Detecting Field Plots from Aerial Images of Wheat Fields

Mohammad Rakib Hasan (moh312)
Graduate Student
Dept. of CS, USask

Gazi Hasnat (gaz454)
Graduate Student
Dept. of CS, USask

Outline

Objective

Data Source

Implementation

Results

Discussion

Future Work

Questionnaire

Objective:

Detect field plots

of

given aerial images of **Wheat field**

A small part of P2IRC project

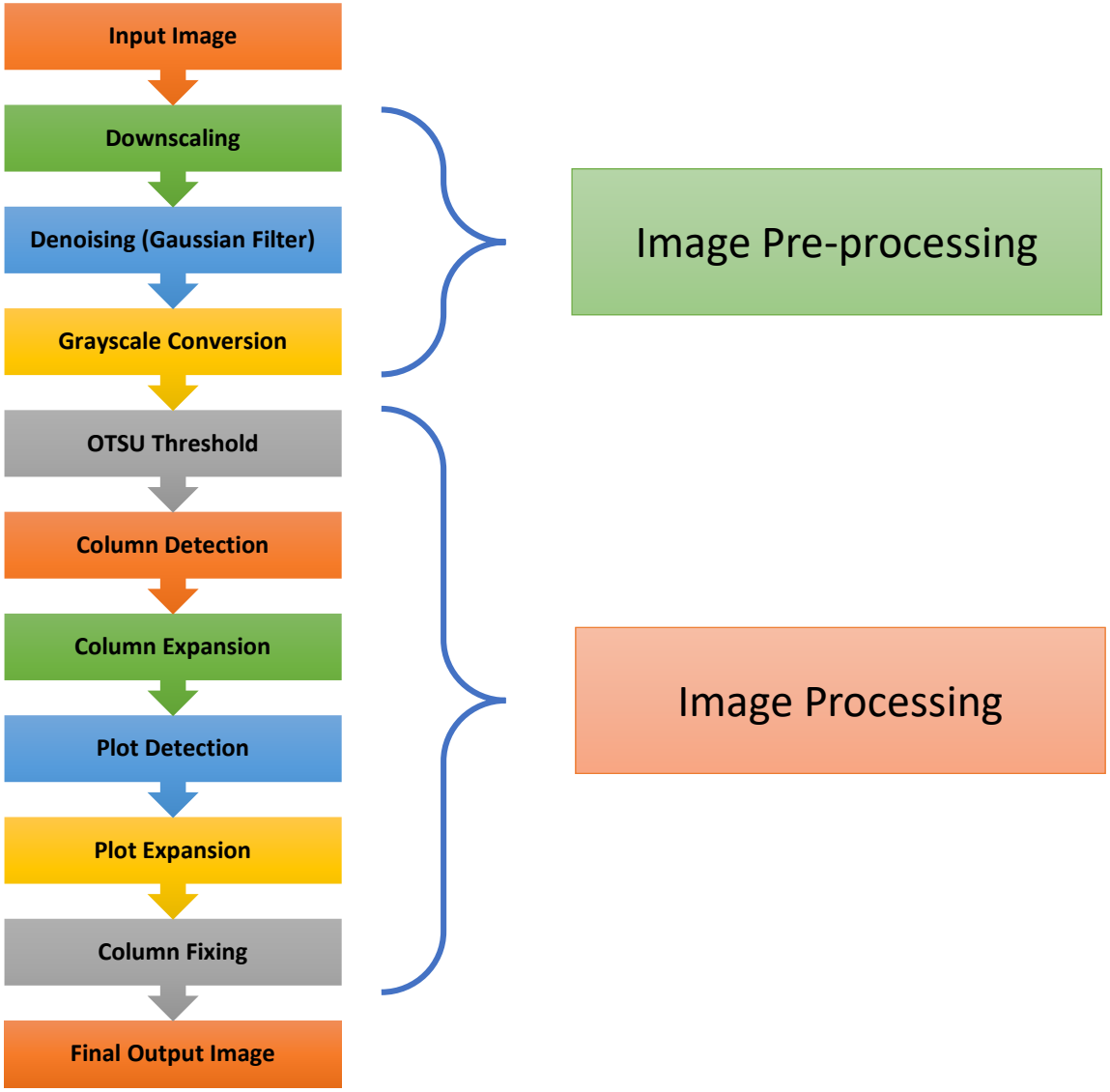
Data Source

Crop breeding trials from P2IRC project

