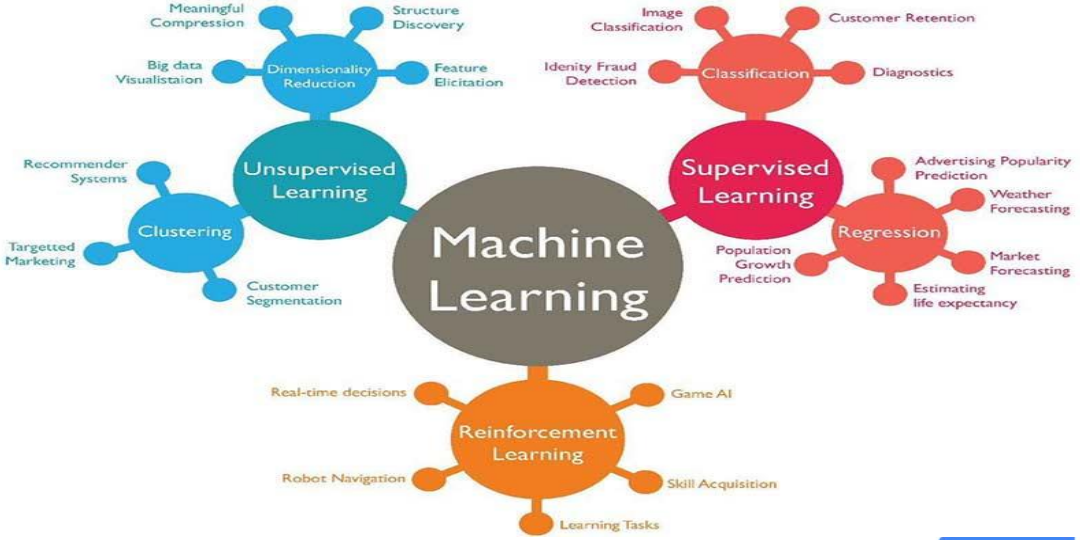
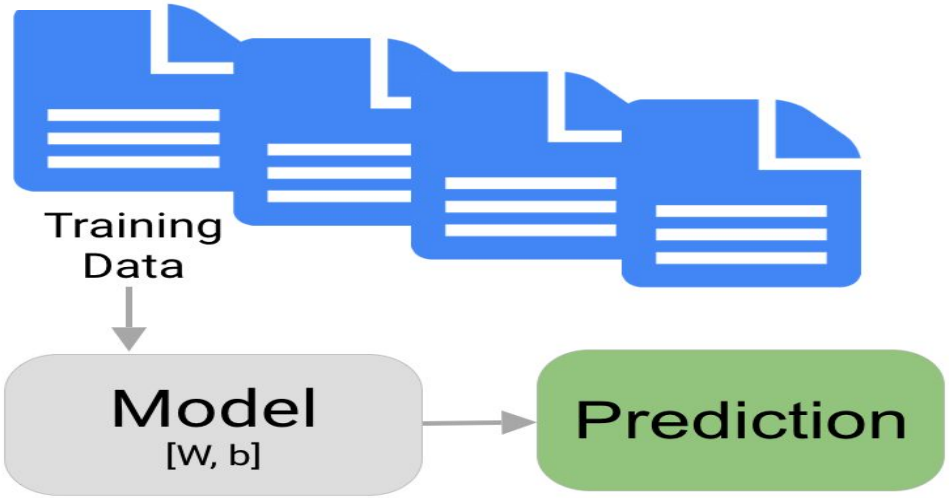
Analyzing and Modeling Forensic Data

Zachary Randall, Tasmia Rahman,
Rosemary Dabbs, Sara Mousavi


Machine Learning
Unsupervised Learning
Supervised Learning
Reinforcement Learning
Dimensionality Reduction
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Clustering
Recommender Systems
Targetted Marketing
Customer Segmentation
Classification
Image Classification
Customer Retention
Idenity Fraud Detection
Diagnostics
Regression
Advertising Popularity Prediction
Weather Forecasting
Population Growth Prediction
Market Forecasting
Estimating life expectancy
Real-time decisions
Game AI
Robot Navigation
Skill Acquisition
Learning Tasks


DEEP LEARNING
ALGORITHMS
BUSINESS
DATA MINING
MACHINE LEARNING
STATS
#84517548


DATA ANALYSIS


Training Data
Model
[W, b]
Prediction

What if:

- Unclean data
- Few labeled
  - 2699 vs 164k images
- Not precise labeling
  - Terminology
  - Bounding boxes
- Uniform textures

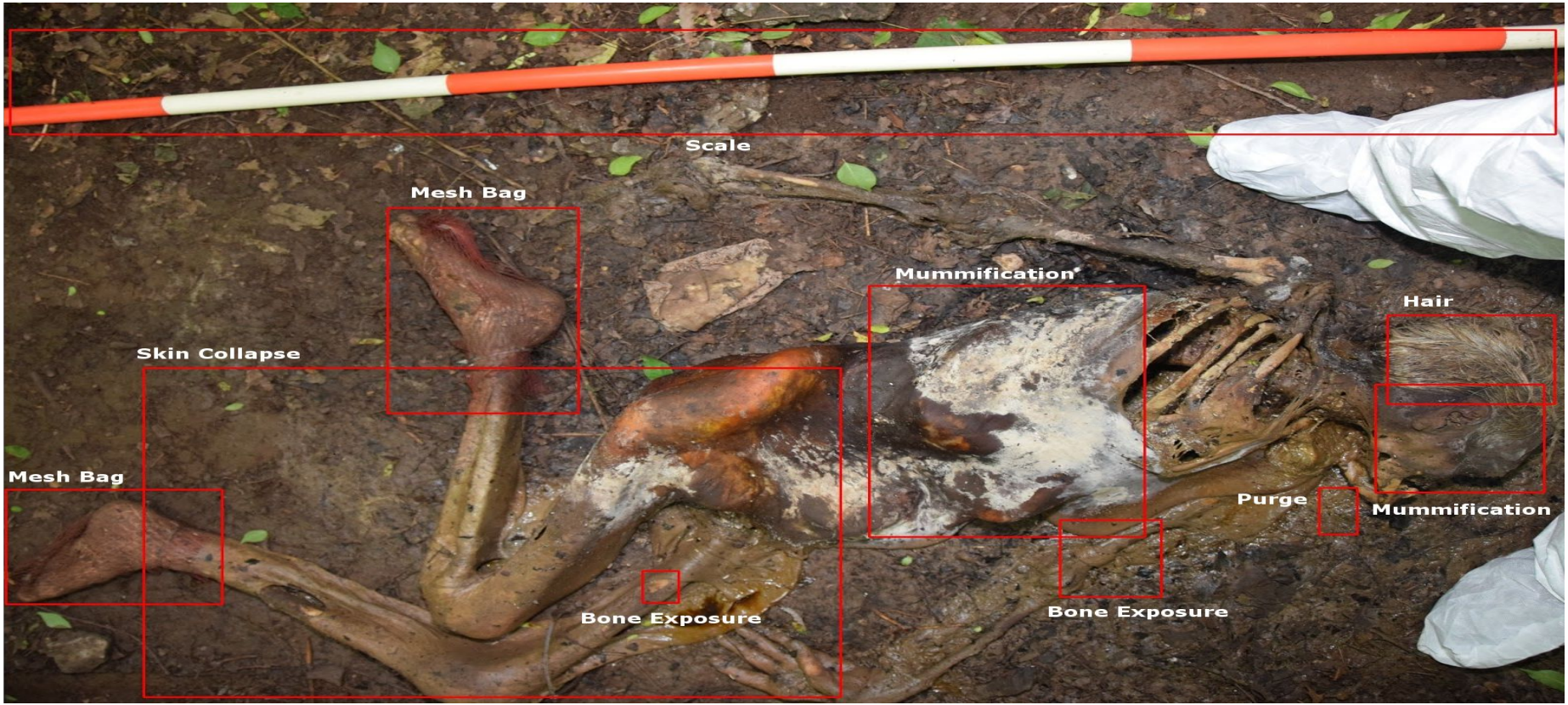
What is the data?

