



Intern Final Presentation

Inderjot Singh Saggu (IJ)

Intern – Machine
Learning

About me!



Second year Masters student at UC San Diego



Majoring in Machine Learning and Data Science

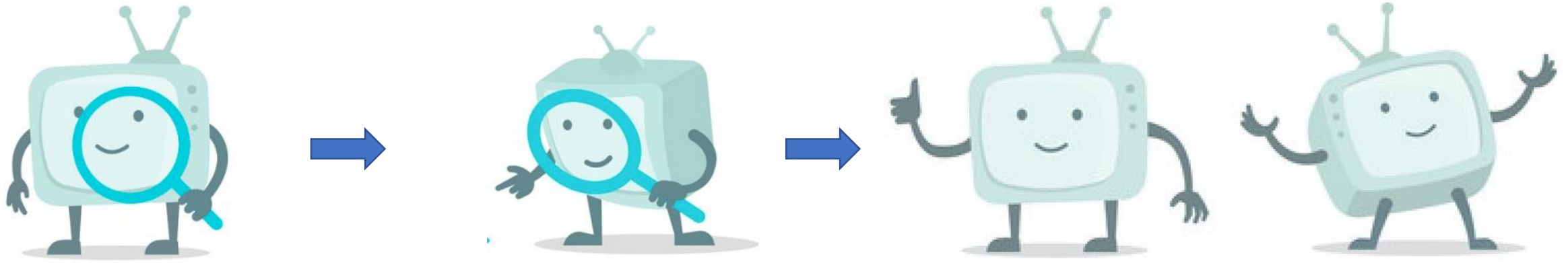


Machine Learning Intern (more like Computer Vision really!)



Worked with the Document Tooling Team on designing an improved ID matching tool for automating document onboarding process and increasing efficiency of modellers.

Image Matcher Tool : Say Hi!



Query Image

Test Images

Output Images

The Problem : Legacy Matcher

Based on thresholding features matched and homography constraints.

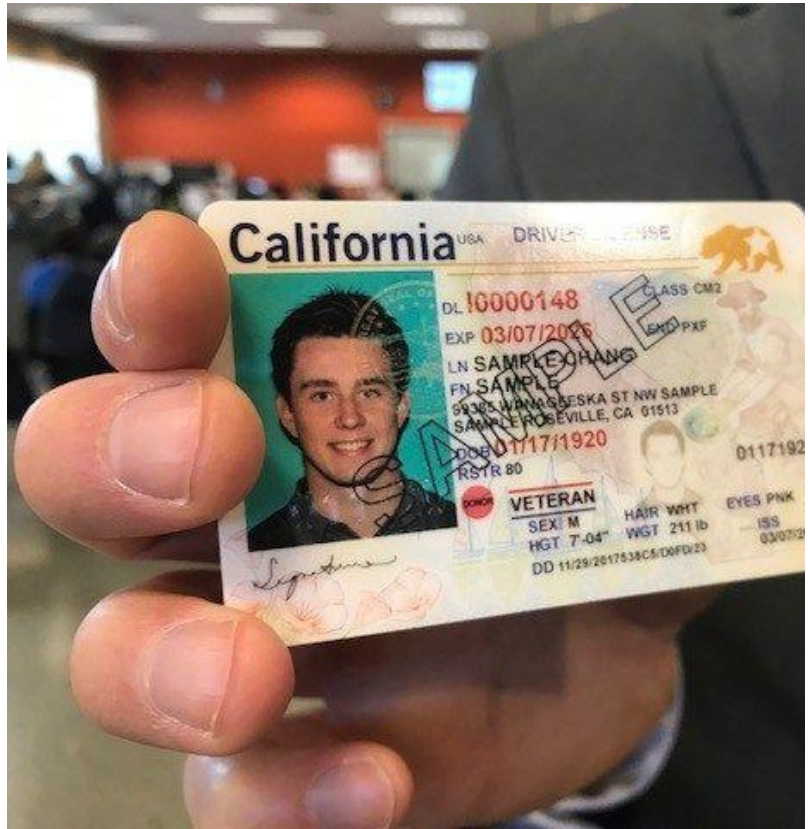
Pros:

- Reasonably Fast (~0.05s to process single test query)
- Near perfect detection of True Positives



Cons

- Couldn't distinguish between sub-categories of IDs for a particular state (real vs standard and ID vs DL)



