Universidad Nacional del Altiplano
Escuela de Posgrado
Doctorado en Ciencias de la Computación

Data Mining

Unit 2. Unstructured data mining

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2024 - I

Contenido

- Unstructured data
- Shallow features
- Deep features
- Problems in computer vision
  - Image segmentation
  - Image classification
  - Object detection
  - Instance segmentation
- Sound event classification
- Examples

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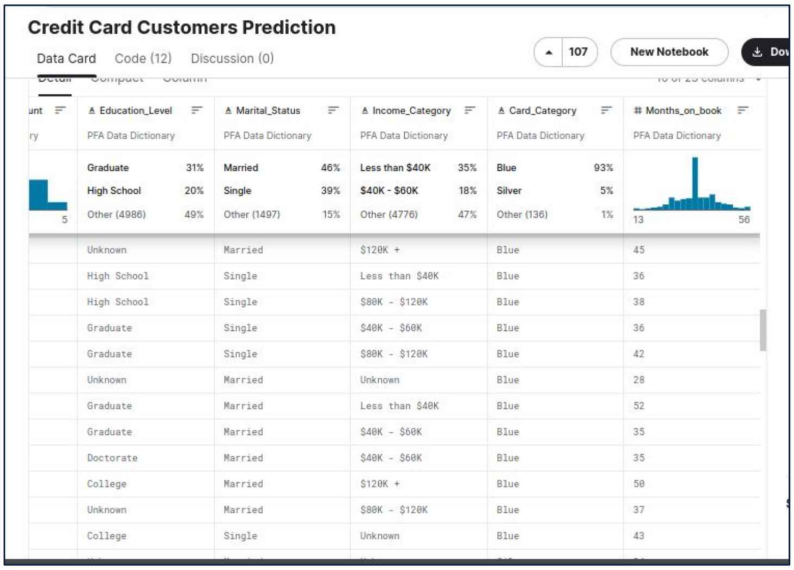
Structured Data vs Unstructured Data

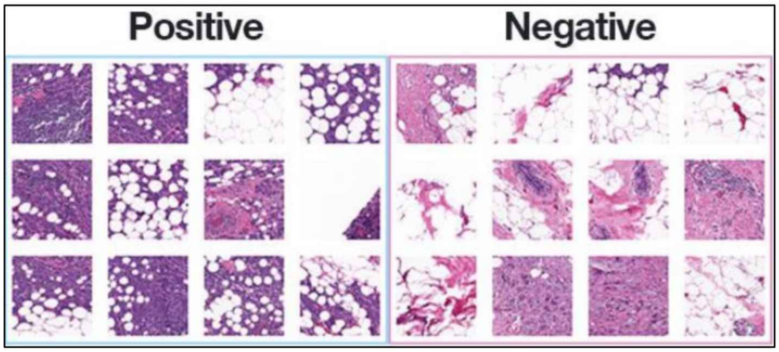
Estructurados	No estructurados (complejos)
Categorías y Numéricos {Enteros, Reales, Fecha}	Imágenes, audios, videos, electrocardiograma, etc.



Credit Card Customers Prediction

Data Card | Code (12) | Discussion (0) | 107 | New Notebook

Education_Level	Marital_Status	Income_Category	Card_Category	Months_on_book
PFA Data Dictionary	PFA Data Dictionary	PFA Data Dictionary	PFA Data Dictionary	PFA Data Dictionary
Graduate 31% High School 20% Other (4986) 49%	Married 46% Single 39% Other (1497) 15%	Less than $40K 35% $40K - $60K 18% Other (4776) 47%	Blue 93% Silver 5% Other (136) 1%	13 – 56
Unknown	Married	$120K +	Blue	45
High School	Single	Less than $40K	Blue	36
High School	Single	$80K - $120K	Blue	38
Graduate	Single	$40K - $60K	Blue	36
Graduate	Single	$80K - $120K	Blue	42
Unknown	Married	Unknown	Blue	28
Graduate	Married	Less than $40K	Blue	52
Graduate	Married	$40K - $60K	Blue	35
Doctorate	Married	$40K - $60K	Blue	35
College	Married	$120K +	Blue	50
Unknown	Married	$80K - $120K	Blue	37
College	Single	Unknown	Blue	43



