

Hands-On Machine Learning with Agricultural Applications

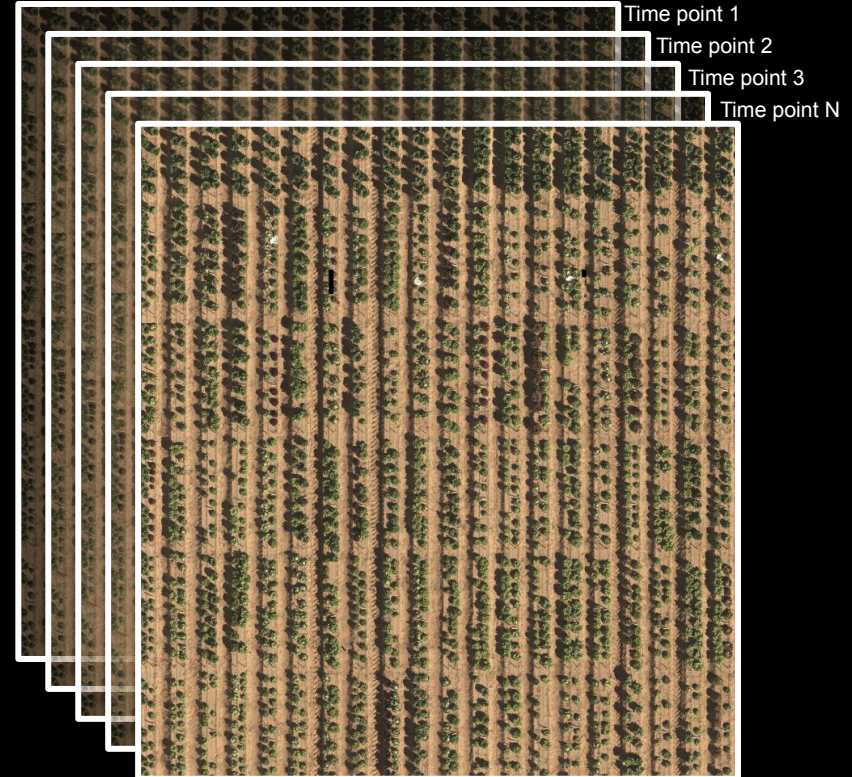
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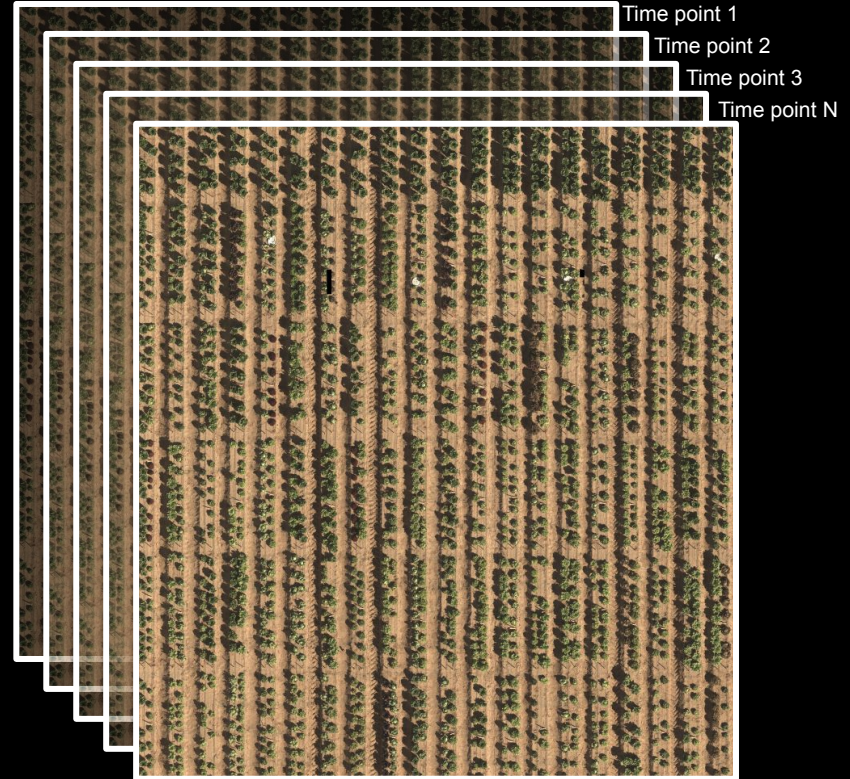
Problem Framing: Tracking thousands of plants

- **Plant Science** perspective
 - Quantitative and predictive focus
 - Can we use data to predict yield ?
 - Can we use data to improve crop performance under drought?
 - Can we identify natural and/or induced variation?
 - What ML algorithms can be used and/or combined?

