Application of Deep Learning
for
Seed Testing

ACIA/CFIA AI Lab, 2023–06–12
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Panelists

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M.Sc Horticulture
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Data-scientist
M.Sc Computer Science

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Manager Ai Lab
M.Sc Actuarial Science (ML)
M.Sc Computer science & IT

CFIA's Commitment

The Canadian Food Inspection Agency (CFIA) is committed to safeguarding food, animals, and plants in Canada, which enhances the health and well-being of Canada's people, environment, and economy

In the field of seed science, CFIA is dedicated to ensuring the **quality** and **safety** of seeds

AI - Lab

Predictive modeling

Using machine learning models, we try to answer this question: "Based on known past behaviour, what is most likely to happen in the future?"

Ai solutions

We engineer solutions from the architecture and training of models.

Applied Research

We pursue novel research in the lab and use the best ideas to power solutions that deliver real impact.

Empowering others

We encourage our partners to cultivate a responsible AI-ready culture throughout their businesses.

CFIA Science– Seed Science & Research

Research Objectives:

Computer vision applications
- ✓ Auto sample analysis (purity & weed analysis)
- ✓ AI (computer) identification
- ✓ Unknown AI seed consultation
- ✓ Method validation

Seed Research Team:

Dr. Rafizul Haque
Dr. Liang Zhao
Yusuf Abuke
Angela Salzl
Jennifer Neudorf
Solomon Sakyi-Quartey

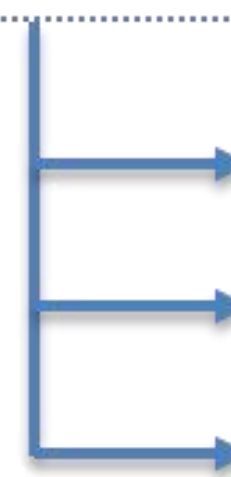**Agricultural products** → **Weed seed contamination** → **Plant Health Regulations**

Seeds

Grains

Others: e.g., Bird Feed
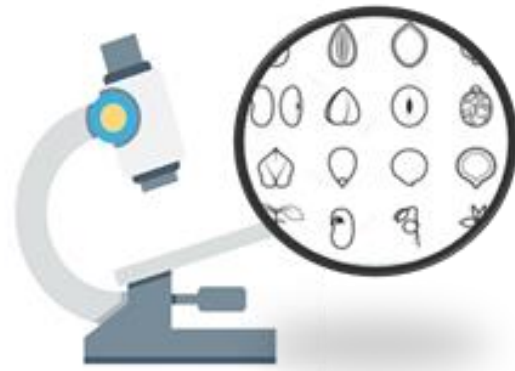
Weed Seeds Order

Pests Regulated by Canada

Foreign Countries (e.g., REGAL)

Computer Vision

Image Acquisition

Labeled Database
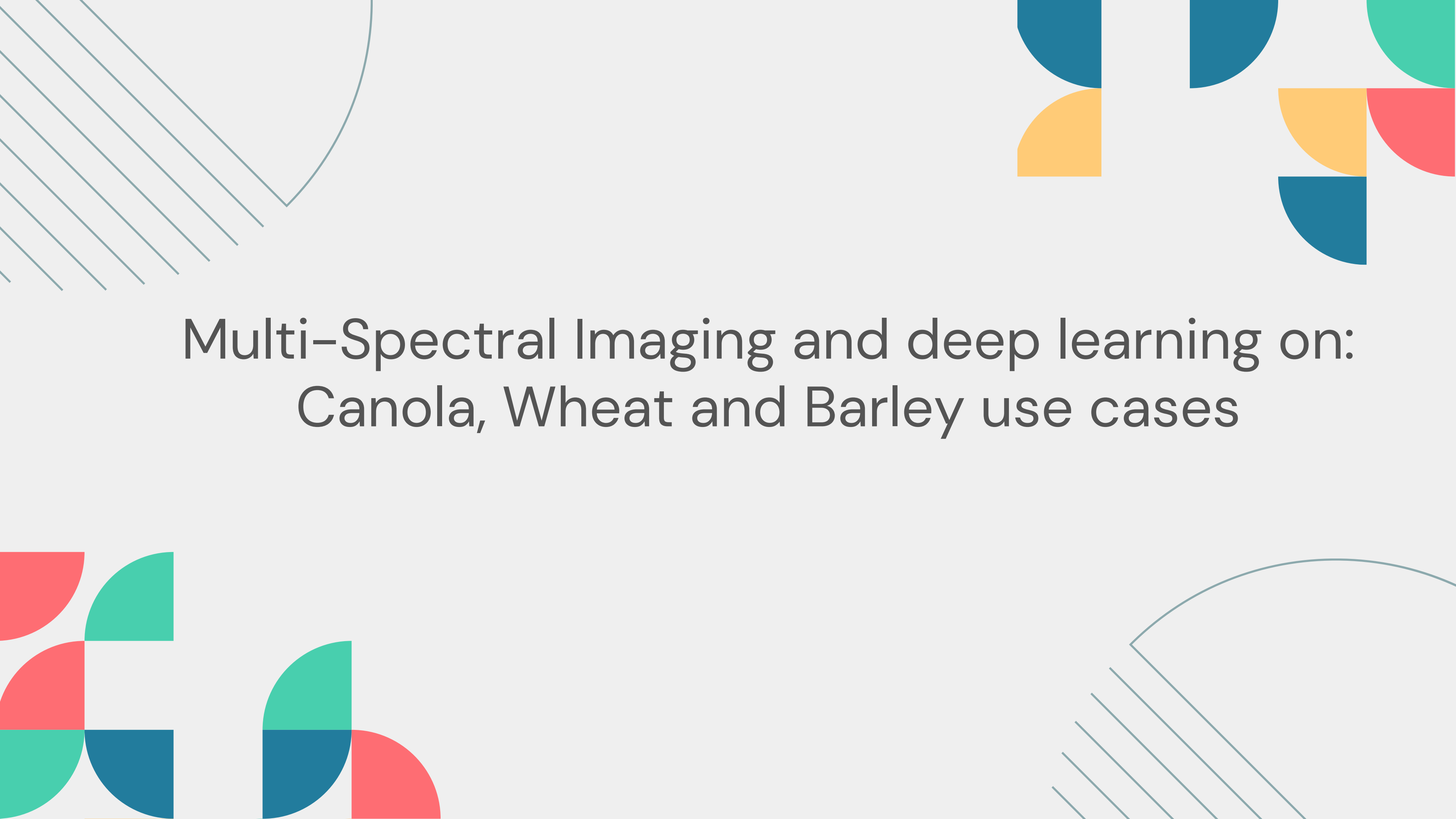
AI Algorithms (Software)