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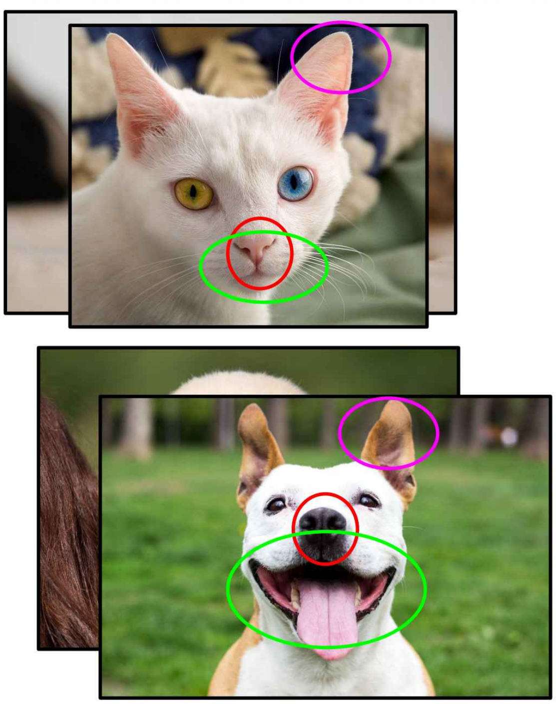
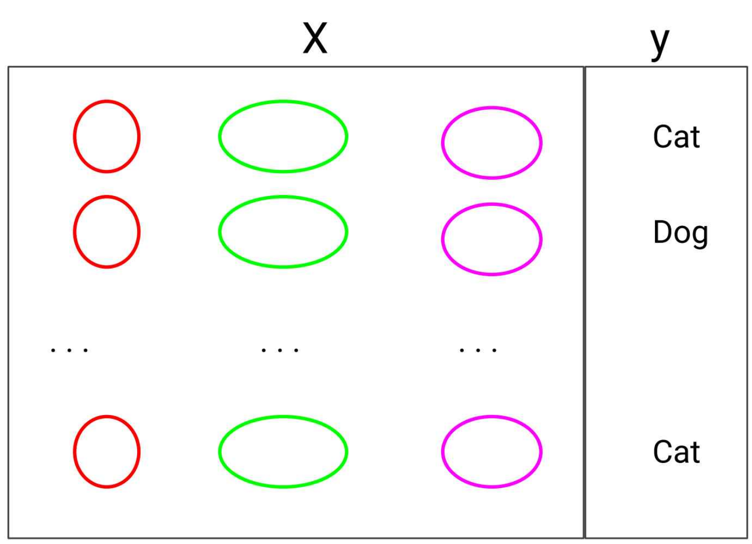
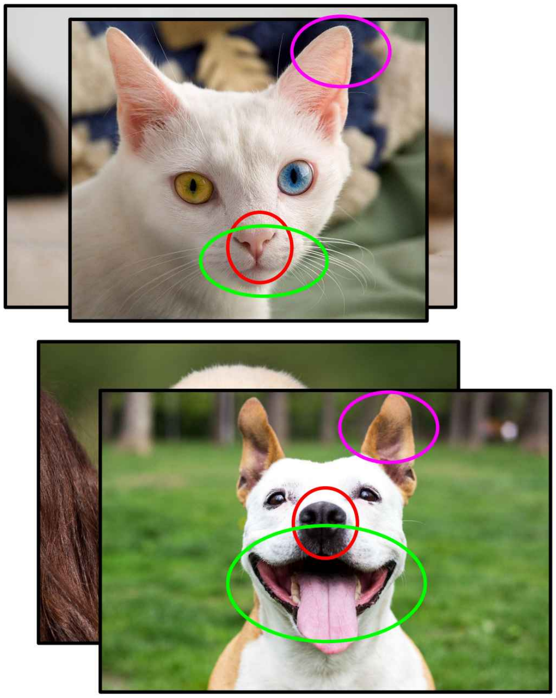
Shallow features





Features descriptors: Color, Shape, Texture, etc.

Shallow features



Feature descriptors: Color, Shape, Texture, etc.

- Co-occurrence matrix (Haralick's coefficient): https://scikit-image.org/docs/stable/auto_examples/features_detection/plot_glcm.html
- Local Binary Pattern for texture classification (LBP): https://scikit-image.org/docs/stable/auto_examples/features_detection/plot_local_binary_pattern.html

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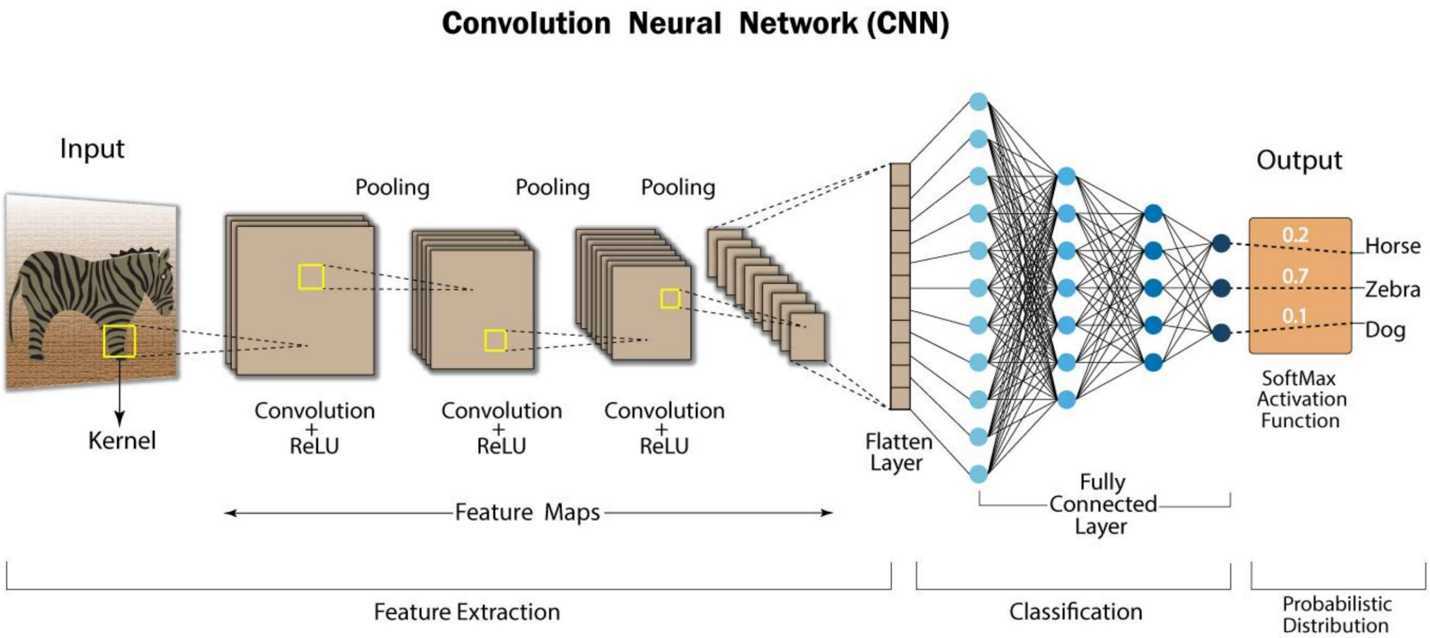
Deep features



https://nafizshahriar.medium.com/what-is-convolutional-neural-network-cnn-deep-learning-b3921bdd82d5