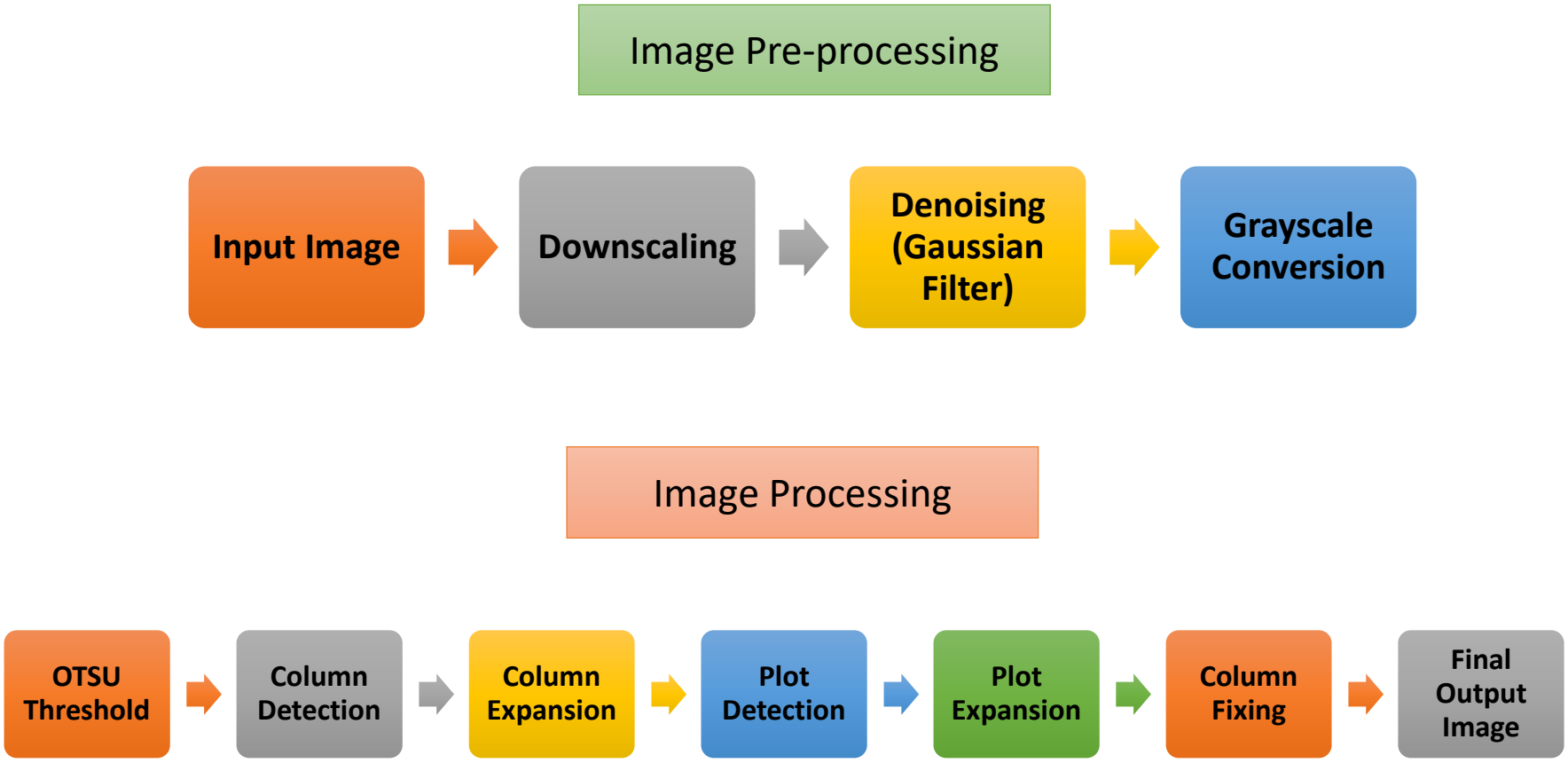
Aerial (drones)

Taken in June, July and August of 2017

Implementation: Overview

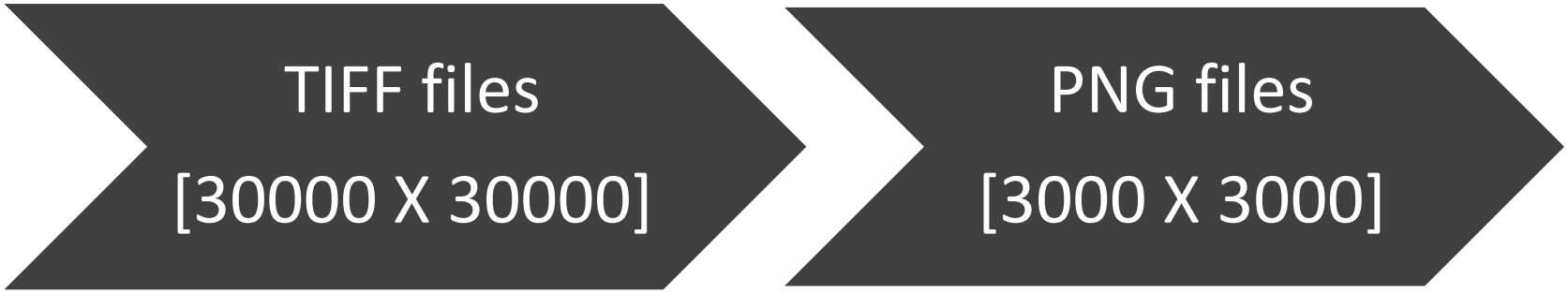


Implementation: Overview



Implementation: Pre-processing

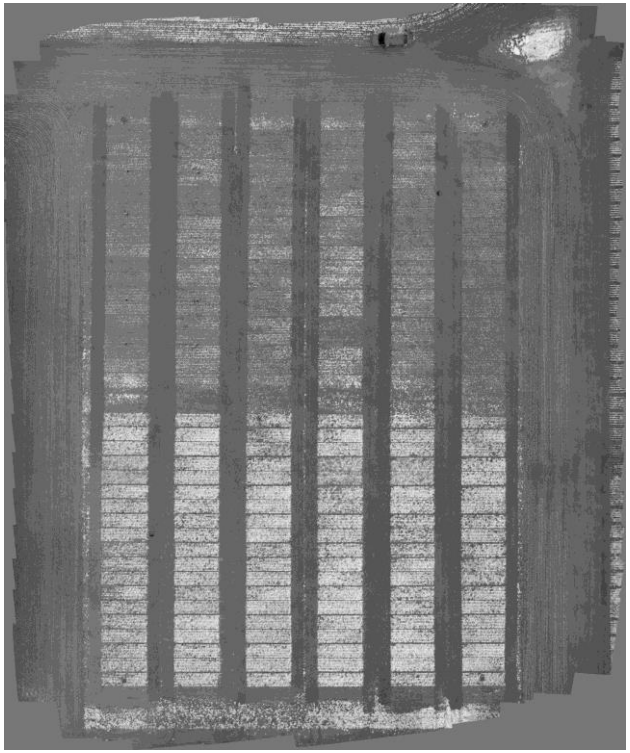
- **Downscaling**



Implementation: Pre-processing (Contd.)

- **Denoising**
  - High resolution image without S&P noise
  - Might have Gaussian noise (a little bit)
  - **Gaussian Filter** was used to denoise

Implementation: Pre-processing (Contd.)