Legacy tool cannot distinguish between these

WISCONSIN DRIVER LICENSE REGULAR

4d DL **S123-4567-8901-23**

1 **SAMPLE**
2 **JANICE**
8 **123 NORTH MAIN STREET**
APT. 1
MADISON, WI 55405

3 **DOB 01/12/1982** 4b EXP **01/12/14**

15 **SEX F** 4a **ISS 01/12/2010**
16 **HGT 5'-06"** 18 **EYES BRO**
17 **WGT 130 lb** 19 **HAIR BLK**

9 **CLASS D**
9a **END S**

5 **DD OTWWW1234567890123456**

Janice Sample

California USA DRIVER LICENSE

DL **I1234562** CLAS
EXP **08/31/2014** END

LN **SAMPLE**
FN **ALEXANDER JOSEPH**
2570 24TH STREET
ANYTOWN, CA 95818

DOB **08/31/1977**
RSTR **NONE**

SEX **M** HAIR **BLK**
HGT **5'-08"** WGT **150 lb**
DD **00/00/0000NNAN/ANFD**

Alex J Sample

ILLINOIS Jesse White • Secretary of State
DRIVER'S LICENSE

4d LIC NO: **P142-4558-7924**
3 **DOB: 11/14/1987**
4b EXP: **11/14/2020**

1 **PUBLIC**
2 **JANE Q**
8 **1234 MAIN STREET**
SPRINGFIELD, IL 62723

9 **CLASS: D** 9a **END: NONE**
12 **REST: NONE**

15 **SEX F** 16 **HGT: 5'-6"**
17 **WGT: 145 lbs** 18 **EYES: BRN**

5 **DD 20160210983DT0328**

Jane Q Public

South Carolina USA DRIVER'S LICENSE

4d DL#: **123456789**

1 **SHWEDO**
2 **KEVIN ANTHONY**
8 **10311 WILSON BLVD**
COLUMBIA, SC 290161234

3 **DOB: 07/04/1956**
4a **Issued: 08/28/2017**
4b **Expires: 07/04/2025**

15 **Sex: M** 16 **Hgt: 5'-11"**
17 **Wgt: 195 lb** 18 **Eyes: BLU**

9 **Class: D**
12 **Restrictions: NONE**

5 **DD 0100010602224403054**

Kevin A Shwedo

VETERAN
Governor

But...is very good at separating these

Goal :



Hybrid Matcher Tool that takes best of Legacy tool while getting rid of all the cons

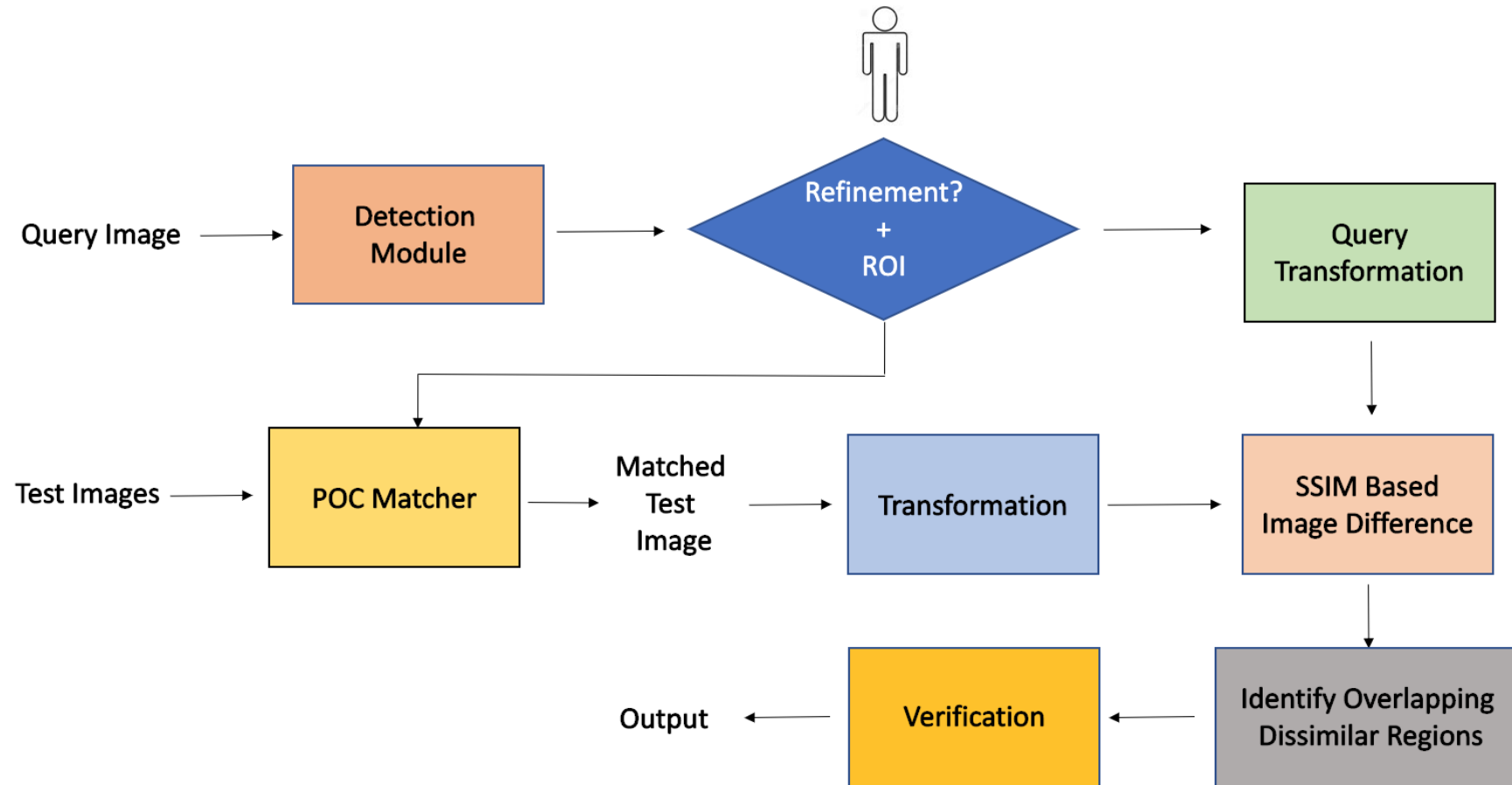


Primary Goal: Significantly reduce the number of FPs while retaining most of the TPs

