GBIF Global Biodiversity Information Facility

CORNELL TECH

Ectatomma tuberculatum observed in Peru by manimiranda.
Photo via iNaturalist (CC BY-NC 4.0)

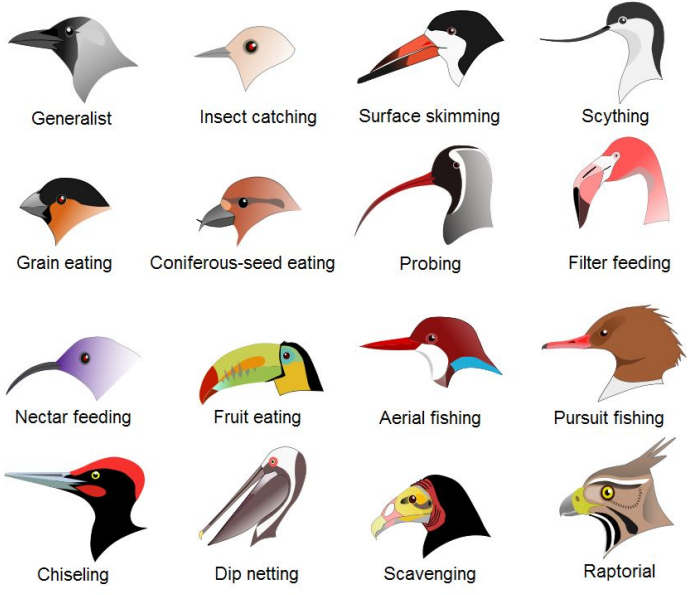
Training Machines to Identify Species using GBIF-mediated Datasets

Serge Belongie

Part I: Visipedia
Capturing & Sharing Visual Expertise

What Is Visipedia?

- A user-generated encyclopedia of visual knowledge
- An effort to associate articles with large quantities of well-organized, intuitive visual concepts



http://en.wikipedia.org/wiki/Bird

Motivation

- People will willingly label or organize certain images if:
  - They are interested in a particular subject matter
  - They have the appropriate expertise

Ring-tailed lemur

Thruxton Jackaroo

(A) Easy for Humans

Chair? Airplane? …

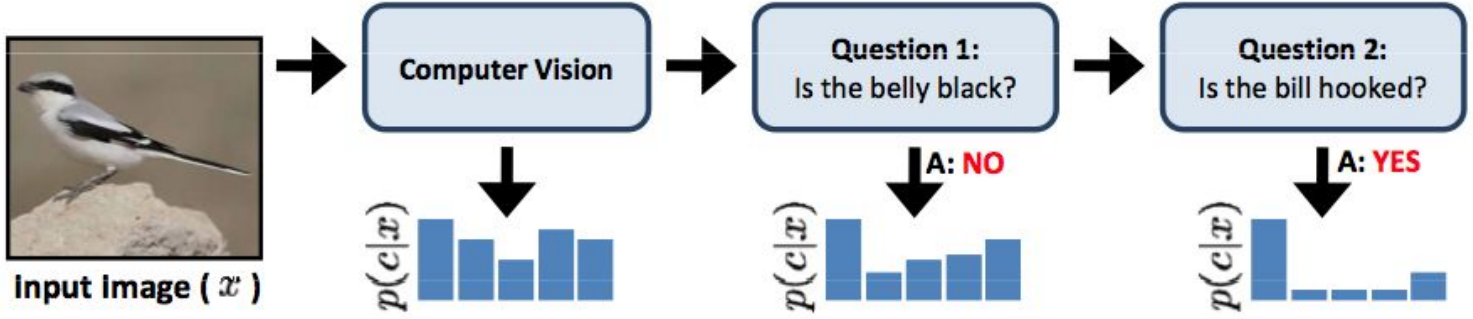
(B) Hard for Humans

Finch? Bunting?…

(C) Easy for Humans

Yellow Belly? Blue Belly? …

Visual 20 Questions



Algorithm 1 Visual 20 Questions Game

1: $U^0 \leftarrow \emptyset$
2: **for** $t = 1$ to 20 **do**
3: $\quad j(t) = \max_k \mathrm{I}(c; u_k | x, U^{t-1})$
4: $\quad$ Ask user question $u_{j(t)}$, and $U^t \leftarrow U^{t-1} \cup u_{j(t)}$.
5: **end for**
6: Return class $c^* = \max_c p(c|x, U^t)$