Auto sample testing

AI Identification
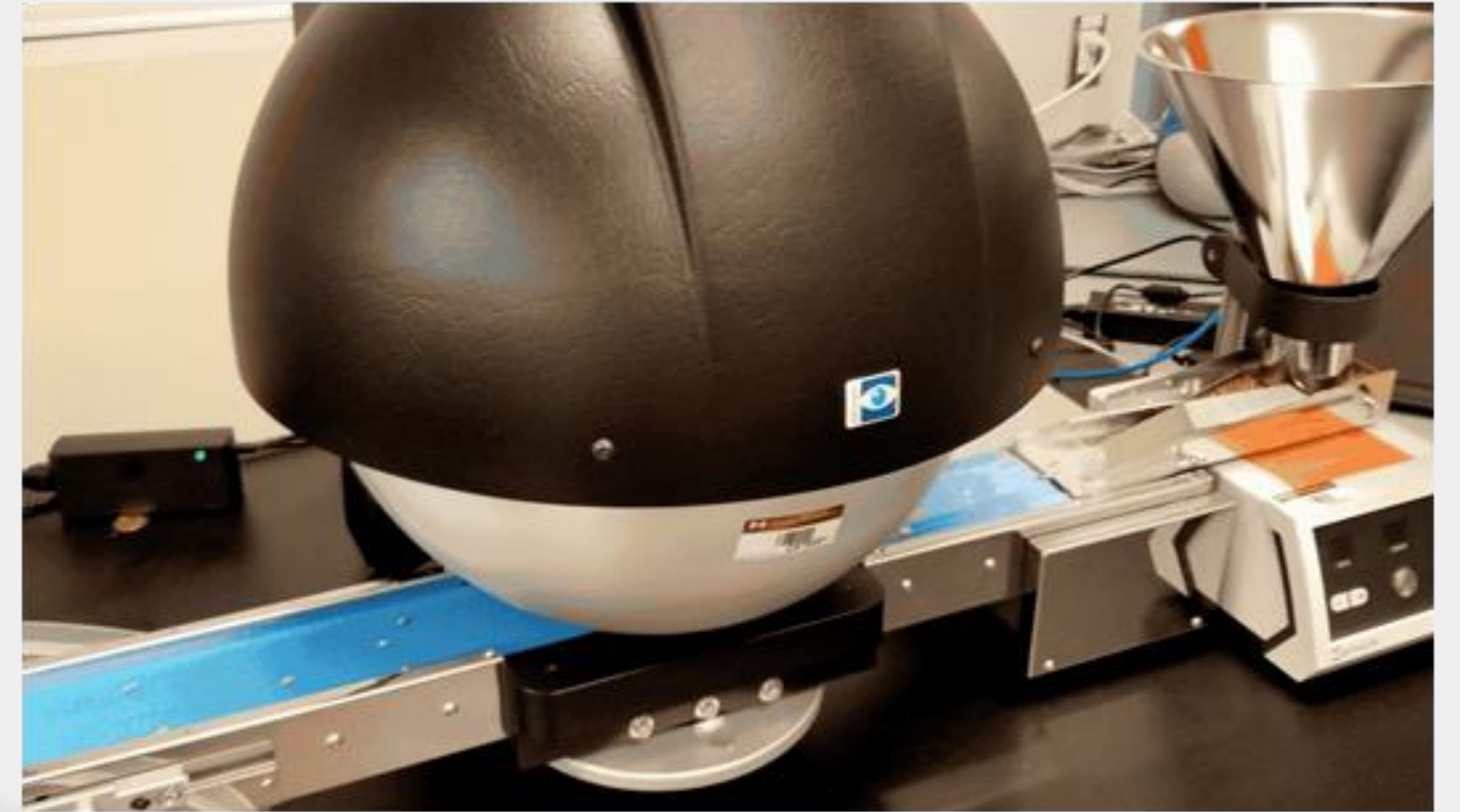
Analyst consultation

Multi-Spectral Imaging and deep learning