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Final Project Proposal
Machine Learning II - DATS 6203 10
11/06/2022

Background:
Imagine you work for a space agency tasked with finding the optimal location for landing a space shuttle on the lunar surface. One critical obstacle to safely landing a moon lander is that it has to be unobstructed from large rocks that could adversely impact the landing space of the lander. You decide to train a deep neural network that can use lunar surface imagery to identify where the rocks are and whether they are large rocks that could impact landing.

Additionally, identifying rocks in rocky terrain is a problem that exists in multiple fields. It can be useful for offroad and self driving vehicles, scientific research, and environmental protection. In order to solve this problem, an image segmentation model needs to be built that can successfully identify rocks in an image. We have chosen this problem to solve due to its importance in a number of fields, and its relevance to the expanding field of deep learning and computer vision.

Dataset:
The dataset[3] we have chosen is from Kaggle and consists of 9,766 photorealistic images of lunar landscapes, as well as the segmentation results of each of those images. Finally, there are 73 test images that consist of actual lunar photographs to test the algorithm on. The training images are artificial, generated with the purpose of being able to train segmentation models to identify rocks in actual lunar photographs. The labels will be segmented images that include the various classes as different colors. There are 3 classes that are to be labeled by the segmentation algorithm, the sky (red), small rocks (green), and large rocks (blue). We believe this dataset will be large enough to train a deep network.

Approach (network we're using and why, how will we judge performance, metrics)
There are multiple possible models we can use to solve this problem.
Possible models:

1. Fully Convolutional Networks[1]
2. UNet[2]

To implement our model we plan to leverage Tensorflow as our framework because we're both familiar with it and we know that Tensorflow is capable of supporting the models that we plan to implement. We plan to start with the standard form of the networks, particularly the UNet network, and then customize as necessary in order to achieve the best results. We plan to also test different image augmentation techniques to determine if that could create better results.

In order to judge the success of our model we plan to look at the dice coefficient. The dice coefficient looks at the overlap of the correct mask with the predicted mask, as well as the union of the correct and predicted masks. The dice coefficient is related to Jaccard's Index, also

known as the Intersection over Union metric, however the dice coefficient double counts the intersection of the masks. The dice coefficient is more easily differentiable than Jaccard's index, making the gradient easier to calculate for back propagation.

References

1. Jonathan Long et. al (2014) - Fully Convolutional Networks for Semantic Segmentation
2. Ronneberger et. al (2015) - UNet: Convolutional Networks for Biomedical Image Segmentation
3. Kaggle Dataset

Schedule

- Proposal - 11/8/2022
- Environment Setup - 11/8/2022
- EDA - 11/11/2022
- Start Model Training - 11/18/2022
- Final Model - 12/02/2022
- Final Report - 12/12/2022
- Final Presentation - 12/12/2022