Image Dataset Examples

An imagery collected from Anthropology Research Facility (ARF) at the University of Tennessee

- Multiple images from multiple donors
- Image sampling not uniform
  - Time of day
  - Weather conditions
  - Angles
  - Lighting
- Image content not easily comparable to other image datasets
- One million images adding up to 4TB of disk space

What do we want to achieve?



Why do we want to achieve this?

- Facilitate utilization of the collection for:
  - Law enforcement officers
  - Forensic researchers
  - Education
  - Statistical analysis
  - Studying the decomposition process
    - What leads to some forensic features
    - Estimating the duration of death and the decom. stage by analyzing images

How?

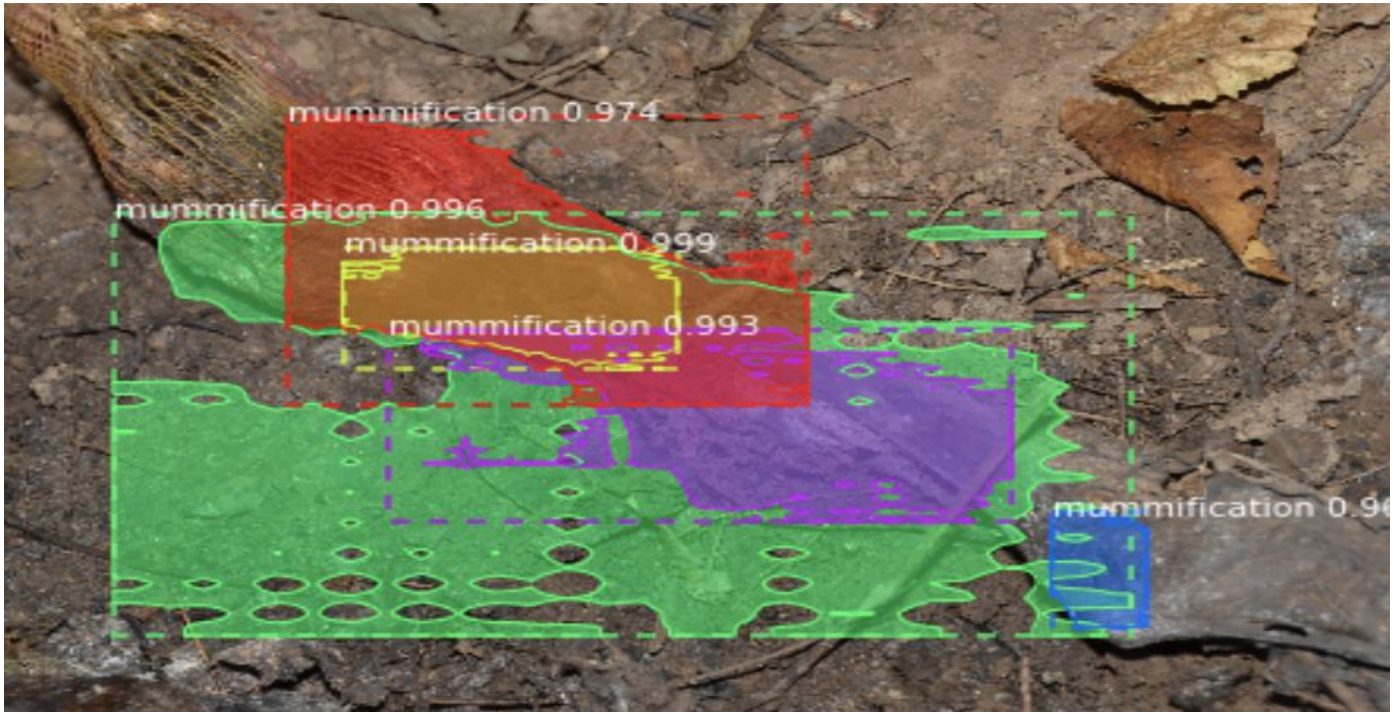
- Automating the labelling process:
  - Reduce expenses and time used to label images
  - Deep Learning: Mask RCNN
- A platform that provides:
  - Usability of existing data and labels
    - Easy browsing
  - Collecting more data

Mask RCNN

- Deep neural network
  - Used for instance segmentation
- Input:
  - An image
- Output:
  - Bounding box
  - Class
  - Mask

Example of Mask RCNN

Example of Mask RCNN on our data



Issues Our Team Investigated

#1 **Rosemary** - Improving the online platform interface and functionality

#2 **Zach** - Cleaning the input image data

#3 **Tasmia** - Adding weather data to the current system

#4 **Sara** - Expanding the dataset artificially to tune the model

ICPUTRD: Image Cloud Platform for Use In Tagging and Research on Decomposition

- Facilitate browsing through images
- Provides tag-based categories
- Provides a tagging environment for domain exports
- Enables multiple user to access and label images

“I see putrid”

What is a MEAN stack?

MongoDB: database

ExpressJS: server-side JS framework

AngularJS: frontend web framework

NodeJS: backend runtime environment

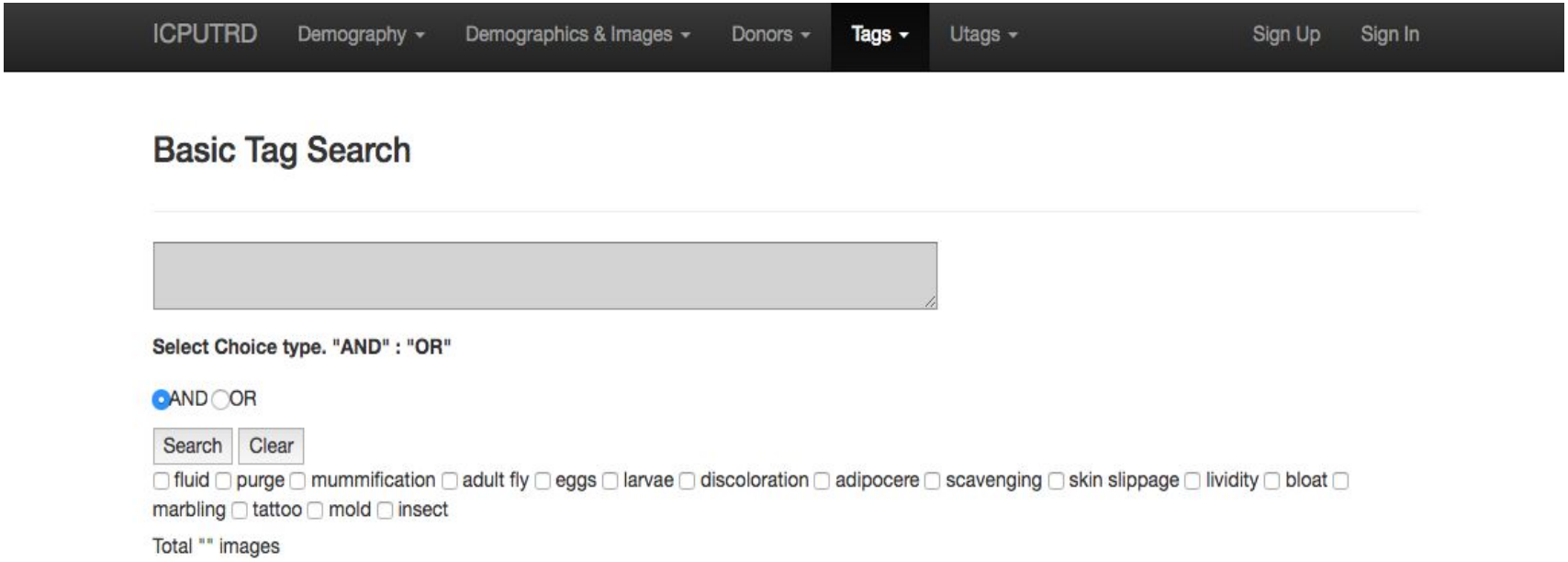
Online Platform - Objectives

- Improve tag searching view
- Add carousel component to image browsing
- Add a feature to mean.js web application that tracks when an image is loaded and viewed by user
    - Currently can only track users if they tag an image
- Search tag includes duplicate images
- Fix the CSS file error, some of the pages do not load the css