antedeepluvian

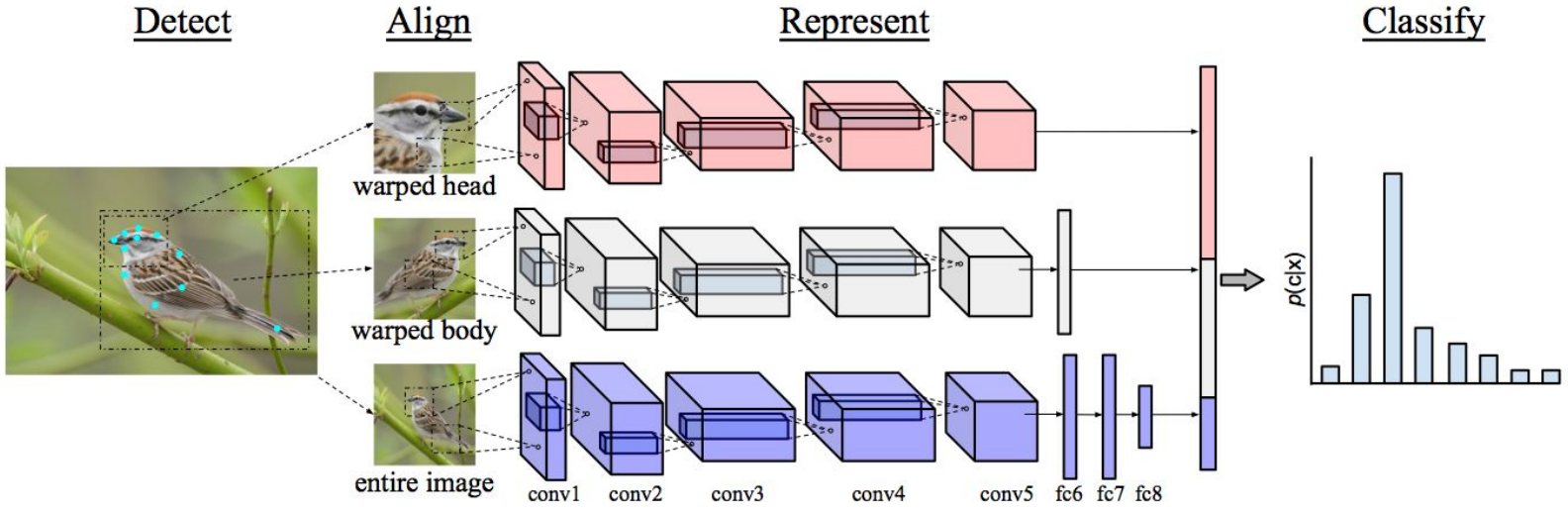
an·te·deep·lu·vi·an

ˌan(t)ēdēpˈlo͞ovēən/

adjective

1. before the flood of deep learning papers
2. “Histograms of vector quantized filter responses are *antedeepluvian* features.”

Pose Normalized Deep ConvNets



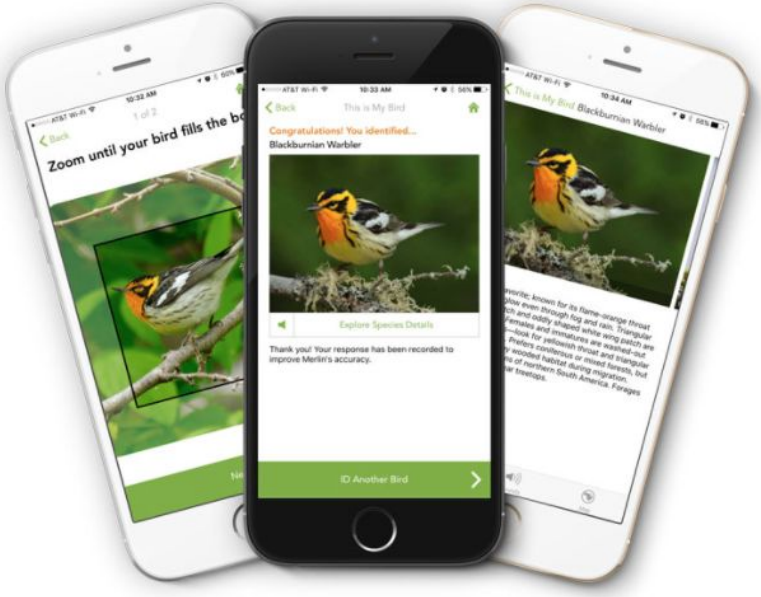
[Van Horn, Branson, Perona, Belongie BMVC 2014]

