Machine Learning for plant phenology

ML at Rosario

ML at Rosario

Rosario's main product is...

ML at Rosario

Long history of Machine Learning applications to agro-industrial problems:

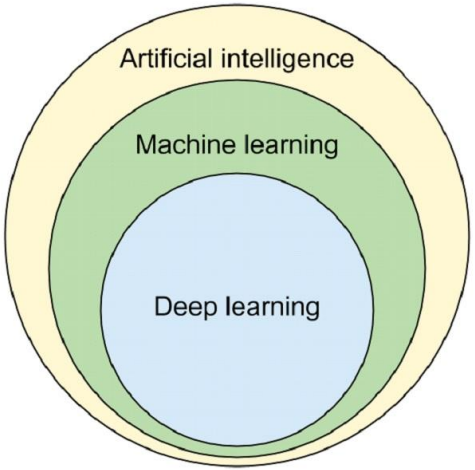
-Classical Machine Vision

-ML for Mass Spectrometry

-Deep Learning

Machine Learning?

What is ML?



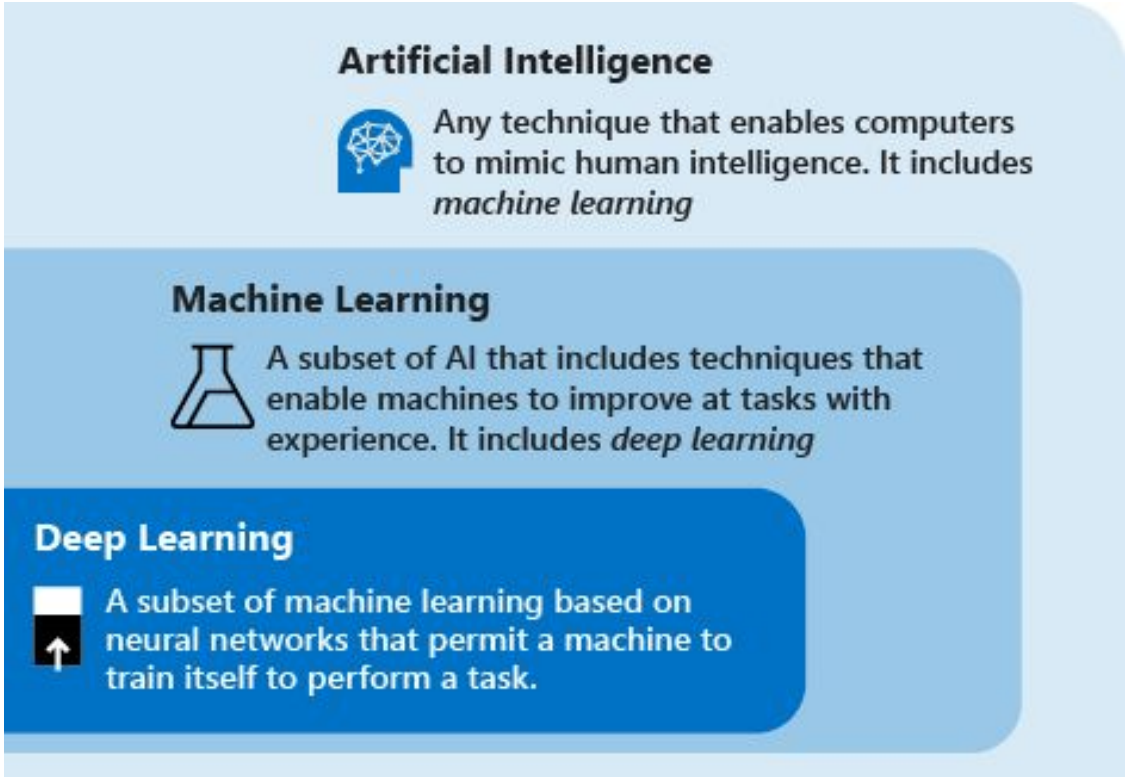
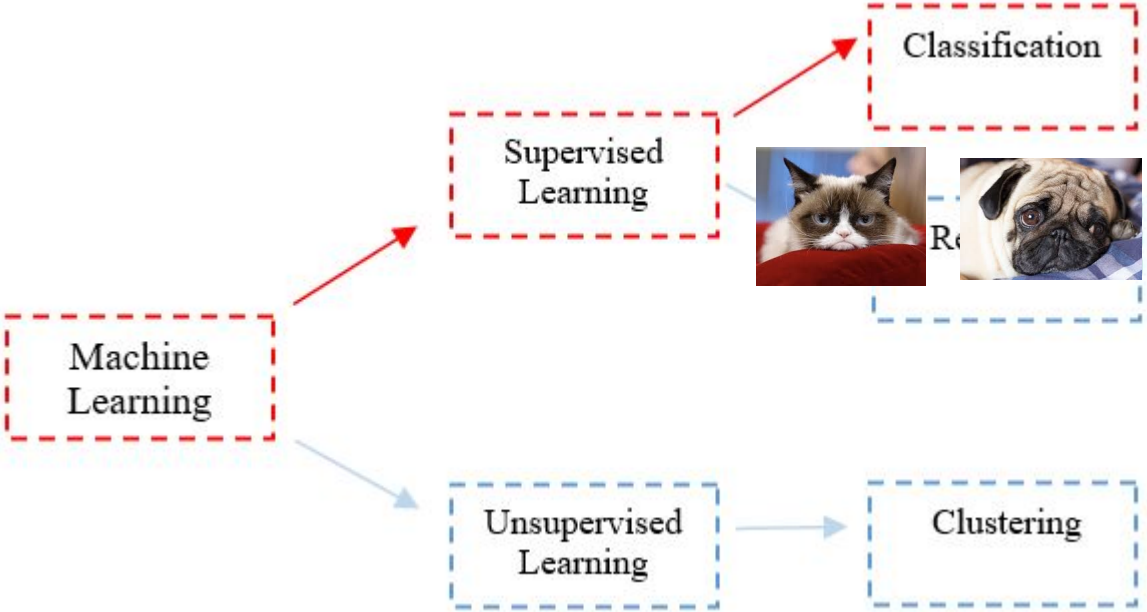