Online Platform - Approaches

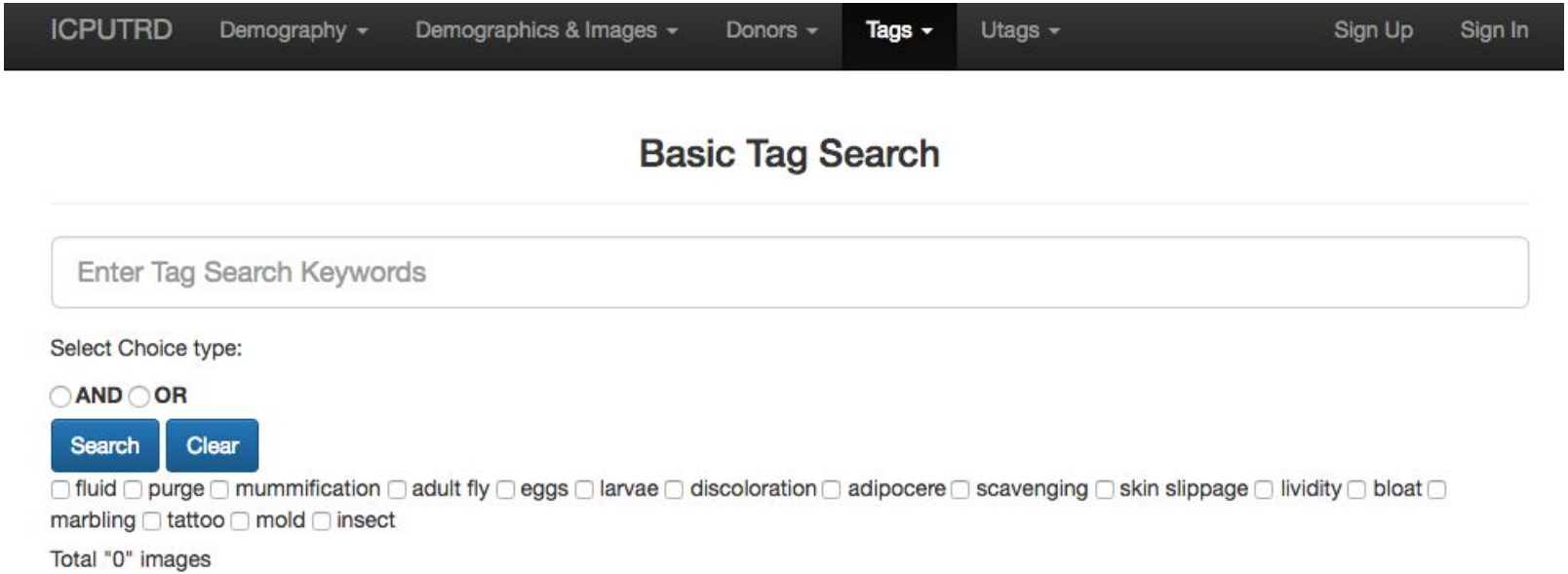
- Outline issues to be improved on
- Gain access
- Become familiar with existing online platform
- Begin add Javascript code:
  - Client side
  - Server side
- Time permitting, test code
  - challenging because of some limitations of access to certain files
  - Some of the files were read only

Results - Online Platform Tag Search Views



Before

Results - Online Platform Tag Search Views



After

Data Cleaning - Objectives

- Remove duplicate and similar images
  - Processing this type of data is expensive
  - Eliminate unnecessary use of resources

- Separate background and foreground
  - Objects surrounding the target can distort results
  - Improve accuracy of labeling and analysis

Data Cleaning - Approach

- Imagehash
  - Image Hash - constructed value based on the contents of an image
    - Average - based on average grayscale value
    - Difference - calculates the difference between adjacent pixels
    - Perceptive - depends of frequency of pixels instead of color

Imagehash approach

- Find hashes corresponding to each image
- Stored in a file with this format:
  - Images name; hash

```
UT108-11D_01_08_12 (10).JPG;00031f7f7f7f0000
UT108-11D_01_08_12 (11).JPG;00031f7f7f7f0000
```

```
17 00031f7f7f7f0000
15 003cfeffffe1c00
12 70f0f0fcfcf8f0f0
 7 60f0f0f0f8f0f030
 7 0038ff7f3e272000
 6 e0f8fcfcf8e0c0c0
 6 e0f0f8fcfcf0e000
 6 003cfeffffc3c00
 5 7070f0f8fcf8f0f0
 5 60f0f0f0f0f0f030
 5 00040e0f1f3f3000
 5 00031f7f3f7f0000
 5 00031f7f3f6f0000
 5 00010f7f7f7f0000
 5 00000c7eff1c0000
 4 e0f8fcf8f8e0c0c0
 4 e0e0f8fcfcfcf0e0
 4 d8fcfcfcfcb88000
 4 c0f8fcfcfcfc9c80
 4 c0f8fcfcfcf8f0c0
 4 c0c0fcfcfcfcf8c0
 4 c0c0f8fcfcf8f0c0
 4 70f0f8fcfcf8f0f0
 4 60f0f0f0f0d0f030
 4 180cfc7ffe1e0000
 4 040f2f1f0f0f0c0c
 4 04001c3e7e060c08
 4 007cfcfcfc0c0c30
 4 003cfeffffe3c00
```

Imagehash stats

- From 26000 images
  - We found 2300 images that had at least one duplicate

- One million (989838)
  - Took 5 days for computation
  - 63468 images with one or more duplicates

Background Removal

- What approaches
  - OpenCV
  - LabelMe
- How it works:
  - Mask created to create a general outline of objects in the image
  - Mask and original image multiplied together to generate new image

Background Removal

Weather Data - Objectives

- Finding the weather pattern prior to occurrence forensic features
  - Input: Image Name
  - Output: Weather data prior to that image
- Using the weather data to provide uniform sampling for the labeling
- Improve the prediction
  - Create categories of the images based on the likelyhood of the occurrence of the features in specific weather
  - Doing prediction based on both images and text (weather data)

Weather Data - Analysis

- Data Sets:
  - Image Names
  - Weather Data
  - Images with tag data
- Inconsistencies fixed
  - Image names format
  - Duplication of Image
- Data generation:
  - Donor id, max-min date
    - Per donor
    - Per image

Image Name
UT01-13D_03_04_13 (29).JPG
UT14-12D_04_23_!2 (1).JPG
UT14-12D_04_23_!2 (10).JPG
UT36-16D_06_30_2016 (9).JPG
UT36-16D_07_01_0216 (1).JPG

image_name	ut_id	date_from_image/max_date	min_date/first date
UT-010-15D_09-21-2015.JPG	UT-010-15D	2015-09-21	2015-09-21
UT01-13D_01_23_13.JPG	UT01-13D	2013-01-23	2013-01-23
UT01-13D_01_24_13.JPG	UT01-13D	2013-01-24	2013-01-23
UT01-13D_01_26_13.JPG	UT01-13D	2013-01-26	2013-01-23
UT01-13D_01_27_13.JPG	UT01-13D	2013-01-27	2013-01-23

