Artificial Intelligence for automatic detection of insects from trap photos

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Supervisors :

Astrid CRUAUD & Jean-Yves RASPLUS

Présentation overview

Machine learning ?

Definitions and explanation

1

NGS OLICIT project

Focus on insect detection using AI

2

1

Machine learning ?

Definitions and explanation

What is machine learning ?

Input data specific program

Output
(e.g : Irrigation system)

Traditional programming

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(e.g : Irrigation system)

Traditional programming

Input data
+
Output data

Data-driven program

Machine Learning
(Supervised Learning)

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Traditional programming

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Data-driven program

Machine Learning
(Supervised Learning)

- ***Arthur Samuel is the creator of the term Machine learning, he describes this as, "It gives computers the ability to learn without being explicitly programmed."***

What is machine learning ?

(Supervised learning)

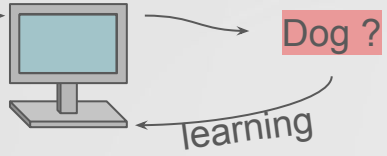
Learning phase

Test phase

What is machine learning ?

(Supervised learning)

Learning dataset



Prediction

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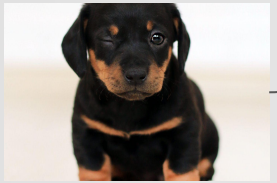

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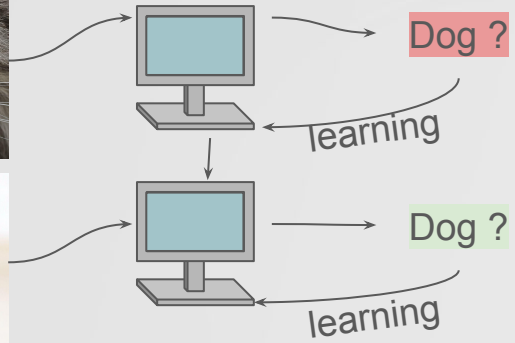

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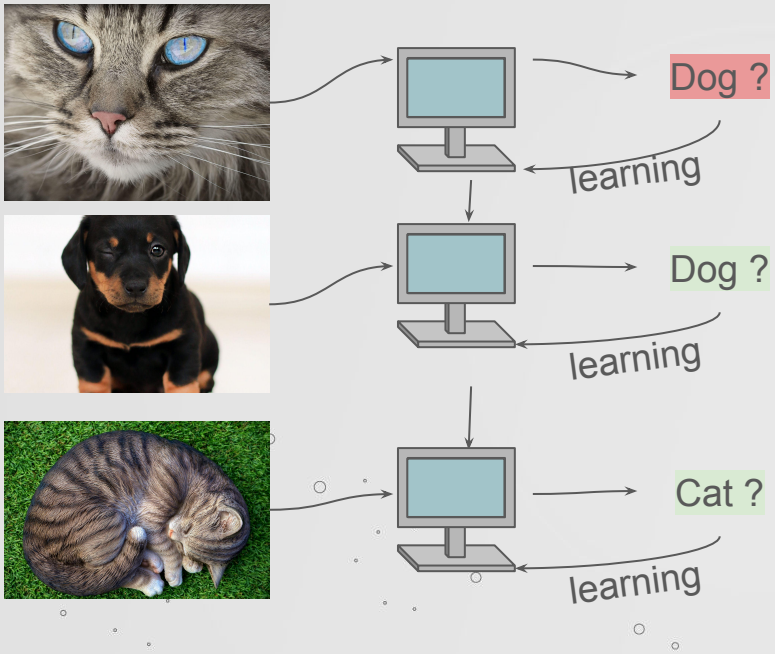

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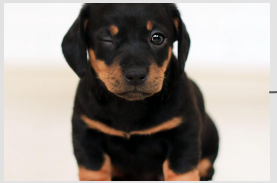
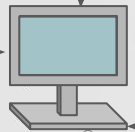


Dog ?

learning

Dog ?

learning



Cat ?

learning

Learning phase

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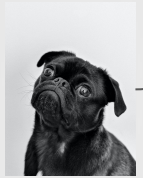
Prediction

Cat ?