- **Grayscale Conversion**

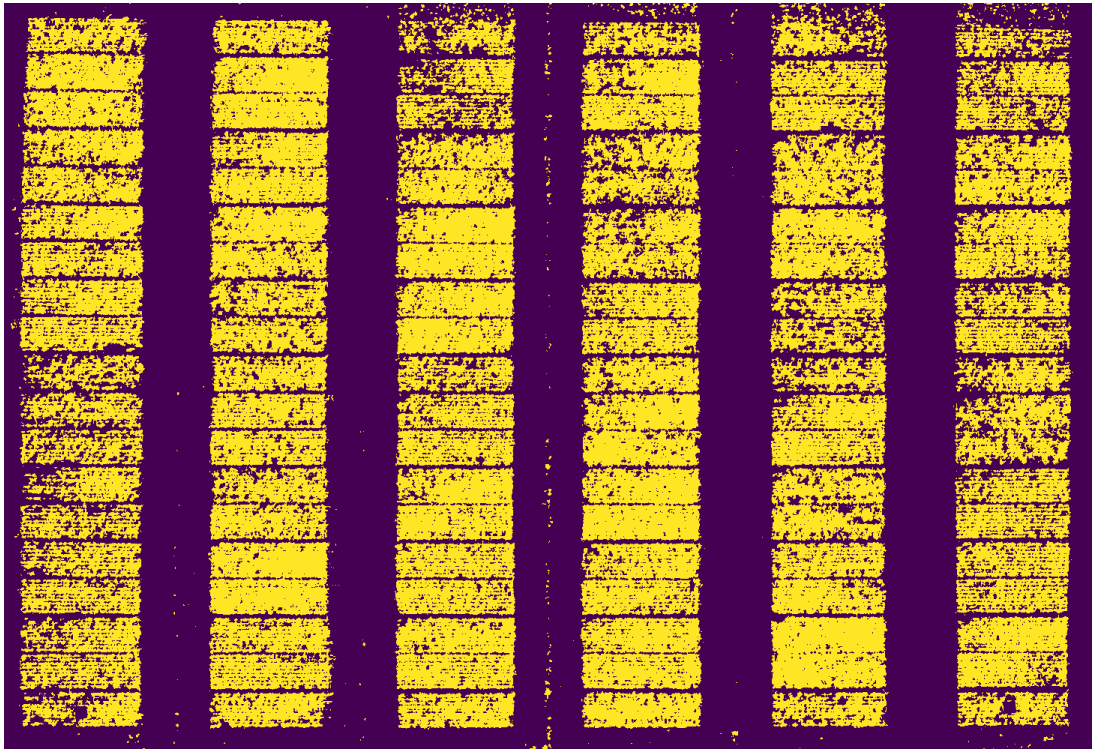
GBNir
Color Space

GNDVI
Color Space

3G-B-Nir
Custom Color Space

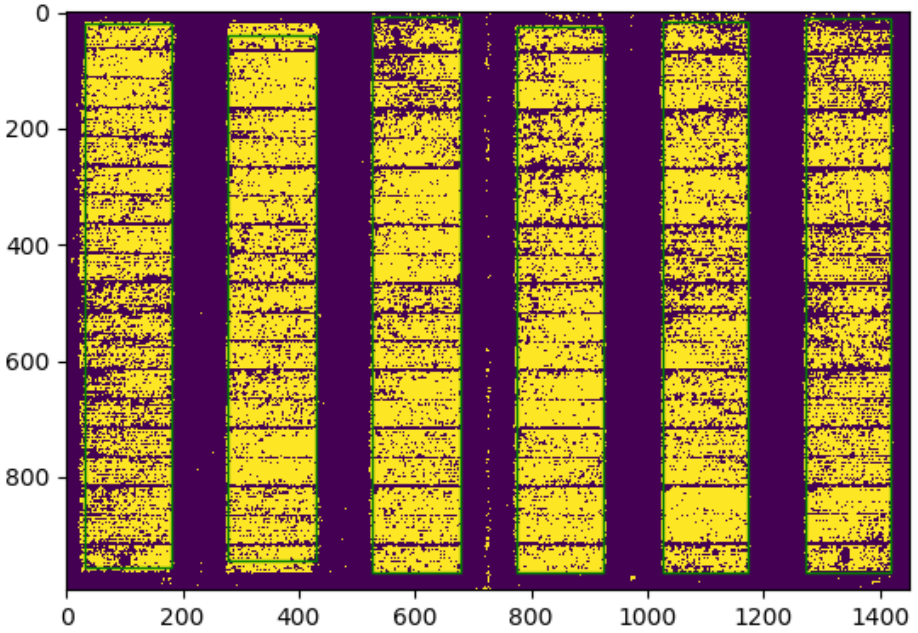
Implementation: OTSU Thresholding

- Considered
  - OTSU only
  - OTSU + erosion
  - OTSU + closing + erosion
  - Random Walker
- Decision
  - OTSU only



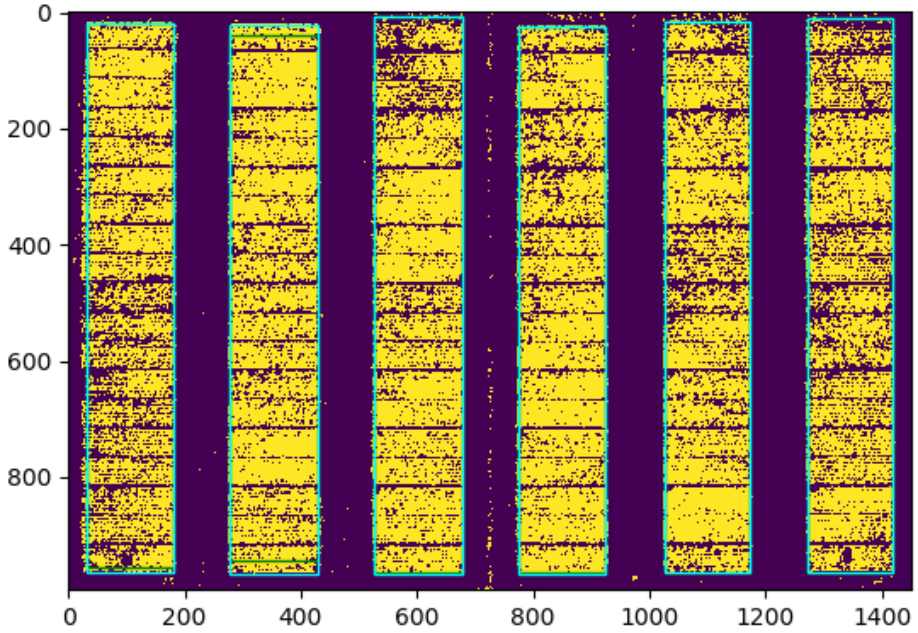
Implementation: Column Detection

- Image Column Histogram
- Calculate # of white pixels
- Start a column
  - prev_column_white < 50% and
  - current_column_white > 50%
- End a column
  - prev_column_white > 50% and
  - current_column_white < 50%