Deep features - Transfer learning

Incorporating a Novel Dual Transfer Learning Approach for Medical Images

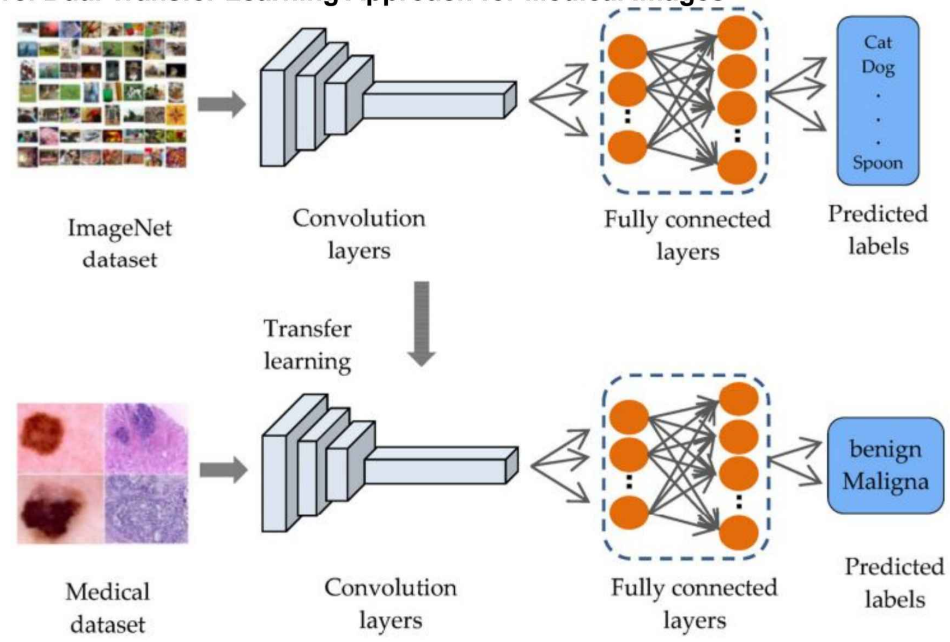


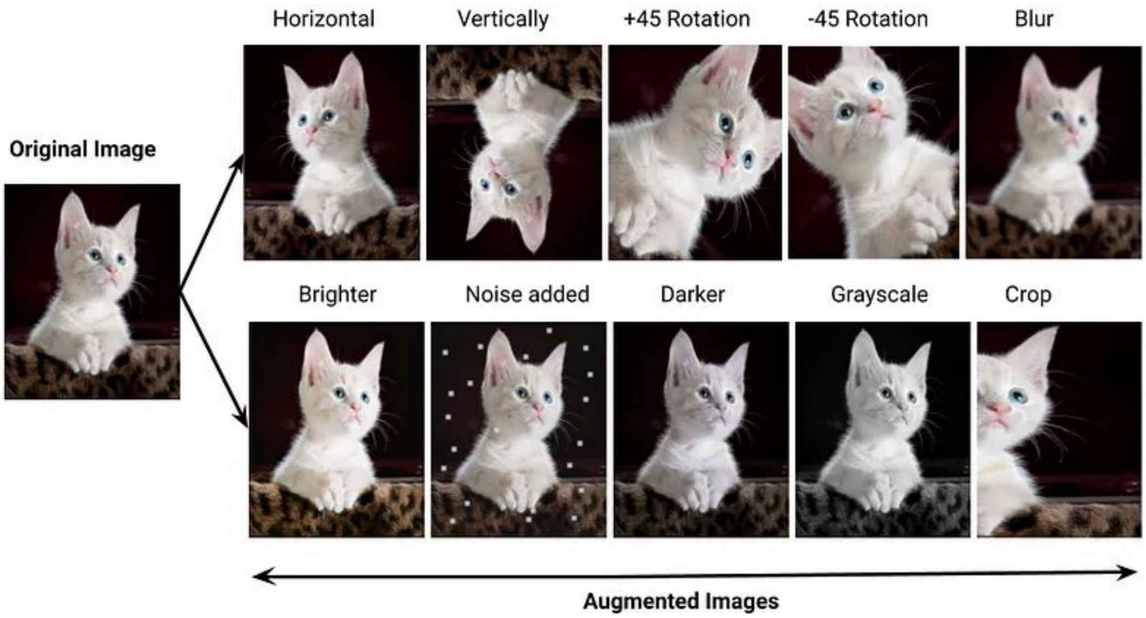
Figure 1. Transfer learning from ImageNet.