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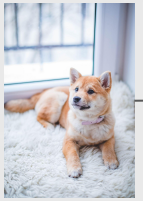

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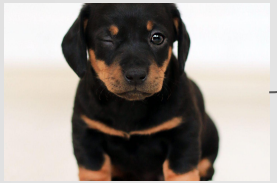

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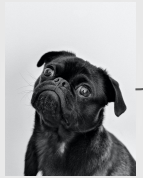
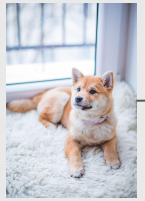




Prediction

Cat ?

Dog ?

Cat ?

Performance evaluation

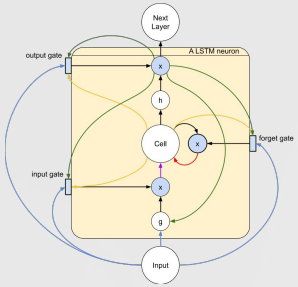
Test phase

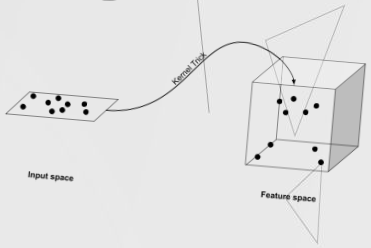
Three kind of machine learning (among others)

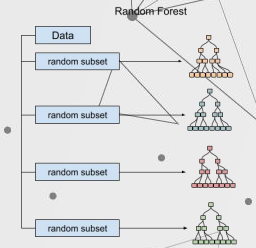
- Tree construction methods

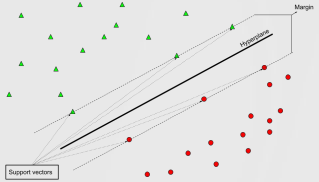
- Kernel methods

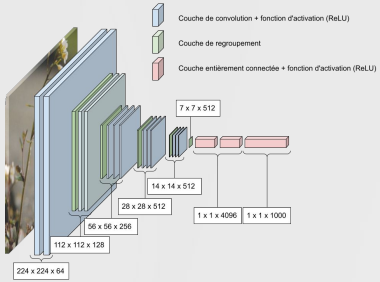
- Deep Learning

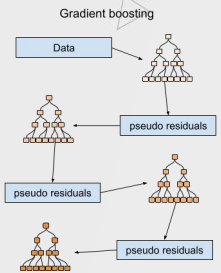


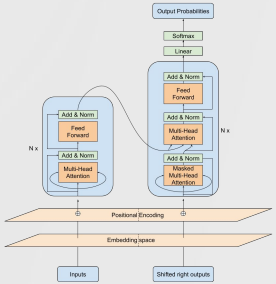


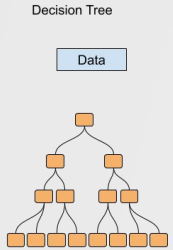












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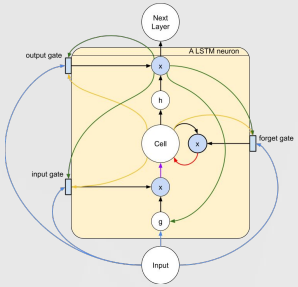

