

# Hands-On Machine Learning with Agricultural Applications

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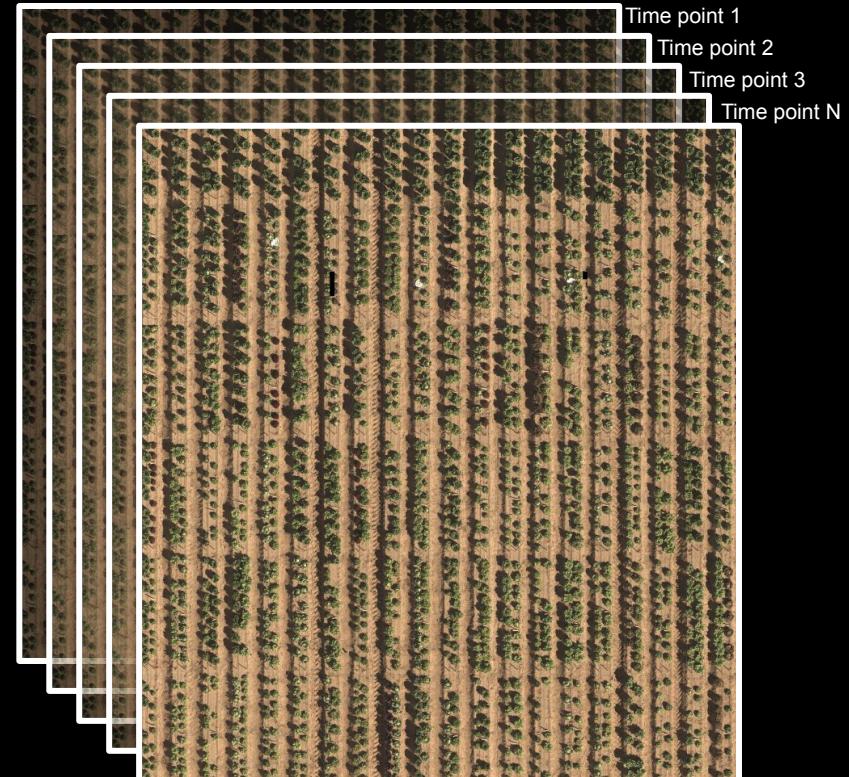
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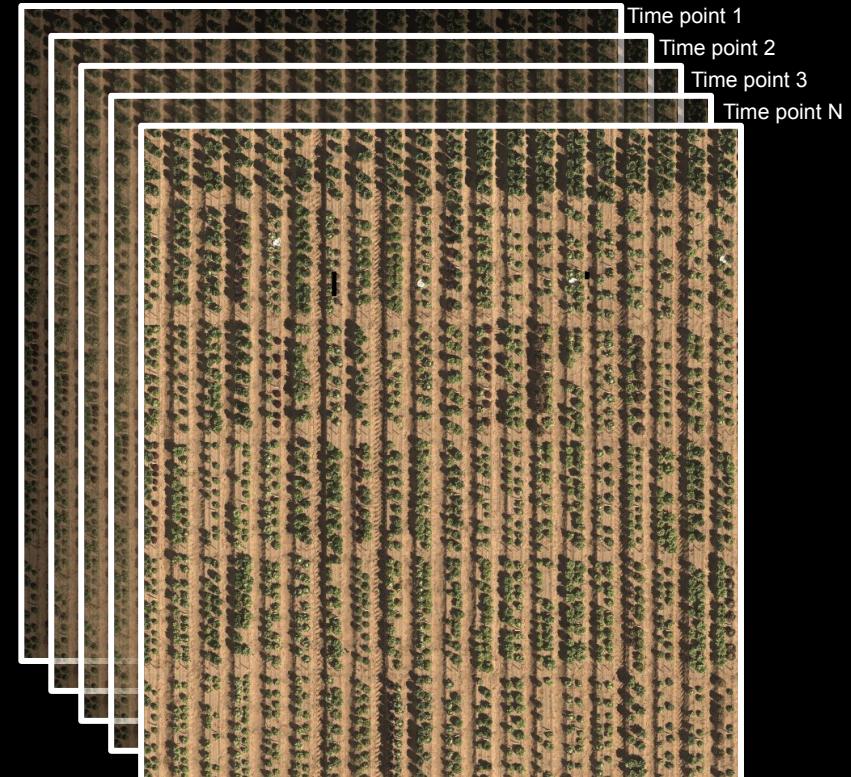
# Problem Framing: Tracking thousands of plants

- **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?