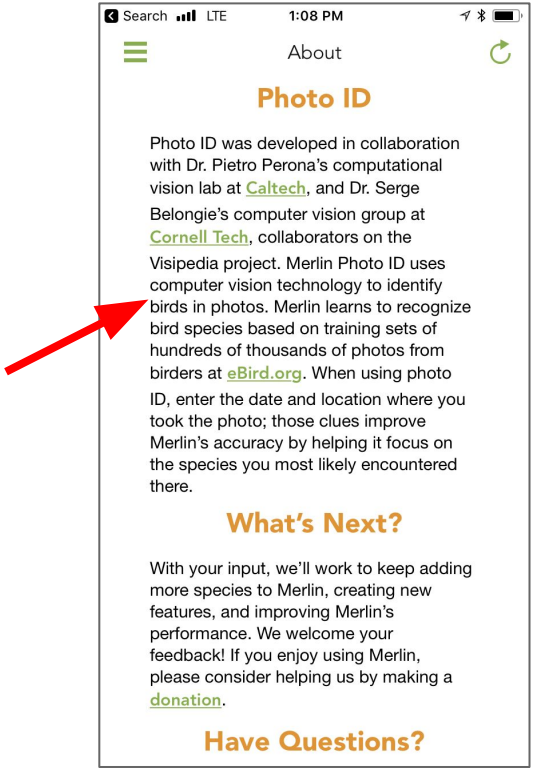

CCUB NABirds
700
Try out on a new dataset
for fine-grained recognition,
featuring 550 of North America's
most common birds. The full dataset will be
available in the fall. Join the competition today
and download the "taster" dataset!
http://birds.cornell.edu/nabirds
CCUB NABirds includes:
• More than 700 visual categories,
organized taxonomically
• Photos curated in collaboration with domain experts
• Data organized in a researcher-friendly, widely-used PASCAL VOC format
For more information contact: Ryan Farrell (farrell@eecs.berkeley.edu)
TheCornellLab
of Ornithology

Merlin (iOS & Android)

Photo ID now in mobile apps

A new advanced version of the Photo ID tool is now available for download in the latest version of Merlin Bird ID for Android and iPhone. Select an image from your smartphone image gallery or snap a shot from the back of your cameras viewfinder, and Merlin will walk you through the 2 quick steps before showing you a list of possible species.





eBird.org


675K
IMAGES
iNaturalist Google
Large Scale Species Classification Competition
Results presented at CVPR 2017 Hawaii at 4th Workshop on Fine-Grained Visual Categorization
5000
SPECIES
https://github.com/visipedia/inat_comp
FGVC4
iNaturalist.org
Google

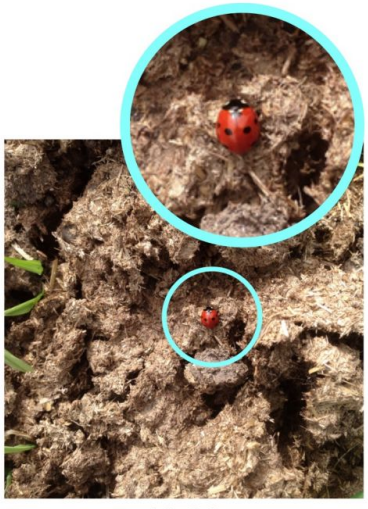

iNaturalist
Competition
2018
8,000 species
Long Tail Distribution
FGVC5
iNaturalist