1000 classes

2 classes

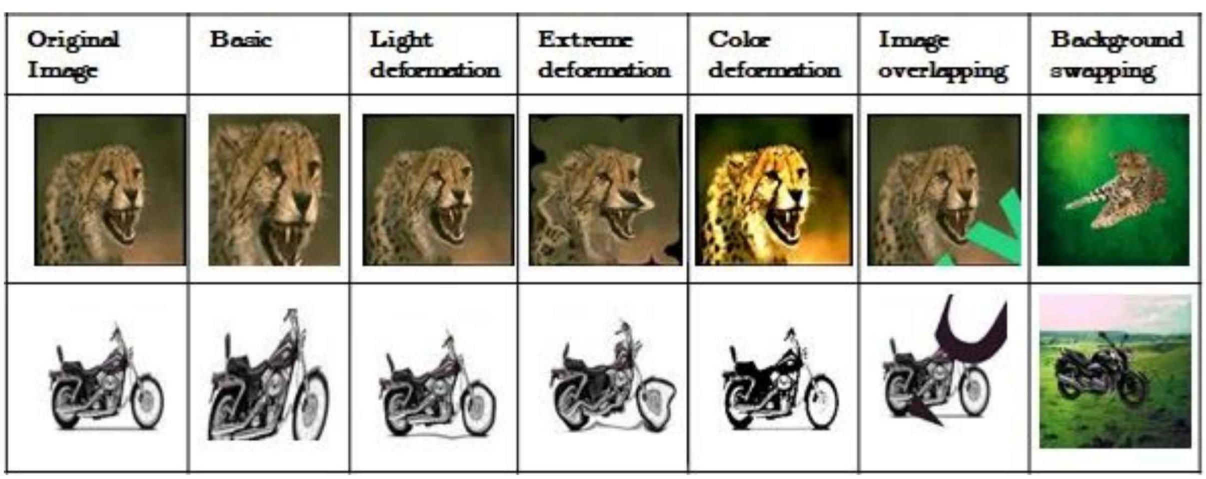
[7] https://doi.org/10.3390/s23020570

Deep features - Data augmentation



https://ubiai.tools/what-are-the-advantages-anddisadvantages-of-data-augmentation-2023-update/

Deep features - Data augmentation



https://medium.com/@marcc22/data-augmentation-benchmark-for-deep-learning-2db712c6eb3e

Deep features - Convolutional neural network architectures

CNN Variants for Computer Vision: History, Architecture, Application, Challenges and Future Scope

Table 1. Performance summary of various CNN variants with its architectural categories.

Architecture Name	Year	Category	Main Role	Parameter	Error Rate
LeNet	1998	Spatial Exploitation	It was the first prevalent CNN architecture	0.060 M	dist]MNIST: 0.8 MNIST: 0.95
AlexNet	2012	Spatial Exploitation	• Deeper and wider compared to LeNet • Used RELU, dropout and overlap pooling GPUs NVIDIA GTX 580	60 M	ImageNet: 16.4
ZfNet	2014	Spatial Exploitation	Provided visualization of intermediate layers	60 M	ImageNet: 11.7
VGG	2014	Spatial Exploitation	It used small-sized kernels and had homogeneous topology	138 M	ImageNet: 7.3
GoogleNet	2015	Spatial Exploitation	It was first architecture to introduce block concept. It used split transform and then merge idea	4 M	ImageNet: 6.7
InceptionV-3	2015	Depth + Width	It was able to handle bottleneck issue and applied small filters rather than using large filters	23.6 M	ImageNet: 3.5 Multi-Crop: 3.58 Single-Crop: 5.6
Highway Network	2015	Depth + Multi-Path	First architecture to introduce the idea of multi path	2.3 M	CIFAR-10: 7.76
Inception V-4	2016	Depth + Width	It used asymmetric filters with split transform and merge concept	35 M	ImageNet: 4.01
Inception ResNet	2016	Depth + Width + Multi-Path	It used residual link with split transform and merge concept	55.8 M	ImageNet: 3.52
ResNet	2016	Depth + Multi-Path	Identified mapping-based skip connections with residual learning	25.6 M 1.7 M	ImageNet: 3.6 CIFAR-10: 6.43

[8] https://doi.org/10.3390/electronics10202470

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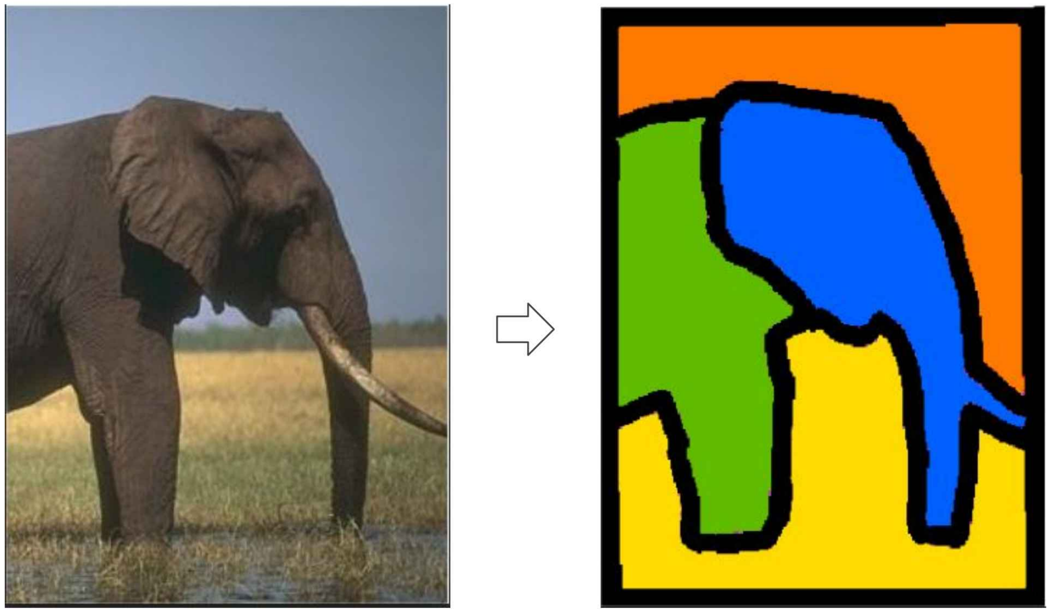
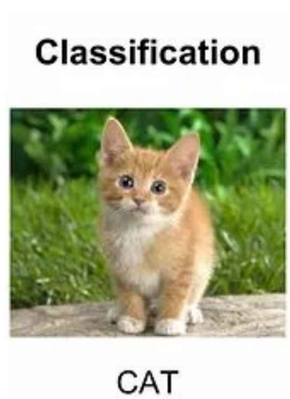
Image segmentation