Weather Data - Approach

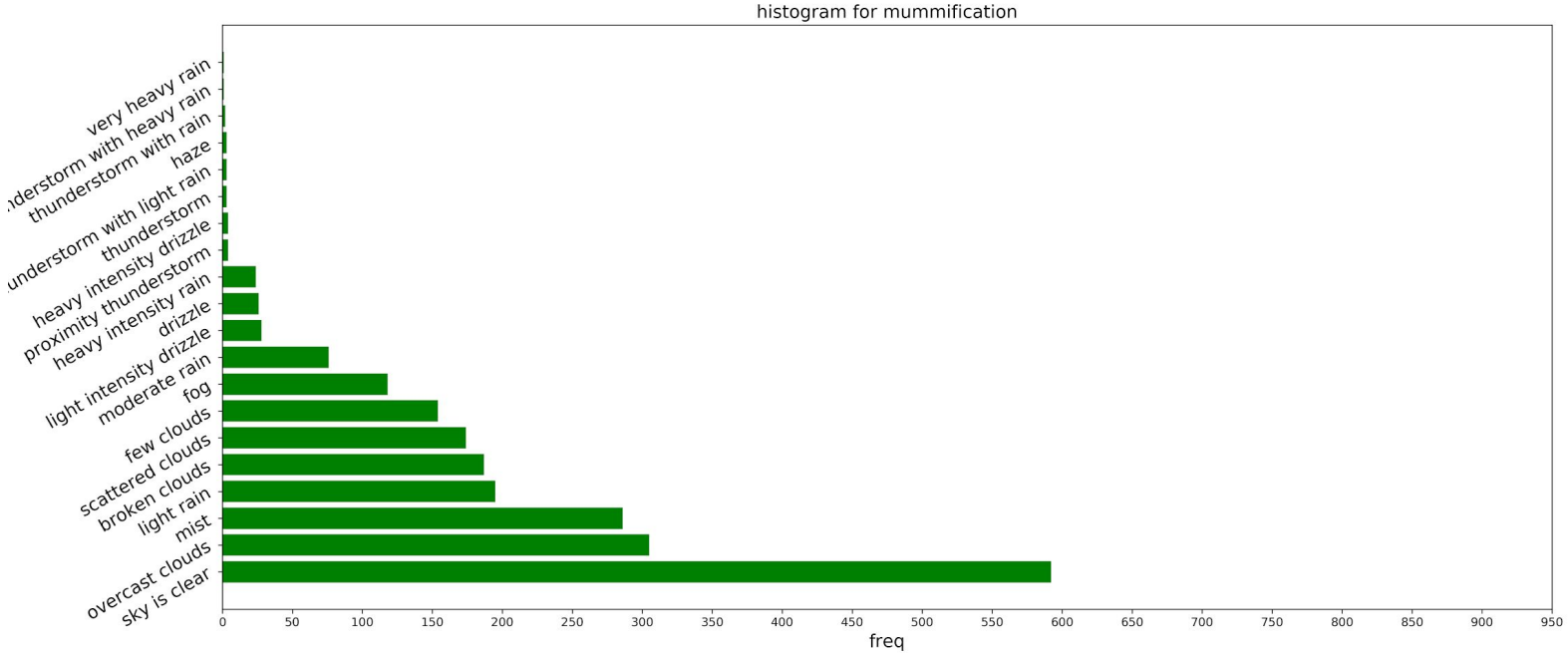
- Calculating Accumulated degree date or ADDs
  - Data Analysis
    - Mapping image names to the donors
  - Finding the first date for each image name
  - Extract the dates and weather data in between minimum/first date and current date

- Weather pattern
  - Compare the weather distribution of a specific feature against that of a general feature
    - Mummification against leg

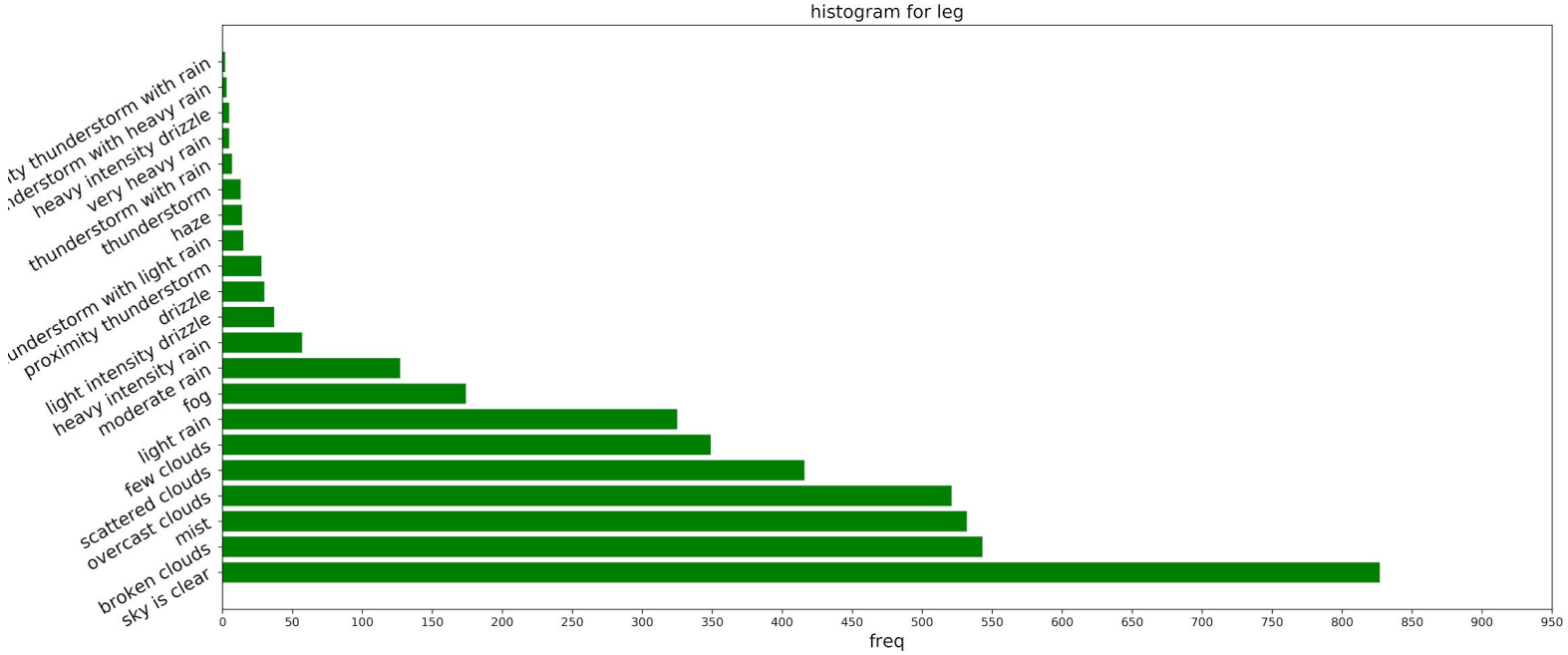
Tagged Data - Data selection

- Mummification Data:
  - Donor: UT35-15D
  - Min Date: 2015-09-09
  - Max Date: 2016-01-09
  - Total in between days: 123
- Leg Data:
  - Donor: UT35-15D
  - Min Date: 2015-06-29
  - Max Date: 2016-01-09
  - Total in between days: 195