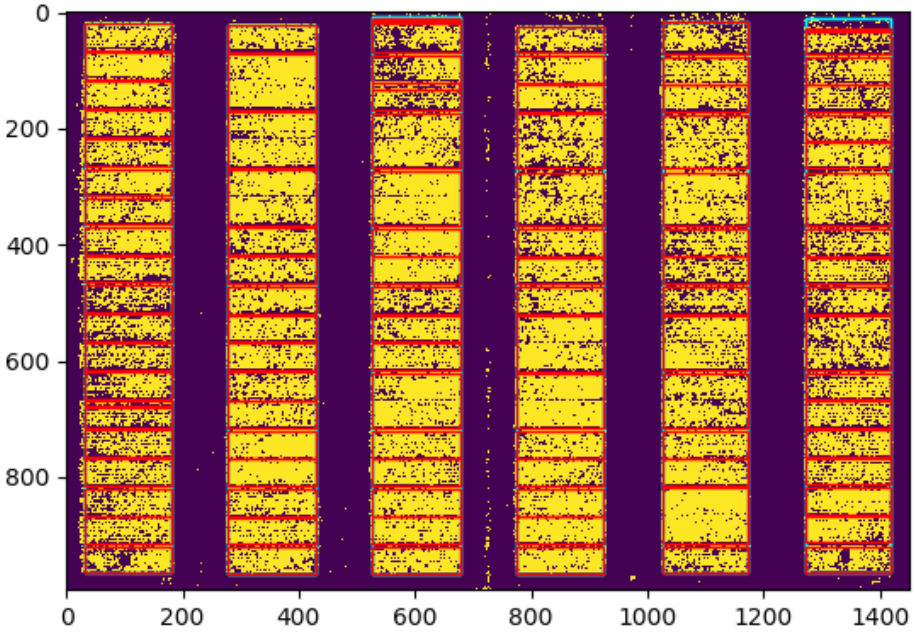
Implementation: Column Expansion

- Extend top and bottom row of a field column
- Add an adjacent row if it has white pixels >= 20% of the column width



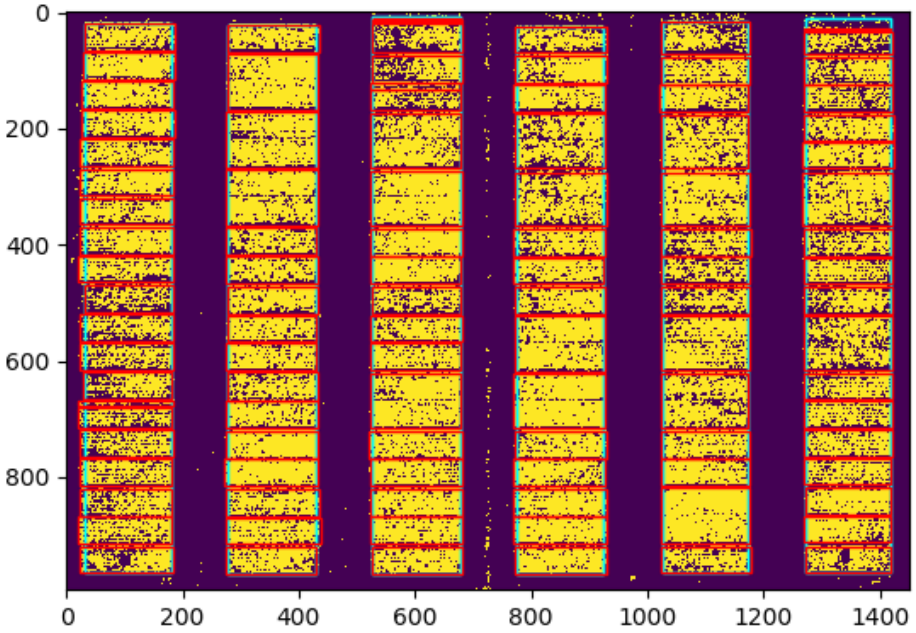
Implementation:
Plot Detection

- Image Row Histogram
- Check rows only inside a field column
- # of white pixels >= 20% of column width
- Start a plot
  - prev_row_white < 20% and
  - current_row_white > 20%
- End a plot
  - prev_row_white > 20% and
  - current_row_white < 20%



