CSCI E-81 Section 1: Machine Learning and Data Mining

Classifying Wildlife Camera Trap Images for Conservation International's Tropical Ecology Assessment and Monitoring Network

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Agenda

- Brief Literature Review
- Wildlife Image Classification Pipeline: Segmentation
- Wildlife Image Classification Pipeline: Feature Extraction
- Wildlife Image Classification Pipeline: Classification
- Wildlife Image Data: Analysis & Limitations
- Future Work

Problem Statement

- Conservation International's Tropical Ecology Assessment & Monitoring (TEAM) network has thousands of camera trap images of terrestrial mammals that for a variety of reasons require manual classification by experts in the field

Brief Literature Review

- Linear classifiers
  - Bolger et al. identified individual animals based on coat patterns for the analysis of mark recapture technique using SIFT keypoints and SVM classifiers
  - Yu et al. proposed a method for automated identification of animal species in camera trap images using dense SIFT descriptor and SVM classifiers
- Learning models
  - Goubin, et al. used graph cut with deep CNNs

Wildlife Image Classification Pipeline: Segmentation

- Chose to work with loxodonta species ~ 31K images
- Manually selected and cropped 287 images of the family
- Scaled the images down based on model run time

Wildlife Image Classification Pipeline: Feature Extraction

- OpenCV
  - Histogram Comparison
  - Template matching
  - Scale Invariant Feature Extraction
  - Speeded Up Robust Features - TBD
  - Local Binary Pattern (LBP) - TBD

Wildlife Image Classification Pipeline: Classification

- Linear Models
  - Most papers achieve good results with SVMs on small carefully segmented images using a variety of feature extraction methods
  - Bag of Visual Words employed for image mining with k-means clustering set to 10 cluster *a priori*
    - Accuracy using linear SVM with SIFT on 287 manually cropped training images and 574 test images got to 98%
- Learning Models
  - Attempted a CNN with dropout regularization between the fully connected layers with Keras/TF backend and achieved poor results

Wildlife Image Data: Analysis & Limitations

- Highly unbalanced classes of species
- Many of the images are misclassified
- There is a class of unlabeled images
- There is a class of unknown images
- Context matters: bursts of images are understood by experts as a sequence of images containing the identified species (part of animal species v whole animal species in frame problem)
- Existence of endangered species images preclude the use of citizen scientists to help classify images
- OpenCV offers many methods for image recognition but running them on many images is extremely slow

Future Work

- Increase training set with and use graph cut for segmentation
- Implement SURF and LBP texture descriptor as additional feature extraction methods
- Extend task to include other species images
- Short term goal is to help TEAM verify the classification of *elephantidae* family of elephants in their database
- Long term goal to automate classification from start to finish using deep learning for classification