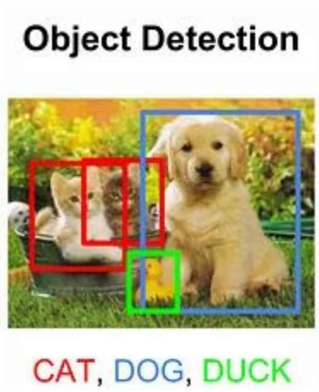
Segmentración: Agrupar pixels que sean similares entre si. La idea es que los segmentos formados tengan potencial de integrar algunos categorías de objetos.

Classification



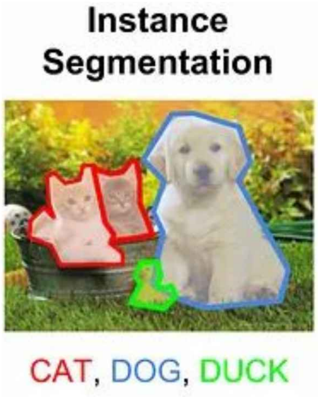
https://paperswithcode.com/task/image-classification

Object Detection



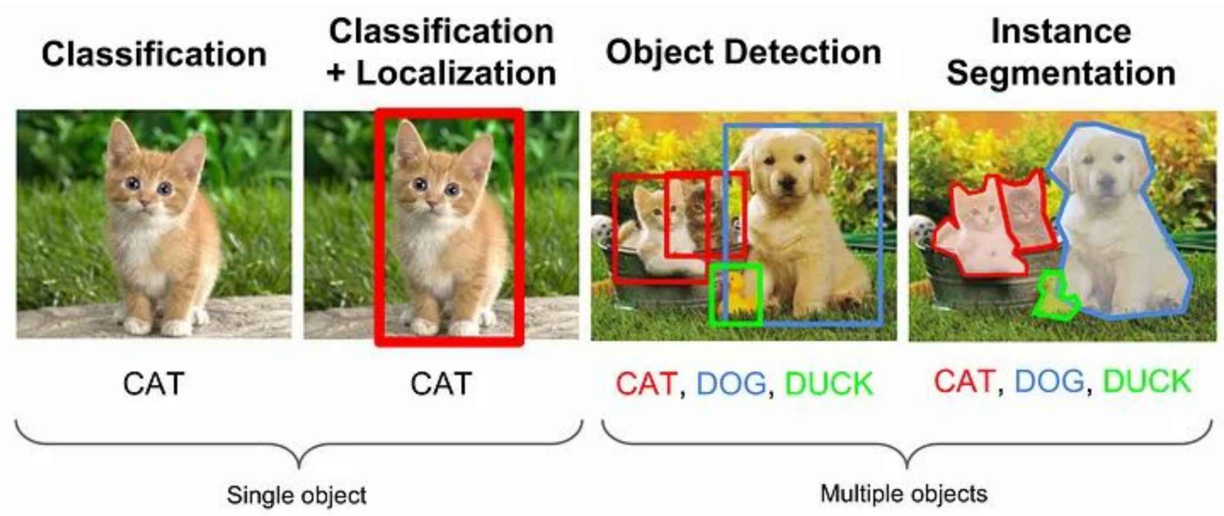
https://paperswithcode.com/task/object-detection

Instance Segmentation



https://paperswithcode.com/task/instance-segmentation

Classification x Object Detection x Instance Segmentation



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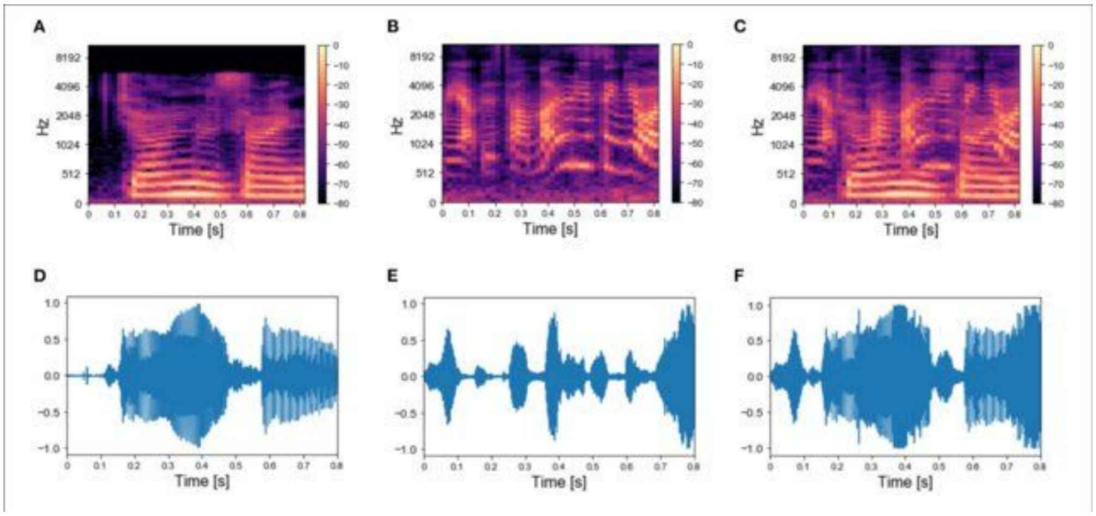
Sound event classification