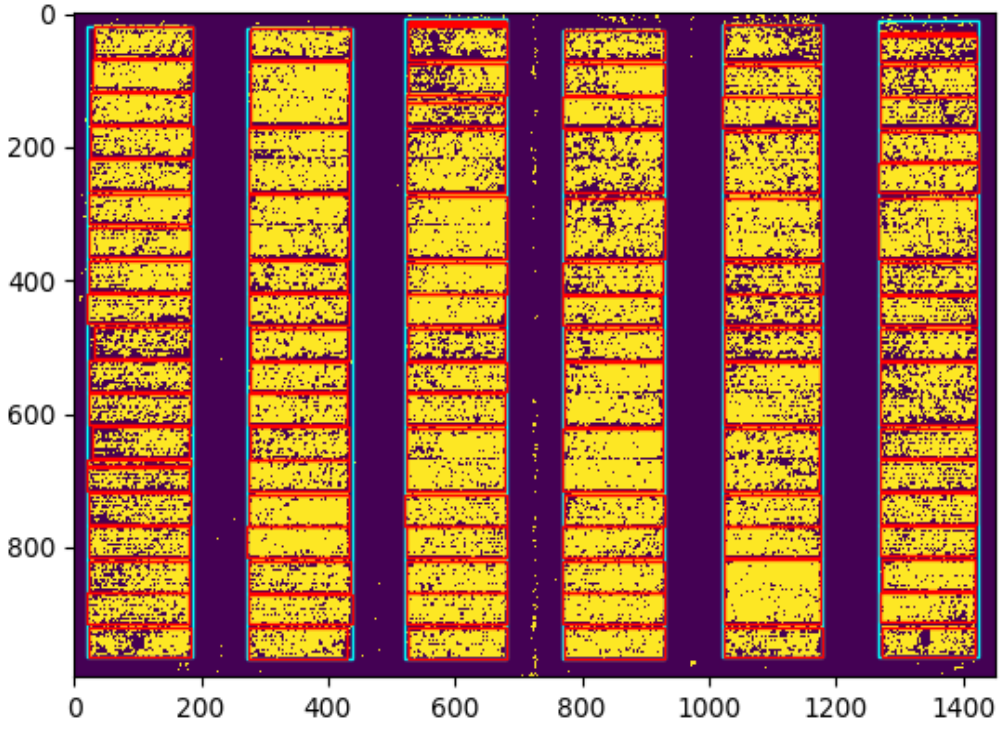
Implementation: Plot Expansion

- Extend a plot to its left and right
- Add an adjacent column to a plot if it has white pixels >= 20% of the plot height width