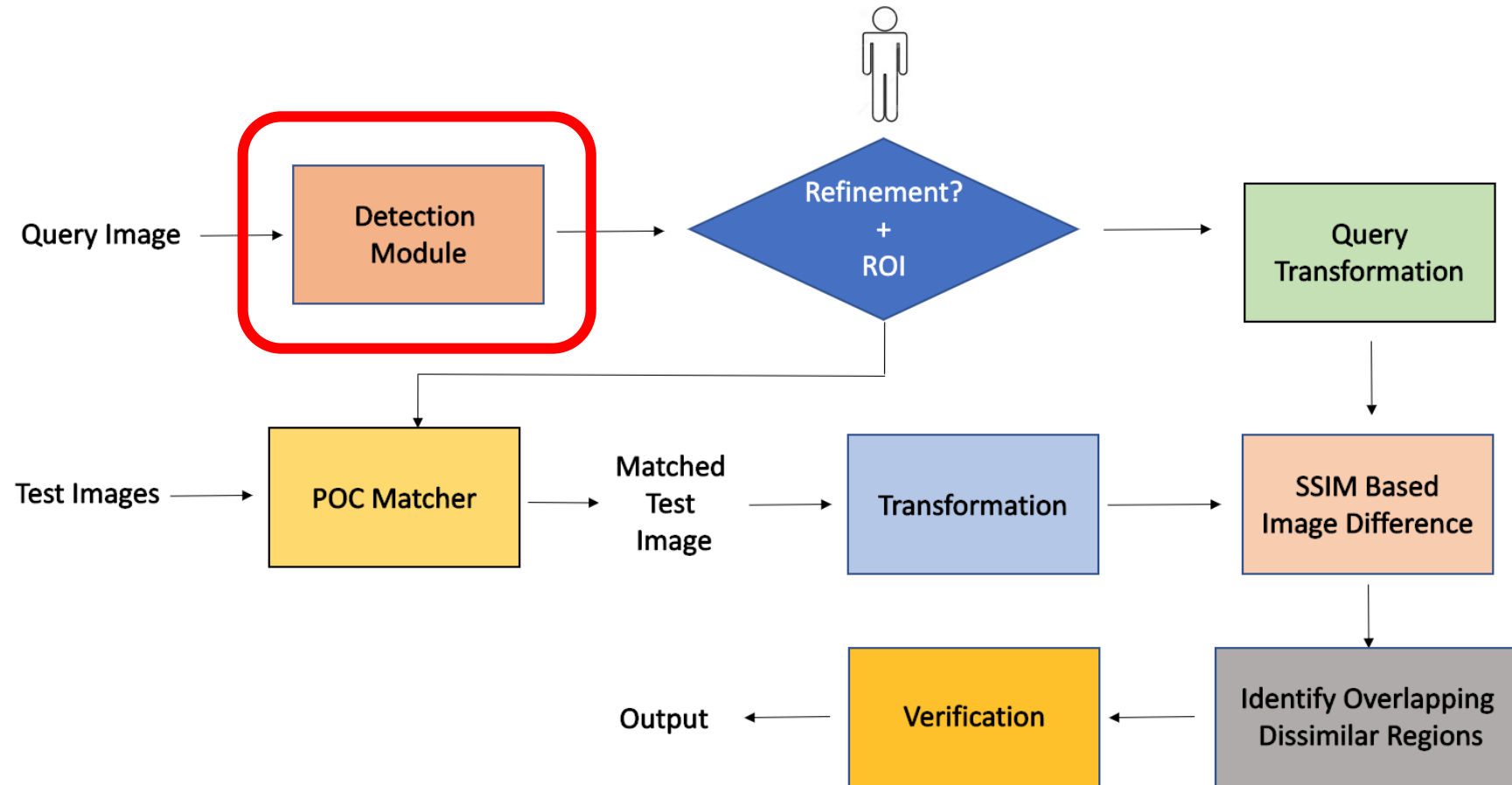


Secondary Goal:
Remove/Reduce manual intervention

Final Pipeline



Final Pipeline

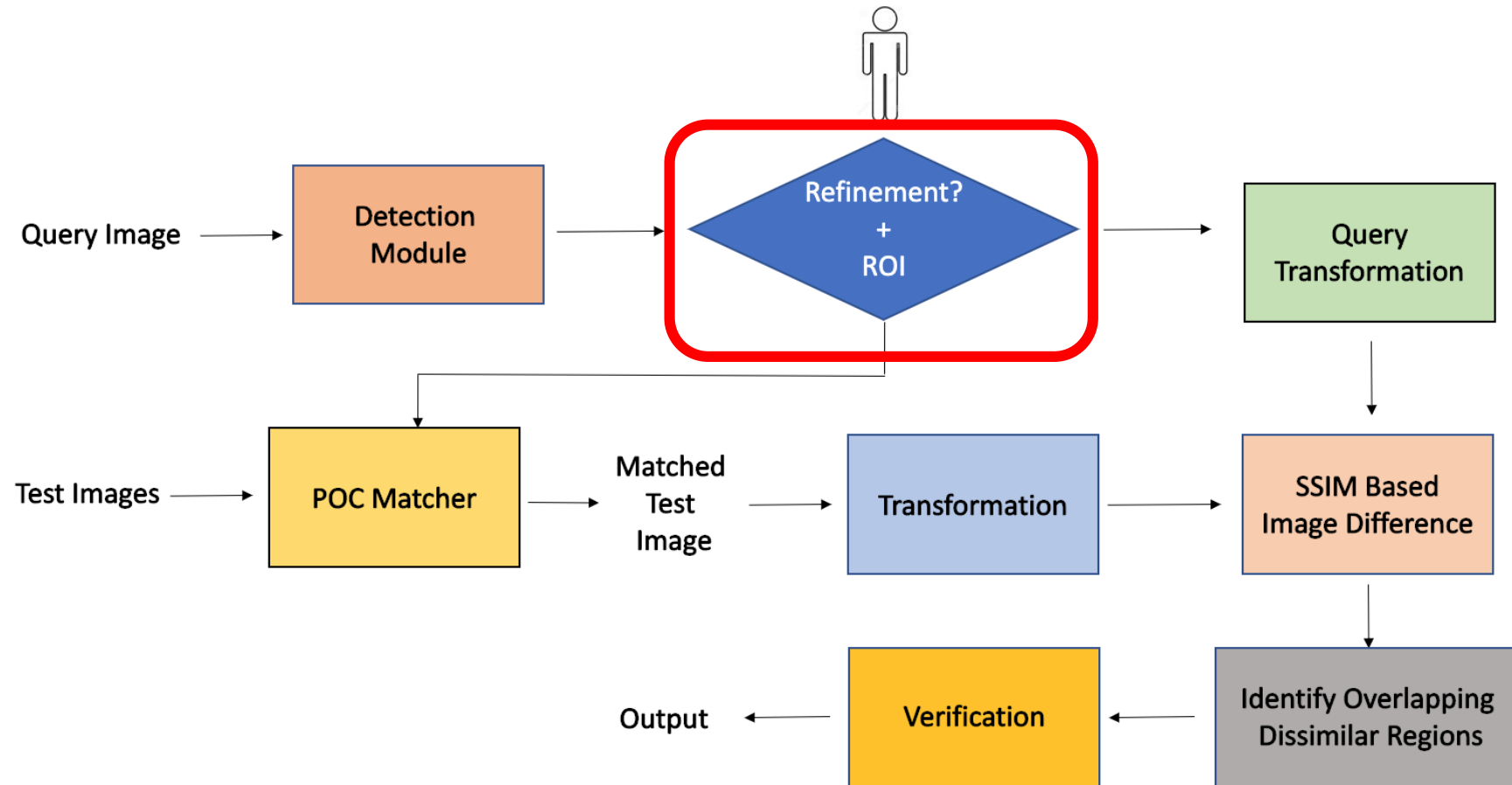




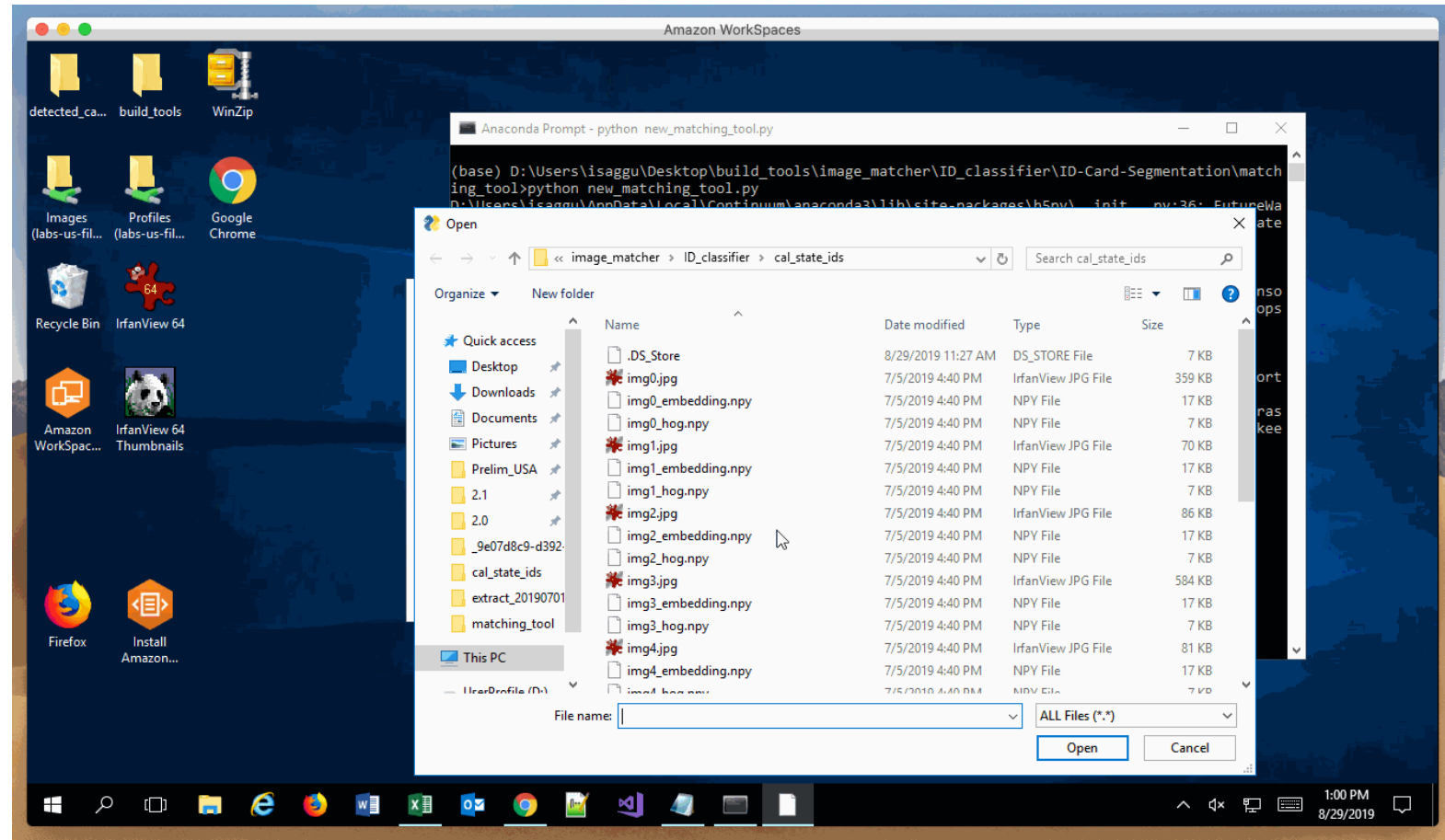