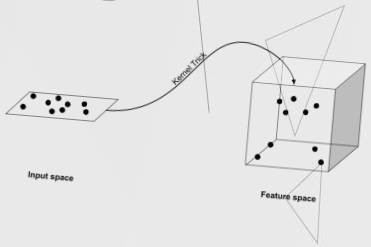

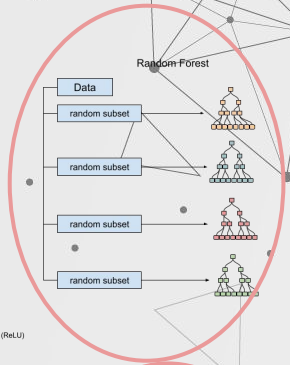

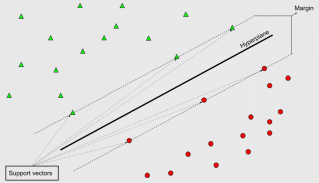

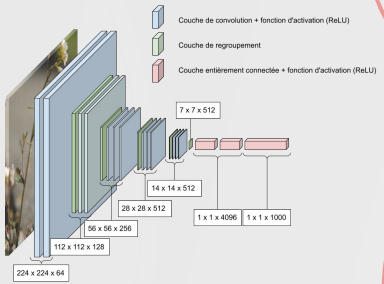

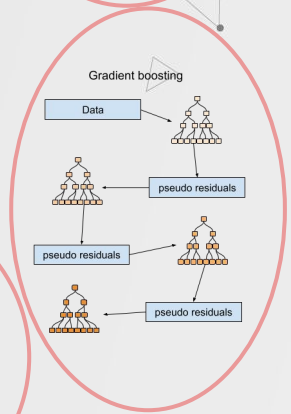

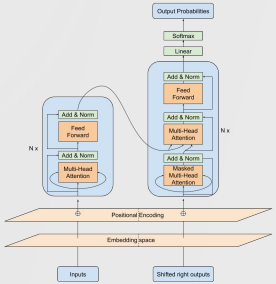

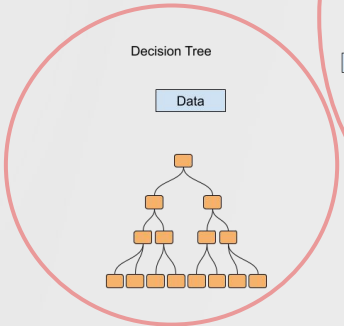

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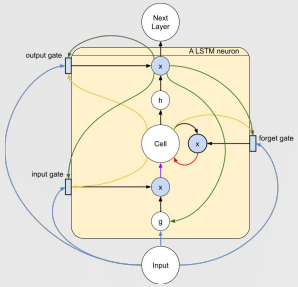