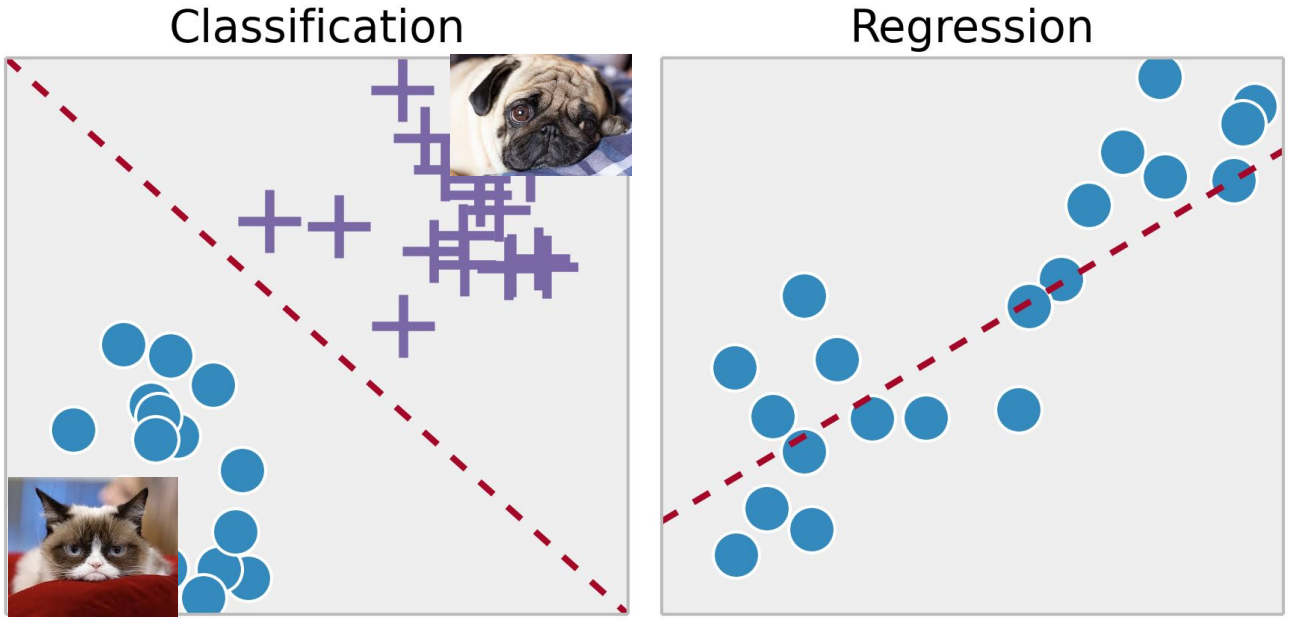
Figure from https://docs.microsoft.com/en-us/azure/machine-learning/concept-deep-learning-vs-machine-learning

What is ML?



