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# Counting Objects

## Population Estimation

**SSIP 2016 Team D**

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# Who we are?

1

Teaching each other!
Tutorial time

2

Counting refugee tents
on satellite imagery

# 1. Teaching each other

4 different nations, 4 different scientific backgrounds & levels of experience in programming

Python

MATLAB

**Image Processing Tutorial**

GitHub

SSIP 2016 Team D

# 2. Initial project

Counting objects → Counting roofs

Oblique Aerial Imagery

Satellite (nadir) Aerial Imagery

# 2.1 **Motivation** (why we did this?)

Ifo 2: Dadaab refugee camp, Kenya

Counting objects (detect refugees tents) to estimate the no. of population/ refugee camp extension (development).

↓

Useful information for international organizations (NGOs)

# 2.2 State of the art

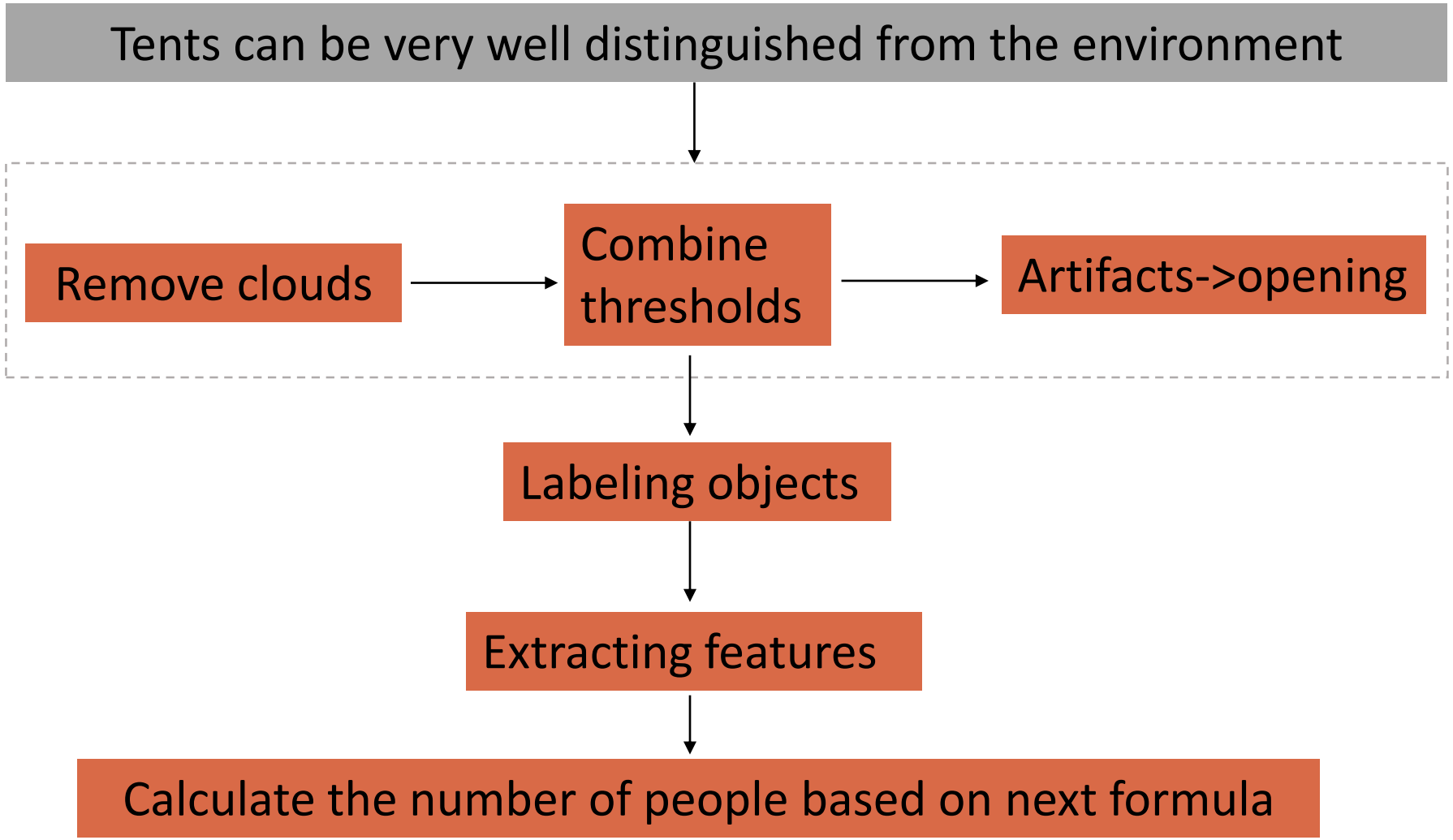
Image segmentation/ buildings detection/ machine learning methods