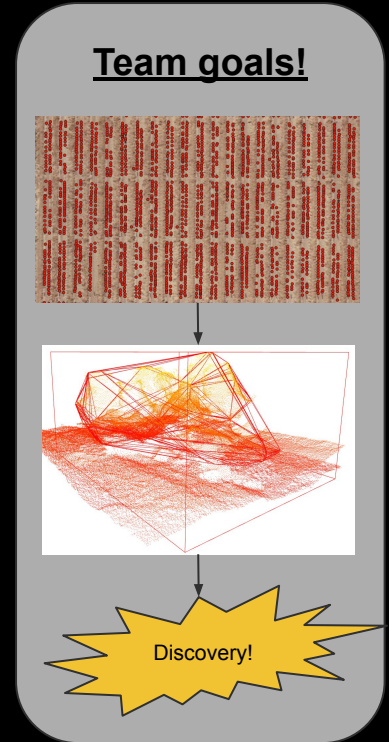
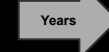
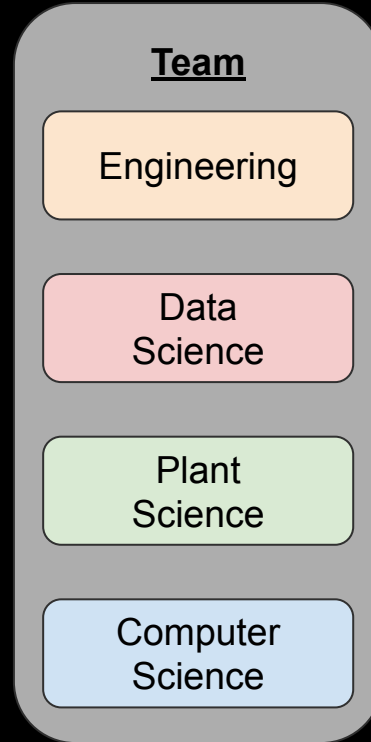
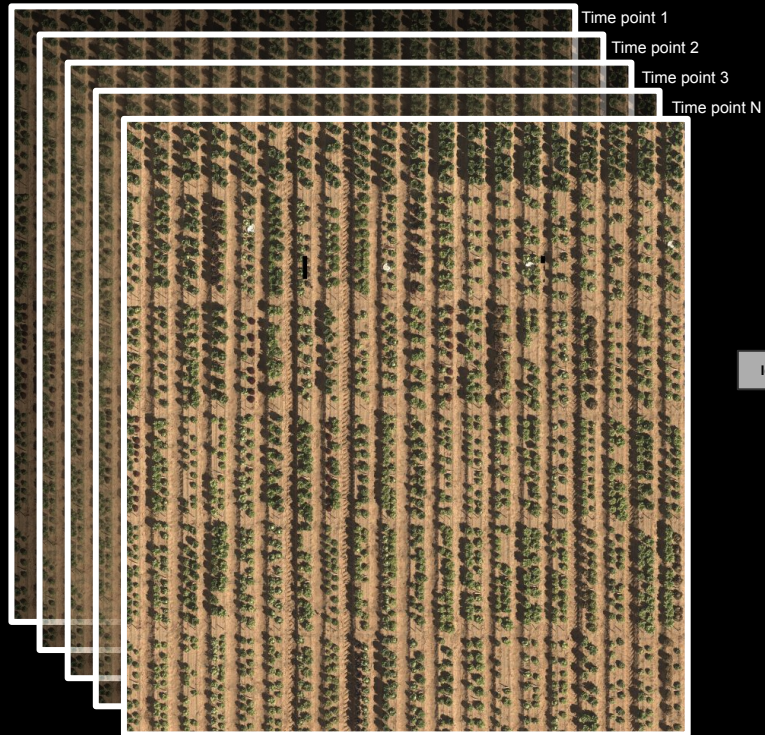