iWildCam
Competition
2018
FGVC5

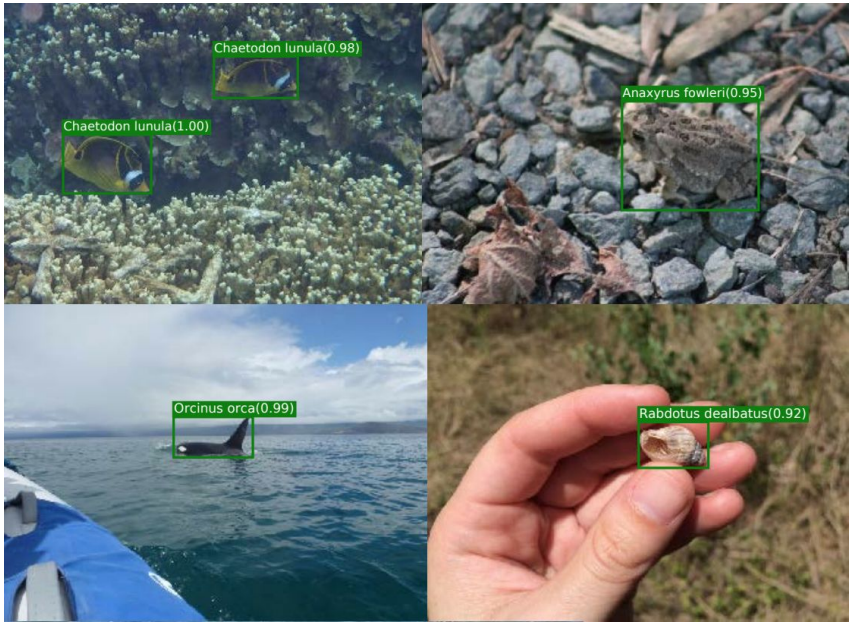

Fungi
Classification
Challenge
2018

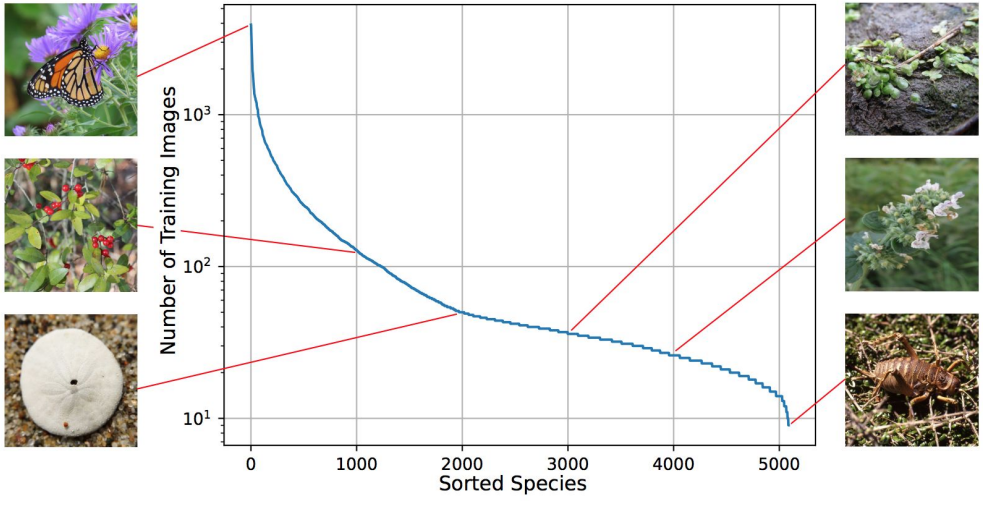

Flower Classification
Challenge 2018
1,000 species
FGVC5
PictureThis

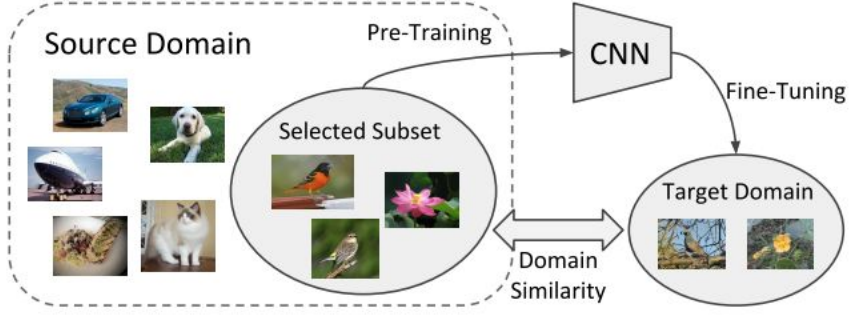
Two-spotted ladybug
Adalia bipunctata



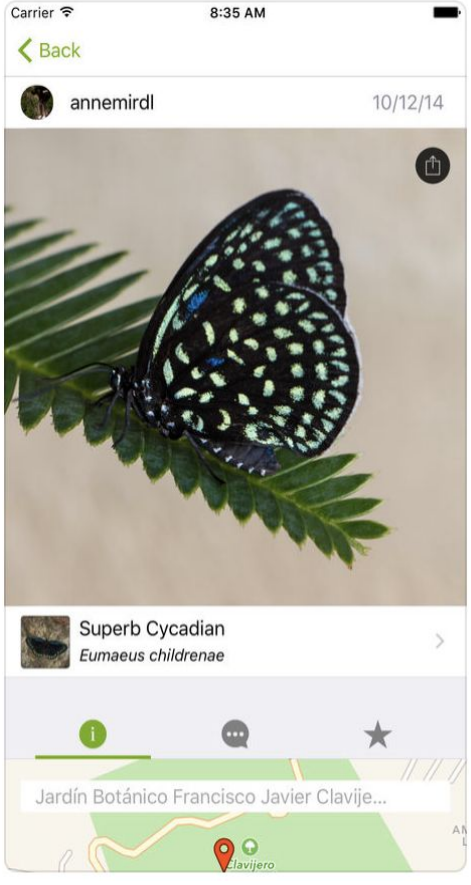
Seven-spotted ladybug
Coccinella septempunctata

