# CS 230: Image Segmentation & Object Detection of Lunar Landscape

Youtube. Link: https://youtu.be/P1EmjuQdJ2s

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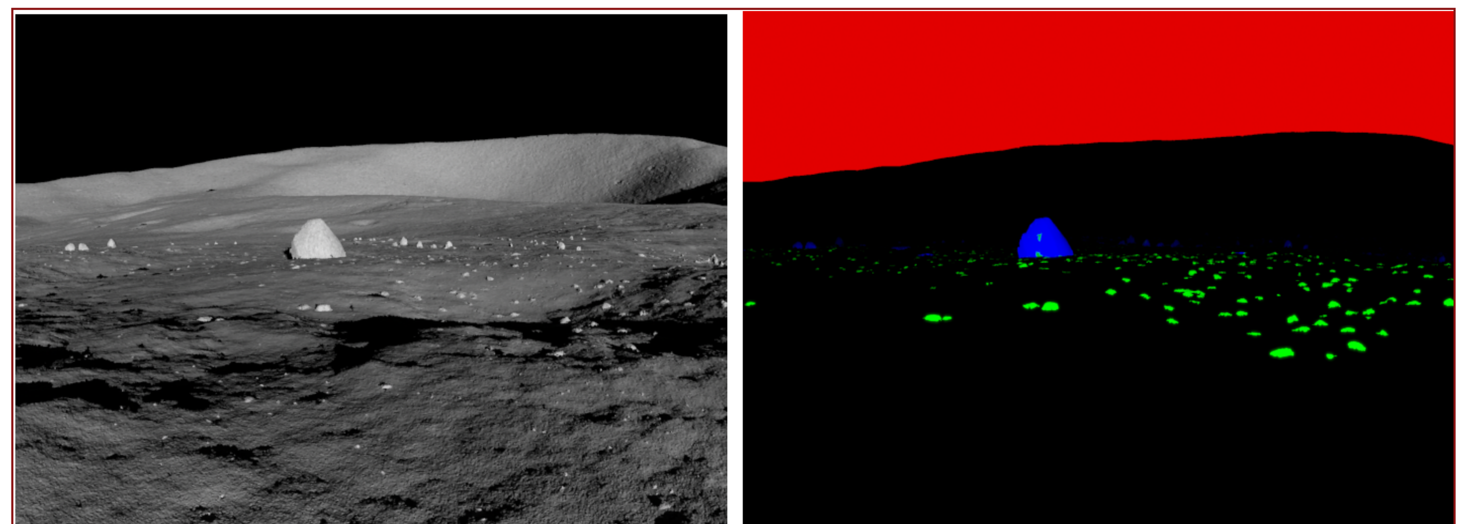
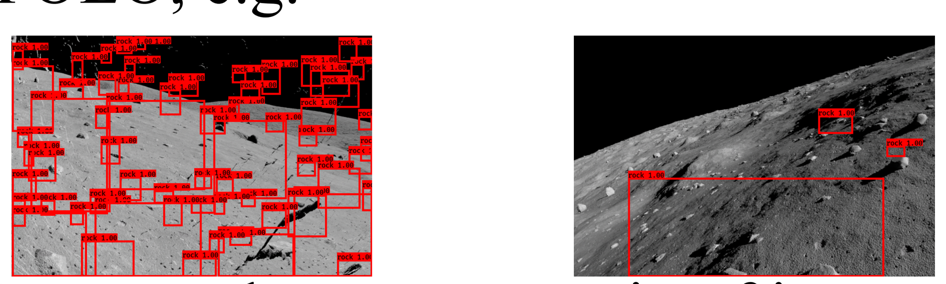
## Introduction and Motivation