Problem Framing: Tracking thousands of plants

- **Data Science** perspective
 - Multiple data time points throughout growing season
 - Lots of training data = good!
 - Other image processing techniques have been unsuccessful
 - Shift to ML methods



Problem Framing: Tracking thousands of plants

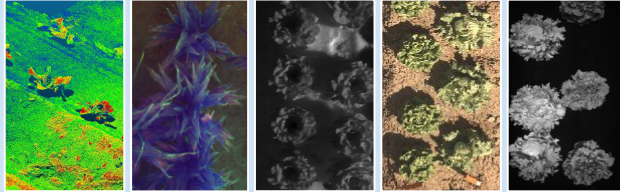


Data Collection: Converting raw data into gold

Collection method



Data management



Data volume:

- Max: 10 TB/day
- Typical: 1.5 TB/day

Data preparation



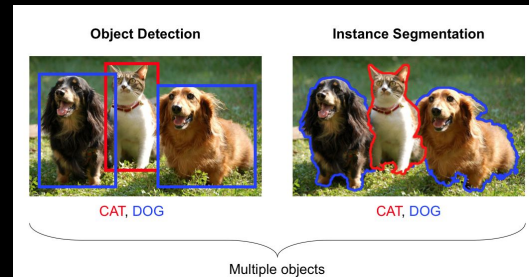
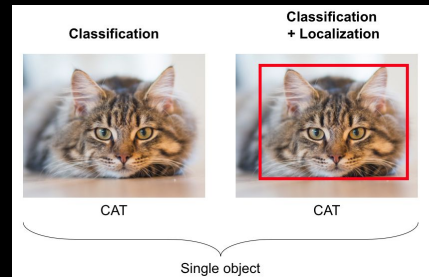
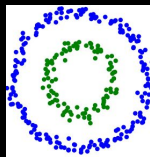
Machine Learning Tasks

- Supervised

- Regression
- Classification
- Localization
- Object Detection
- Segmentation
 - Semantic Segmentation
 - Instance Segmentation