From: Sossi Alaoui, Safae & Aksasse, B. & Farhaoui, Yousef. (2020). 10.1007/978-3-030-23672-4_6.

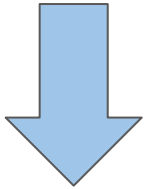
What is ML?



Machine Learning in plant breeding

ML in plant breeding

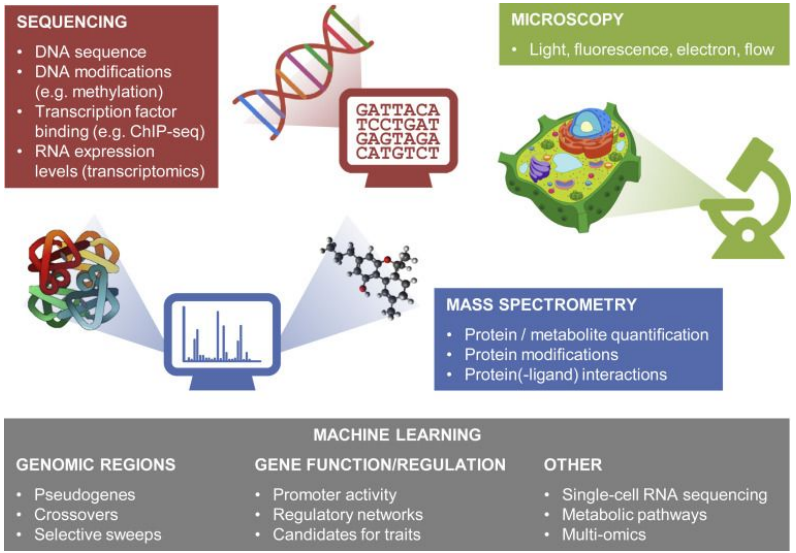
Microscopic level



Macroscopic level

ML at Microscopic level

Microscopic level

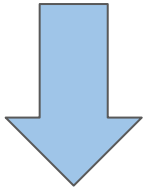


ML can unveil patterns, relationships, causality

Jan van Dijk et al., Machine learning in plant science and plant breeding (2021), iScience, 24:1, 101890

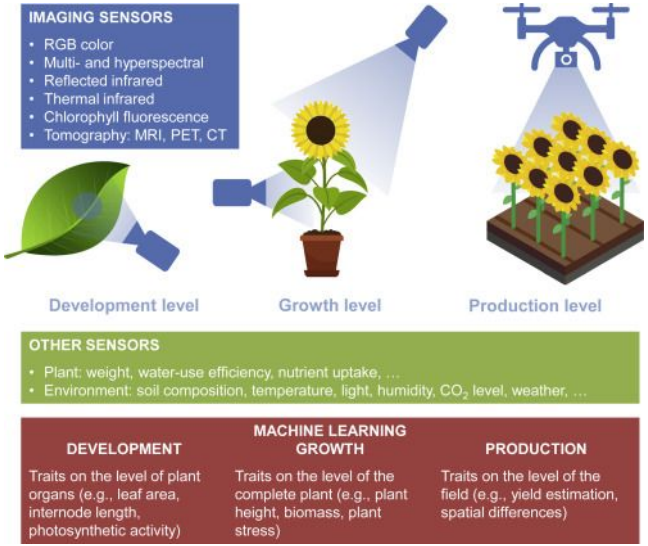
ML in plant breeding

Microscopic level



Macroscopic level

ML at Macroscopic level



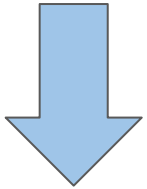
ML can measure, evaluate, compare

Macroscopic level

Jan van Dijk et al., Machine learning in plant science and plant breeding (2021), iScience, 24:1, 101890