on: Canola, Wheat and Barley use cases
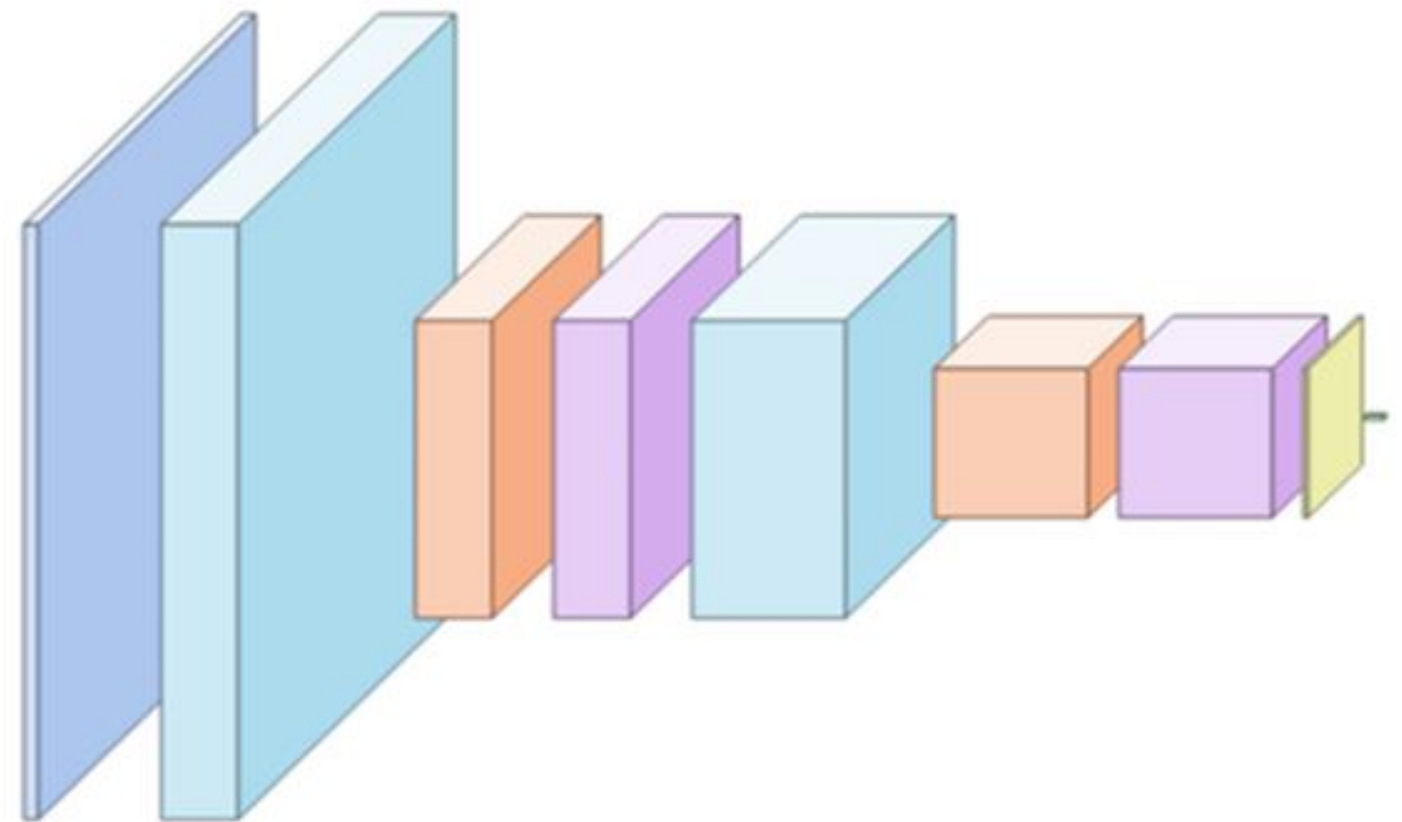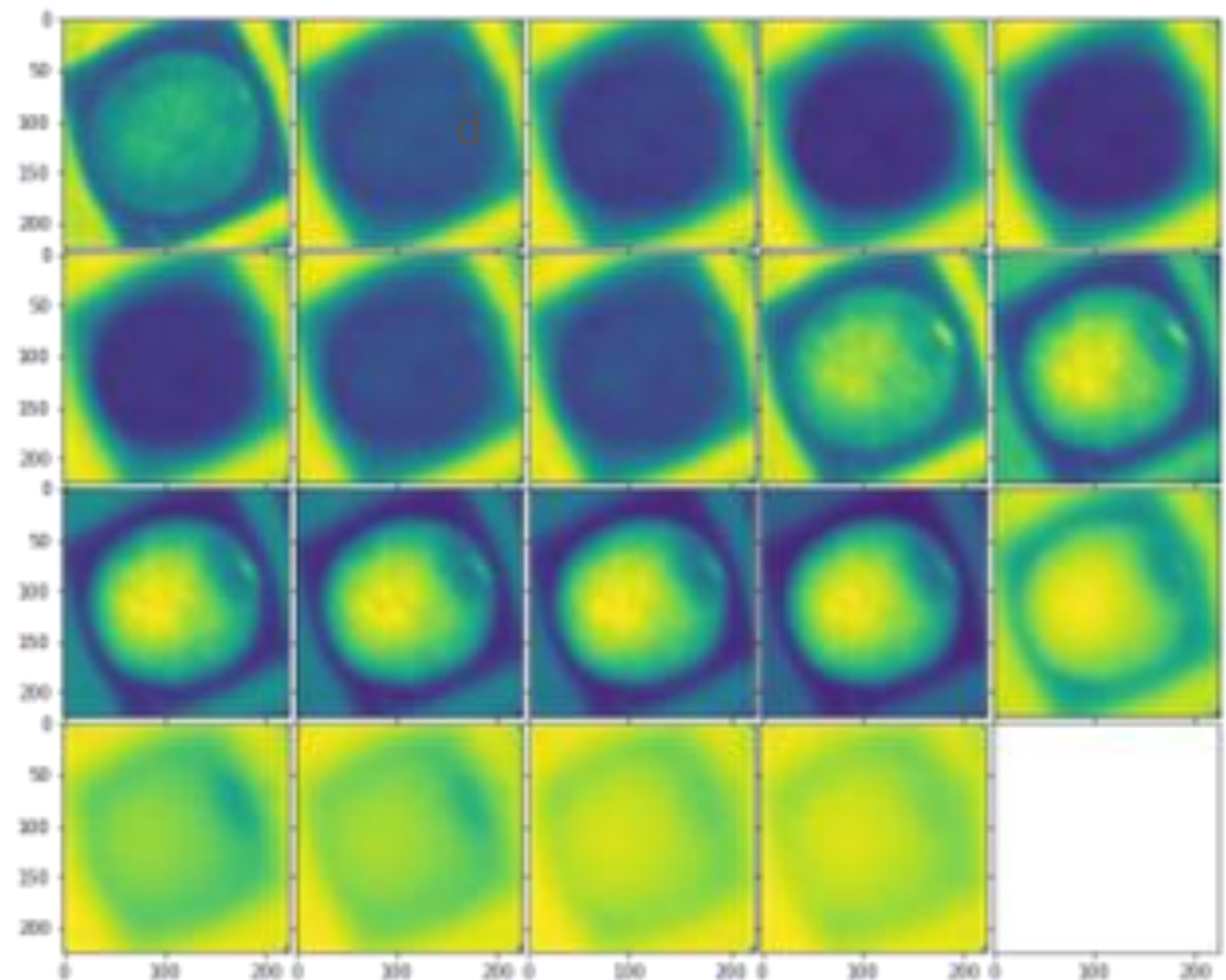
Crops: Wheat and barley