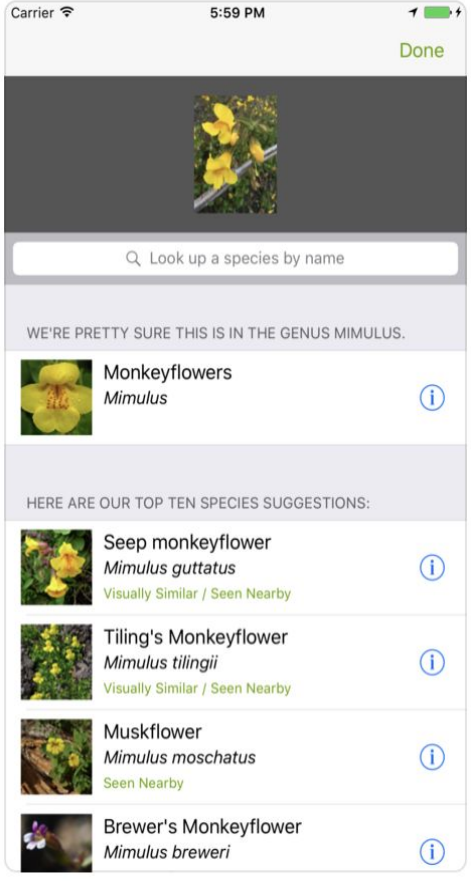


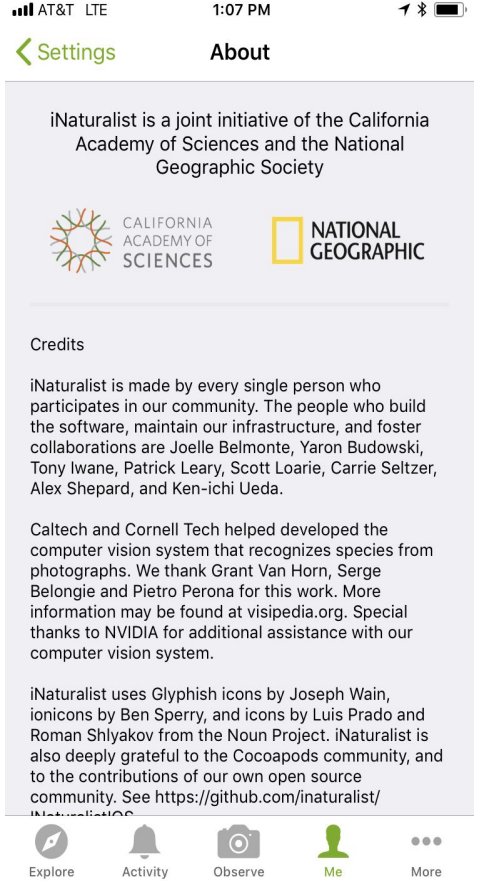




iNaturalist (iOS & Android)