Modeling the Repetition-Based Recovering of Acoustic and Visual Sources With Dendritic Neurons



[9] http://dx.doi.org/10.3389/fnins.2022.855753

Sound event classification

Mel-spectrogram and Deep CNN Based Representation Learning from Bio-Sonar Implementation on UAVs

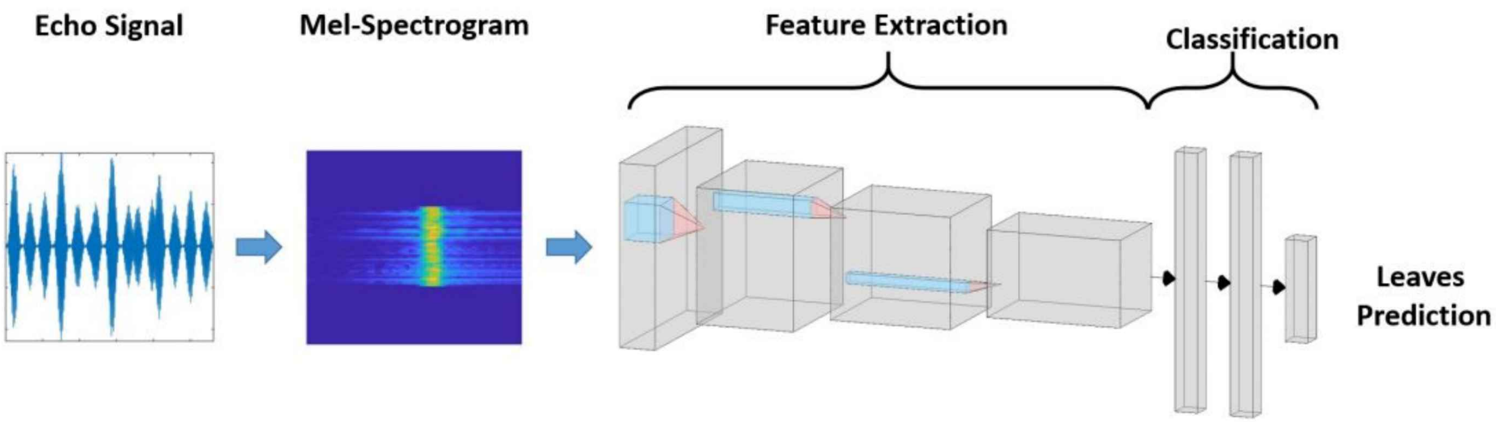


Fig. 1: The proposed pipeline. Mel-spectrogram converts the audio signal to an equivalent image. This image is then used for feature extraction using CNN. The number of leafs in the biosonar lobe is then returned as the output.

[10] https://doi.org/10.1109/ICCCR49711.2021.9349416

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Example: Image segmentation

Automatic image segmentation based on label propagation

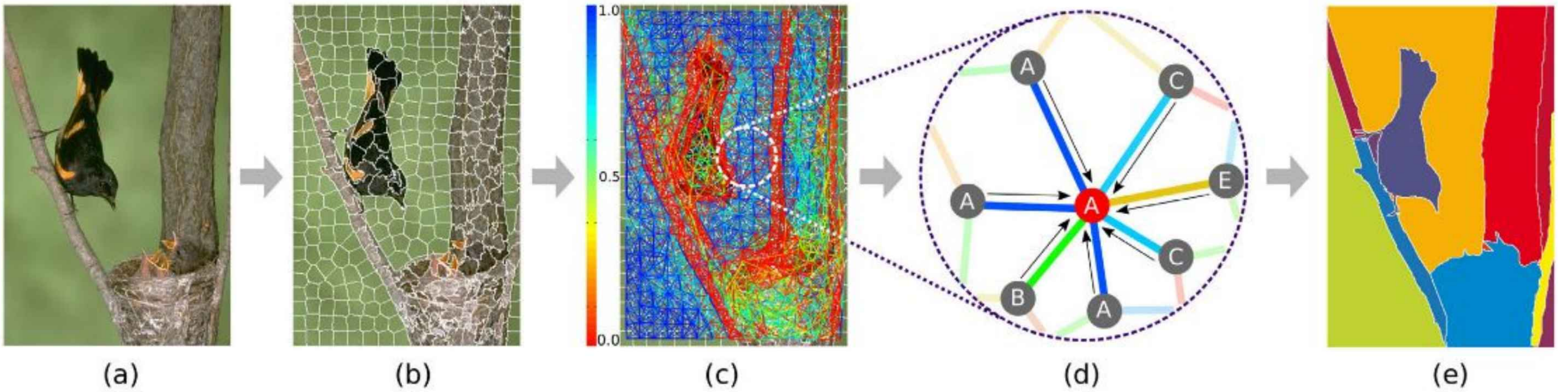


FIGURE 1 Illustration of our method. (a) Input image; (b) super-pixel extraction; (c) graph building. Blue edges indicate high similarity among vertices, whereas red edges represent low similarity; (d) label propagation. The red vertex is assigned the most frequent label in its neighbourhood, (e) segmentation result, that is, regions containing super-pixels with the same label