Weather Data - Mummification



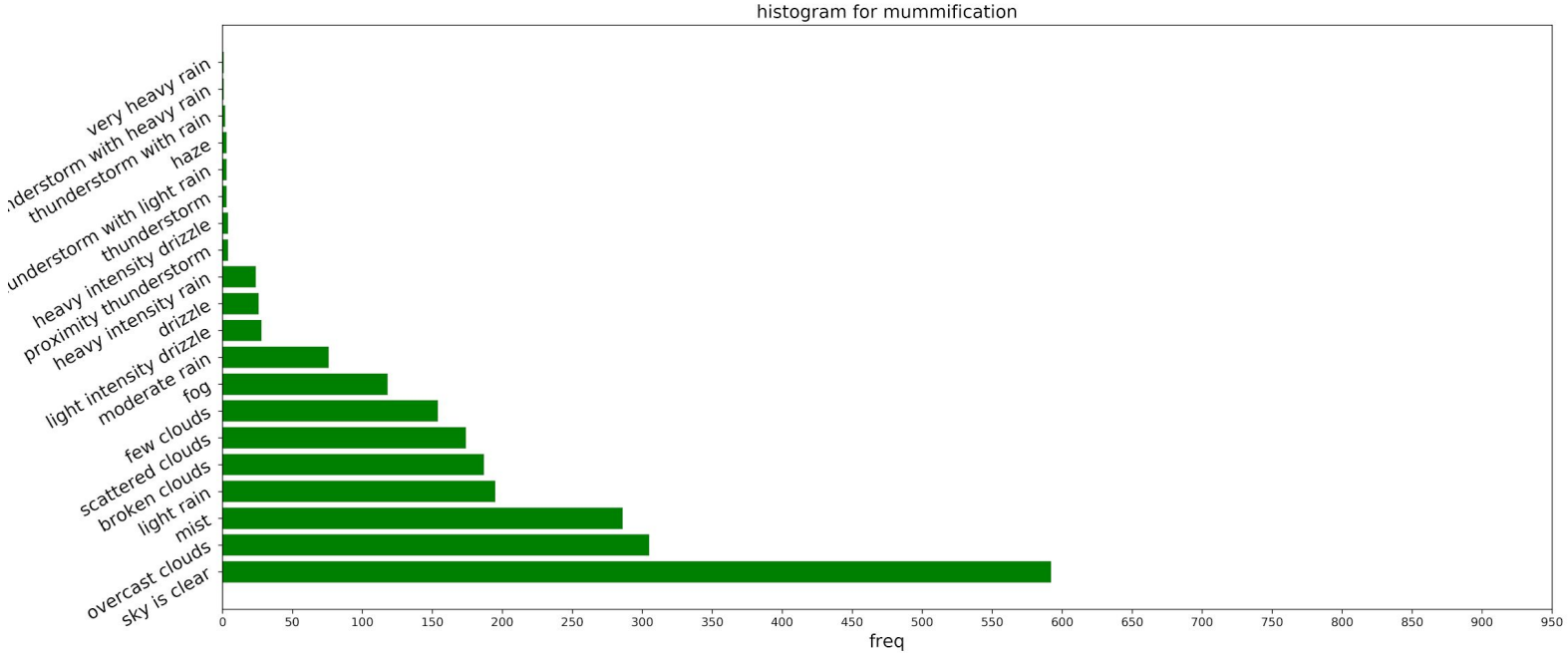
Weather Data - Leg



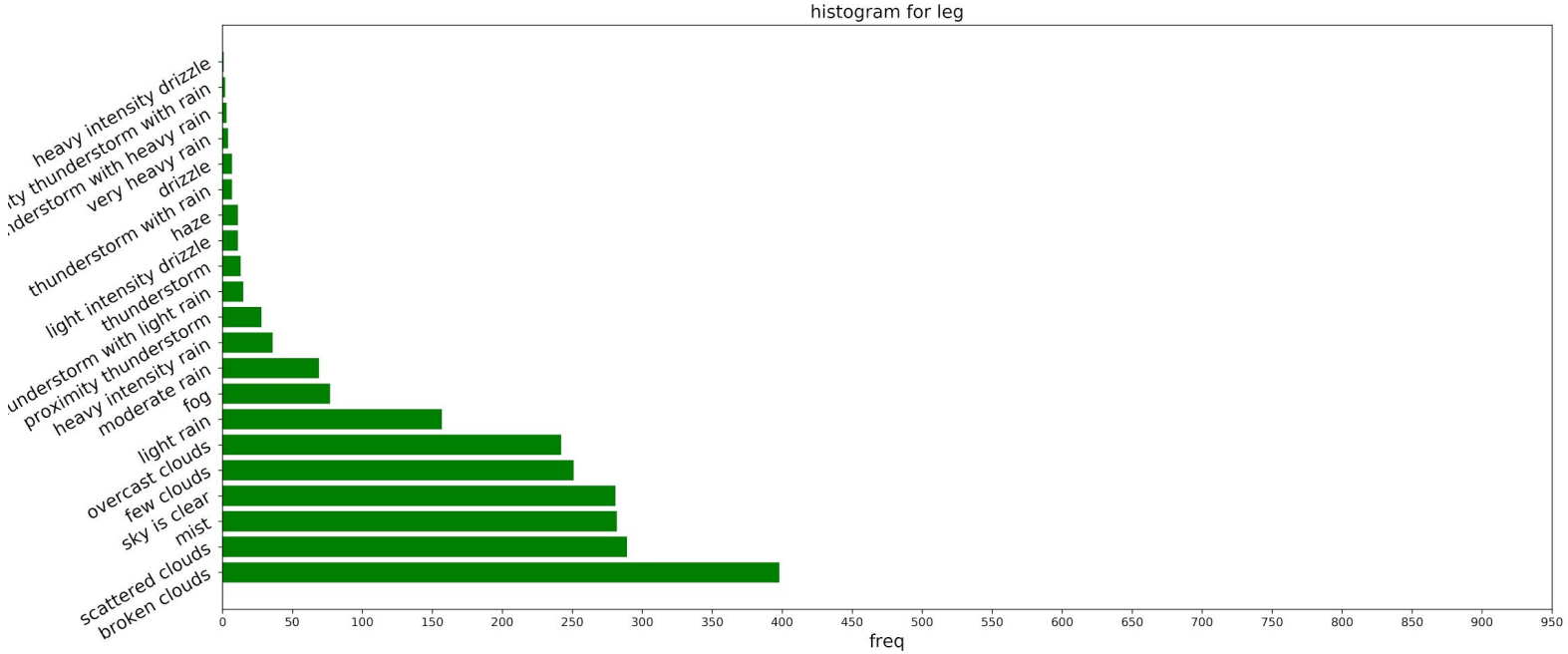
Tagged Data - Data selection: Two different donors

- Mummification Data:
  - Donor: UT35-15D
  - Min Date: 2015-09-09
  - Max Date: 2016-01-09
  - Total in between days: 123
- Leg Data:
  - Donor: UT06-15D
  - Min Date: 2015-04-07
  - Max Date: 2015-09-17
  - Total in between days: 195

