Automating the Identification of Illegal Human Activities in the Amazon Rainforest
Computer Vision Algorithms for Satellite Imagery Analysis
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Overview
First, we perform a softmax regression on the extracted features and compare that to the result from the K-Means. Then we run a NN on the actual satellite images and compare the results from the CNN.

Softmax Regression
Our first approach was to just try running a softmax regression on our dataset. We used the extracted features with an intercept term as the input. For the loss function, we used the log likelihood function from lecture. We ran gradient descent on the loss function to train our model.

K-Means
Our next approach was to use the filter and separate the dataset with K-Means into 3 clusters, assigning each cluster to one of the three classes. We conducted K-Means on the features extracted (of which there were 7), rather the images themselves, and ran K-Means 20 times with different random initialization and took the best result.

Standard Feed-Forward Network
We ran a feed-forward network with 5 hidden layers on the flattened images of size 256 x 256 x 3. We used Cross Entropy Loss for our output layer, which had 3 neurons, one corresponding to each class. All other neurons were activated with a sigmoid function.

CNN
The network is composed of two convolution layer 24 and 16 filters respectively with one sigmoid fully connected hidden layer. We used Cross Entropy Loss for our output layer, which had 3 neurons, one corresponding to each class. We used L2 regularization to prevent overfitting.

Models

Results

<table>
<thead>
<tr>
<th>Model</th>
<th>Training accuracy</th>
<th>Test accuracy</th>
<th>Stitched Test accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softmax Regression</td>
<td>0.651</td>
<td>0.685</td>
<td>NA</td>
</tr>
<tr>
<td>K-Means</td>
<td>NA</td>
<td>0.72</td>
<td>NA</td>
</tr>
<tr>
<td>Standard Feed-Forward Network</td>
<td>0.61</td>
<td>0.71</td>
<td>NA</td>
</tr>
<tr>
<td>CNN</td>
<td>0.80</td>
<td>0.81</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Discussion
- Deriving meaningful features was a difficult and time consuming process.
- The K-Means and the Standard Feed-Forward Neural Network performed better than random, but it was highly biased by the prior distribution of the labeled data.
- The CNN performed better with two convolution layer and less neurons in hidden layer. Adding more neurons in fully connected layer caused it to overfit on training data.
- The CNN model performed better when partly cloudy images were not categorized in cloud class.

References