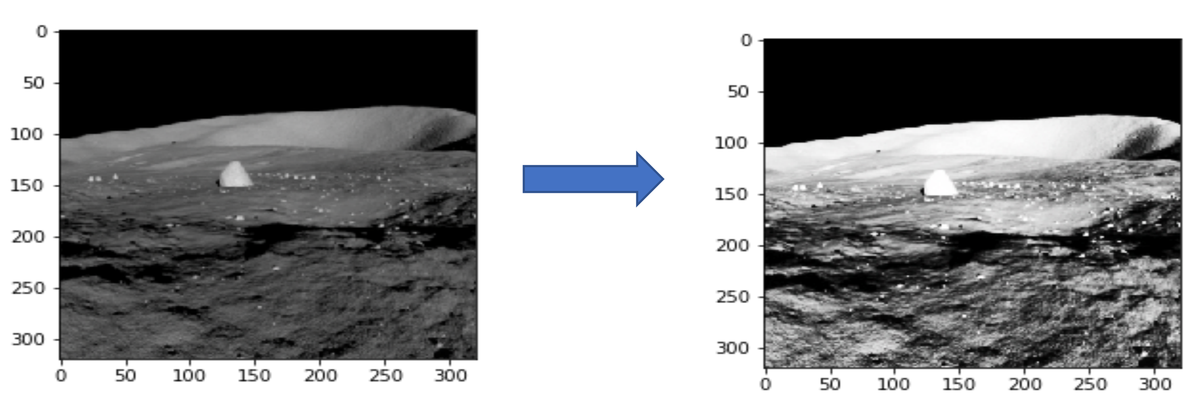
- Use the synthetic image (left) and segmentation (left) to train model
- Segment the synthetic lunar landscape
- Segment the real lunar landscape
- To see the possibility of lunar auto-driving

## Dataset and Preprocessing

- Ishigami Laboratory group of Keio University: Artificial Lunar Landscape data set
- 9700 images
- Training Set: 6400
- Validation Set: 2000
- Eye balling defect images and rock labels for YOLO, e.g.



- Increase the contrast ratio of inputs:

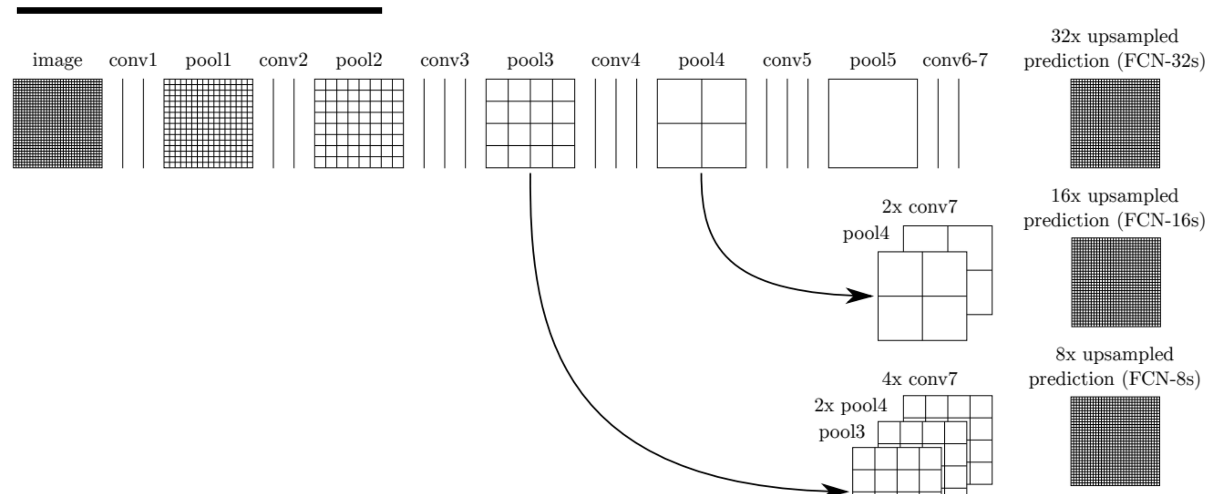


## Model

### YOLOv2

- Trained with YOLOv2 pretrained weights (full YOLO)
- Learning rate: 0.0001
- Optimization: Adam
- Anchors: 5 anchor boxes
- Grids: 13 × 13