- Convolutional Neural Network (CNN)
- AdaBoost algorithm
- Linear Discriminant Analysis (LDA)
- Support Vector Machine (SVM)
- Edge Detection (Canny edge detection)
- Corners: Harris corners detection

REFERENCES:


- Castelluccio, M., et al. (2015). "Land Use Classification in Remote Sensing Images by Convolutional Neural Networks." arXiv preprint arXiv:1508.00092.
- Cote, M. and P. Saeedi (2013). "Automatic rooftop extraction in nadir aerial imagery of suburban regions using corners and variational level set evolution." Geoscience and Remote Sensing, IEEE Transactions on 51(1): 313-328.
- Guo, Z., et al. (2016). "Identification of Village Building via Google Earth Images and Supervised Machine Learning Methods." Remote Sensing 8(4): 271.
- Li, E., et al. (2015). "Robust rooftop extraction from visible band images using higher order CRF." Geoscience and Remote Sensing, IEEE Transactions on 53(8): 4483-4495.
- Manno-Kovacs, A. and T. Sziranyi (2015). "Orientation-selective building detection in aerial images." ISPRS Journal of Photogrammetry and Remote Sensing 108: 94-112.

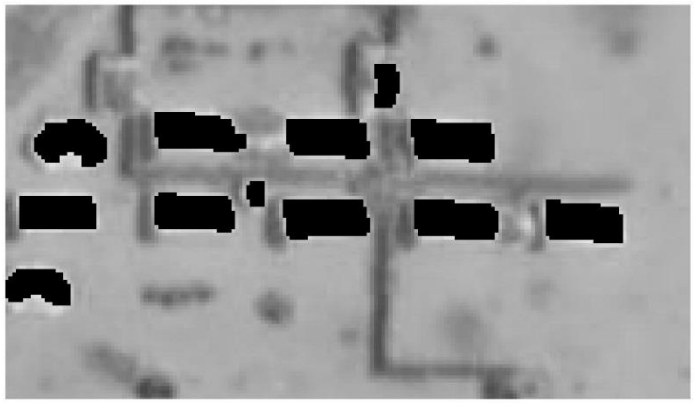
## 2.3 Methodology




$$PPL = total\_pix \cdot \frac{people\_per\_household}{pixel\_per\_household}$$

# Results

Population estimation in Ifo 2 Dadaab refugee camp



the results of our algorithm

+

other information (e.g. average household sizes of Somalis)

**Estimate the population of the total camp**

| Source | Date | Population estimation |
|---|---|---|
| Official Estimation according to UNHCR | 31.05.2016 | 46.334 |
| Official Estimation according to UNHCR | 30.06.2014 | 51.685 |
| **Our Estimation** | **30.06.2014** | **53.029** |