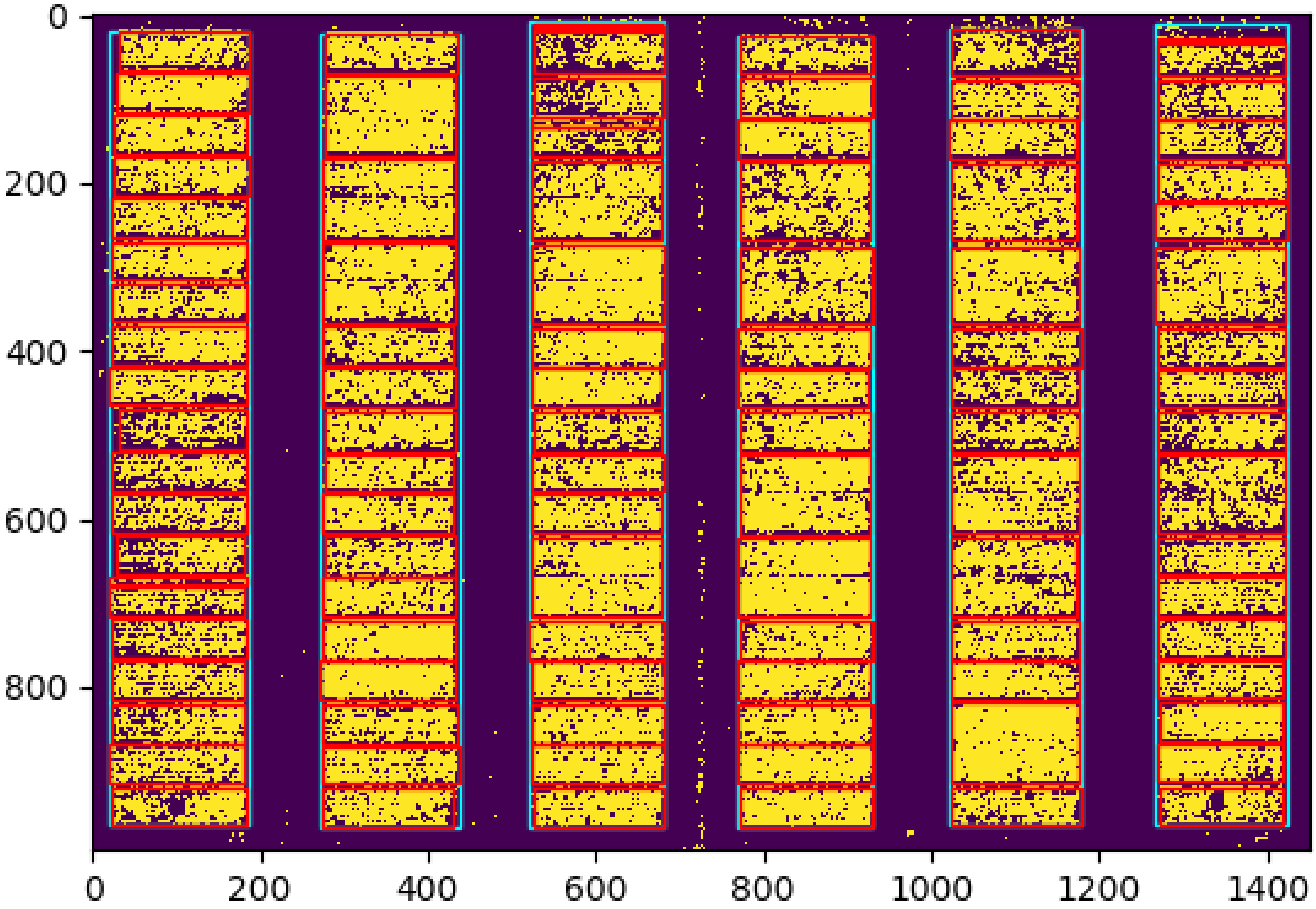


Implementation: Column Fixing

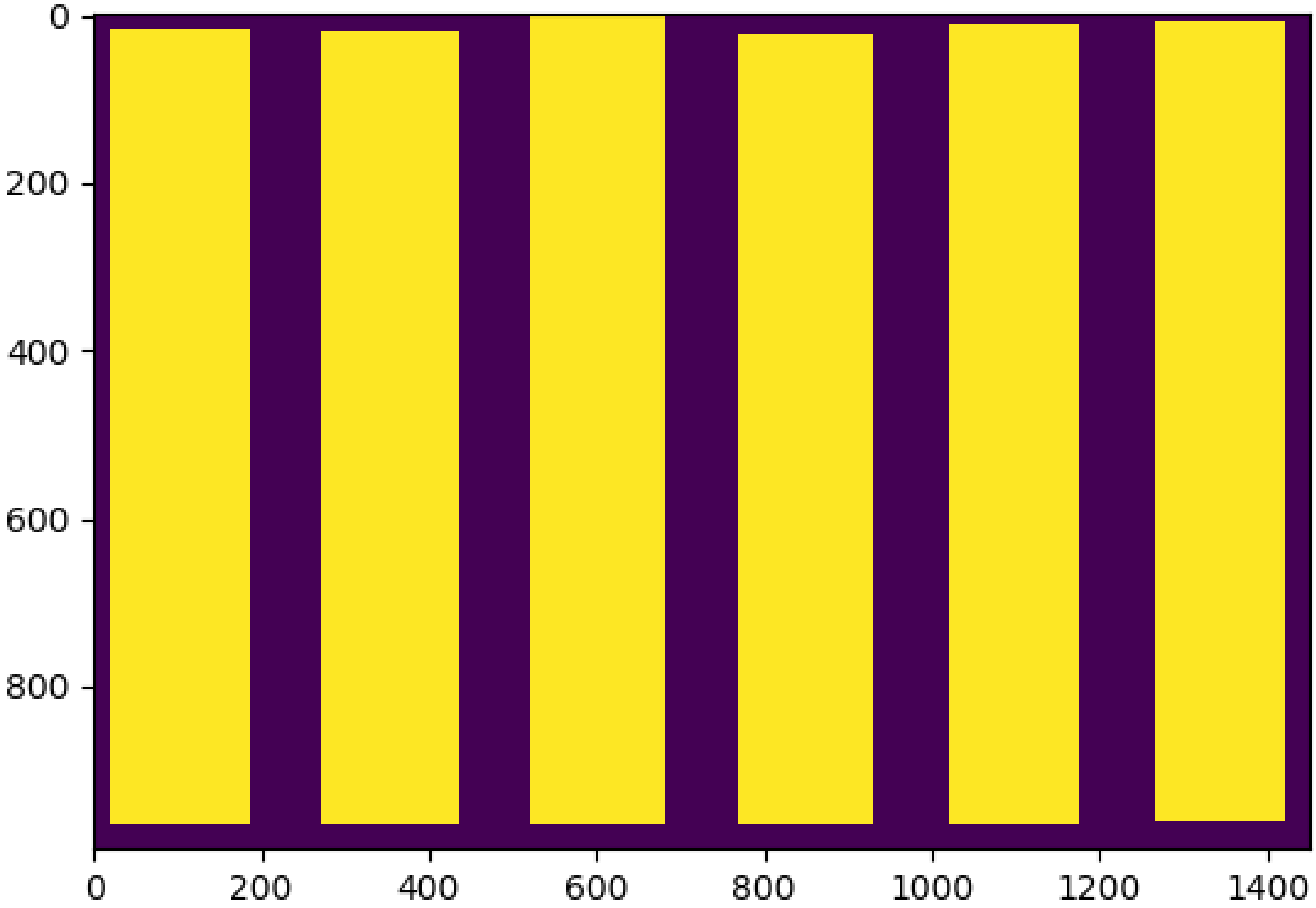
- Reshape Field Columns
- For the left side, take the minimum of all the plots' column values
- For the right side, take the maximum of all the plots' column values