Weather Data - Mummification



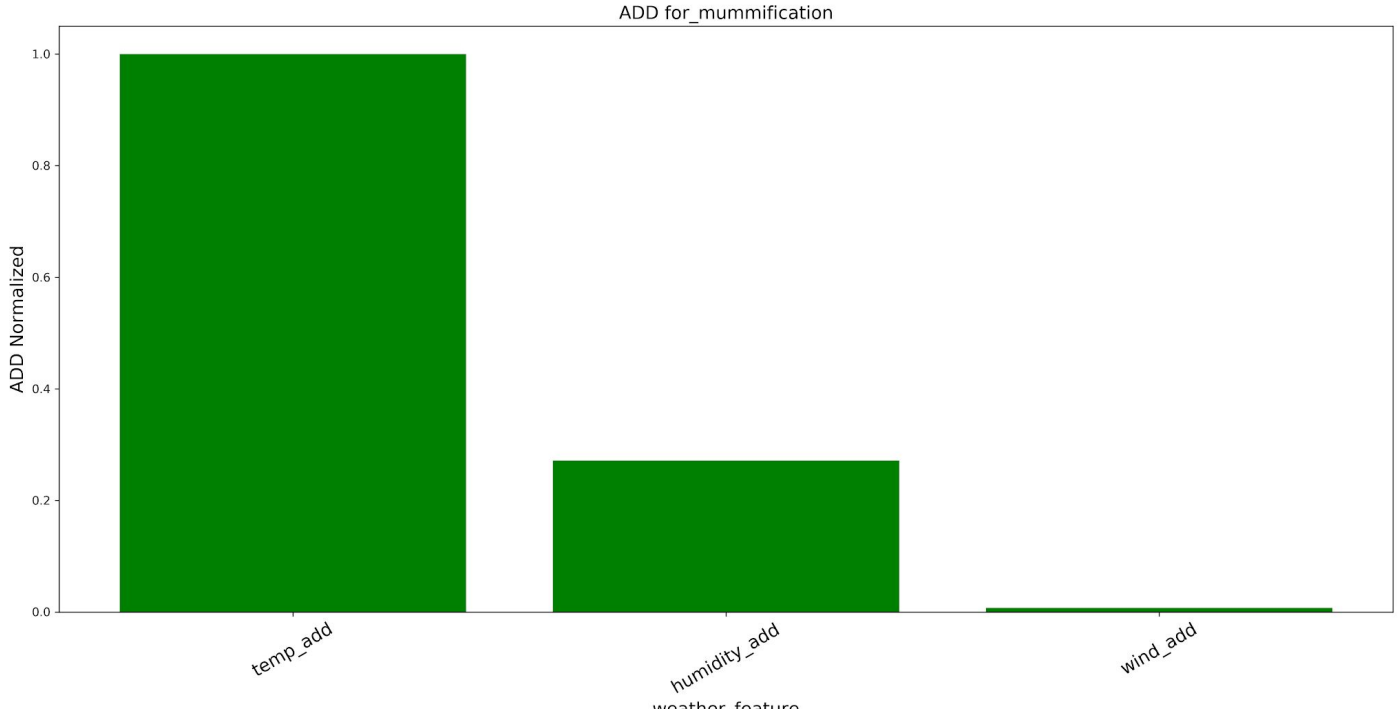
Weather Data - Leg



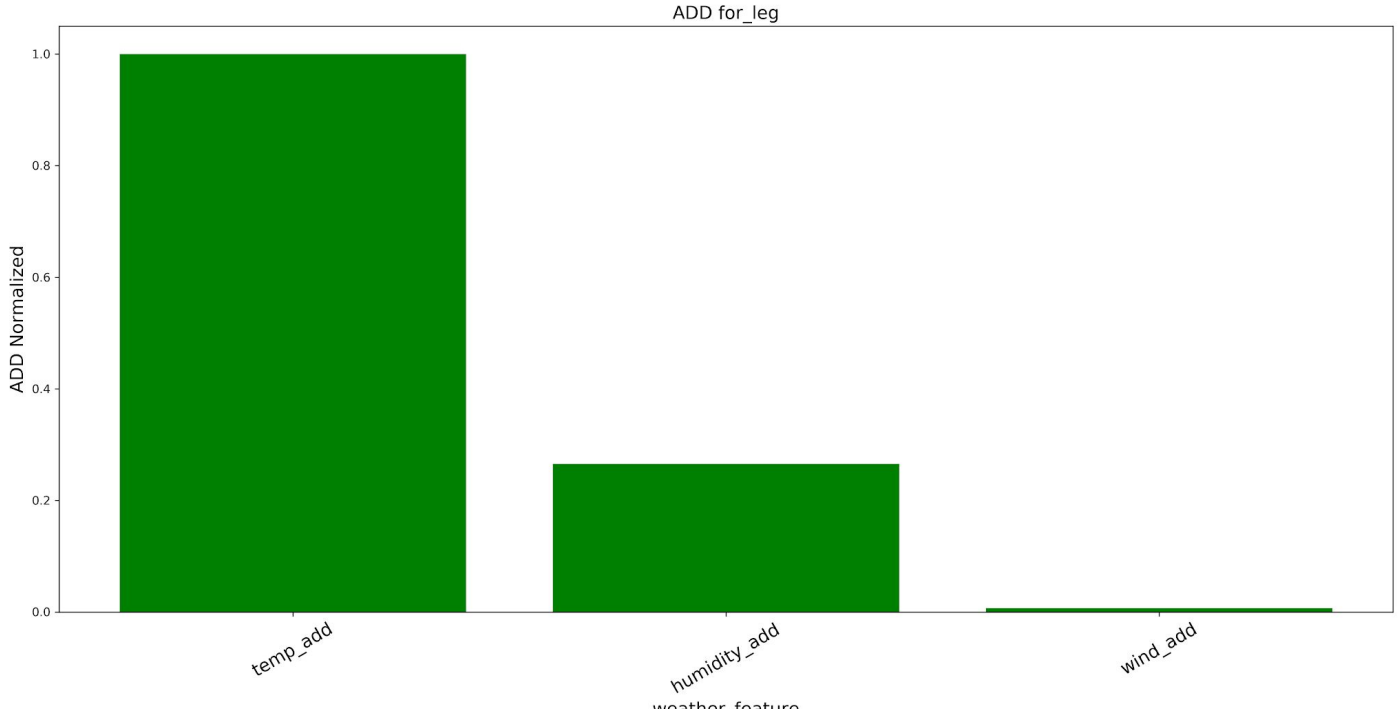
ADD Calculation - Data Selection

- Mummification Data:
  - Donor: UT35-15D
  - Min Date: 2015-09-09
  - Max Date: 2016-01-09
  - Total in between days: 123
- Leg Data:
  - Donor: UT35-15D
  - Min Date: 2015-06-29
  - Max Date: 2016-01-09
  - Total in between days: 195

ADD - Mummification



ADD - Leg


ADD for_leg
ADD Normalized
1.0
0.8
0.6
0.4
0.2
0.0
temp_add
humidity_add
wind_add

Increasing the Size of the Training Set

- Image augmentation
  - Scale
  - Flip
- Iterative validation
  - Predicting labels on unlabeled images
  - Asking a knowledgeable in forensic area person for a manual evaluation

Augmentation: Scale

- Cropping different ratios of images with respect to each tag
  - Check if any of the other tags will be in the cropped part
  - Resize the cropped part to the original image size
  - Recalculate the location of the tag in the new image

Augmentation: Flip image

- 0: flip around x axis
- 1: flip around y axis
- -1: flip around x and y axis

$$dest_{ij} = \begin{cases} src_{row-i-1,j} & if\ \ flipCode = 0 \\ src_{i,col-j-1} & if\ \ flipCode = 1 \\ src_{row-i-1,col-j-1} & if\ \ flipCode = -1 \end{cases}$$

Augmentation: Flip tag

$$bbox\_flipped\_start_{ij} = \begin{cases} bbox_{i,row-j-h-1} & if\ \ flipCode = 0 \\ bbox_{col-i-w-1,j} & if\ \ flipCode = 1 \\ bbox_{col-i-w-1,row-j-h-1} & if\ \ flipCode = -1 \end{cases}$$

$$bbox\_flipped_end_{ij} = \begin{cases} bbox_{i,row-j+h-1} & if\ \ flipCode = 0 \\ bbox_{col-i+w-1,j} & if\ \ flipCode = 1 \\ bbox_{col-i+w-1,row-j+h-1} & if\ \ flipCode = -1 \end{cases}$$