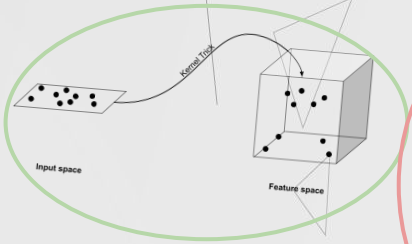

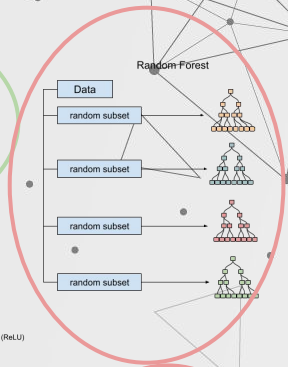

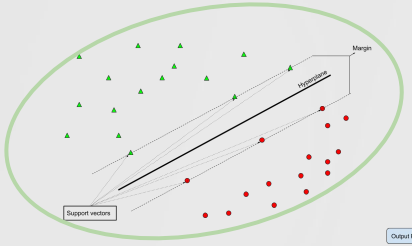

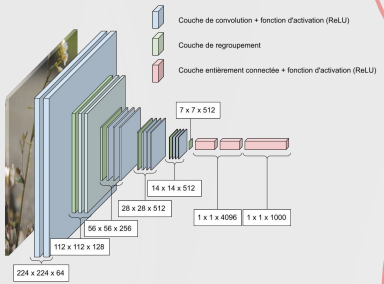

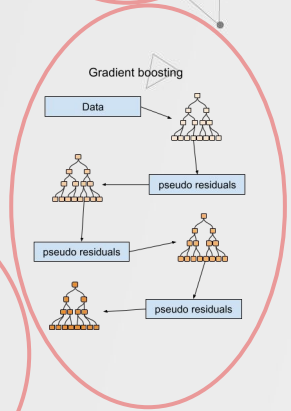

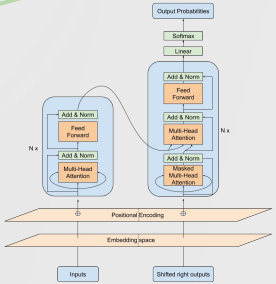

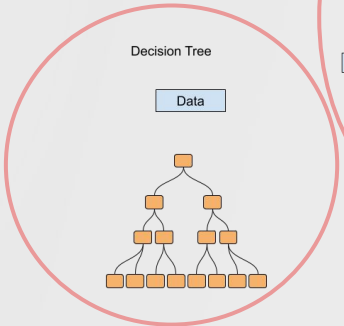

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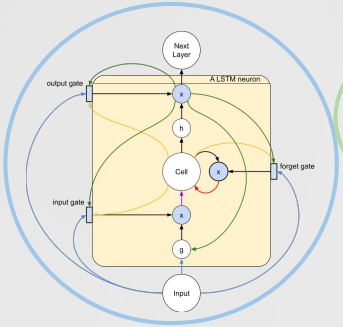
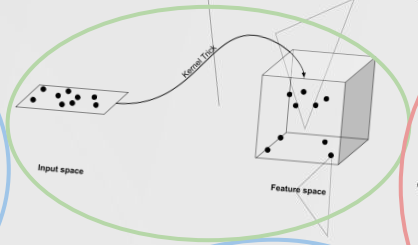
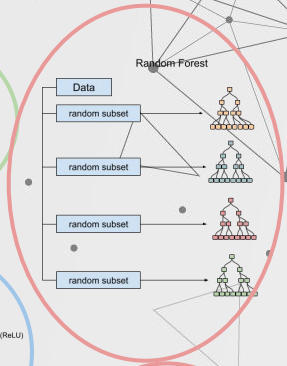
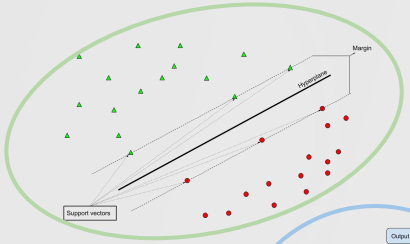
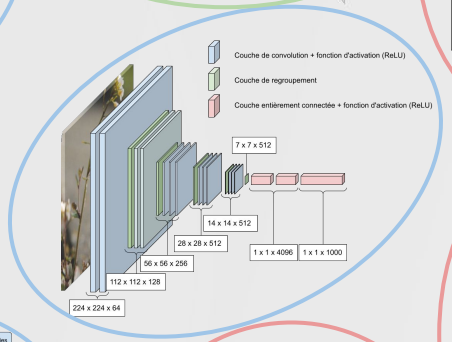
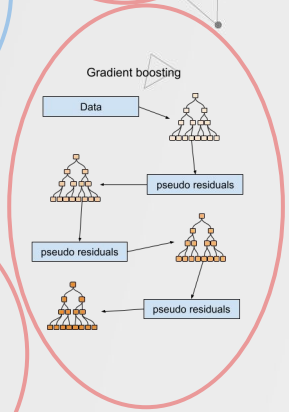