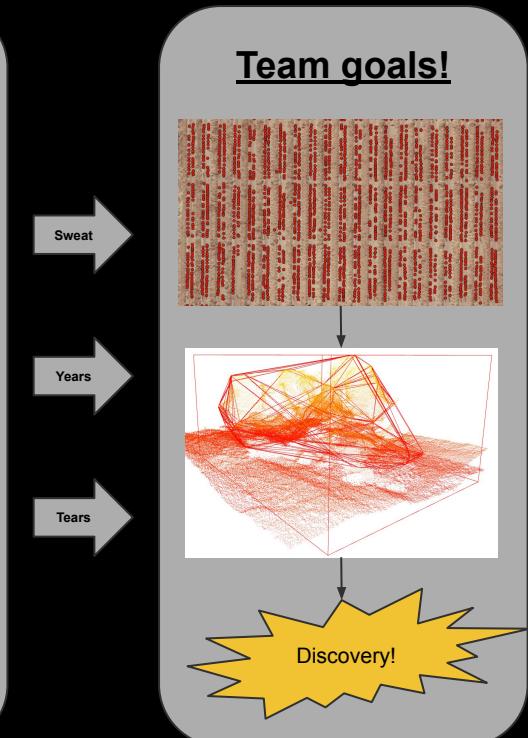
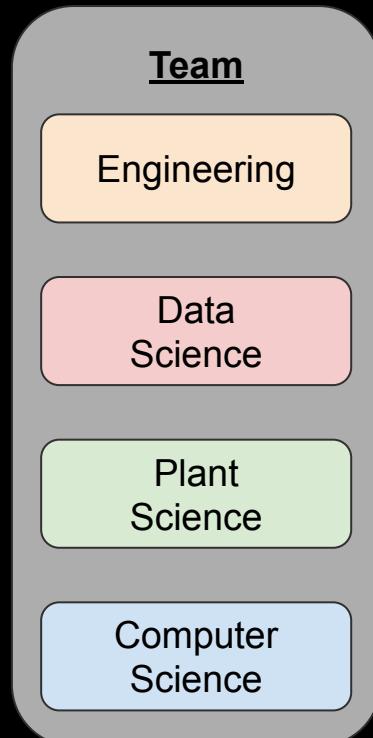
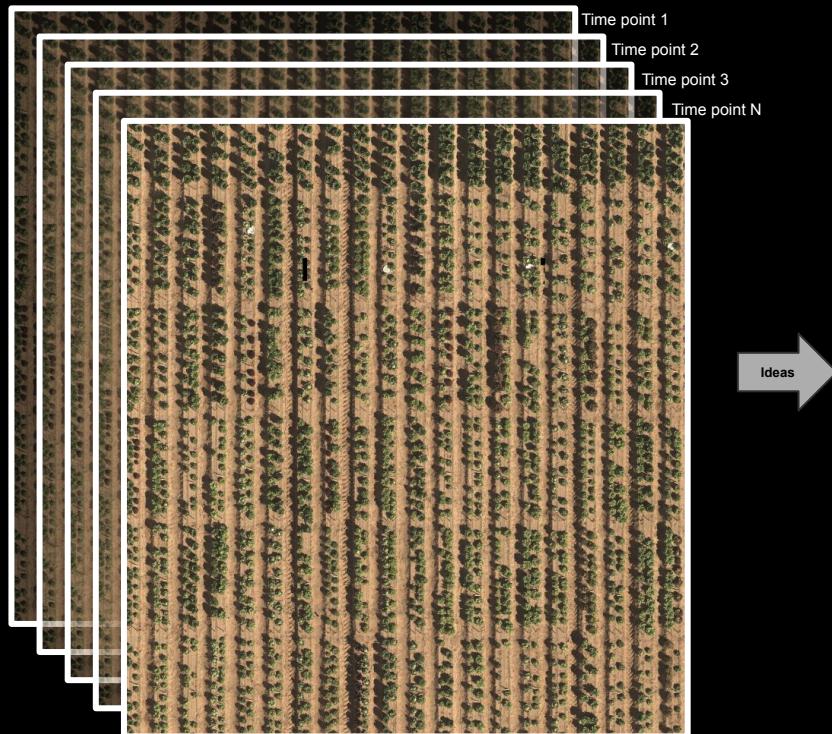