Detection Module

- Automatic detection of four-corners (cyan)
- Reduces manual effort of modelers

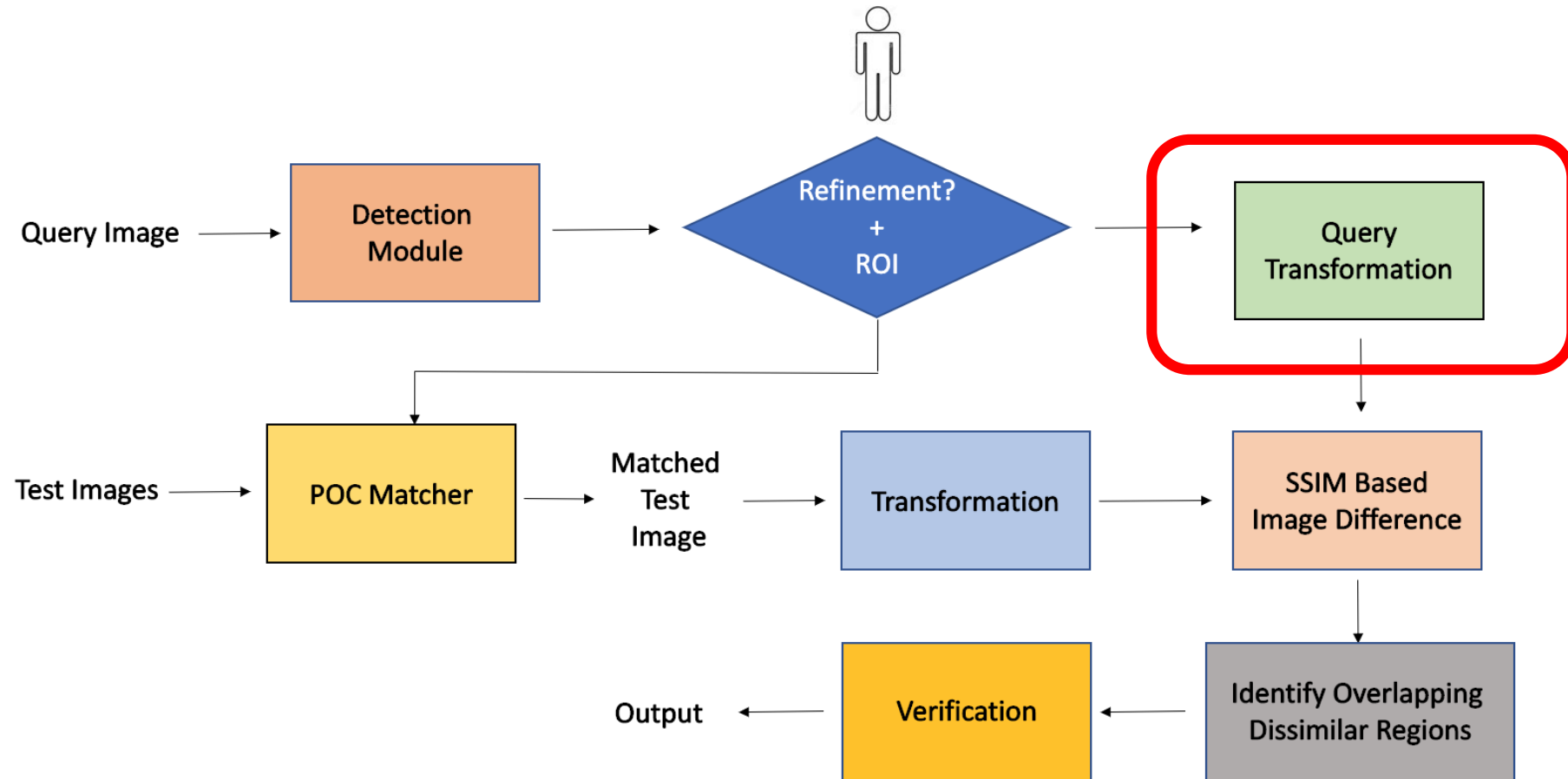
Final Pipeline



Four-Corner Refinement and RoI Selection