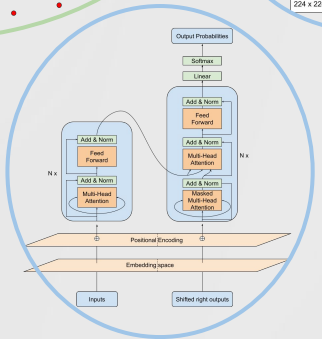


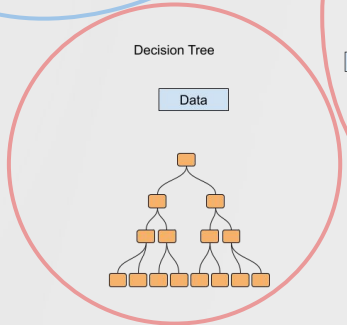










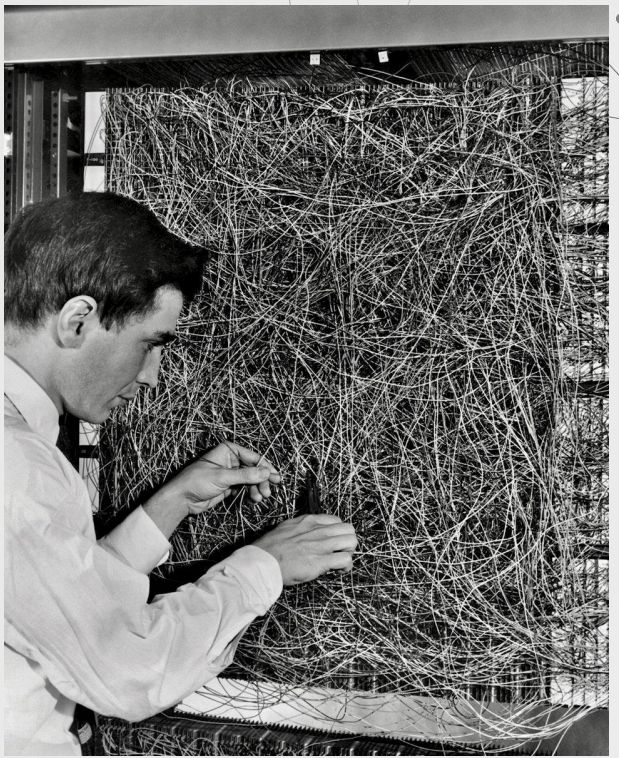


Deep Learning

Introduced in 1957 by Frank Rosenblatt: The perceptron.

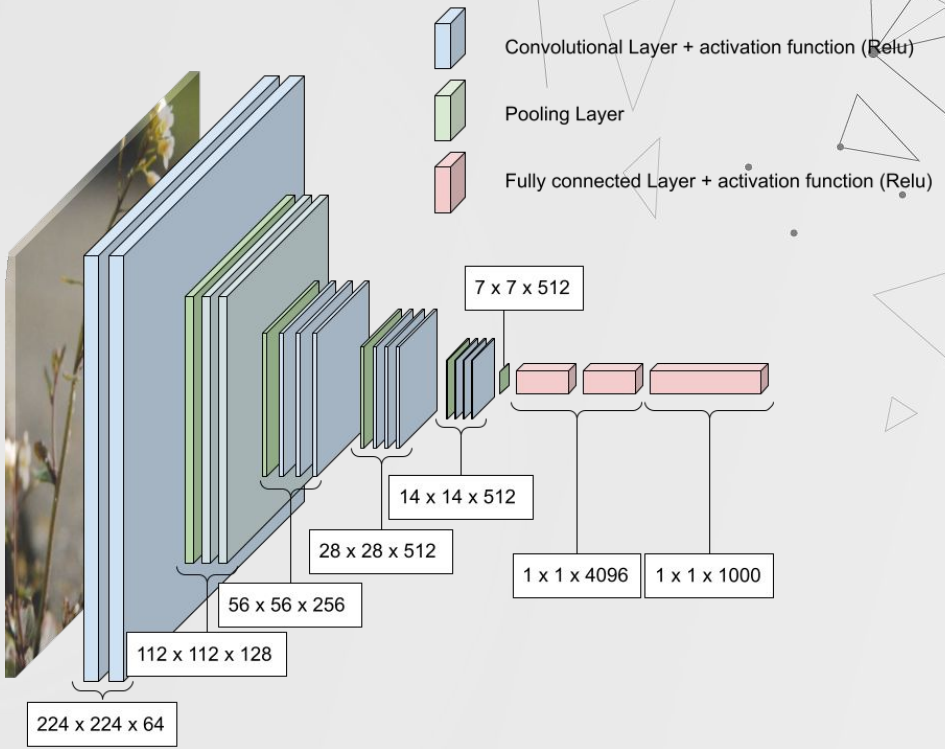
- Solves linearly separable problems.

Multi-layer networks needed to solve more complex problems.