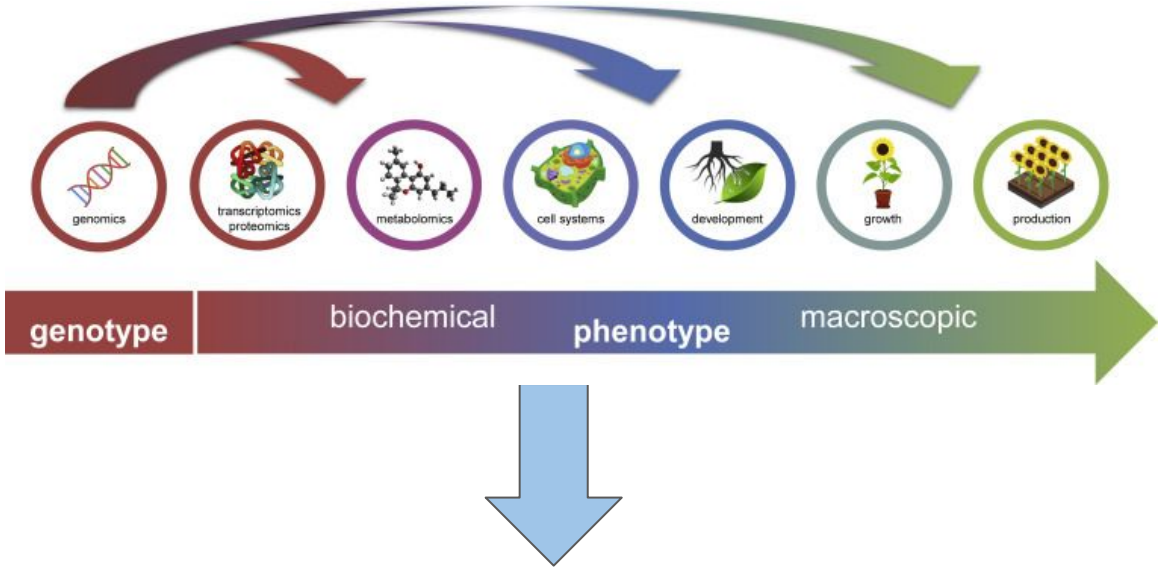
ML in plant breeding

Microscopic level



Macroscopic level

ML in plant breeding

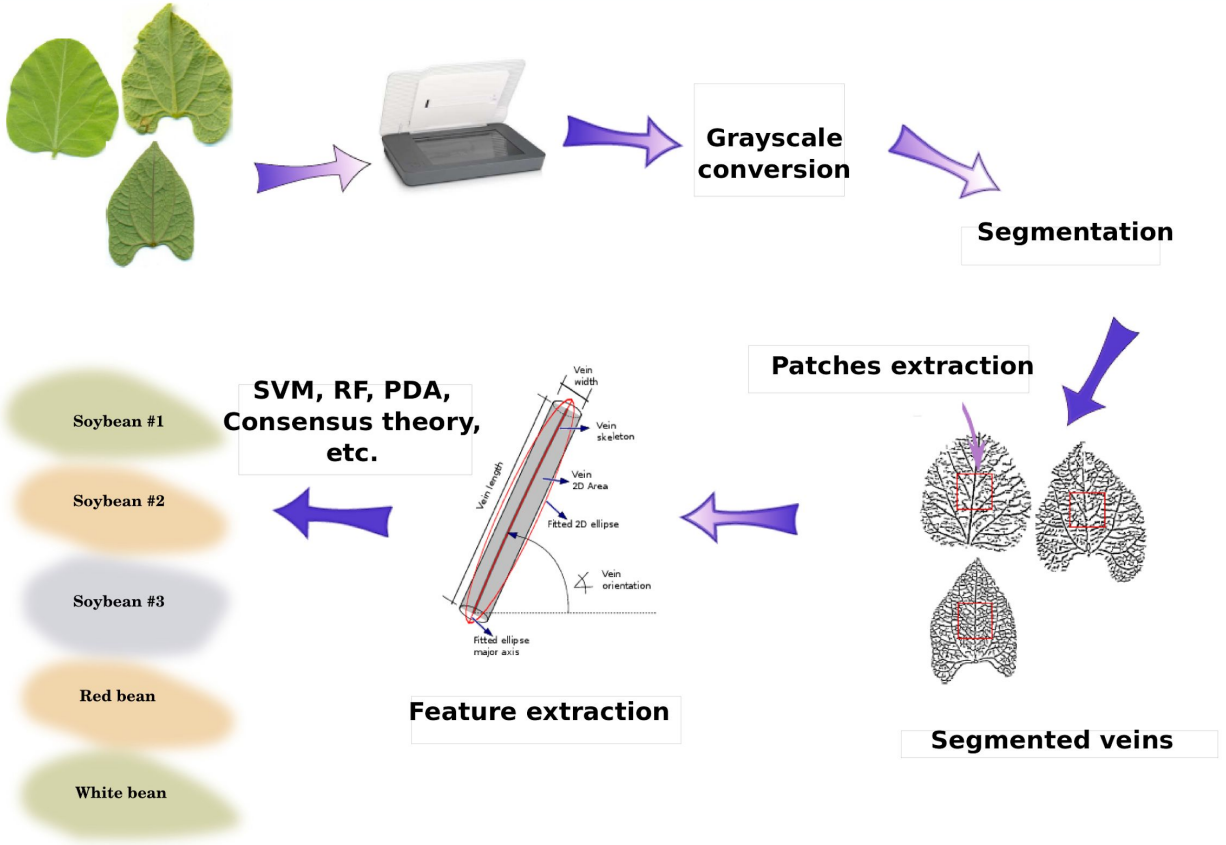


ML for prediction of phenotypes using genotypes

Jan van Dijk et al., Machine learning in plant science and plant breeding (2021), iScience, 24:1, 101890