Final Pipeline



Transformation Module

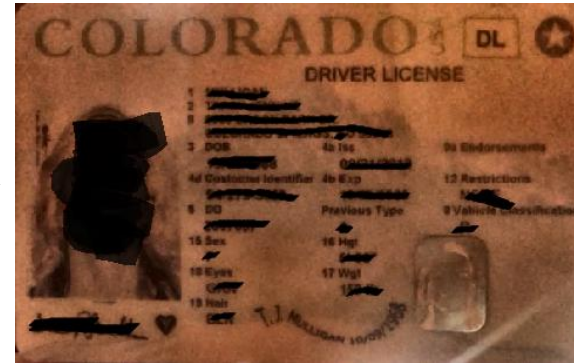
Original Image



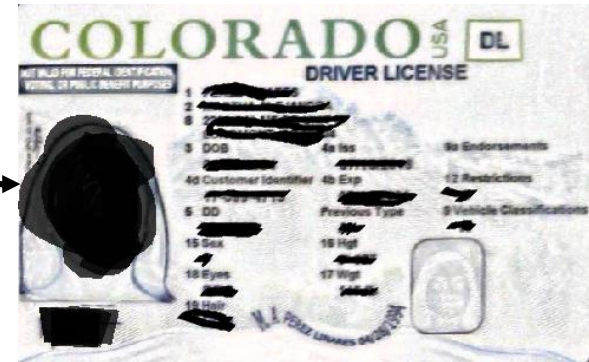
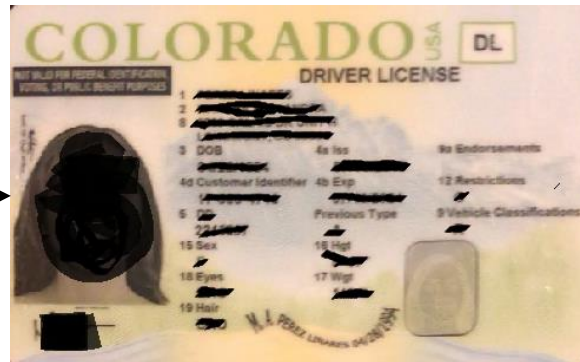
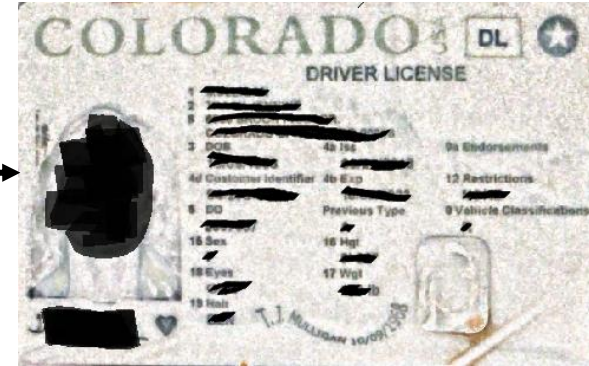