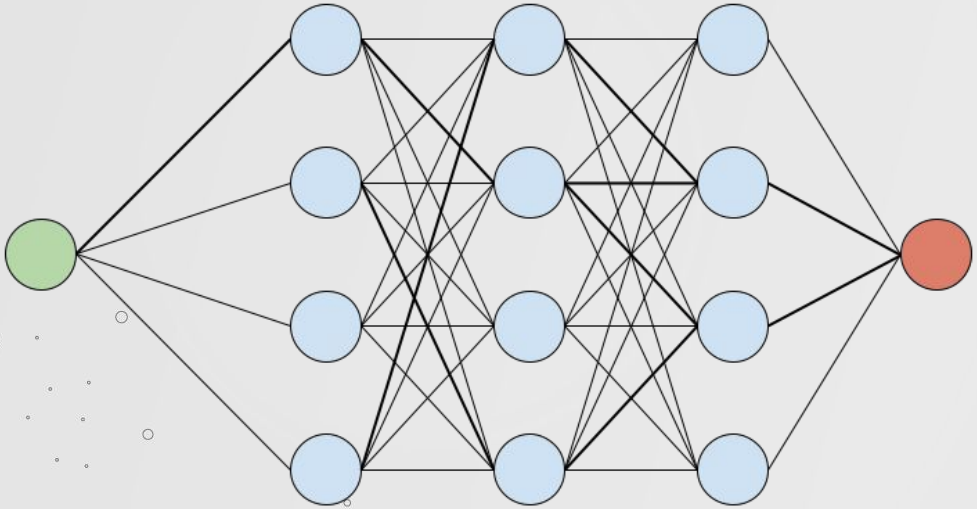
Deep Learning

Popularized in 1997 by Yann Lecun: The CNN



Deep Learning

Solves a problem by adjusting the weights of connections between neurons to minimize the gap between model predictions and true target values



2

NGS OLICIT project

Focus on insect detection using AI

Project background

Study of partner farmers' Citrus and Olea plots in Corsica and on the mainland

Project background

Need to study the interactions of species (pests and beneficials) with each other and with their environment

1 - Collecting insect community

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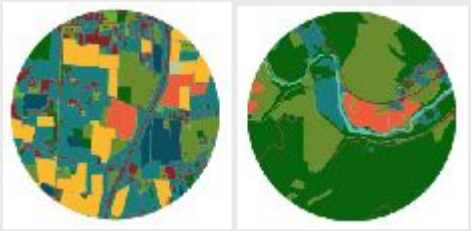

Importance of environmental data, climate, naturalness, inputs, etc…

2 - Collecting environment information

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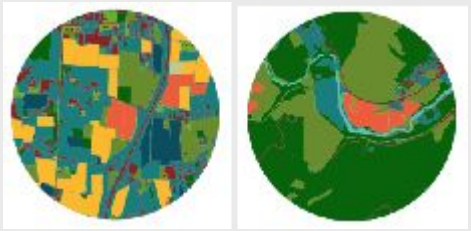

Importance of environmental data, climate, naturalness, inputs, etc…

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Importance of studying ecosystem functioning (regulation proxy)

3 - Collecting parasitism rate/ damages

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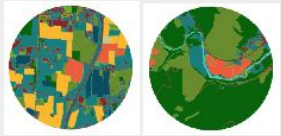

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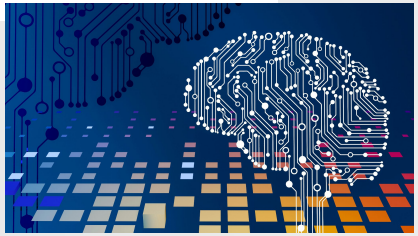


Importance of combining all these sources of information to create a regulation score