ML for Image Analysis

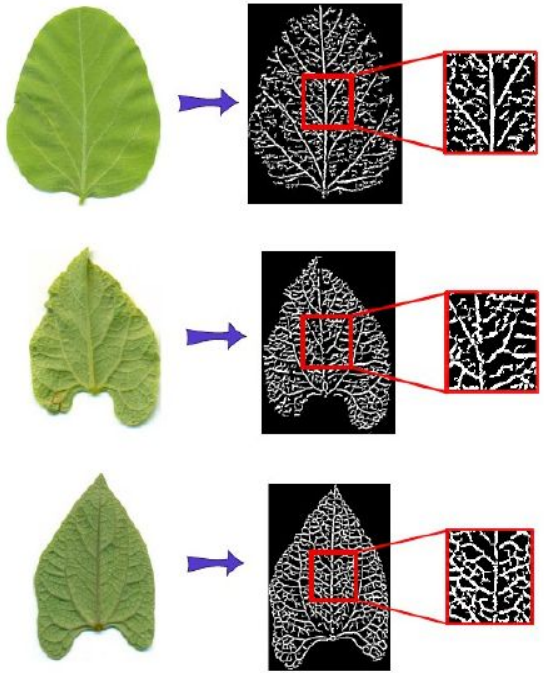
Classic computer vision



Larese, M.G. & Granitto, P.M. Machine Vision and Applications (2016) 27: 709

Image analysis

Leaf venation analysis for cultivar identification

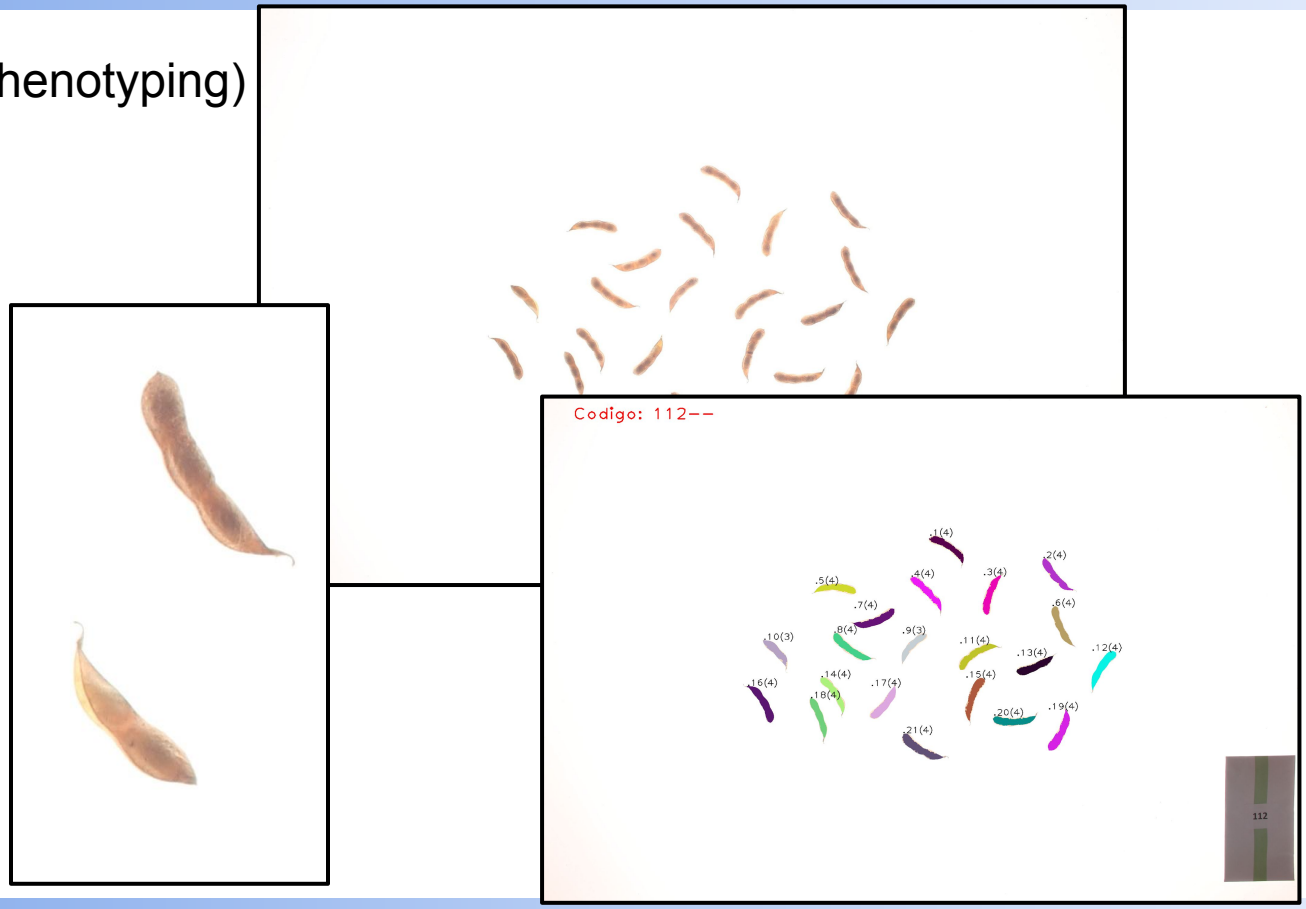


Detection of keypoints and relevant patterns

Cultivar identification:
Average human accuracy: 45%
Best result for automatic system: 60%

Image analysis

Counting seeds in pods (phenotyping)



Collaboration with IICAR (Conicet/UNR)