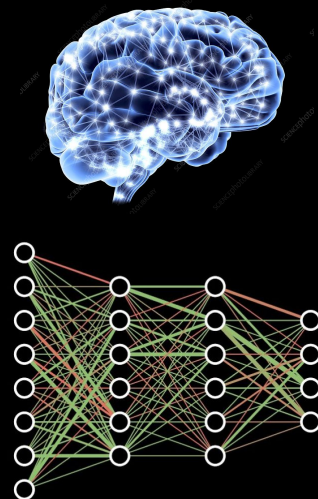
- Unsupervised

- Clustering

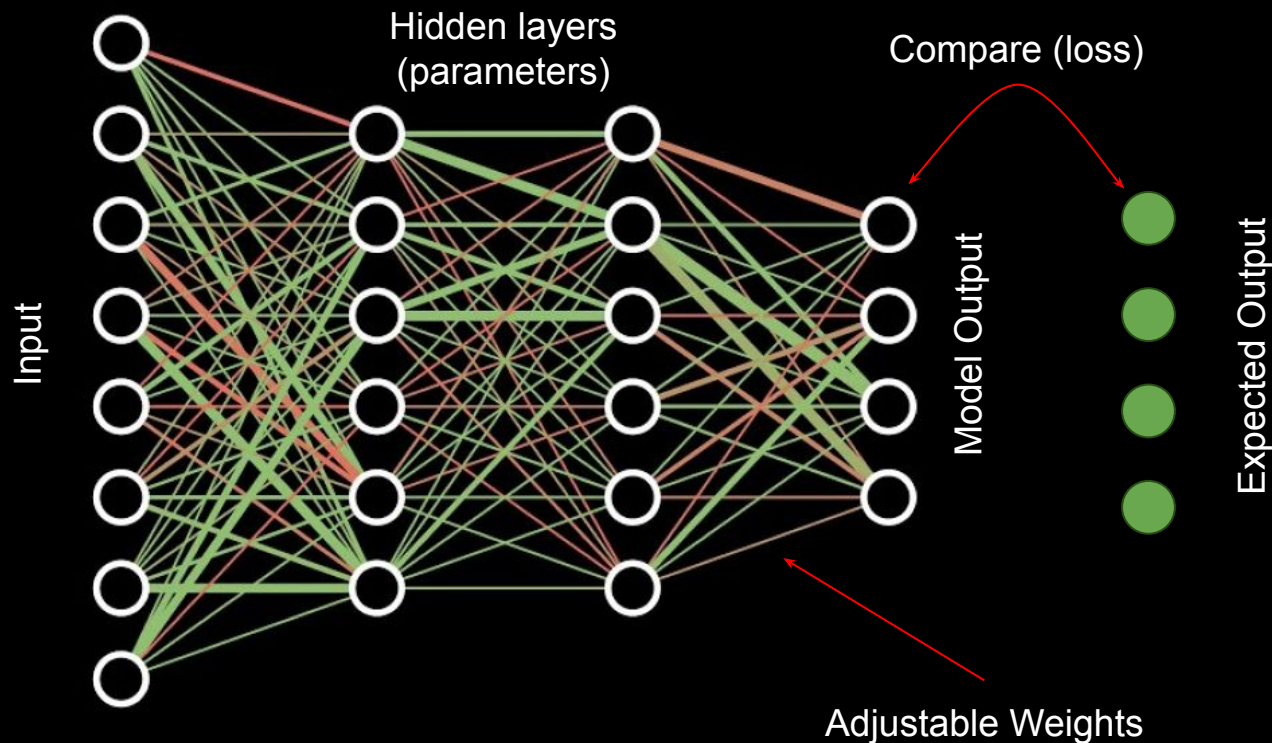


Neural Networks and Computer Vision

- Visual Perception for Computer
- Learn discriminative models for different CV tasks
- Inspired by brain Neural System
- Adjust parameters by penalizing errors