4 -Natural regulation score and levers for improvement

Project stages

1 Insect capture

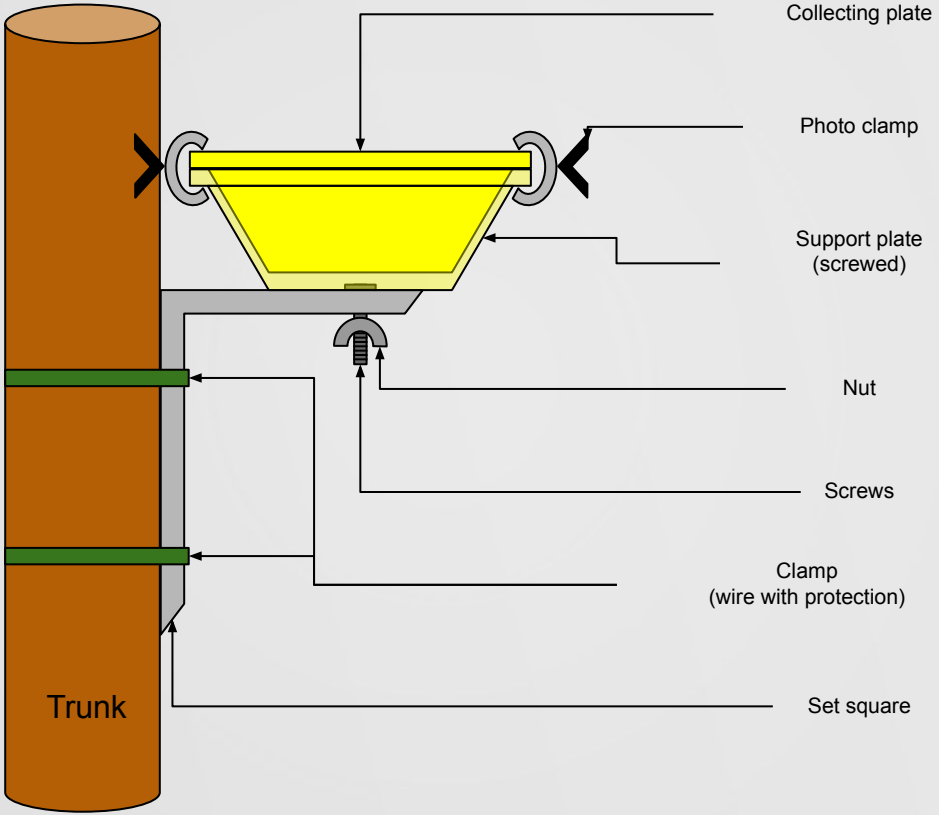
2 Image acquisition

3 Image labeling

4 Learning and evaluation

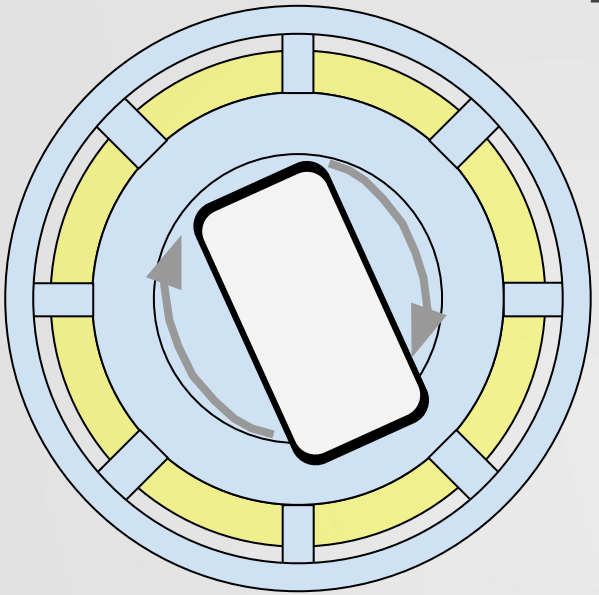
5 What's next?

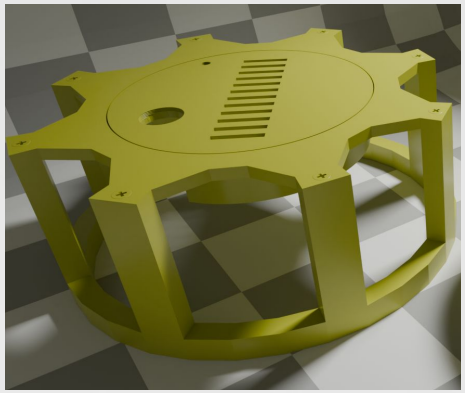
1- Insect capture

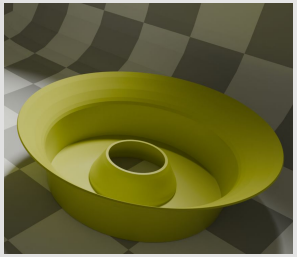


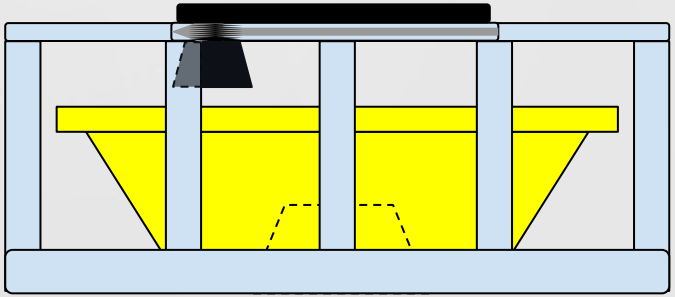
- Use of MPG (food-grade monopropylene glycol)
- Citrus and Olea plots in Corsica and on the mainland
- Collection 1 to 2 times a month