Image analysis

3D phenotyping of dried soybean plants

+

+ .... = 3D Model

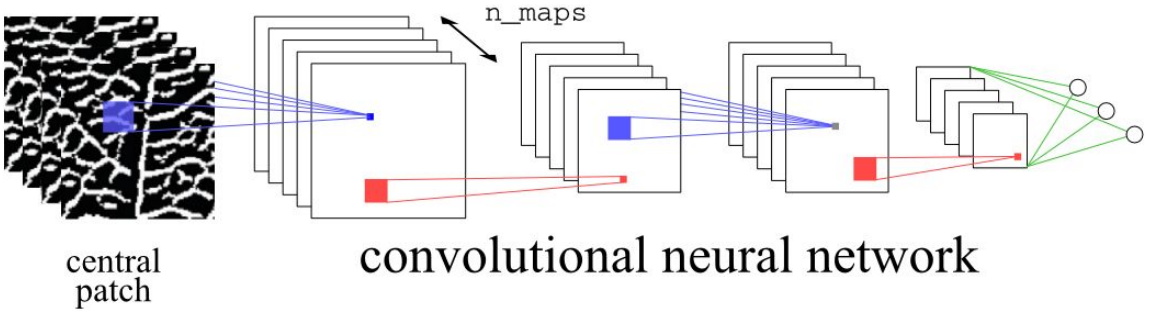
3D segmentation and analysis

Deep Learning

Leaf venation (again)

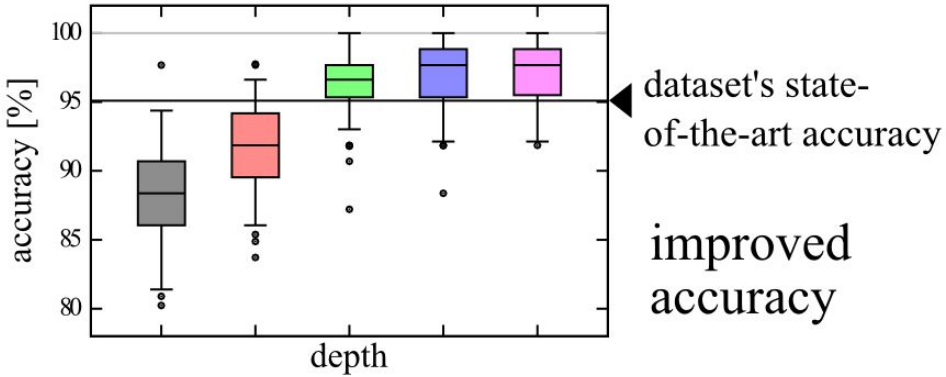
original image

vein segmentation



central patch

convolutional neural network



Grinblat, G. L., Uzal, L.C., Larese, M. G. & Granitto, P. M. (2016). Deep learning for plant identification using vein morphological patterns, Computers and Electronics in Agriculture, 127, 424.

