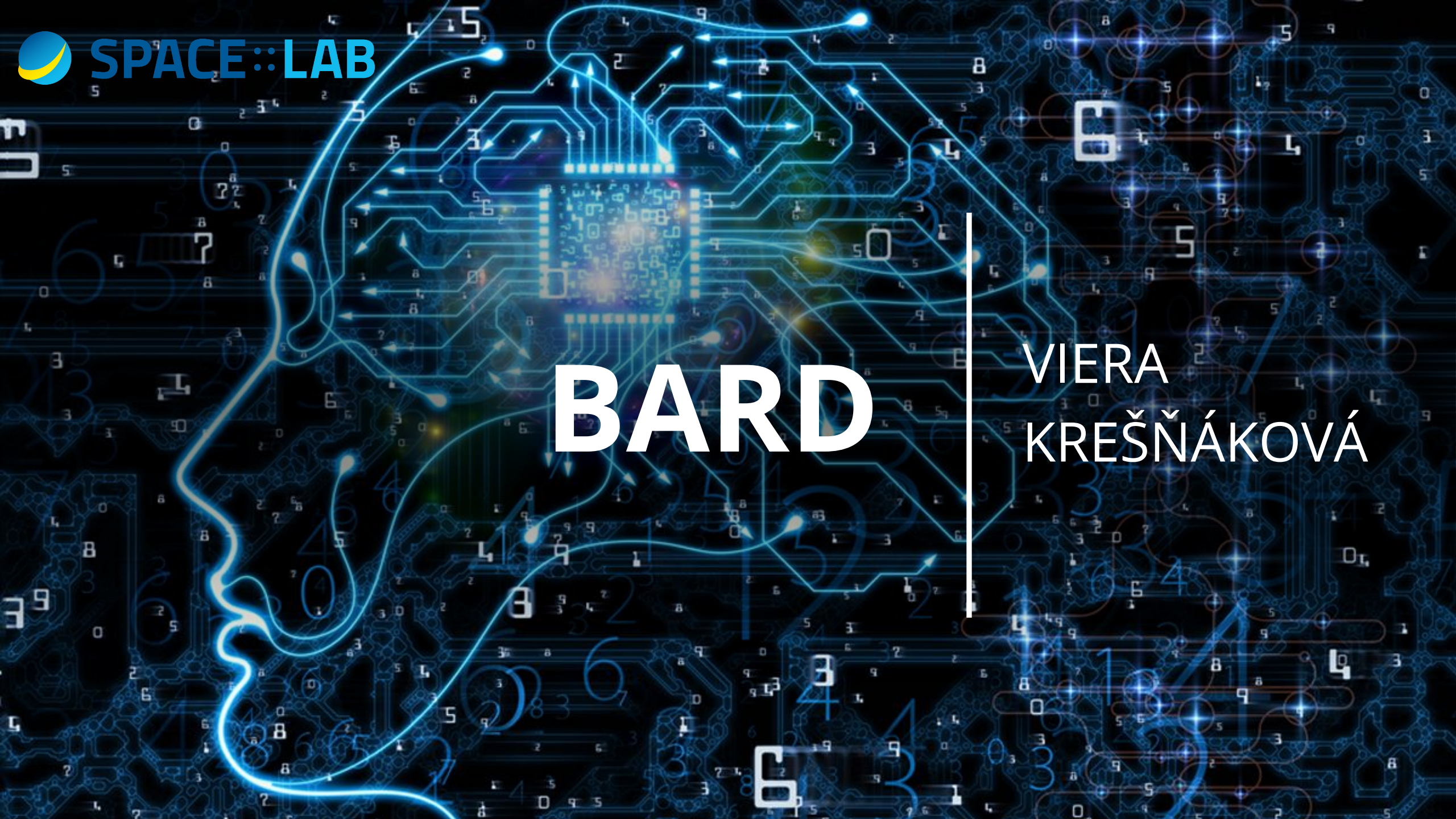
Unlike virtual reality (VR), it replaces the real world only partially, adding new layers of information to the real image.



NINE WAYS WE USE AR AND VR ON THE INTERNATIONAL SPACE STATION

https://www.nasa.gov/mission_pages/station/research/news/nine-ways-we-use-ar-vr-on-iss


SPACE::LAB
END OF
PART I
QUESTIONS ?