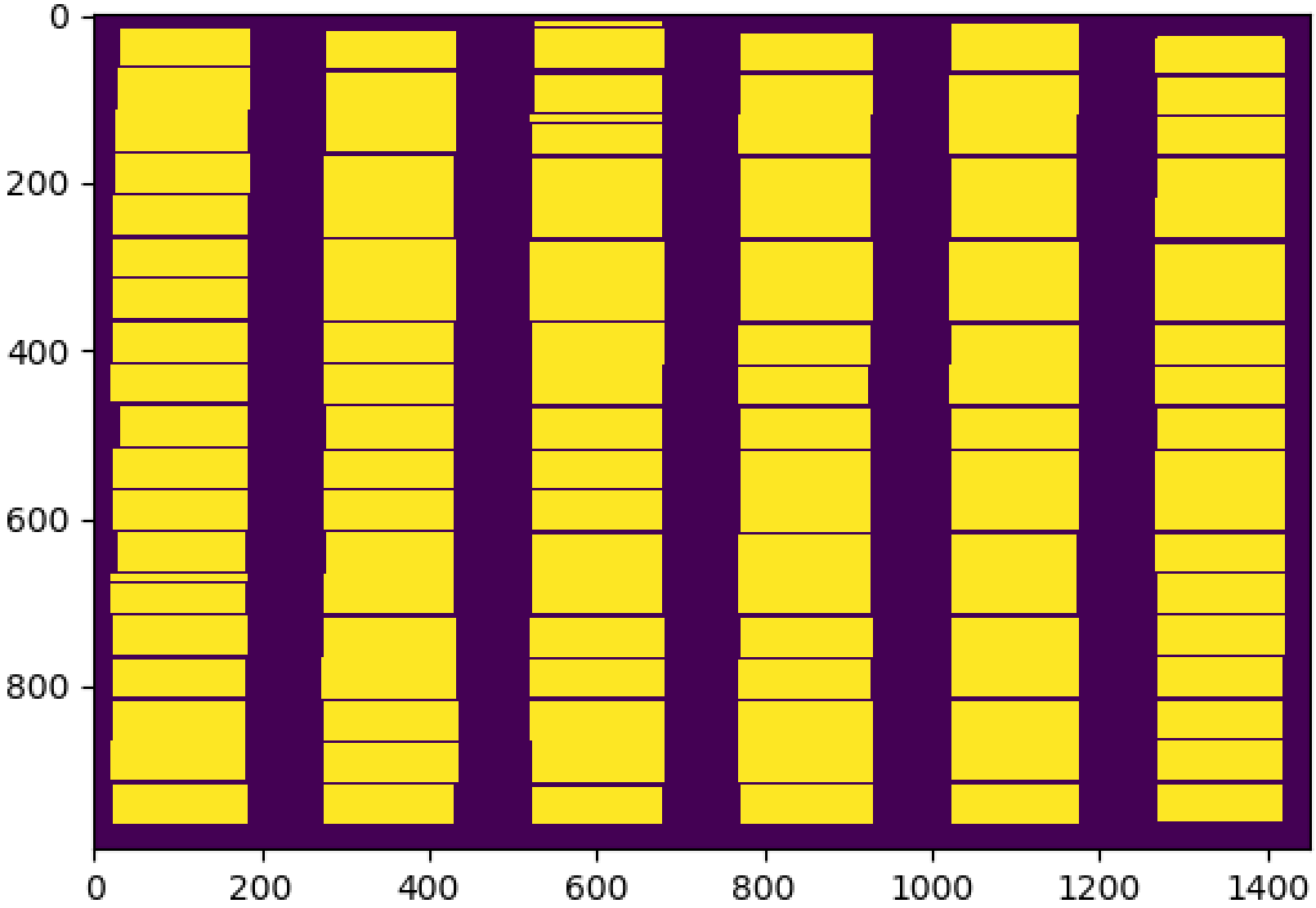
Implementation: Final Output



Implementation: Final Column Bins

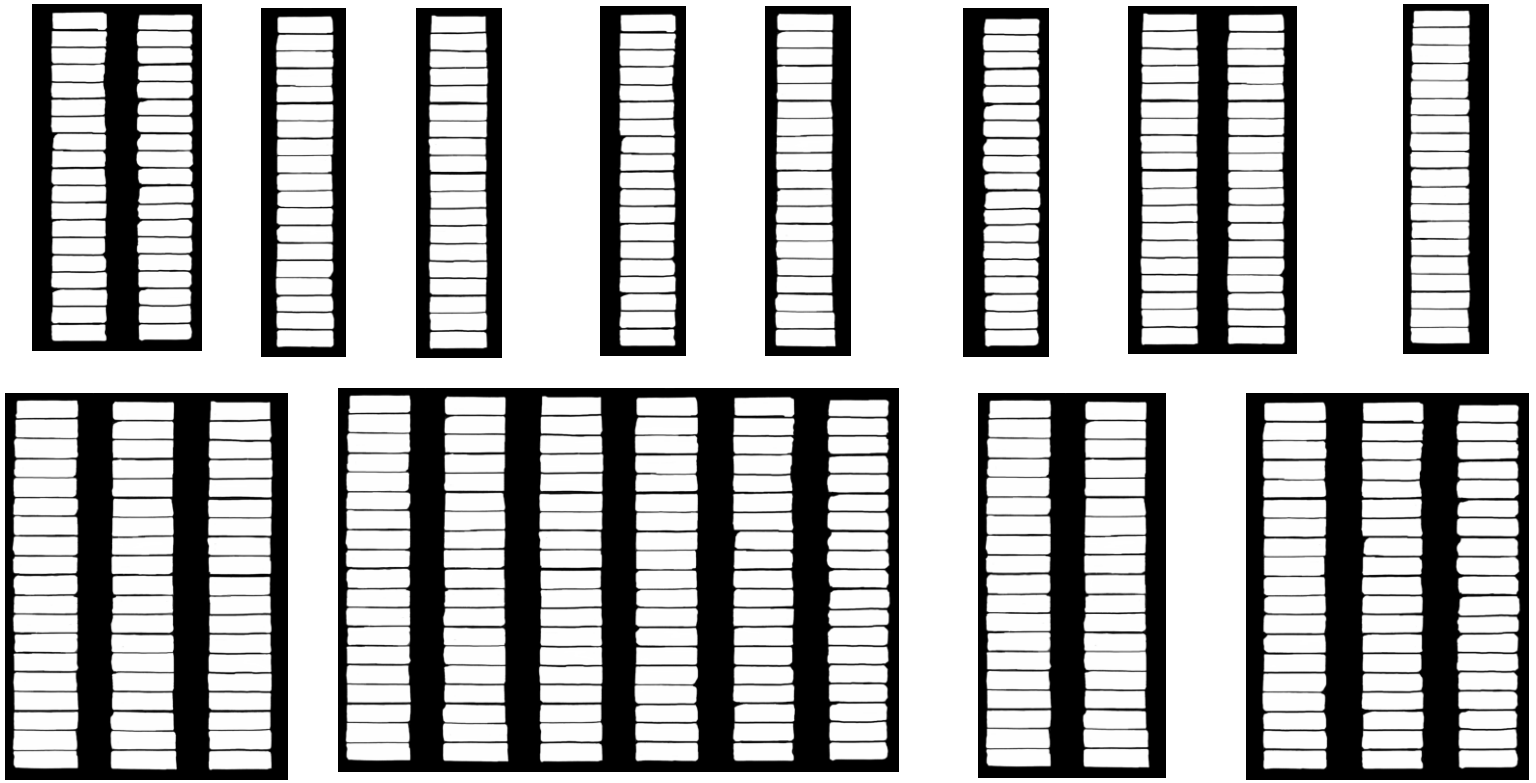


Implementation: Final Row Bins

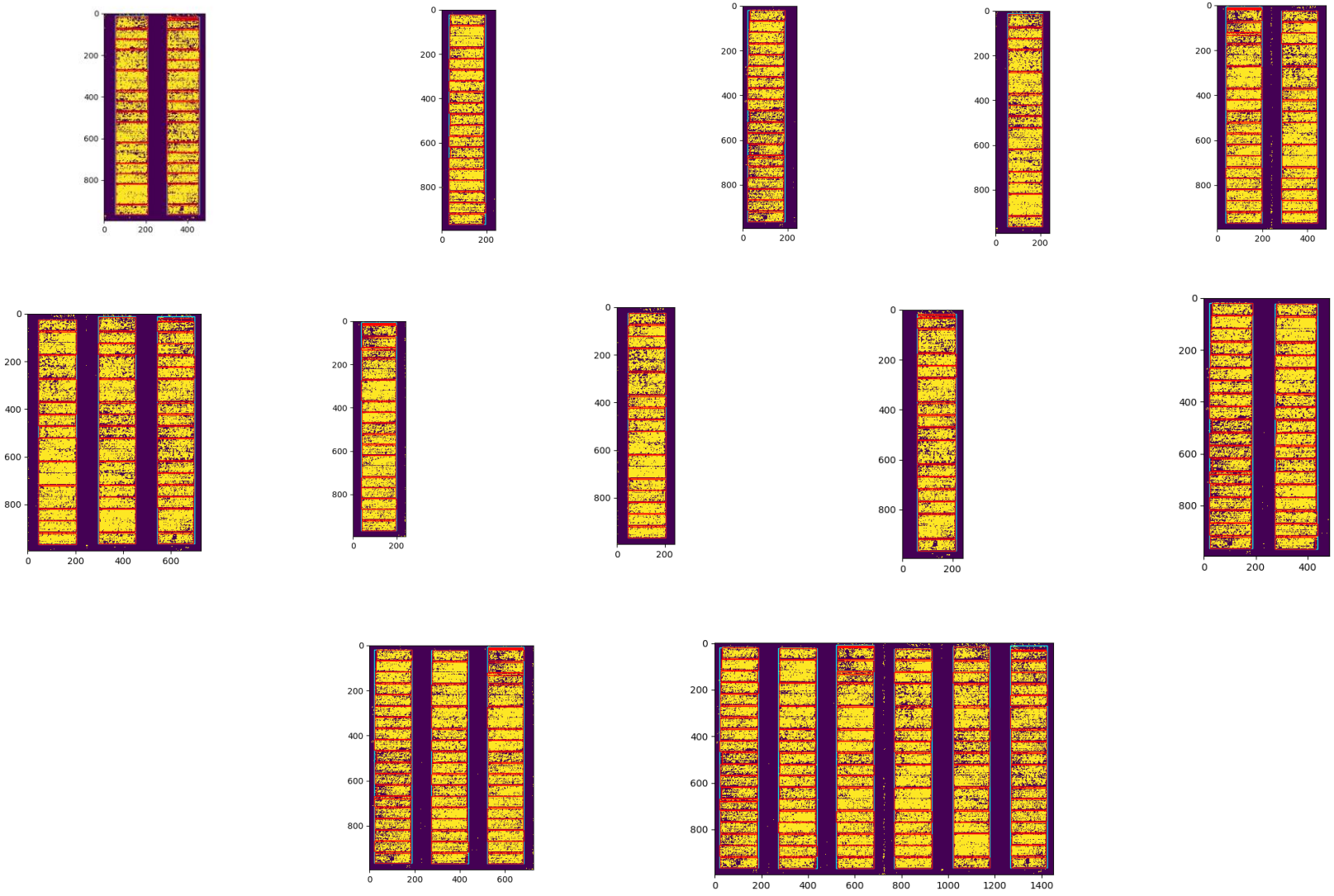


Results: Ground Truth

- Ground Truths were generated using Adobe Photoshop



Results: Image Patches



Evaluation Metrics

- Dice Similarity Coefficient (DSC)

$$DSC = \frac{2|B \cap G|}{|B| + |G|}$$

- Recognition Rate (RR)

$$RR = \frac{\text{total number of recognized regions}}{\text{total number of ground truth regions}}$$

- Misidentification Rate (MR)

$$MR = \frac{\text{number of segmented regions in } \mathcal{A} \text{ not in correspondence}}{\text{total number of segmented regions}}$$

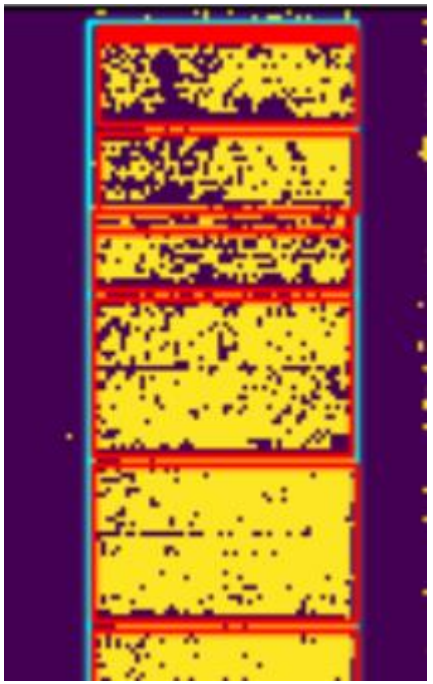
Results

- Avg. DSC - **0.9633**
- Avg RR - 90.6%
- Avg MR - 19.5%

File Name	Dice Similarity Coefficient (DSC)	Recognition Rate (RR)	Misidentification Rate (MR)
1.PNG	0.9684	1.0526	0.0526
2.PNG	0.9708	0.9474	0.0526
3.PNG	0.9584	1.0000	0.3158
4.PNG	0.9682	0.7895	0.2105
5.PNG	0.9550	0.7368	0.2631
6.PNG	0.9586	0.9474	0.2631
7.PNG	0.9690	0.9737	0.0789
8.PNG	0.9635	0.9211	0.2368
9.PNG	0.9569	0.8421	0.2632
10.PNG	0.9656	0.9825	0.1579
11.PNG	0.9604	0.7895	0.2632
12.PNG	0.9642	0.8947	0.1842
Average	**0.9633**	**0.9064**	**0.1951**

Discussion

- Designed for Vertically or Horizontally oriented rectangular field plots
- Ground Truth
- Misidentification rate:
  - Falsely identified plots
  - Merged Plots



Future Work

- Remove false plots using plot height threshold
  - Calculate average plot height
  - Remove false plots
- Divide merged plots considering average plot height of the field column
- Detect rotated and arbitrary shaped plots

References

- Mark G. Eramian, Class Lectures, CMPT 819, University of Saskatchewan
- Travis Gray et al., ‘Plot Segmentation and Localization (Poster)’, Department of Computer Science, University of Saskatchewan
- RC Gonzalez, RE Woods, SL Eddins, ‘Digital Image Processing using MATLAB’, 2nd Edition, 2009