2- Image acquisition





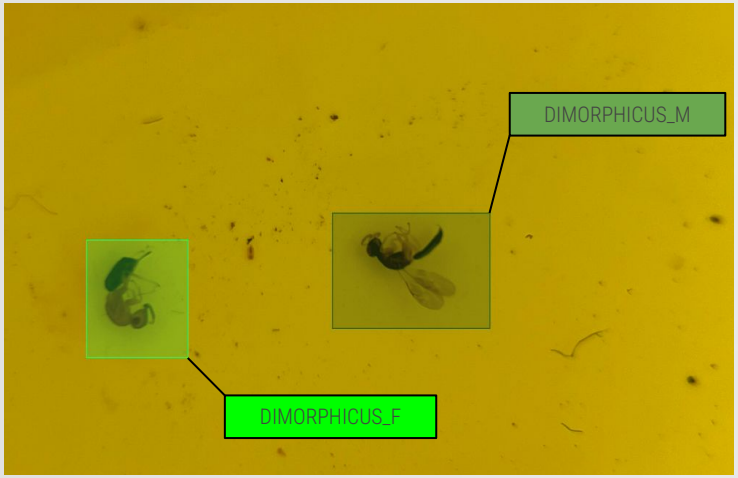


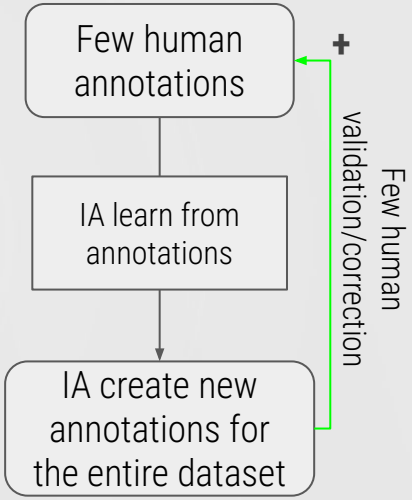


- Photo station and 3D-printed model photo plate
- X10 magnification lens to aim at the station
- Photo station takes 8 photos of the entire plate via a rotating system
- Photo plate allows to reduce the surface of the plate, ignoring the center

3- Image labeling

🔁 HixLoop by BionomeeX





- Labeling tool capable of learning to annotate from any human annotation
- Expert labeling
- Annotation composed of a restricted area and an insect label.

4- Learning and evaluation

- Quick and easy to set up
- Less accurate for overlays and small objects
- Less effective for high-resolution images

YOLOv7

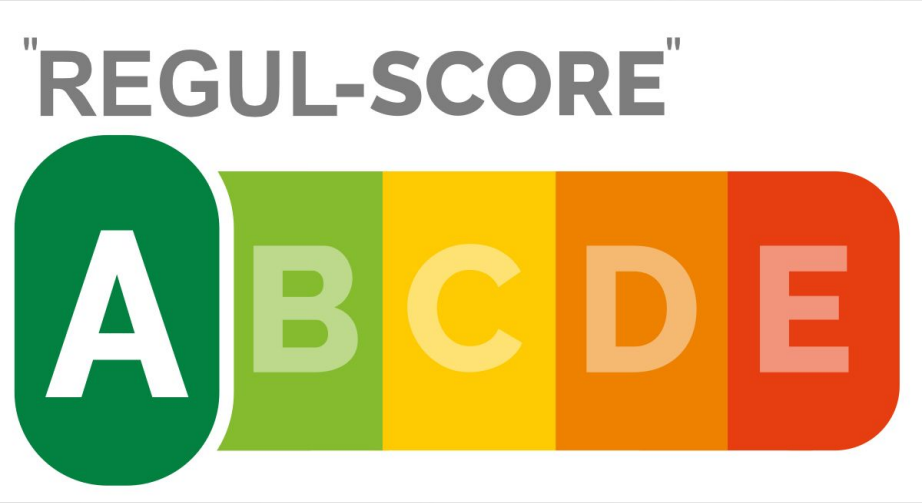
by Hong-yuan Mark Liao's Lab

4- Learning and evaluation

- Architectural flexibility
- Wide range of applications
- Not well suited to real time problems.

Detectron2
by Meta Research

5- What's next?



- Creation of documented metric for evaluating plots according to the population found as well as environment informations.

- Consideration of climatic factors to improve this score and make it adaptable to climate change.

Thank you for your attention !