Augmentation: image example

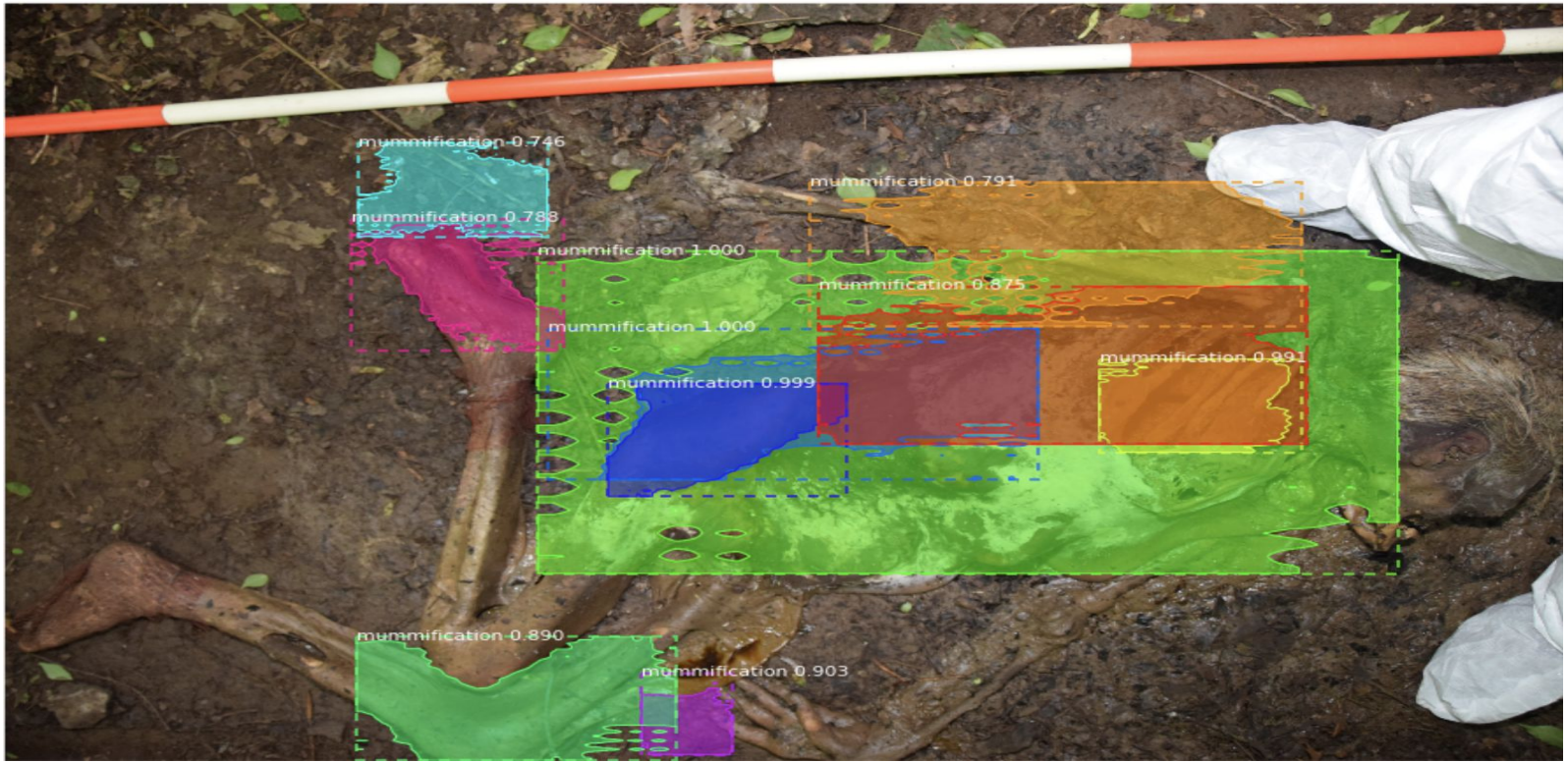
Augmentation: csv example

```
row_number,_id,user,location,image,tag,created,__v,image1
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""type"":""rect"",""geometry"":{""x"":0.6141666666666666,""y"":0.5245283018867924,""width"":0.11583333333333333,""height"":
0.1761006289308176},""style"":{}}]",http://localhost:3000/2015/UT01-15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""type"":""rect"",""geometry"":{""x"":0.18583333333333332,""y"":0.49433962264150944,""width"":0.2816666666666667,""height""
:0.1320754716981132},""style"":{}}]",http://localhost:3000/2015/UT01-15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""type"":""rect"",""geometry"":{""x"":0.2158333333333332,""y"":0.7748427672955975,""width"":0.2808333333333333,""height"":
0.15345911949685534},""style"":{}}]",http://localhost:3000/2015/UT01-15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3.JPG
```


```
row_number,_id,user,location,image,tag,created,__v,image1
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.5245098039215687, ""x"": 0.2700892857142857, ""height"": 0.17585784313725483, ""width"": 0.11566558441558444}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3.fliped_x.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.2903259803921565, ""x"": 0.6140422077922078, ""height"": 0.17585784313725493, ""width"": 0.11566558441558845}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3.fliped_y.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.2903259803921565, ""x"": 0.2700892857142857, ""height"": 0.17585784313725493, ""width"": 0.11566558441558444}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3.fliped_xy.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.4941789215686274, ""x"": 0.5324675324675324, ""height"": 0.13204656862745096, ""width"": 0.2816558441558442}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3.fliped_x.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.3734681372549019, ""x"": 0.1856730129870103, ""height"": 0.13204656862745096, ""width"": 0.2816558441558416}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-
15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3.fliped_y.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.3734681372549019, ""x"": 0.5324675324675324, ""height"": 0.13204656862745096, ""width"": 0.2816558441558442}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3.fliped_xy.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.7748161764705882, ""x"": 0.5034496753246753, ""height"": 0.1531862745098393, ""width"": 0.2806412337662373}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3.fliped_x.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.07169117647058823, ""x"": 0.2157061688316883, ""height"": 0.1531862745098393, ""width"": 0.2806412337662338}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-
15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3.fliped_y.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.07169117647058823, ""x"": 0.5034496753246753, ""height"": 0.1531862745098393, ""width"": 0.2806412337662373}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-
15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3.fliped_xy.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""type"":""rect"",""geometry"":{""x"":0.6141666666666666,""y"":0.5245283018867924,""width"":0.11583333333333333,""height"":0.1761006289308176},""style"":{}}]",http://localhost:3000/2015/UT01-15D/Daily Phot
os/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.3084780388151175, ""x"": 0.3822734235453314, ""height"": 0.5863125638406538, ""width"": 0.3856562928687415}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3._0_mummification0.3.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.5992647058823529, ""x"": 0.5263798701298701, ""height"": 0.23133116883116889, ""width"": 0.3517156862745098}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15D
/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3._0_mummification0.5.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.5679816162389889, ""x"": 0.7645865043125317, ""height"": 0.2198391420911528, ""width"": 0.14459665144596645}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3._0_mummification0.8.JPG
205,ObjectId(5b97516b1025fcfc18ae1b55),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.5300651091535811, ""x"": 0.2290715372907136, ""width"": 0.3521055301877219, ""height"": 0.1650708540788897}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:48:55.827Z,0,UT01-15D_01_02_2016 (3._0_mummification0.8.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""type"":""rect"",""geometry"":{""x"":0.18583333333333332,""y"":0.4943396226415094,""width"":0.2816666666666667,""height"":0.1320754716981132},""style"":{}}]",http://localhost:3000/2015/UT01-15D/Daily Pho
tos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.18488253331971393, ""x"": 0.0, ""height"": 0.4402451481031673, ""width"": 0.9391069012178624}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15D/Daily Photos/
UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3._1_mummification0.3.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.6893382352941176, ""x"": 0.021915584415584416, ""width"": 0.5633116883116883, ""height"": 0.2640931372549002}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3._1_mummification0.5.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.4308693986971693, ""x"": 0.013698630136986, ""height"": 0.1650708540788897, ""width"": 0.3521055301877219}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3._1_mummification0.8.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.46878590578322748, ""x"": 0.5492135971588027, ""height"": 0.14459665144596645, ""width"": 0.2198391420911528}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3._1_mummification0.8.JPG
206,ObjectId(5b97516b1025fcfc18ae1b57),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.7816928379931061, ""x"": 0.05124302384576357, ""width"": 0.3508371385083714, ""height"": 0.19149751053236297}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:19.081Z,0,UT01-15D_01_02_2016 (3._1_mummification0.8.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""type"":""rect"",""geometry"":{""x"":0.2158333333333332,""y"":0.7748427672955975,""width"":0.2808333333333333,""height"":0.15345911949685534},""style"":{}}]",http://localhost:3000/2015/UT01-15D/Daily Pho
tos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.33605720212257405, ""x"": 0.01759133964817320?, ""height"": 0.5107252298263534, ""width"": 0.9357239512855211}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3._2_mummification0.3.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.6599264705882353, ""x"": 0.06534090909090909, ""width"": 0.5612824675324676, ""height"": 0.3063725490196078}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-15
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3._2_mummification0.5.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.09865196078431372, ""x"": 0.005275974025974026, ""height"": 0.26409313725490197, ""width"": 0.5633116883116883}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01
-15D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3._2_mummification0.5.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.7889697433933358, ""x"": 0.17250126839167934, ""height"": 0.19149751053236308, ""width"": 0.3508371385083714}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3._2_mummification0.8.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.4760628111834546, ""x"": 0.6704718417047184, ""width"": 0.14459665144596656, ""height"": 0.2198391420911528}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3._2_mummification0.8.JPG
207,ObjectId(5b97516b1025fcfc18ae1b58),ObjectId(5984676ae94fb4bc9c04bc64),"[{""geometry"": {""y"": 0.4381463040980647, ""x"": 0.1349568746829021, ""width"": 0.35210553018772195, ""height"": 0.1650708540788704}, ""style"": {}, ""type"": ""rect""}]",http://localhost:3000/2015/UT01-1
5D/Daily Photos/UT01-15D_01_02_2016 (3.JPG,mummification,2017-12-18T17:49:31.139Z,0,UT01-15D_01_02_2016 (3._2_mummification0.8.JPG
```