# Kibera informal settlement – Nairobi, Kenya

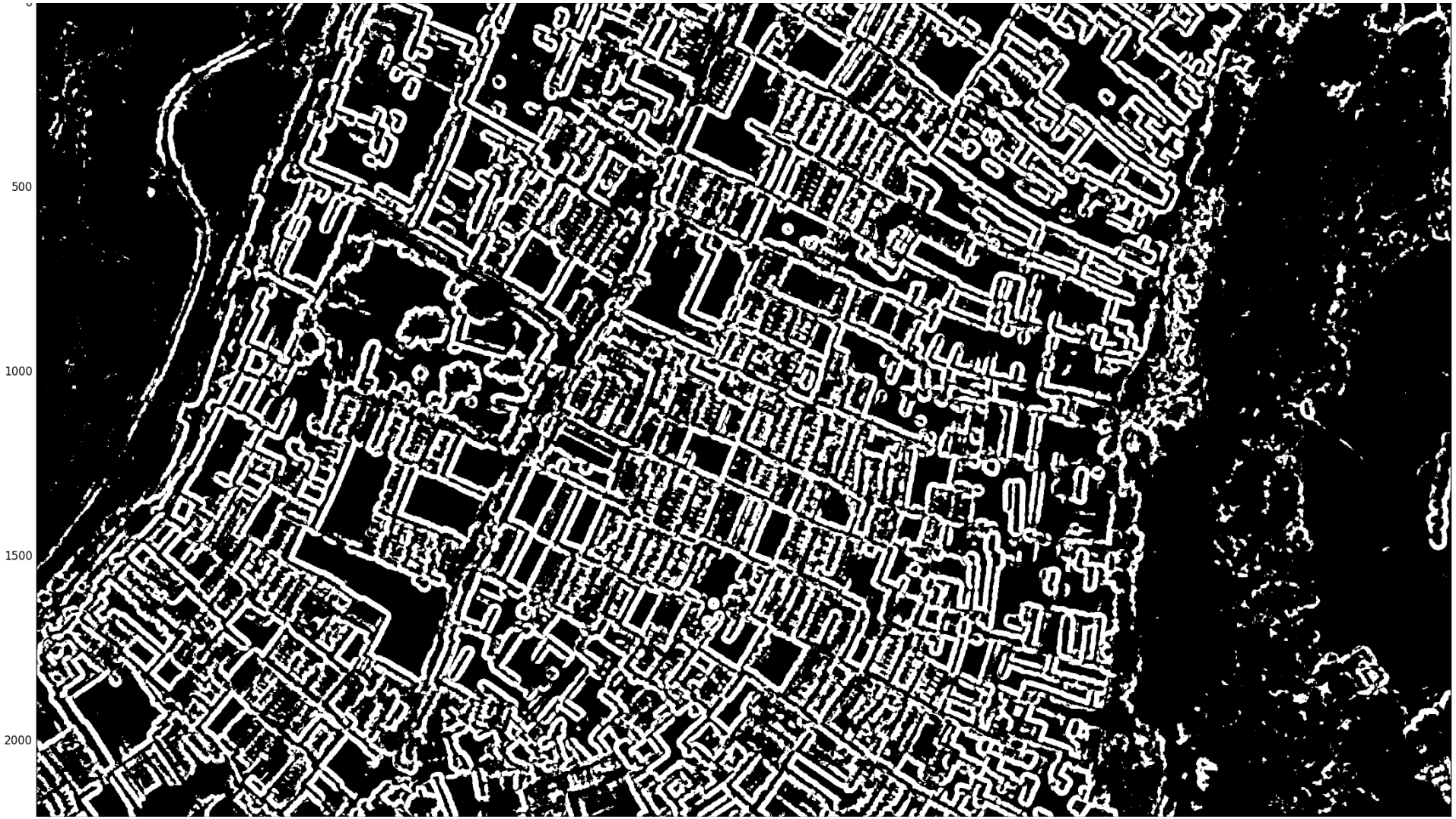
- Image complexity = heterogeneity


Hard to count the building roofs:

- Different types of roofs materials = different texture
- Varying roof geometry & sizes
- Densely build-up urban areas

# Kibera - ML Segmentation

# Kibera - Streets



# Conclusion

- Pair programming and tutorial
  - First tastes of…
    - Python/MATLAB
    - Image Processing/ML
    - Web-Dev
- Refugee Camps
  - Results close to official UN numbers
- Kibera
  - Displayed open challenges
  - Limits of pure image processing

Dziękujemy za uwagę!

Анхаарал тавьсан та бүхэнд баярлалаа!

Multumesc pentru atentie!

Köszönöm a figyelmet!