Overview of the PlantCLEF 2020 Task

Cross-domain plant classification (from herbariums to field photos)

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nowadays automated systems perform well in **temperate regions**
- deep learning
- big data

**Top1 PlantCLEF 2018: 0,88**
nowadays automated systems perform well in **temperate regions**
- deep learning
- big data

...but poorly in **tropical regions**:

Top1 PlantCLEF 2018: 0.88

Top1 PlantCLEF 2019: 0.25

**Plant biodiversity long tail distribution**
Data deficient tropical countries

- remote isolated areas
- plant in canopy
- many species in a genus
- very small sp.
- But potentially millions of underexploited digitized herbarium sheets collected over centuries
A cross domain classification task

One **training** sample in domain of **herbariums**

One **test** sample in domain of **field photos**

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**An “easy” example**

- brownish, dry and matt content VS shiny green leaves
- but the "obovate" shapes and the nervation should match both domains

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**Unonopsis stipitata Diels**
A cross domain classification task

One **training** sample in domain of **herbariums**

One **test** sample in domain of **field photos**

- global view vs close-up
- dry fruits vs immature fruits

**Inga acrocephala Steud.**
A cross domain classification task

One **training** sample in domain of **herbariums**

One **test** sample in domain of **field photos**

A difficult example

- two branches with leaves and fruit(s)
- but flattened vs 3D perspective (side view of the fruit), light
- strips of scotch tape, several textual annotations, paperclip, envelopes ...

*Strychnos cayennensis* Krukoff & Barneby
A cross domain classification task

**Training samples in domain of herbariums**

One **test** sample in domain of **field photos**

**A impossible example**

- barks are rarely collected in herbariums
- plant observations with several photos of various organs may compensate the lack of information

*Bocca prouacensis Aubl.*
A cross domain classification task

- State of the art?
  - “classical” CNNs? (ability to represent features in a common space?)
  - vs domain adaptation approaches?

- Performances?
  - Overall?
  - vs genericity on rare species? (on species with only herbarium sheets as training examples)
  - On common species with many training photos (do the herbarium sheets disturb here the performances?)
Dataset

**TRAINING SET**

- L’HERBIER IRD DE GUYANE
- iDigBio

997 species (French Guiana)
330,752 herbarium sheets
4,482 field photos (375 sp)
354 specimens on both domains

**TEST SET**

Two world-class experts of the Guyana flora
Tribute to Marie-Françoise “Fanchon” Prévost
Jean-François Molino

638 plant observations related to 3,186 field photos and 408 species

Grid density map of the dataset

External data allowed

- Life
- Encyclopedia of Life
- Bing
- GBIF
- Google
Metric *(primary)*

Mean Reciprocal Rank

\[
\text{MRR} = \frac{1}{|Q|} \sum_{i=1}^{Q} \frac{1}{\text{rank}_i}
\]

\(Q = 638\) plant observations
Mean Reciprocal Rank

\[ \text{MRR} = \frac{1}{|Q|} \sum_{i=1}^{Q} \frac{1}{\text{rank}_i} \]

\( Q = 200 \) plant observations related to the most difficult species “in the world”
## Participation

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<th>Domain Adaptation</th>
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- **With or without external data**
- **Auxiliary tasks (self supervision, genus & family classifiers)**
- **Separate data augmentation techniques adapted to each domain**

71 registered teams
7 teams crossed the finish line
49 tested methods
Results:

A difficult task

MRR 2019: 0.376
(same flora, more species, mainly photos in the training set)
Results: “classical” CNNs performed quite poorly
The use of external data with “classical” CNNs did not greatly improve the performances.
Results: “classical” CNNs vs domain adaptation

2 different domain adaptation approaches performed much better than CNNs alone:

- **ITCR PlantNet: Few shot Adversarial Domain Adaptation (FSADA)**
  -> fool a discriminator to learn common feature space

- **Neuon AI: Triplet loss and siamese network**
  -> learn the similarity between herbarium sheets and field photos instead of directly classifying the plant species
Results: overall performances vs genericity

Multi-task: taxonomy + self supervision help significantly

Neuron's method generalizes better to species with few training field photos
Predictions filtered to 1k classes for fair comparison
Conclusions

The most **difficult task** in all PlantCLEF editions

**Domain adaptation** approaches outperformed “classical” CNNs

**Rare species**: have to deal with a compromise between **genericity** and overall performance

**Common species**: herbarium sheets not really profitable for the species with many training photos

-> still searching for an efficient universal technique!

PlantCLEF 2021
Thank you