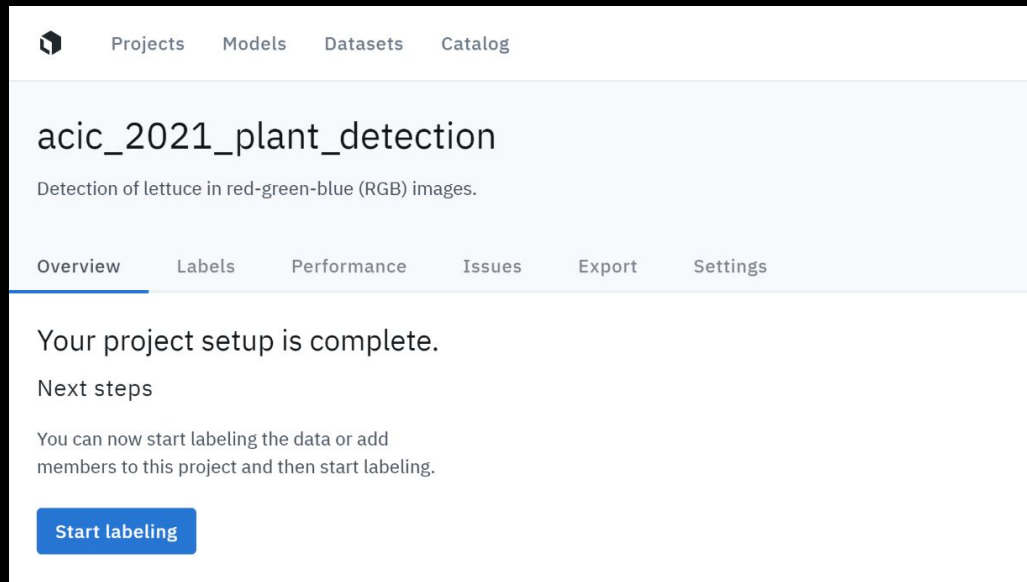


Neural Networks and Computer Vision



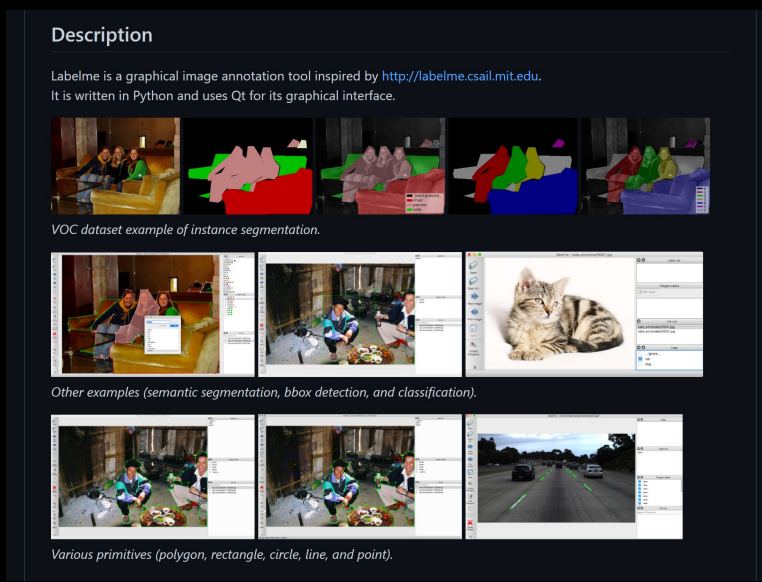
Data Preparation: Labeling is a crucial step

Web-based



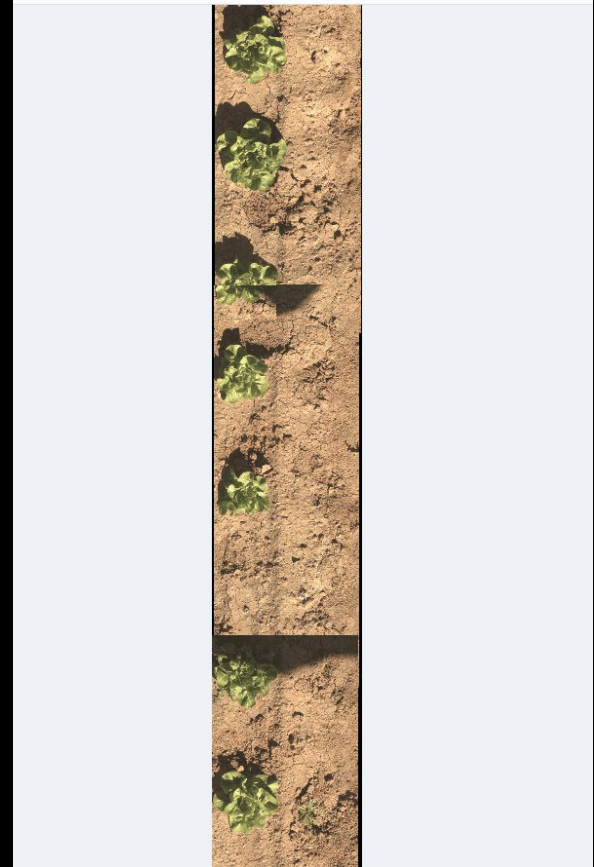
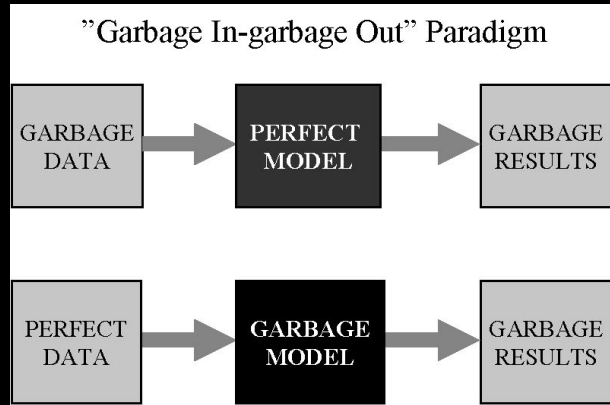
The screenshot shows the Labelme web-based interface. At the top, there are navigation links: Projects, Models, Datasets, and Catalog. The main heading is 'acic_2021_plant_detection' with a subtitle 'Detection of lettuce in red-green-blue (RGB) images.' Below this, there are tabs for Overview, Labels, Performance, Issues, Export, and Settings. The Overview tab is active, displaying the message 'Your project setup is complete.' and 'Next steps' which include 'You can now start labeling the data or add members to this project and then start labeling.' A blue button labeled 'Start labeling' is at the bottom.