Weeds:

- *Cirsium arvense*, (Canada thistle, targeted species)
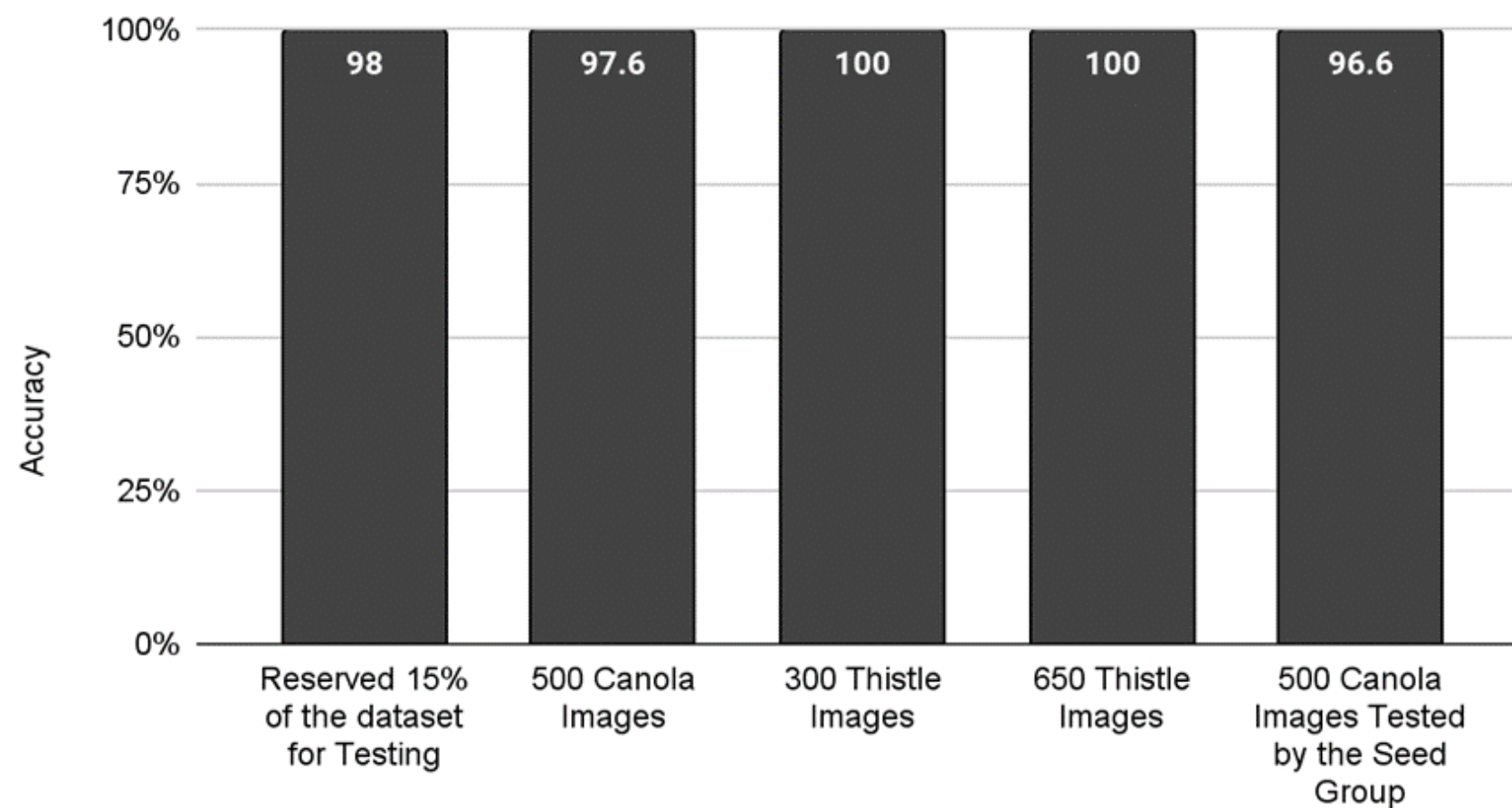- *Carduus nutans*
- *Cirsium vulgare*

DEEP NEURAL NETS!