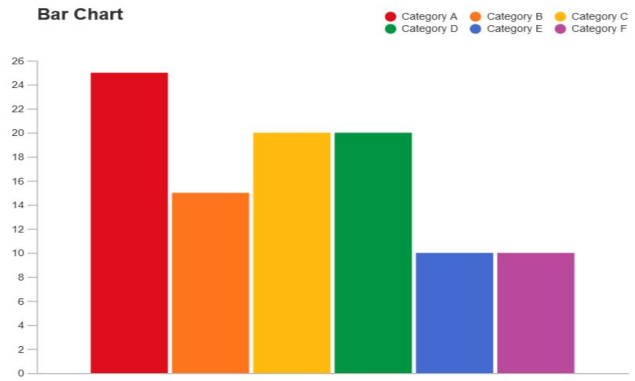

SPACE::LAB
BARD
VIERA
KREŠŇÁKOVÁ

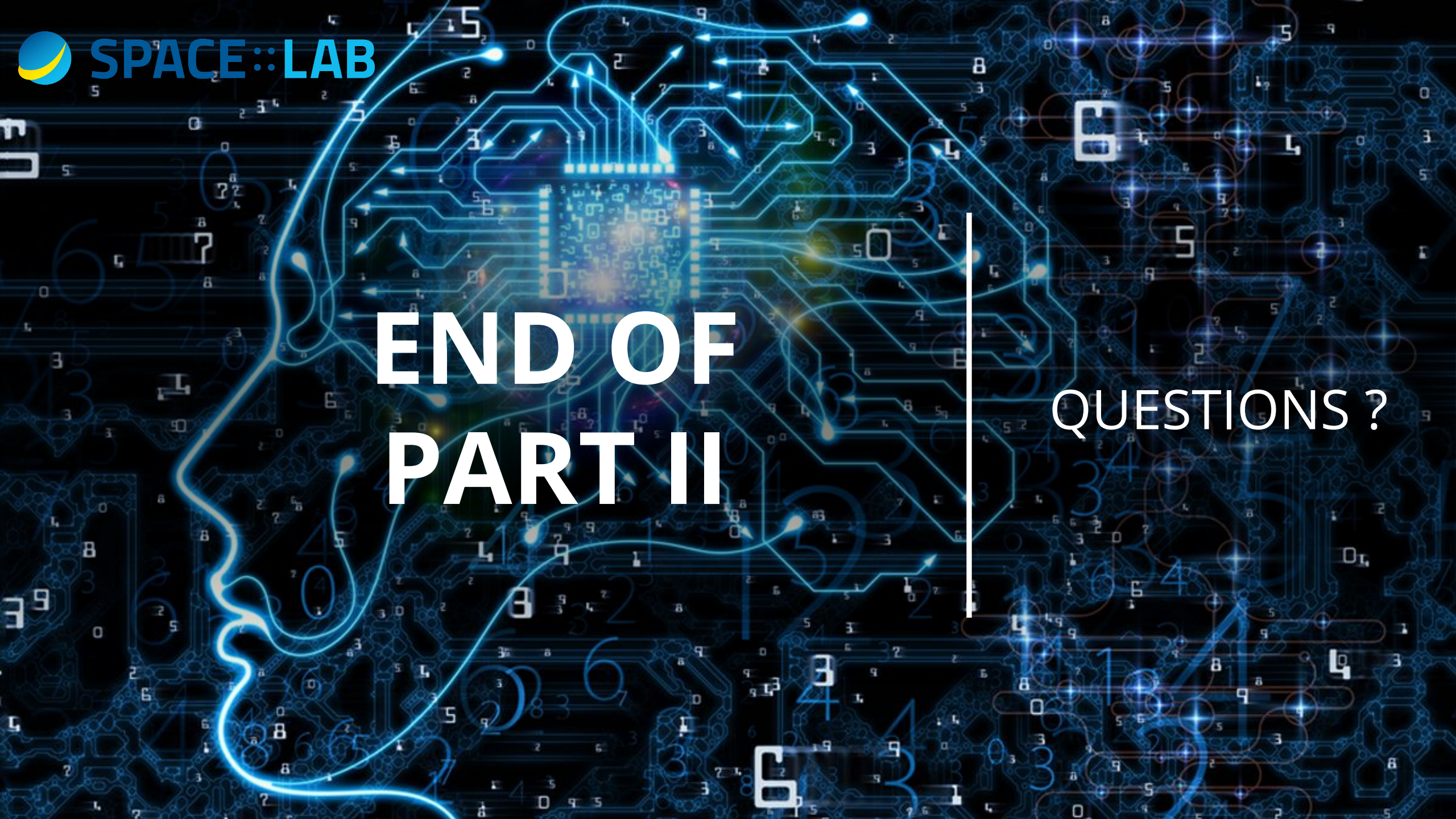
LOG IN

https://bard.google.com/

TASKS

1. Use Bard to generate an 'image to text' conversion. Describe the contents of the picture.
2. Add a black rectangle to the image and test if the generative model can detect the damaged image.
3. Find a chart and have the generative model evaluate it. Then, seek recommendations on how to enhance it.
4. https://www.nasa.gov/webbfirstimages




SPACE::LAB
END OF
PART II
QUESTIONS ?