# Wildlife Census via LSH-based animal tracking

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# National Parks and wildlife conservation

Jim Corbett National Park, India

Amboseli National Park, Kenya

And many more …

# The Challenge

- Surveillance around the sanctuary
- Tracking animals and their lifestyle
- Finding the habitat of animals, especially rare species
- Carrying out animal census – eg: number of tigers in the sanctuary?

# Current techniques

- Video surveillance through cameras at specific locations around the sanctuary territory.

- Manual surveillance

  - Tedious to manually process large amounts of video data collected through various sources and answer questions.

# From Data to Solutions …

- Video Processing for foreground/background estimation
  - Additive Matrix Factorization

  Hybridized with

- Image Processing for Object recognition
  - LSH based object recognition

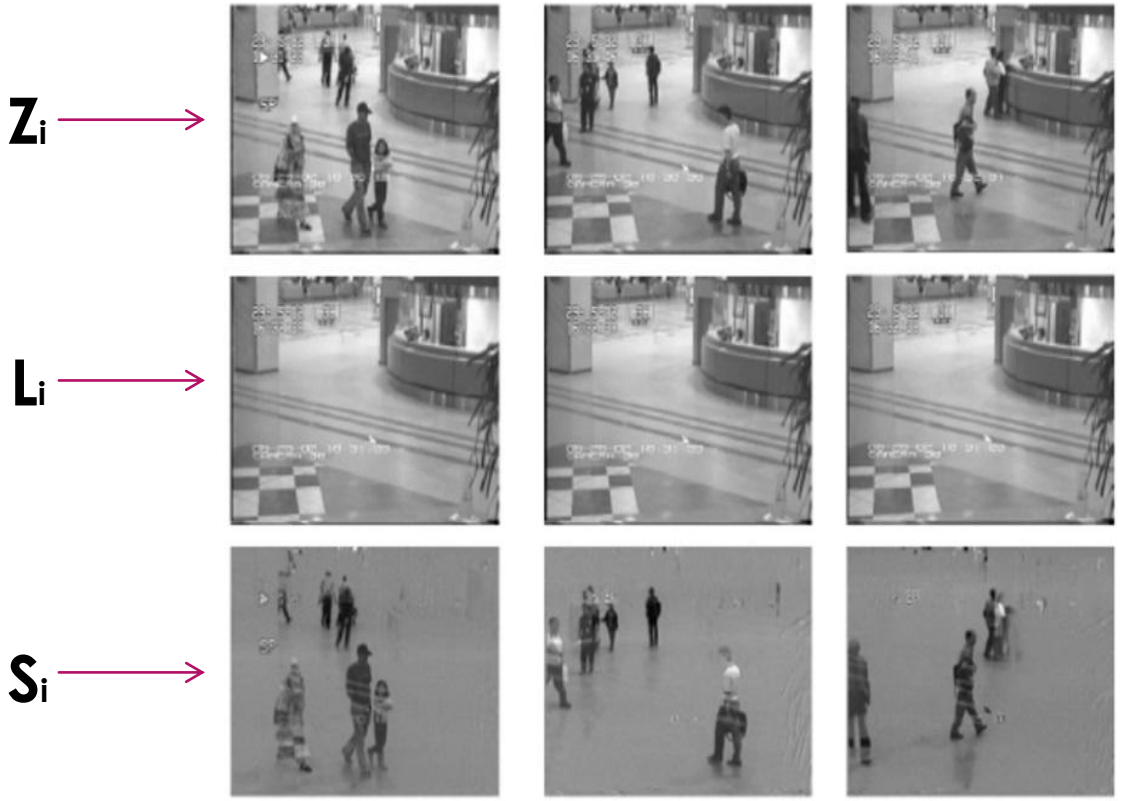
# Additive Matrix Factorization

Decompose matrix **Z** such that,

$$Z = L + S$$

Where **L** is a low-rank matrix and **S** is sparse

- Used extensively in foreground/background separation for videos
- Can be solved efficiently by Convex Optimization techniques