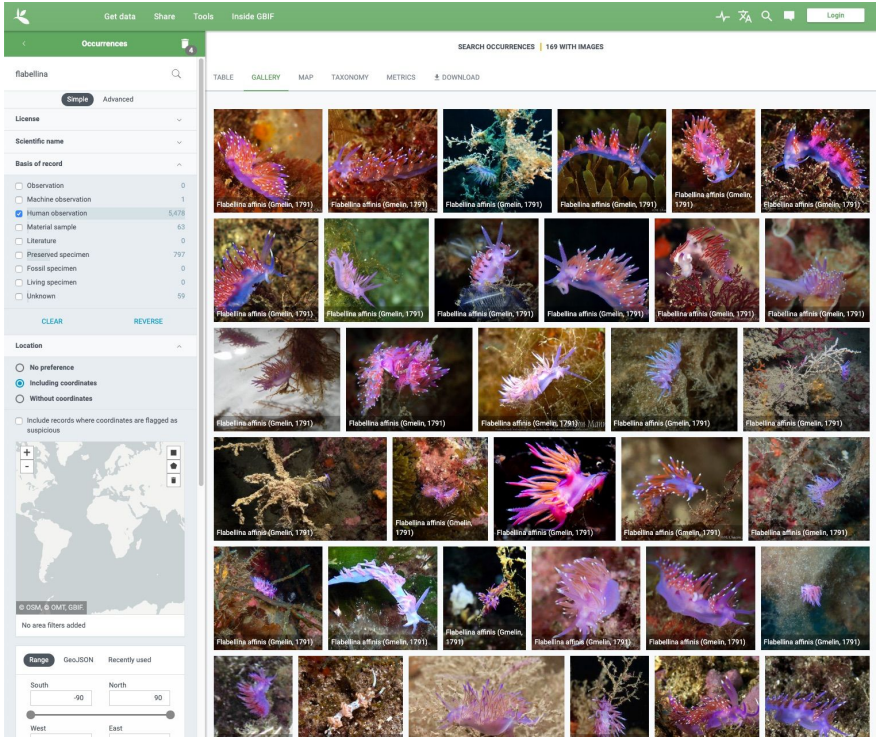




Part II: Mediated Machine Vision

Scaling up with GBIF

Global Biodiversity Information Facility: Infrastructure

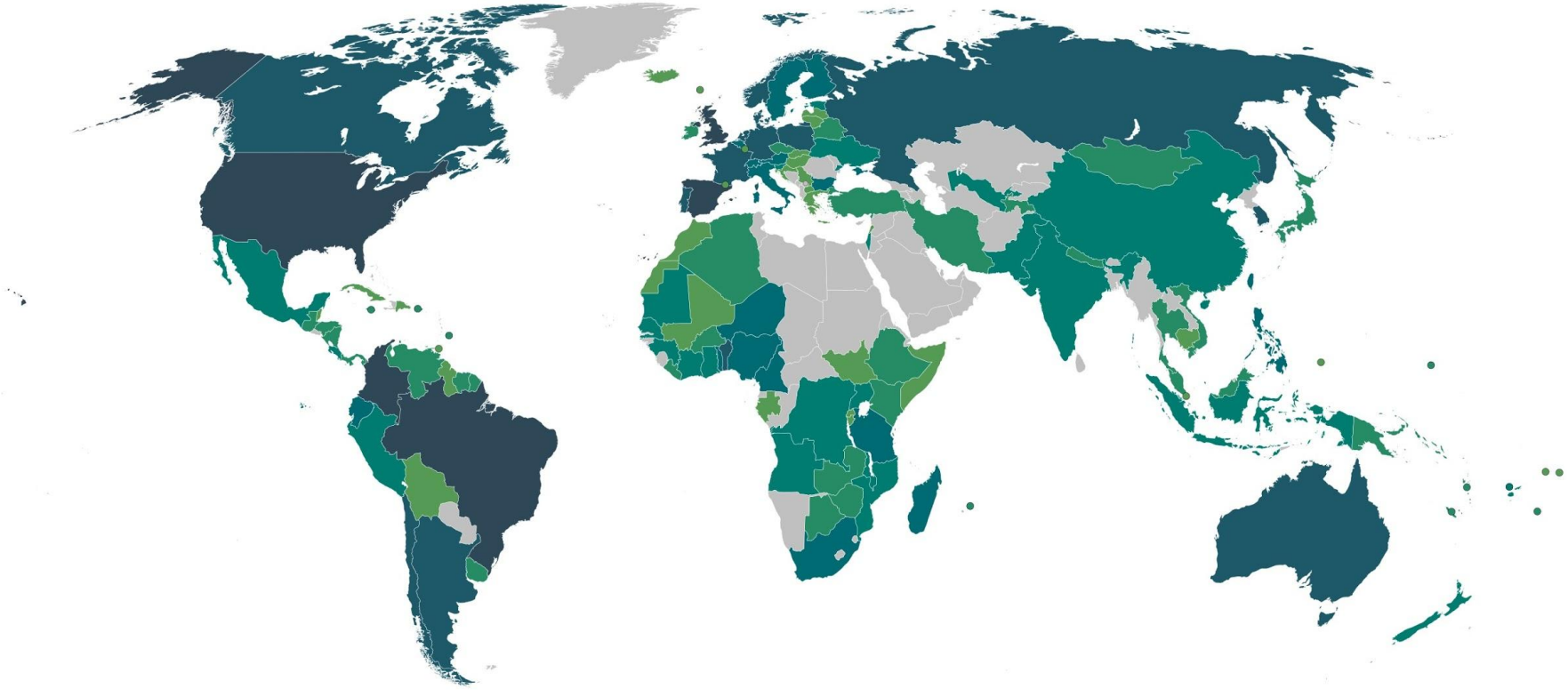


1. Distributed network of data publishers
2. Real-time data indexing with sophisticated search and download capabilities
3. 47M records with images
   a. +19M in 11 months
   b. labelled with date, location and scientific identification

https://www.gbif.org

GBIF

GBIF Community



Countries of institutions
publishing data

Goals

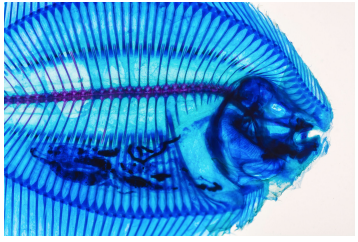
1. Make it easy to use machine vision models in our community

2. Promote responsible use of data
    a. Open data licenses
    b. Clear citation practice and track use

3. To connect communities
    a. Discuss sociological issues surrounding this use of data
    b. Connect data publishers, users, biological domain experts and computer vision scientists

GBIF

Challenges

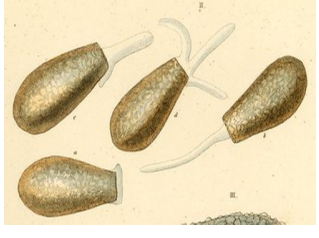


University of Texas, Biodiversity Center, Ichthyology Collection (CC0)

D. Hobern (CC-BY)

Yale Peabody Museum (CC0)

Royal Botanic Gardens, Kew (CC-BY)