Leaf venation (again)

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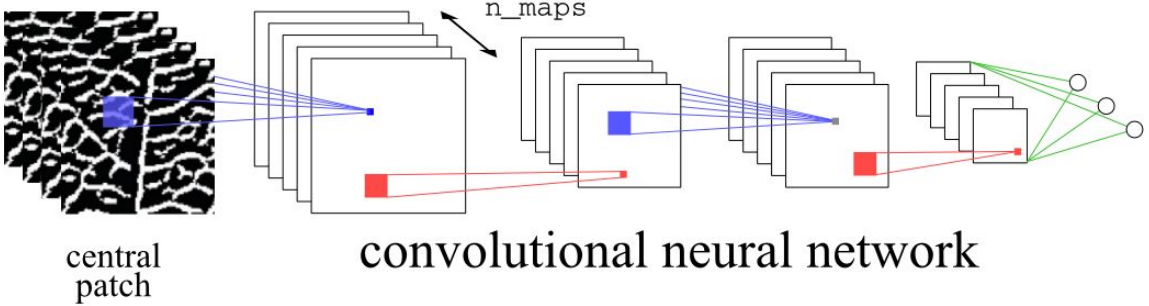


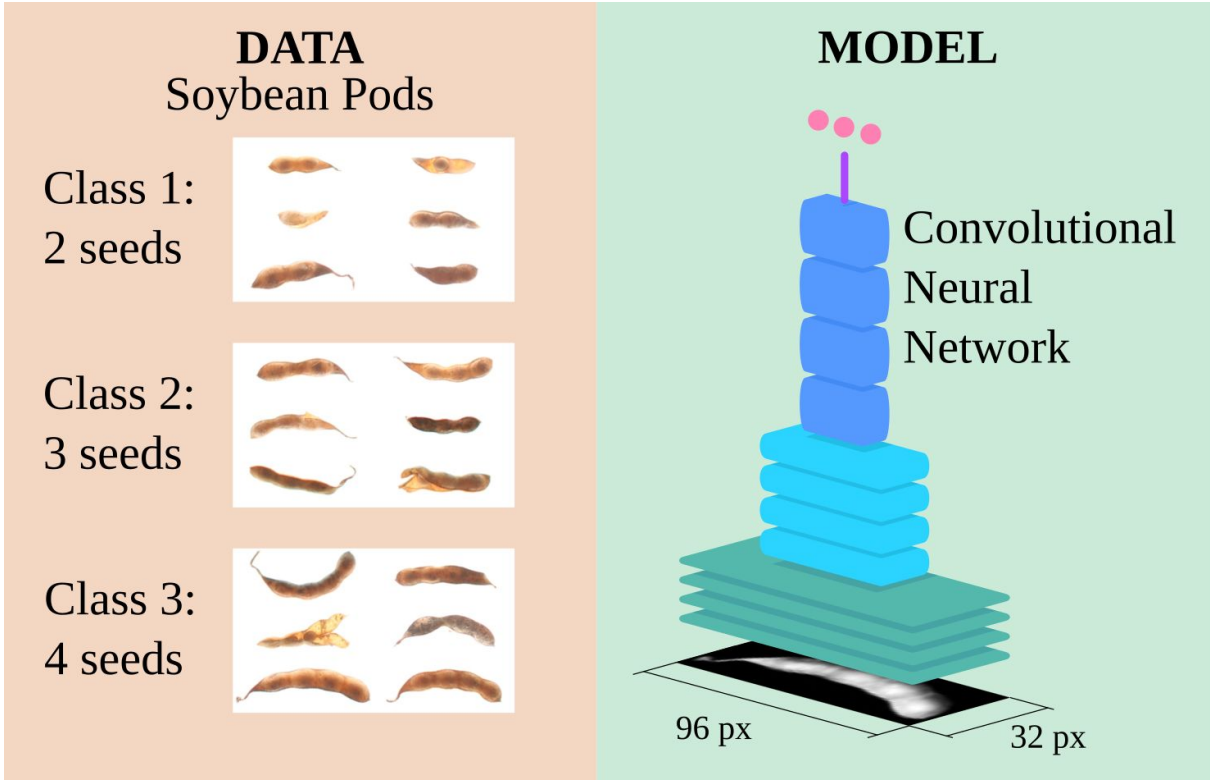
central patch

convolutional neural network

relevant patterns visualization

Grinblat, G. L., Uzal, L.C., Larese, M. G. & Granitto, P. M. (2016). Deep learning for plant identification using vein morphological patterns, Computers and Electronics in Agriculture, 127, 424.