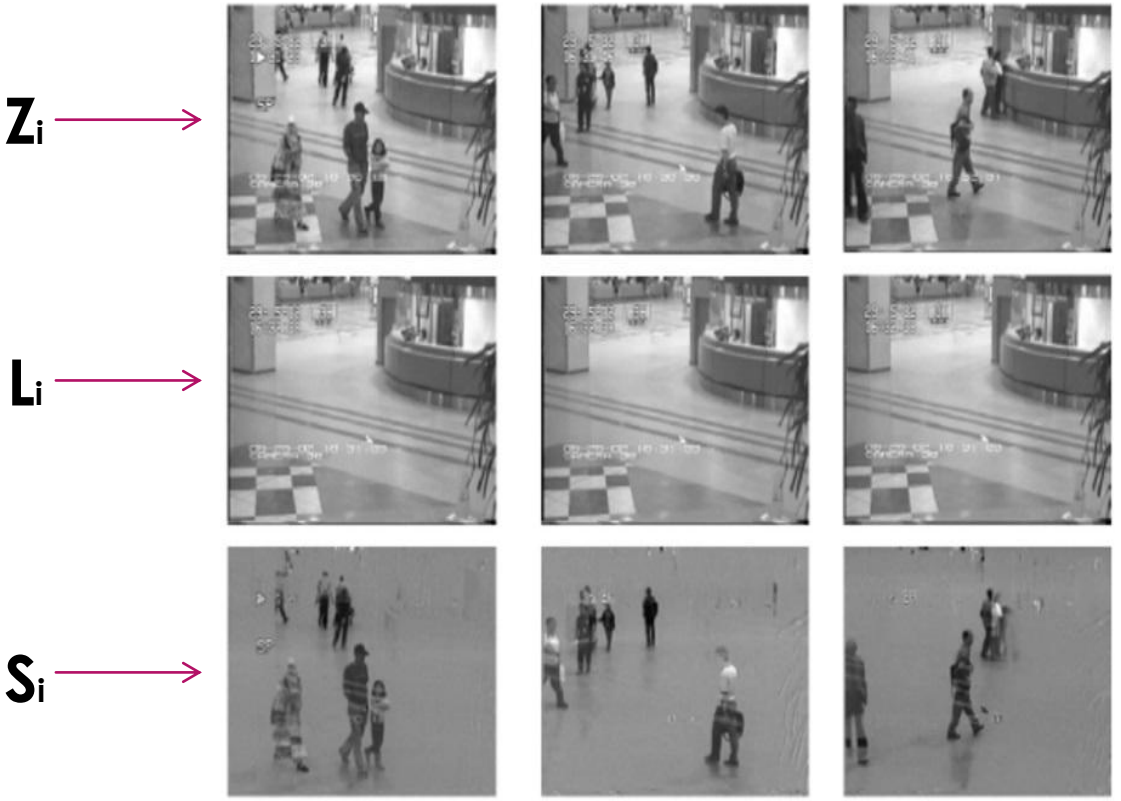


# LSH-based object recognition

Decompose matrix **Z** such that,

$$Z = L + S$$

- Process the sparse matrix **S** to recognize the mobile object
- Relevant work in Liu, Wei, et al. "Supervised hashing with kernels." *Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on*. IEEE, 2012.



# Pipeline

Surveillance camera in some area of the sanctuary

Video Feed

Video Processor recognizes objects (animals) and stores in file.

Rare species?

Alert!!!

Keep track of the animals found in a file

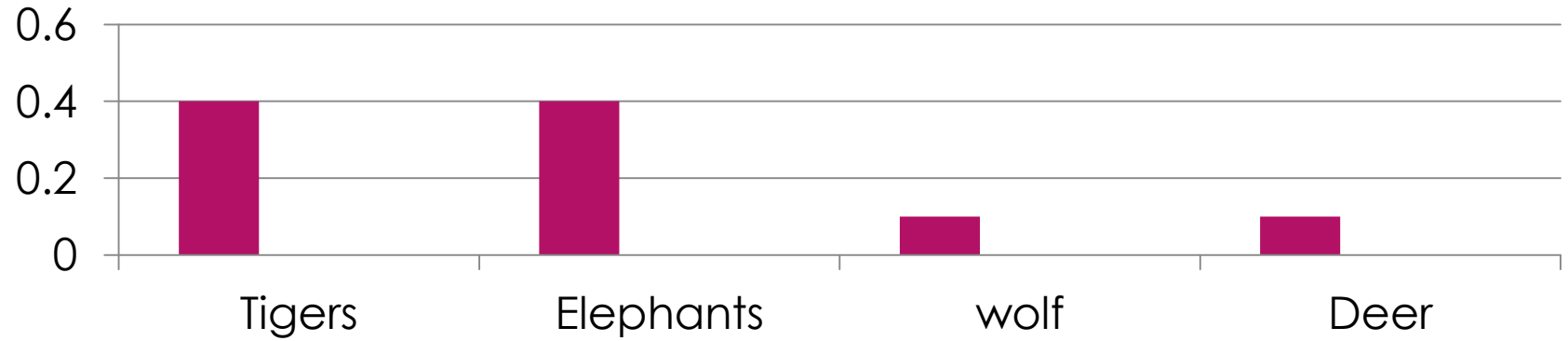
# Animal Census

- Certain animals are recognizable by certain features
  - For example, every tiger has a unique pattern of stripes on their body
  - Similarly for zebras
- Can train LSH for identifying different individuals within the same specie.
- This can lead to a more accurate estimate of the number of individuals within a specie than manual counting and saves time.

# And Topic Modeling …

- Each file corresponds to a video.
- Can run topic modeling algorithms on the file corpus to organize the data.
- Topic modeling can help to analyze composition of species according to geographic area

For some geographic area within the sanctuary →



# Tools and Evaluation

Tools:

1) Lin, Zhouchen, Minming Chen, and Yi Ma. "The augmented lagrange multiplier method for exact recovery of corrupted low-rank matrices." arXiv preprint arXiv:1009.5055 (2010). [Matlab code]
2) Kulis, Brian, and Kristen Grauman. "Kernelized locality-sensitive hashing for scalable image search." Computer Vision, 2009 IEEE 12th International Conference on. IEEE, 2009. [Matlab code]

Evaluation:

Motion-based Segmentation and Recognition Dataset

- Brostow, Gabriel J., et al. "Segmentation and recognition using structure from motion point clouds." *Computer Vision–ECCV 2008*. Springer Berlin Heidelberg, 2008. 44-57.

- Brostow, Gabriel J., Julien Fauqueur, and Roberto Cipolla. "Semantic object classes in video: A high-definition ground truth database." *Pattern Recognition Letters* 30.2 (2009): 88-97.

# References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- http://www.mouthshut.com/product-reviews/Jim-Corbett-National-Park-reviews-925003708
- http://www.radiomastfm.com/amboseli-national-park-kenya-4955
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- Surveillance camera: http://ipcameraguide.com/2016/04/protecting-yourself-using-home-surveillance-cameras/
- He, Jun, Laura Balzano, and John Lui. "Online robust subspace tracking from partial information." *arXiv preprint arXiv:1109.3827* (2011).