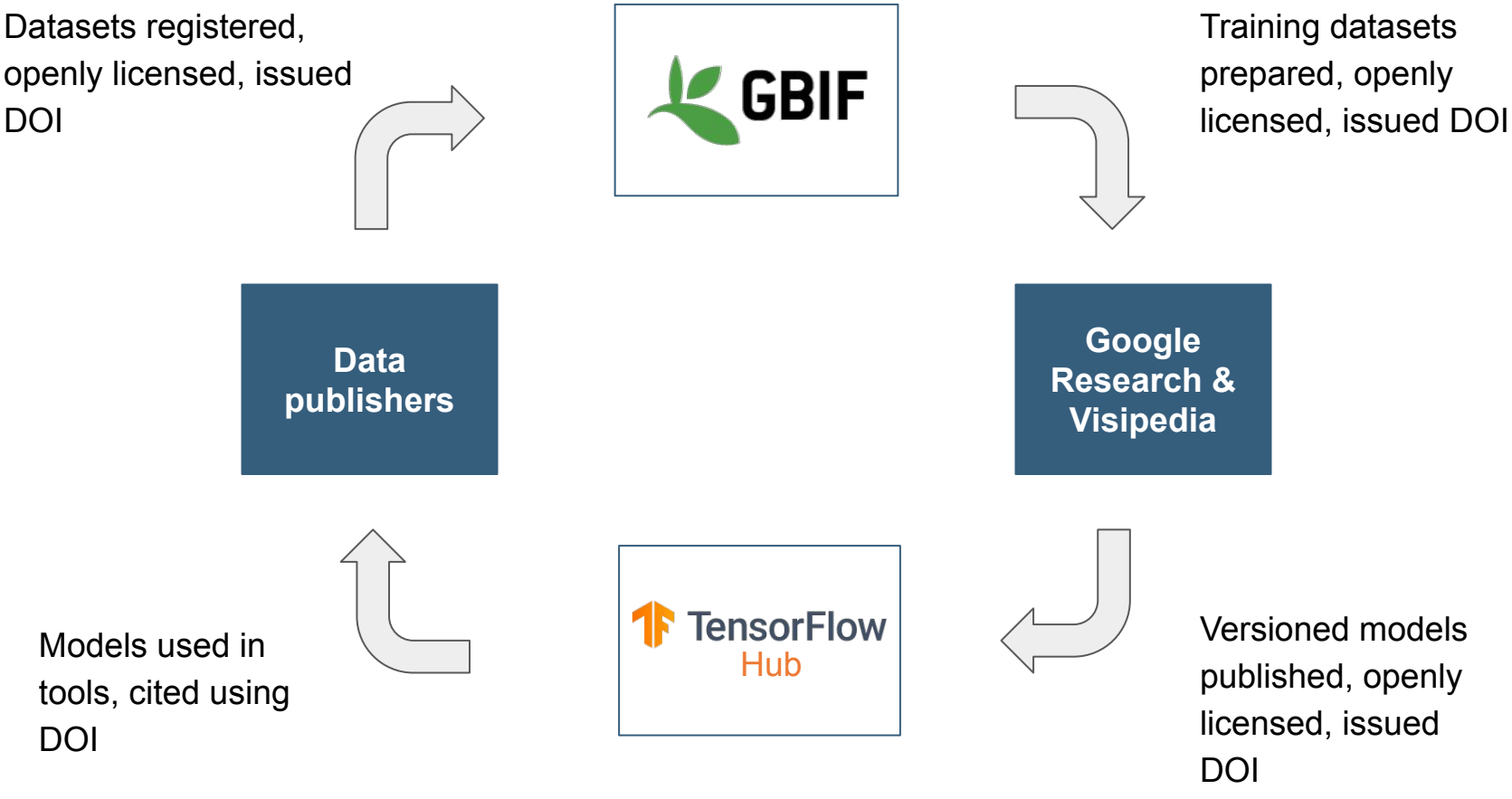
Botanic Garden and Botanical Museum Berlin (CC-BY)

1. **Variety** in images
   a. Photographs in nature
   b. Prepared specimens
   c. Drawings
   d. Photos of labels
   e. Photos of evidence (e.g. scat)
2. **Taxonomic** opinion when integrating datasets
3. **Geographic** scope