Canola Results

Wheat Results
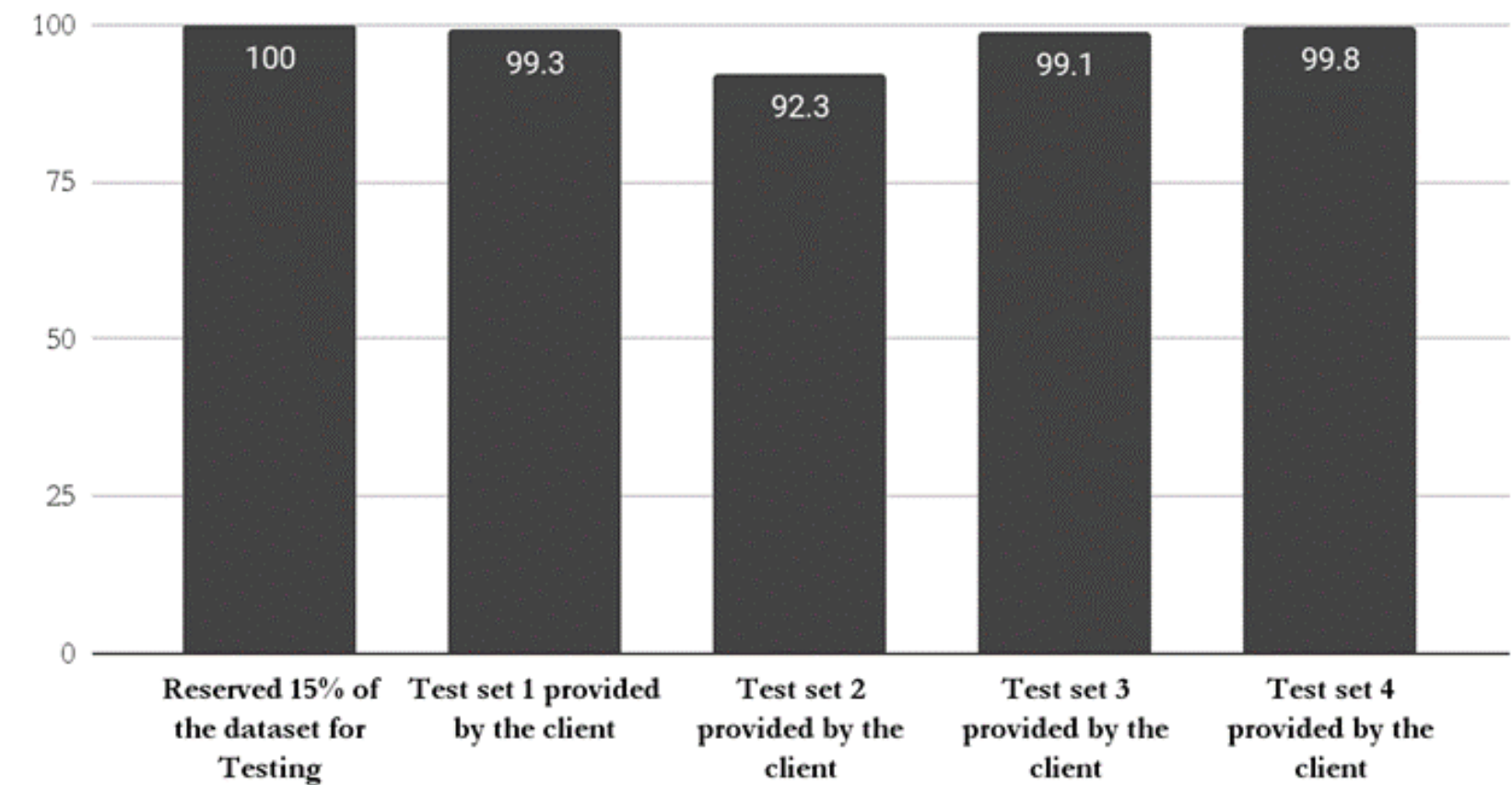

Accuracy

Category	Accuracy
Reserved 15% of the dataset for Testing	98
500 Canola Images	97.6
300 Thistle Images	100
650 Thistle Images	100
500 Canola Images Tested by the Seed Group	96.6

Average Per Class Accuracies

| Category	Accuracy