[11] https://doi.org/10.1049/ipr2.12242

Example: Image segmentation

Multi-level Graph Label Propagation for Image Segmentation

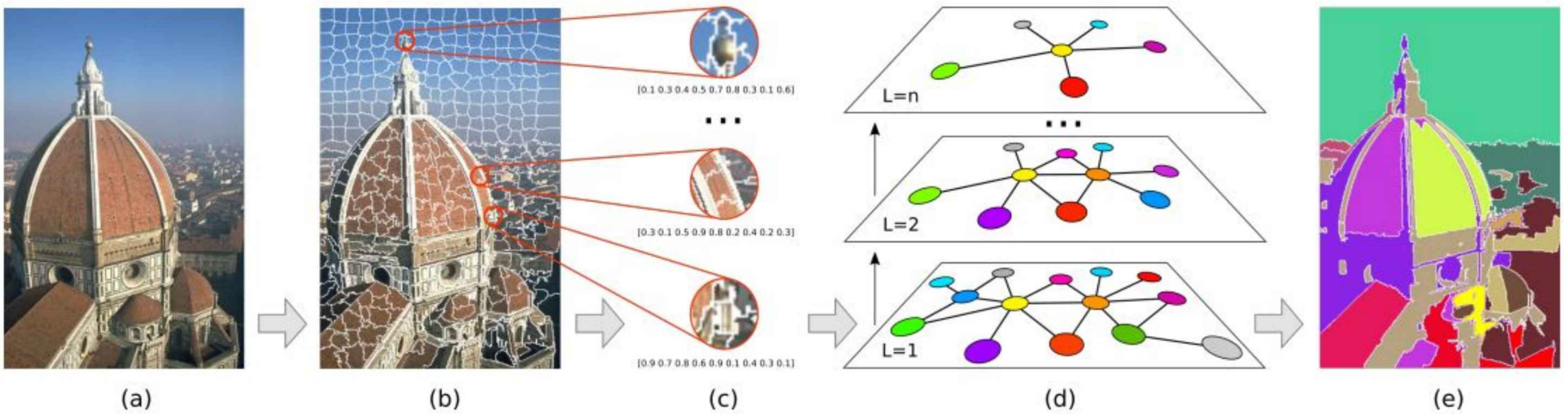


Fig. 1. The proposed method: (a) Input image; (b) super-pixel pre-segmentation; (c) feature extraction; (d) multi-level propagation where new graphs are created by merging similar super-pixels from the previous level; (e) final segmentation at the last level.

[12] https://doi.org/10.1109/SIBGRAPI51738.2020.00034

Example: Image classification

Analysis of vertebrae without fracture on spine MRI to assess bone fragility: A Comparison of Traditional Machine Learning and Deep Learning

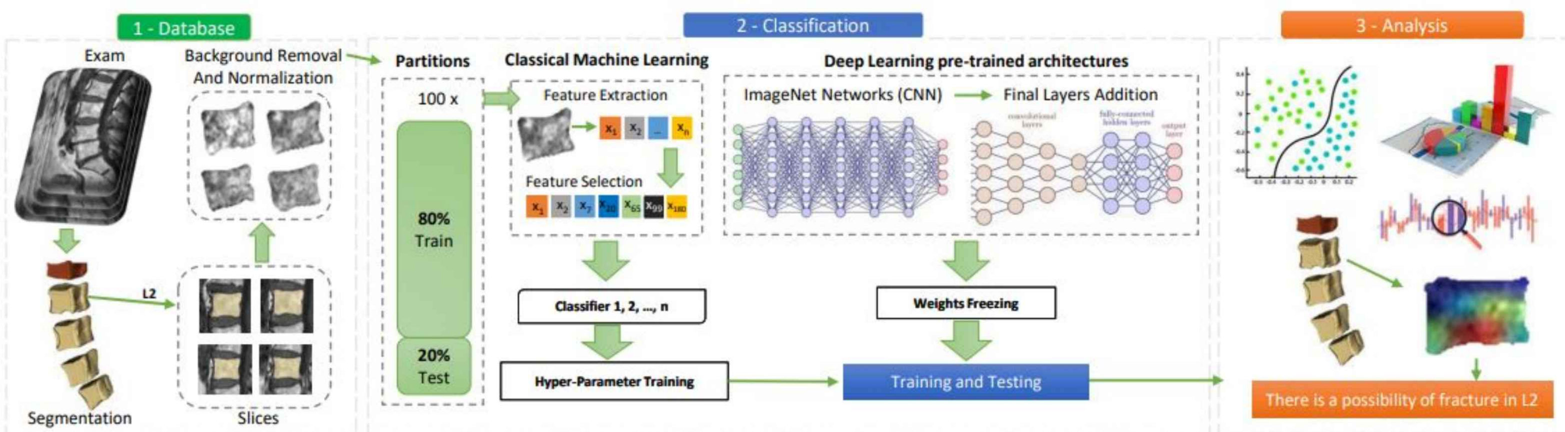


Fig. 1. Workflow employed in this study.