Segmentation and Detection



Adaptive Histogram Equalization



Shadow Removal



Histogram Matching

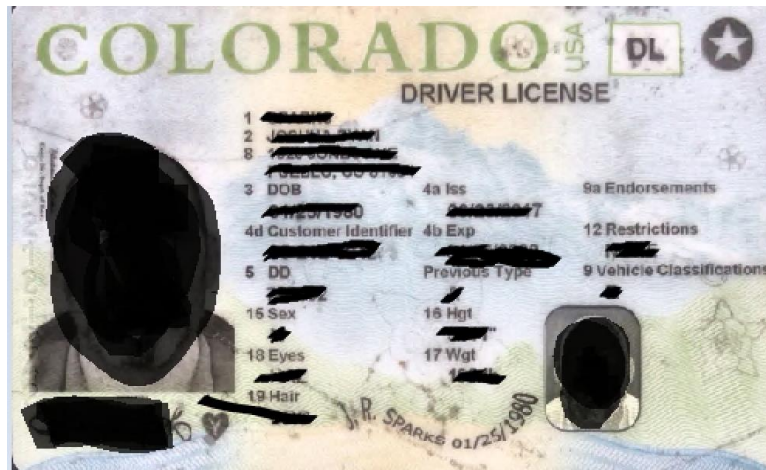
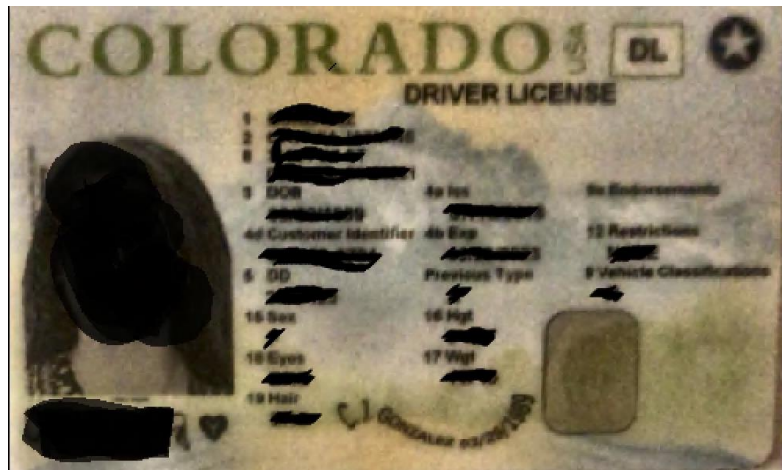
Source