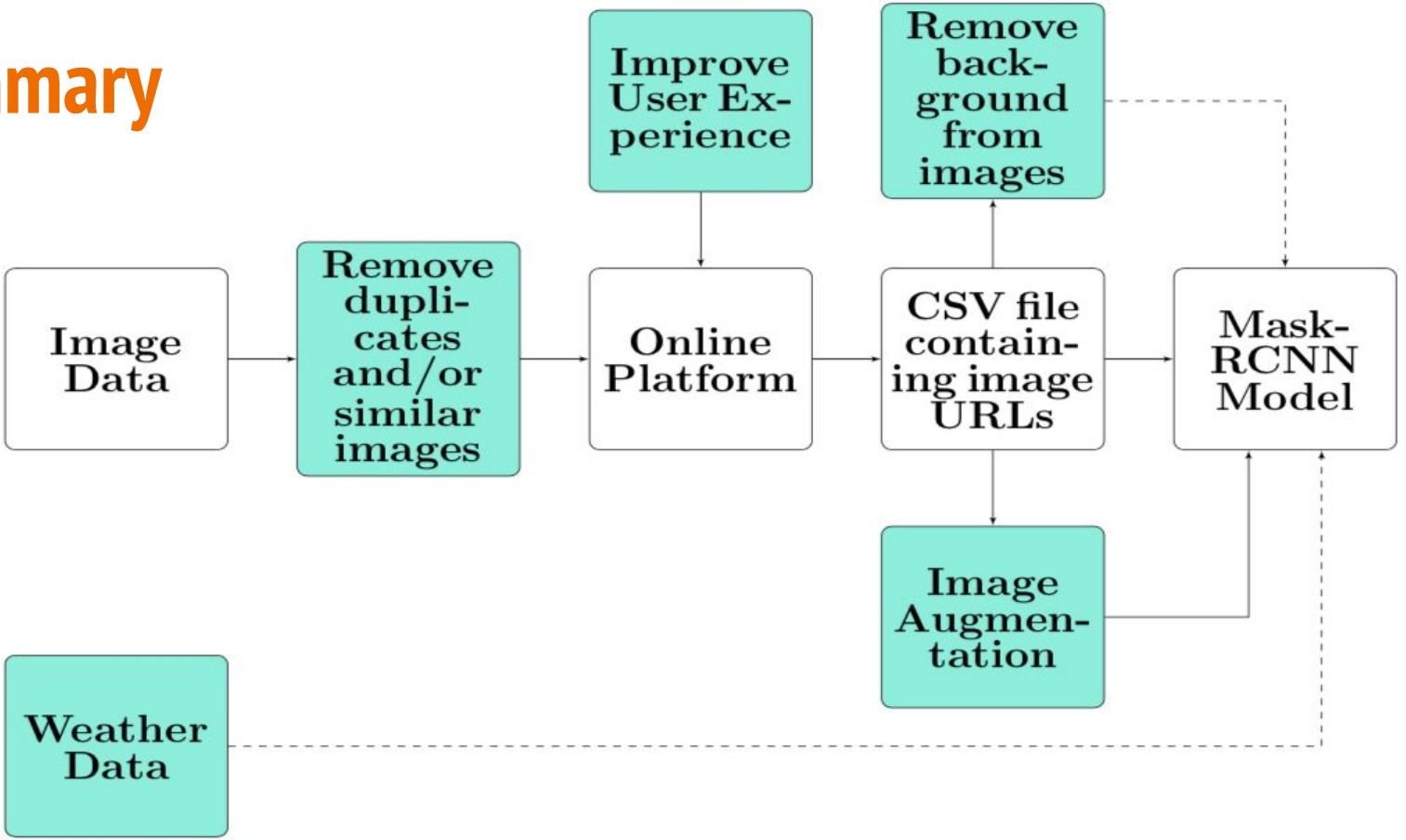
Example

Old model's prediction for Mummification



New model's prediction for Mummification

Summary


Improve User Experience
Remove background from images
Remove duplicates and/or similar images
Image Data
Online Platform
CSV file containing image URLs
Mask-RCNN Model
Image Augmentation
Weather Data

Lessons learned

- Using docker containers slows down the development process
  - Specifically when accesses are limited

Future Work

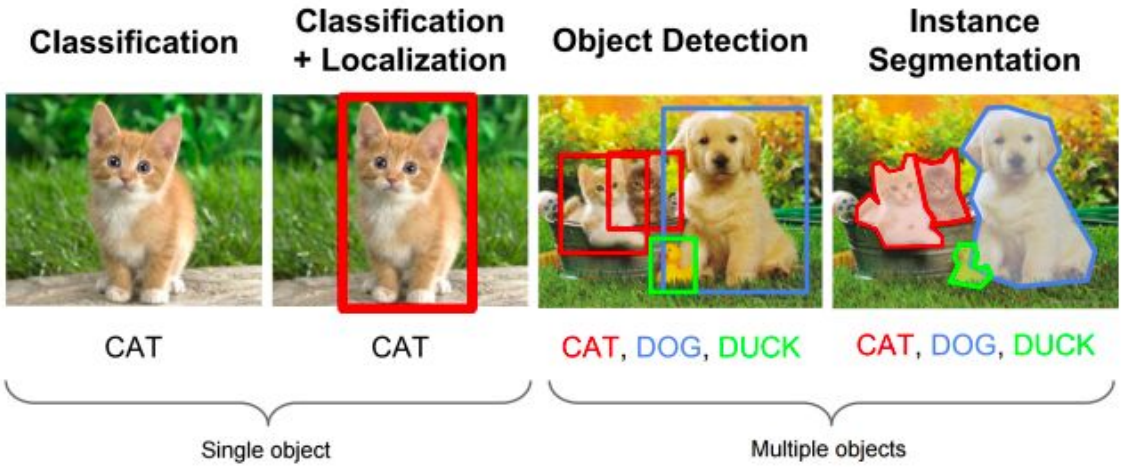
- Integrating the works together
- Use a simpler approach that Mask RCNN
- Train on multiple tags together

Thank you

EXTRA SLIDES:

What is Mask R-CNN?

Object instance segmentation: detecting “objects of interest” in a particular image



Source: https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/object_localization_and_detection.html

ARF

- Anthropology Research Facility (ARF) at the University of Tennessee
  - Aka the “Body Farm”
  - Studying decomposition
  - Founded in 1987 by Dr. William M. Bass

Tasmia

- A function that get the image name and gives weather data prior in a matrix format
  - col = wind, humidity, rain...
  - row = date
  - input= image name
  - Output = ..up
- Sets of images with either leg or mummification
- Plot ADD for wind, humidity, temp-ADD, rain,..
  - Distribution that we get is the stat. Part
  - Dist. of images with mumm
  - Dist. of images with either leg or mumm

Cleaning the Data

- Remove the duplicate and similar images
  - Image hash
  - Images with identical hashes marginally different are removed
  - Any other approach than can be done fast
- Removing background
  - Improves the accuracy of the labeling algorithms
  - OpenCV library in python
- What id image hash
- We want to remove them because of expensive
- ML methods
- How many images
- How many matches
- Show numbers and results

Incorporate Weather Data

- Weather pattern prior to each image
  - How weather affects the decom. process
- ADD value corresponding to each image
  - Image_name components:
    - Donor ID
    - Date of image being taken
  - So calculate ADD for an image for that donor and for that date
- ADD corresponding to each donor
- Minimum date for each image
  - Each image's date is its current date
  - List all the prior dates for that image(the day the current image was taken for that donor)
  - Return the minimum date
- All the prior dates for each image

Weather Data Purpose

ADD - uniform distribution for tagging?

What causes mummification, rain?

Implement in deep learning model

Ex. weather data plus object mask => forensic feature detection

What I learned?

For weather data:

In addition to the images and the demography we would like to use the weather data

The primary reason is the see the effect of the decom.

Weather data is complicated and people do the ADD which is...

Show the result

A function that can return..

Challenges

Challenge 1 | Challenge 2 | Challenge 3 | Challenge 4

Online Platform Usability

Interface and functionality improvements.

Uncleaned Data

Duplicate images

Having Misleading objects in images

Absence of Weather Data

Uniform sampling for different ADDs

Do some features appear only under specific weather patterns?

Small Training Dataset

Lack of training data for model

ADD Calculation - Data Selection

- Mummification Data:
  - Donor: UT35-15D
  - Min Date: 2015-09-09
  - Max Date: 2016-01-09
  - Total in between days: 123
- Scavenging Data:
  - Donor: UT01-16D
  - Min Date: 2016-02-04
  - Max Date: 2016-04-23
  - Total in between days: 80

ADD - Scavenging