Reserved 15% of the dataset for Testing	100
Test set 1 provided by the client	99.3
Test set 2 provided by the client	92.3
Test set 3 provided by the client	99.1
Test set 4 provided by the client	99.8

Digital Microscope Use case
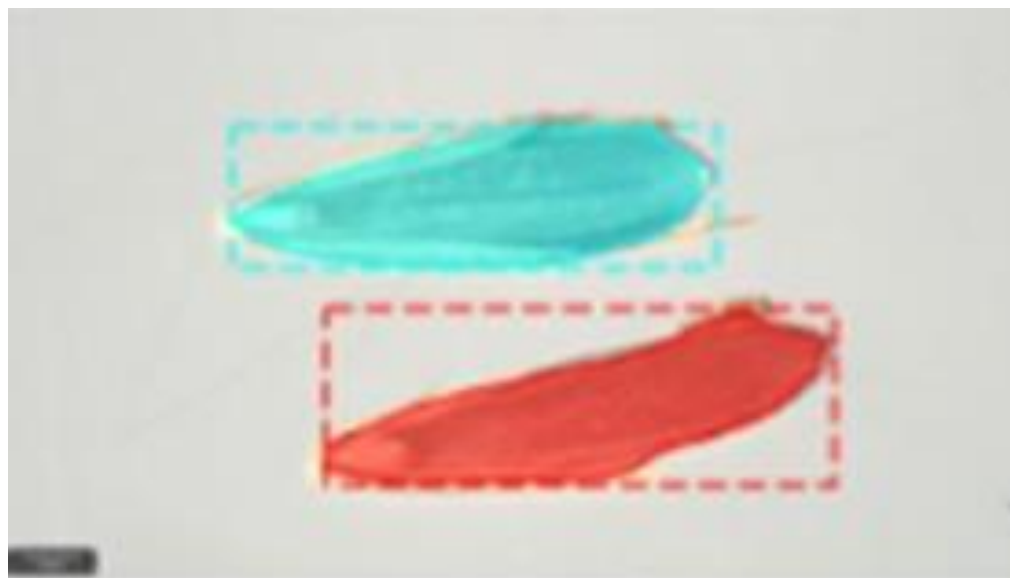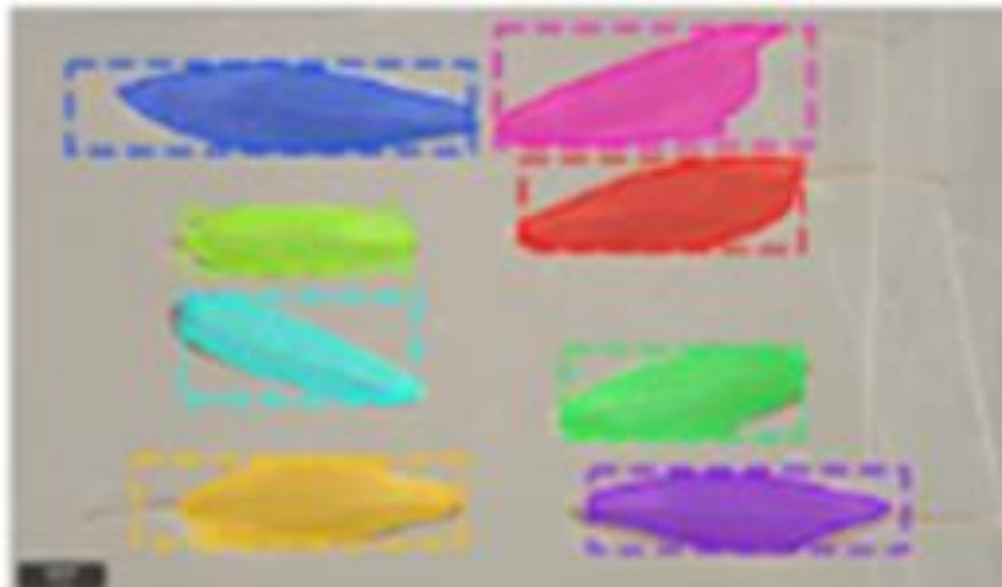
AI Seed identification