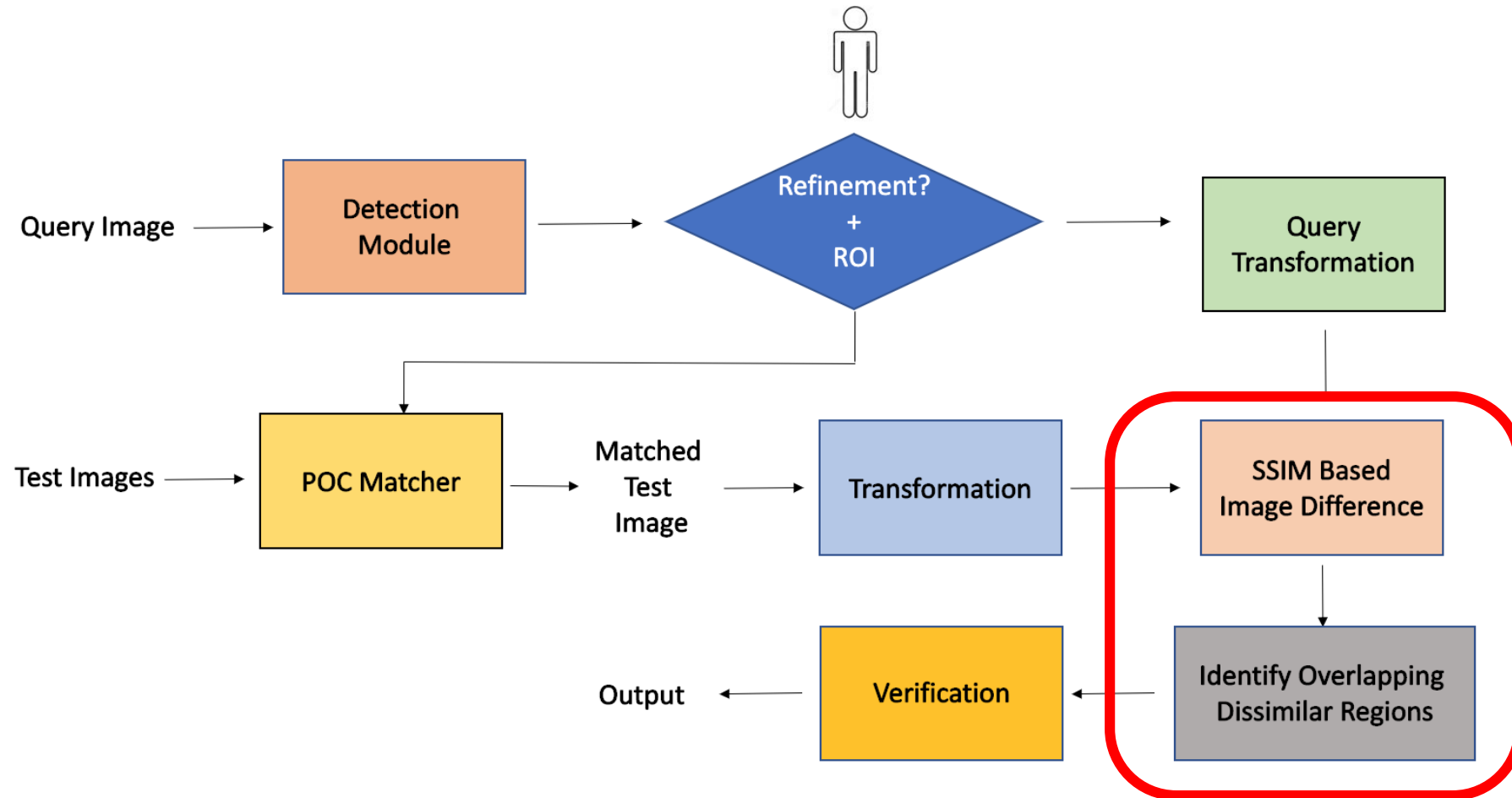
Reference



Matched



Final Pipeline



Identifying Dissimilar Regions

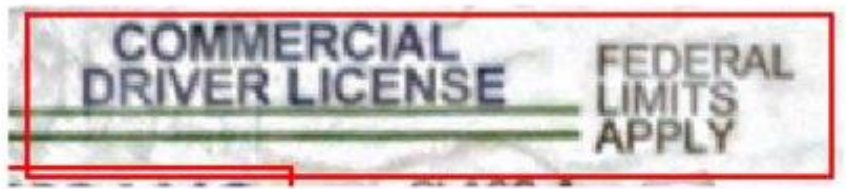
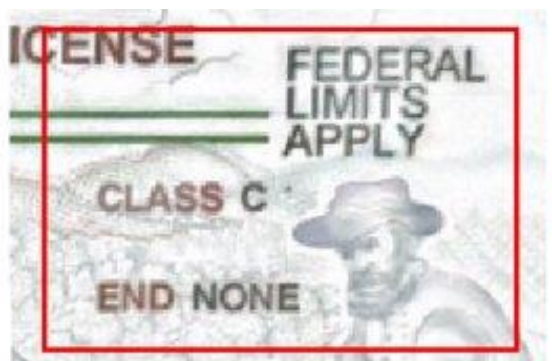
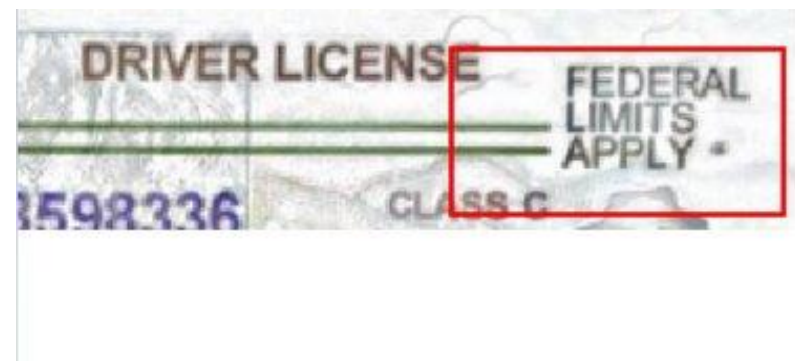
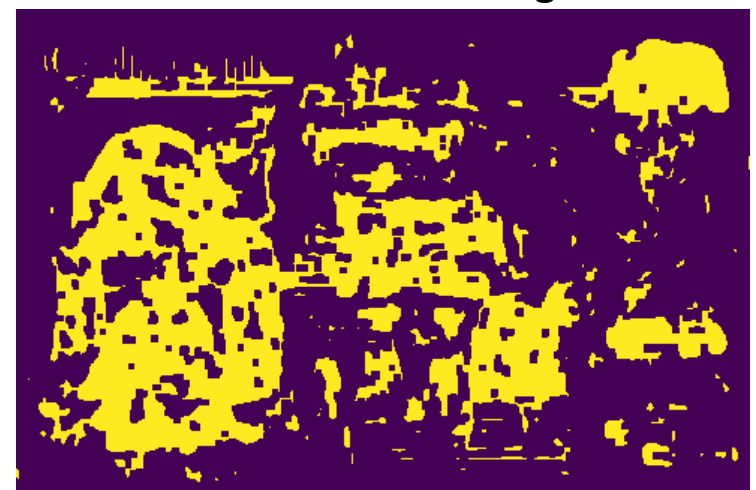
Query Image



Test Image



SSIM
Difference Image



Results

Auto-ID segmentation and subsequent four-corner detection achieves an accuracy of 7 pixels



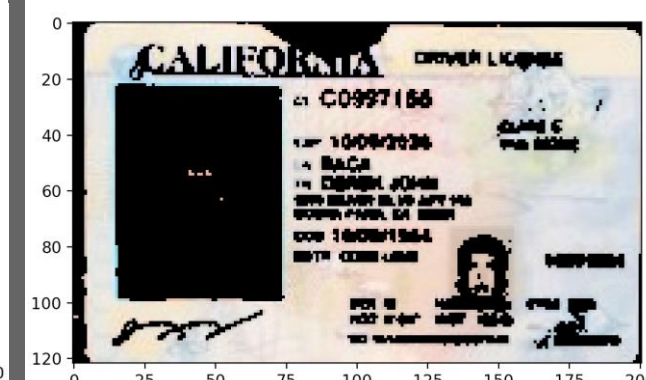
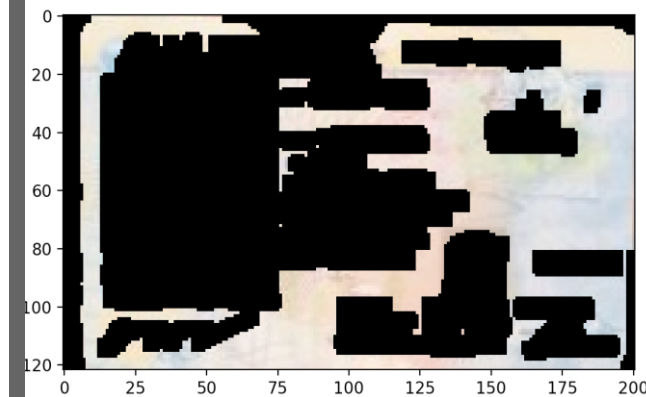
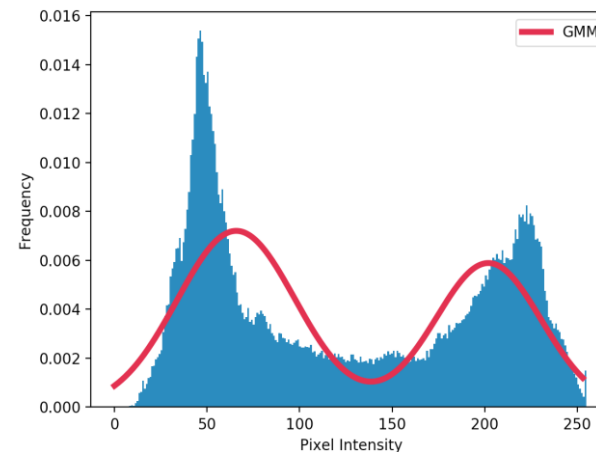
Improved matcher tool rejects 92% of FPs over legacy while retaining over 80% of TPs



Matching tool documented with improved UI and handed over to modelers

Some Other Stuff I Worked On : ID Decomposition

- Build a pixel histogram
- Fit a mixture of gaussian on the data (n = 2)
- Why? Exploit contrast change between text-background
- Separate region into two parts
 - Values best explained by first gaussian
 - $\mu_1 \pm 2 \cdot \sigma_1$
 - Values best explained by second gaussian $\mu_2 \pm 2 \cdot \sigma_2$





Thanks for your Time!