Local, graphical user interface



The screenshot shows the Labelme local graphical user interface. It features a 'Description' section at the top, stating 'Labelme is a graphical image annotation tool inspired by <http://labelme.csail.mit.edu>. It is written in Python and uses Qt for its graphical interface.' Below this, there are several examples of image annotations. The first row shows a 'VOC dataset example of instance segmentation' with a grid of images and their corresponding segmented masks. The second row shows 'Other examples (semantic segmentation, bbox detection, and classification)' with images of a cat, a person, and a car. The third row shows 'Various primitives (polygon, rectangle, circle, line, and point)' with images of a person, a car, and a road. Each example includes a small window showing the Labelme interface with the corresponding annotation.

Data Preparation: Label quality matters



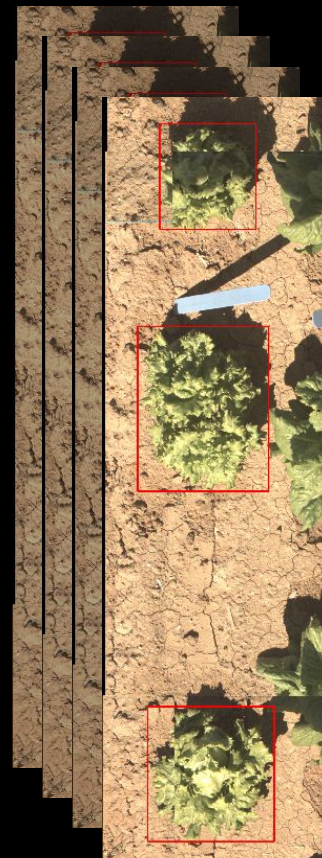
Data Preparation: Interpreting labels

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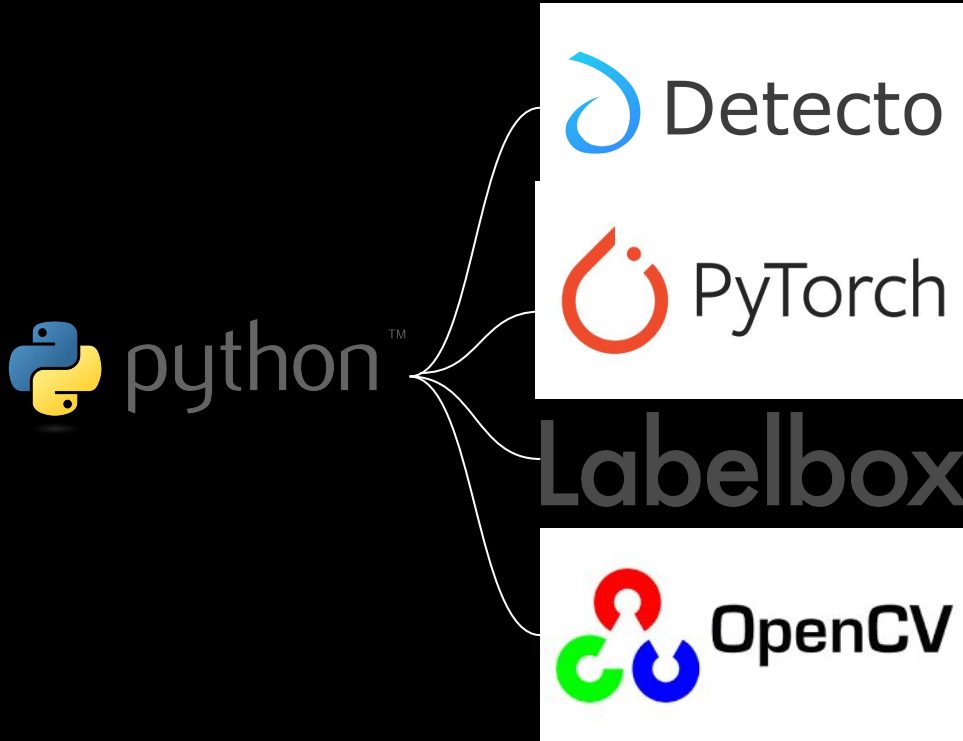
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Model training: The relatively easy part



Object detection: [here](#)

Semantic segmentation: [here](#)