Seed-per-pod estimation (again)



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Seed-per-pod estimation (again)

DATA

Soybean Pods

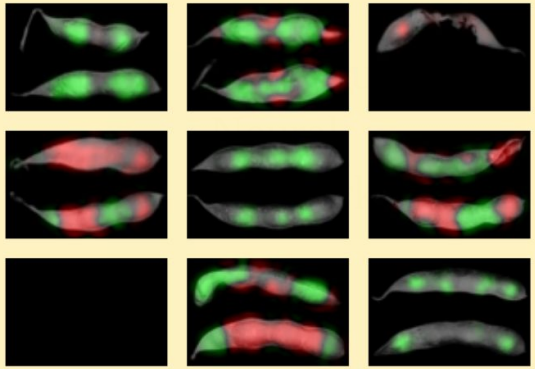
Class 1:
2 seeds

Class 2:
3 seeds

Class 3:
4 seeds

RESULTS

CNN's features visualization



Reached Classification Accuracy

0.92±0.05

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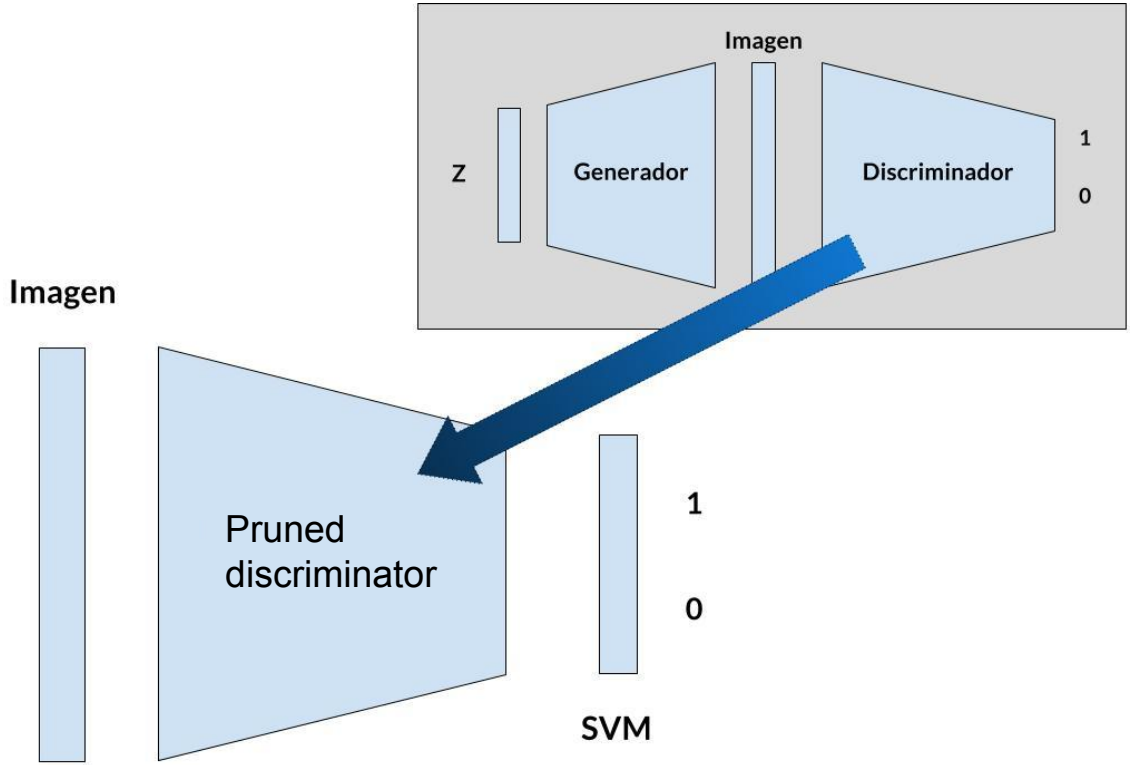
GANs for Transfer Learning



GANs for Transfer Learning

Autonomous agro-platform

GANs for Transfer Learning

Thank you!

C I F A S I S