# Problem Framing: Tracking thousands of plants

- 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

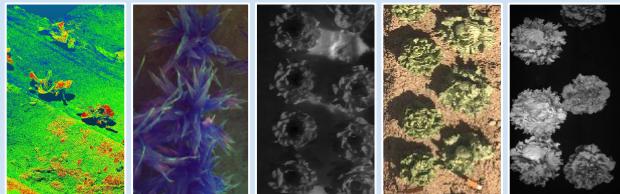


# Data Collection: Converting raw data into gold

## Collection method



## Data management



### Data volume:

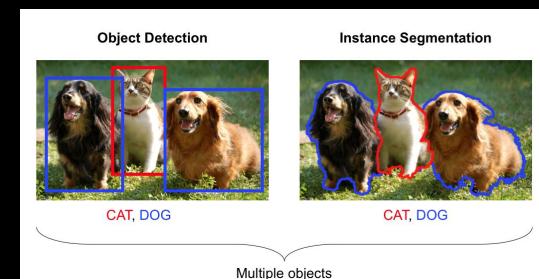
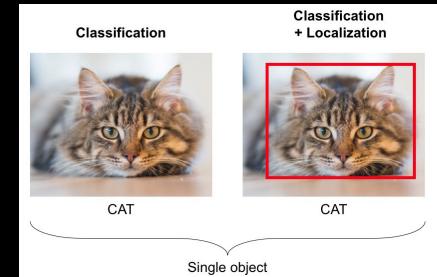
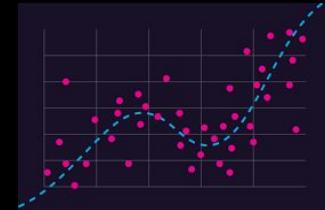
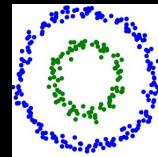
- Max: 10 TB/day
- Typical: 1.5 TB/day

## Data preparation



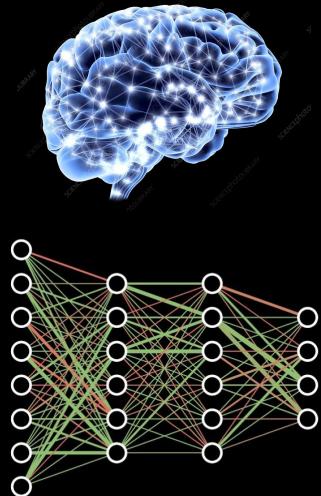
# Machine Learning Tasks

- Supervised
  - Regression
  - Classification
  - Localization
  - Object Detection
  - Segmentation
    - Semantic Segmentation
    - Instance Segmentation
- Unsupervised
  - Clustering