GBIF

DOI: Digital Object Identifier

Mediated machine vision



Two models: 2018 FGVCx Fungi and v2

TensorFlow Hub

https://doi.org/10.26161/dhpb-3346

Demo:
https://www.gbif.org/tools/machine-vision

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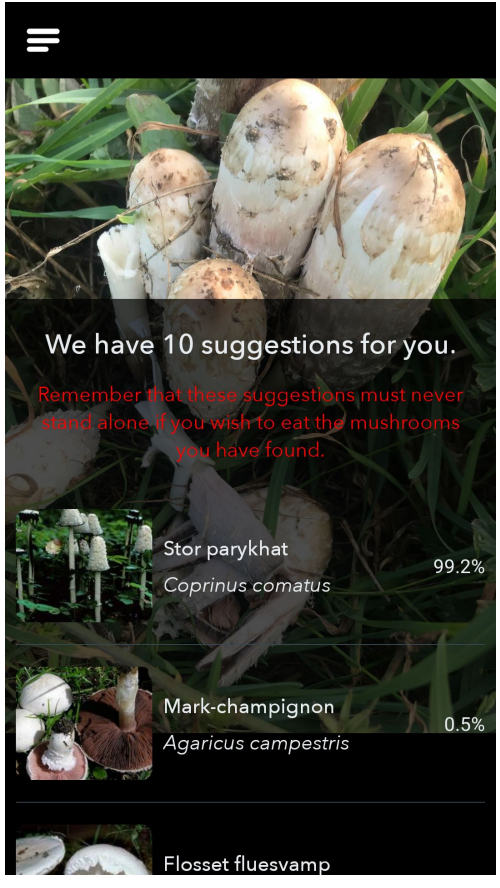
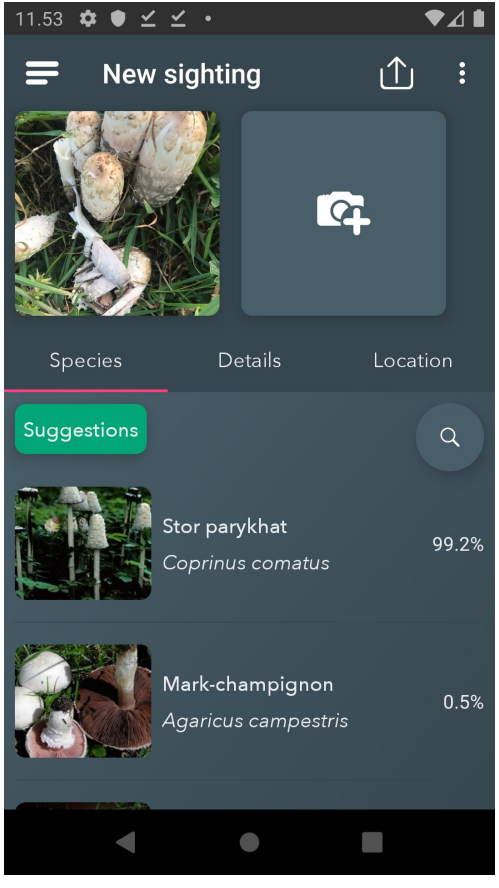
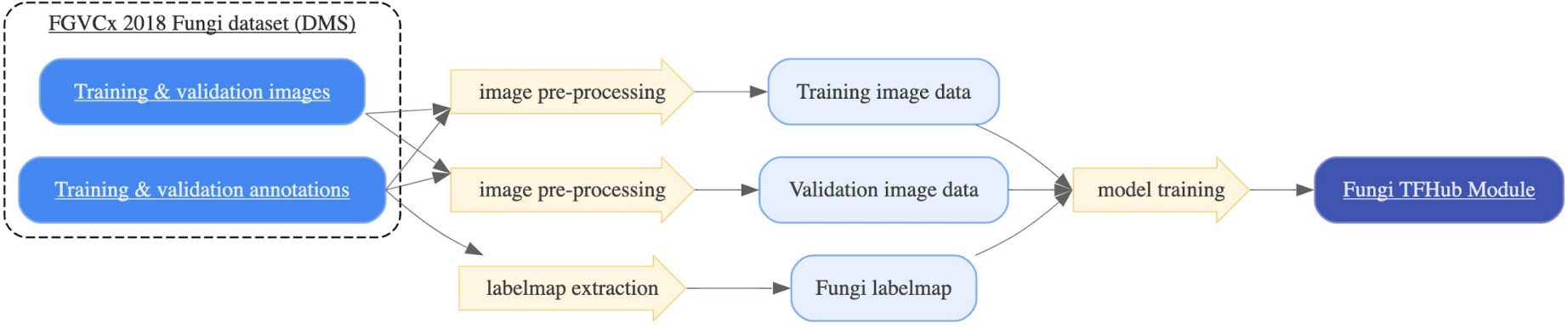
Danish Fungal Atlas (SvampeAtlas)





Building the models

Provenance Graph



Model architecture

- Christian Szegedy, Sergey Ioffe, Vincent Vanhoucke, Alex Alemi: “Inception-v4, inception-resnet and the impact of residual connections on learning”, 2017.
- Deep ConvNet pre-trained on iNaturalist model, fine tuned on Fungi

Get involved

Status: First models now built piloting the process

Read more: https://www.gbif.org/tools/machine-vision

Mailing list: Mediated Machine Vision (https://lists.gbif.org)

Fine Grained Visual Categorization (FGVC) workshop

- Conference on Computer Vision and Pattern Recognition (CVPR)
- This Friday (June 19, 2020)

Thank you: Tim Robertson (GBIF), Christine Kaeser-Chen (Google)