[13] https://doi.org/10.1109/CBMS55023.2022.00021

Example: Object detection

Object Detection Using Deep Learning, CNNs and Vision Transformers: A Review

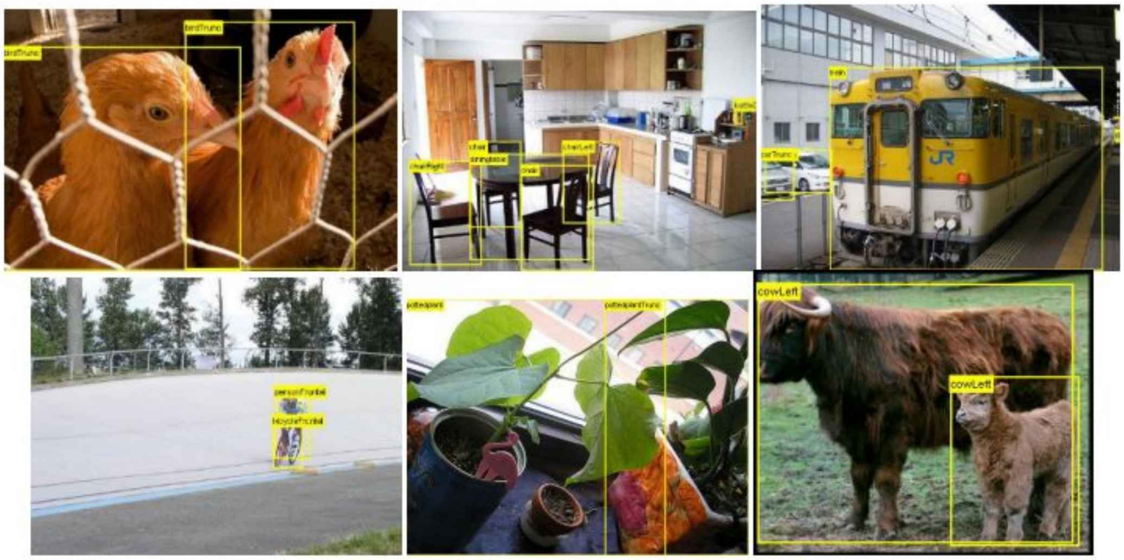


FIGURE 1. Samples from Pascal VOC 07.

[14] https://doi.org/10.1109/ACCESS.2023.3266093

Example: Object detection

Automatic detection of Aedes aegypti breeding grounds based on deep networks with spatio-temporal consistency

Fig. 1. Selected frames of video sequences from the MBG database, showing annotated bounding boxes.

[15] https://doi.org/10.1016/j.compenvurbsys.2021.101754

Example: Object detection

Automatic detection of Aedes aegypti breeding grounds based on deep networks with spatio-temporal consistency

Fig. 2. Examples of objects associated to potential mosquito breeding grounds in the MBG database: (a) 'bottle', (b) 'bucket', (c) 'pool', (d) 'puddle', (e) 'tire', and (f) 'water tank'.

[15] https://doi.org/10.1016/j.compenvurbsys.2021.101754

Example: Instance segmentation

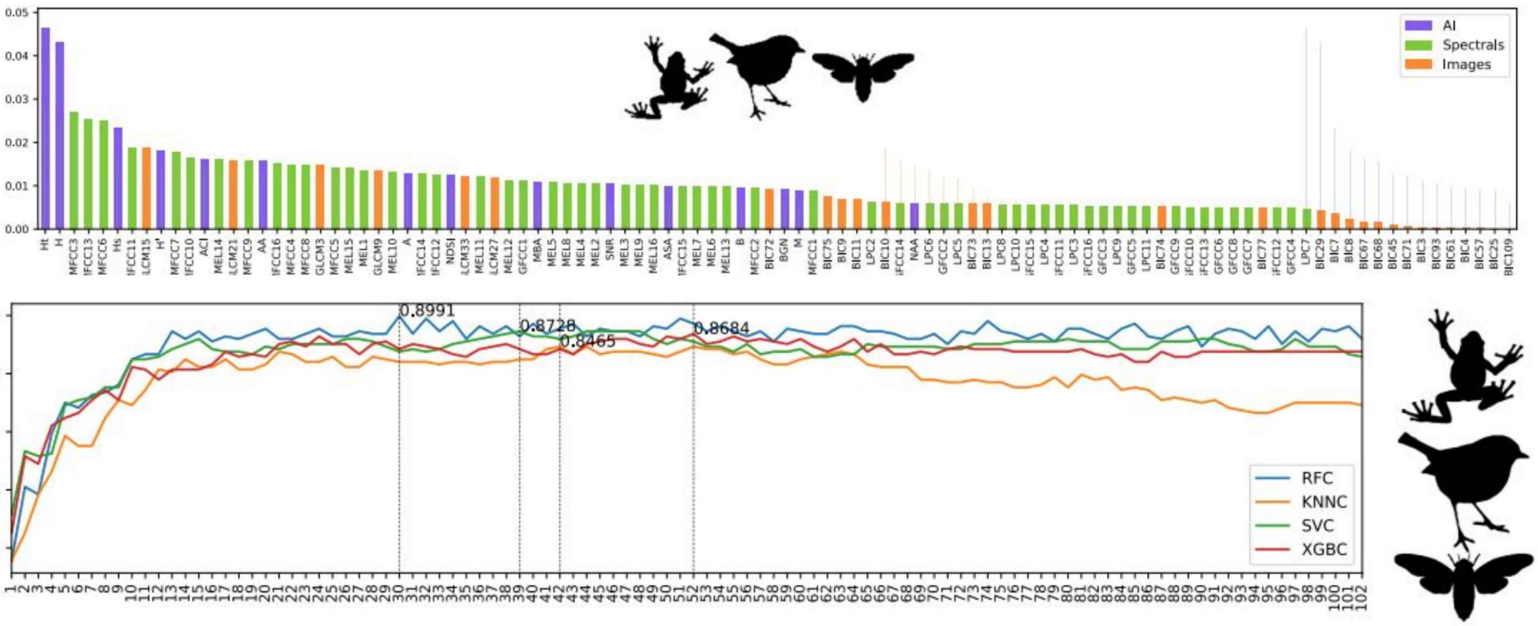
Application of one-stage instance segmentation with weather conditions in surveillance cameras at construction sites

Fig. 10. Qualitative evaluation of models with and without weather augmentation, with a focus on the quality of the polygon masks.

[16] https://doi.org/10.1016/j.autcon.2021.104034

Example: Sound event classification

Visualization and categorization of ecological acoustic events based on discriminant features



[17] https://doi.org/10.1016/j.ecolind.2020.107316

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Gracias

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