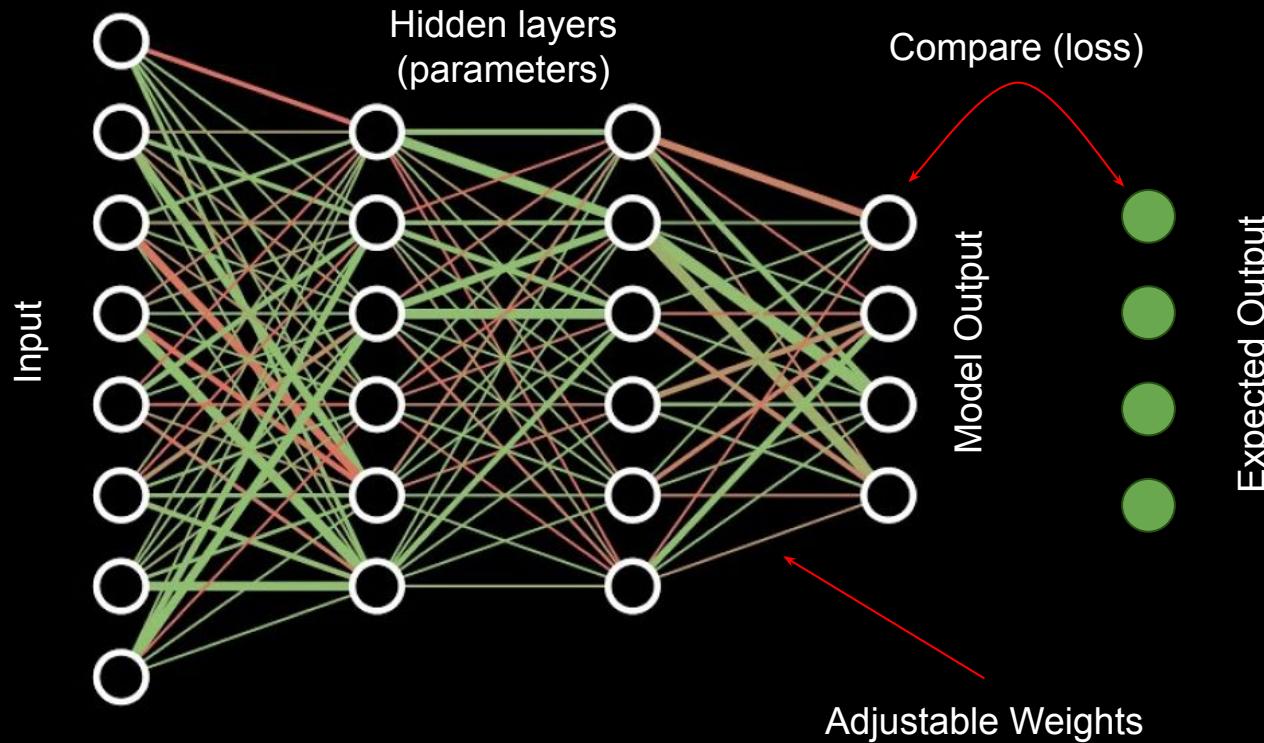


# Neural Networks and Computer Vision

- 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

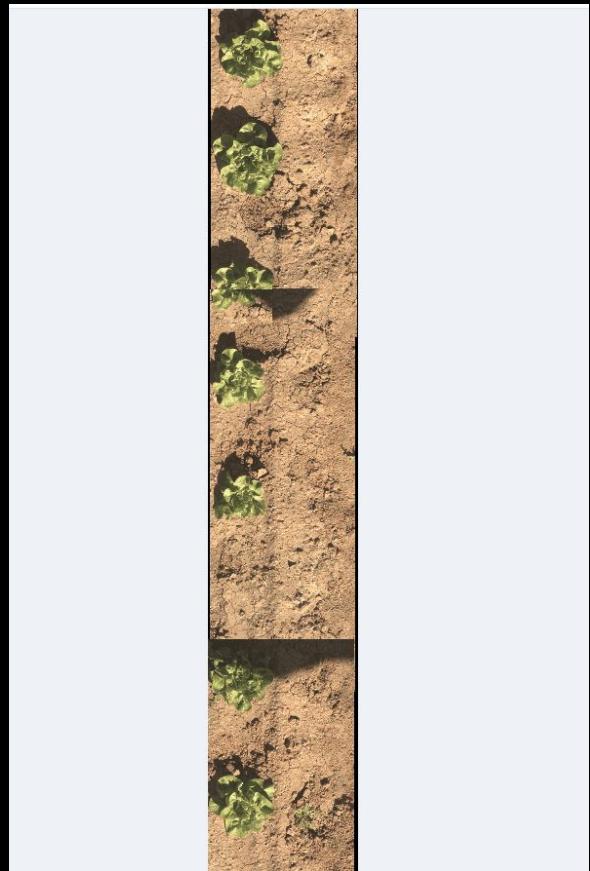
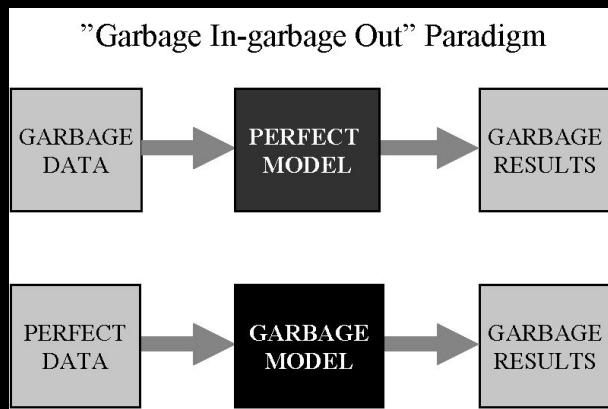
Web-based

The screenshot shows a web-based project management interface. At the top, there's a navigation bar with icons for Projects, Models, Datasets, and Catalog. Below the navigation bar, the project title "acic\_2021\_plant\_detection" is displayed, followed by a subtitle "Detection of lettuce in red-green-blue (RGB) images." A horizontal menu bar below the title includes "Overview" (which is underlined), "Labels", "Performance", "Issues", "Export", and "Settings". The main content area features a message "Your project setup is complete." and a section titled "Next steps" with the text "You can now start labeling the data or add members to this project and then start labeling." At the bottom left is a blue button labeled "Start labeling".

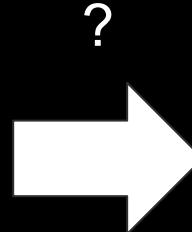
Local, graphical user interface

The screenshot shows a local graphical user interface for image annotation. On the left, a "Description" panel contains text about the Labelme tool, stating it is a graphical image annotation tool inspired by <http://labelme.csail.mit.edu>, written in Python, and uses Qt for its graphical interface. It includes a small image thumbnail showing a group of people. Below this are two rows of images demonstrating semantic segmentation and other annotation primitives. The first row shows a group of people with colored overlays (pink, green, blue) and a cat with a color-coded mask. The second row shows a person at a table with a yellow overlay and a road scene with green line annotations. The right side of the interface shows a detailed view of the annotation tools, including a color palette and various selection and drawing tools.

# Data Preparation: Label quality matters



# Data Preparation: Interpreting labels



# Model training: The relatively easy part