- Selected 13 weed species

- Develop image protocol

- Validate the AI results
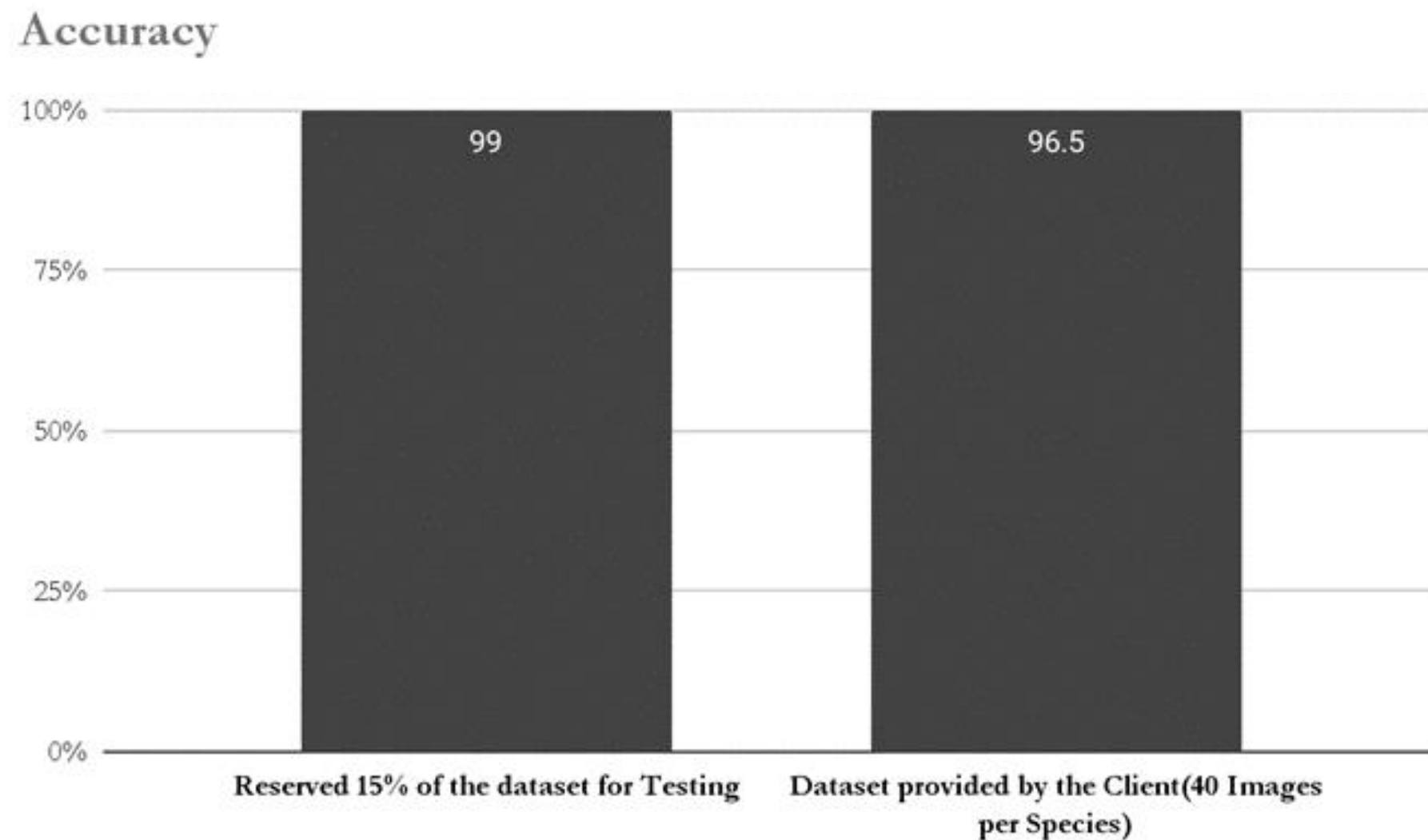
Digital Microscope Seed Image Data
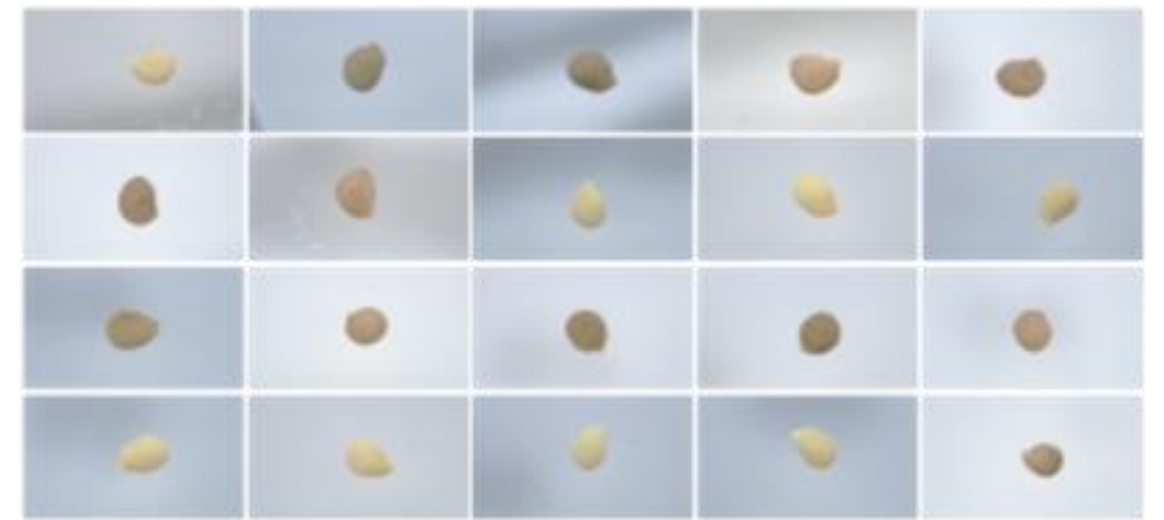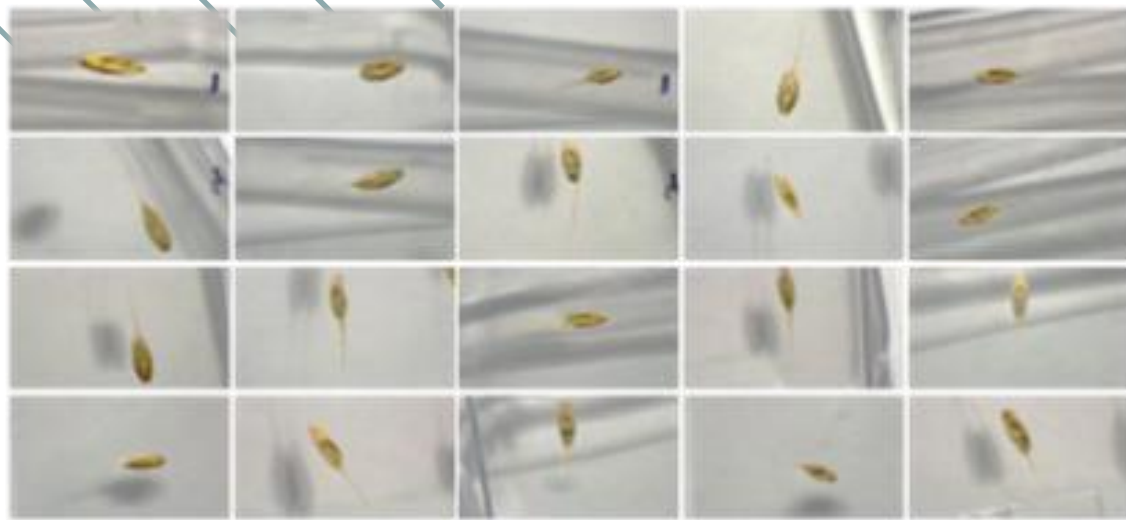
TWO DEEP NEURAL NETS!

- The first model isolates and crops out the seeds from the photo.
- Subsequently the images are passed to the second network for classification.

Preliminary results

Accuracy

- The model must be robust to changes incurred from images being taken by different labs.
- Magnification, zoom, etc...

PROPOSED COLLABORATION

Challenges

- Data gathering

- Automatic segmentation and cropping

- Benchmarking and validation

- Usage of APIs for Magnification, zoom, etc.

- Dealing with screenings as opposed to whole sized seeds

Collaboration

Shared labelled data

01 Collaborating parties will share their seed images with us

Standardized data

02 Collaborating parties will ensure shared images follow a a specified convention

Models - AILab

Free data storage

03 CFIA will host images on our servers to reduce computational burden for collaborators

Accelerate research

04 Added training images will improve models performance

Increase number of prediction labels

05 Increased diversity of labels will enable the models to classify more seed species

Open sourced models for public use (long term goal)

06 Deployment of publicly available 'web app' (ie. Python package)

THANK YOU
MERCI

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