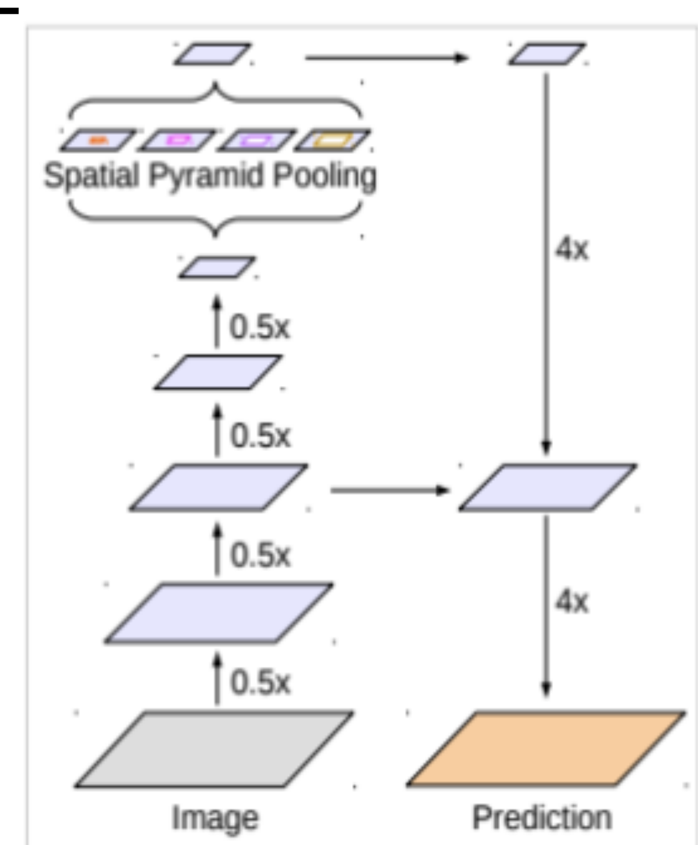
### FCN-8S




- Trained from VGG-16 layer 15
- Learning rate: 0.0005
- Optimization: Adam

### Deeplabv3+

- Learning rate: 0.0005 and then 0.0007 to overcome local minimum
- Optimization: Adam




## Result and Comparison

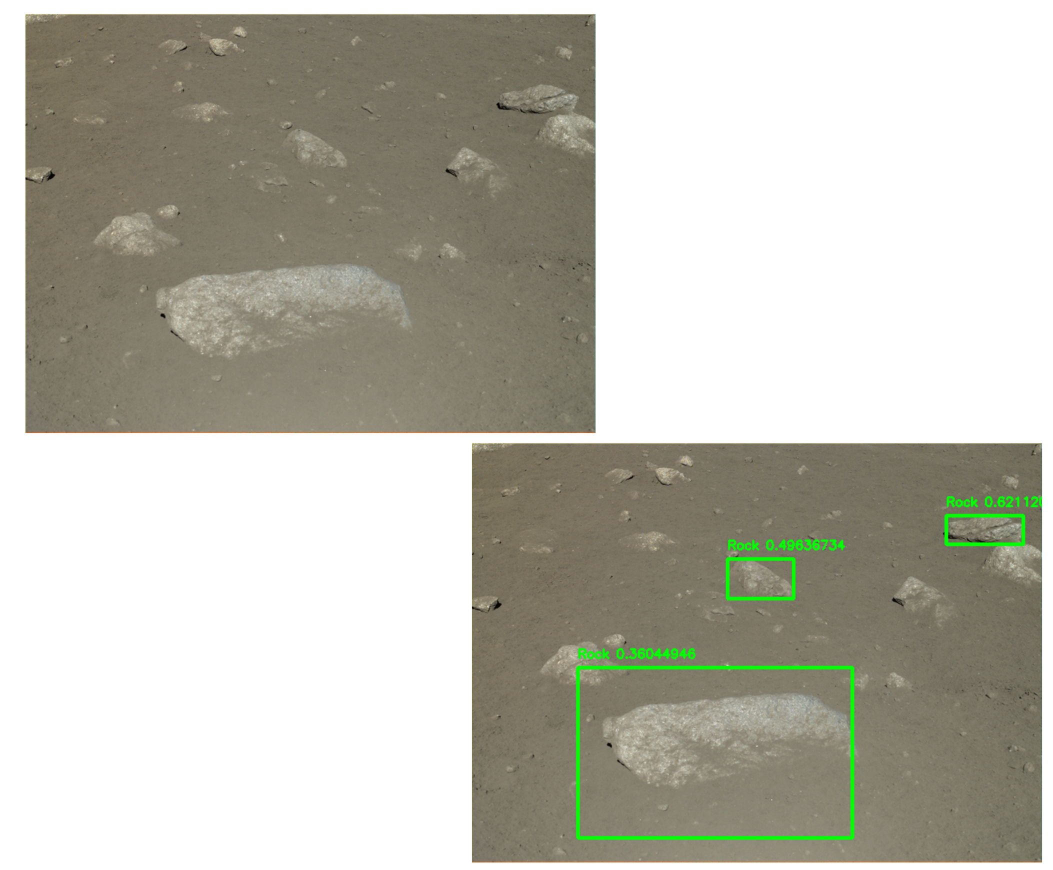


Figure 1: YOLOv2 rock detection on real lunar surface image

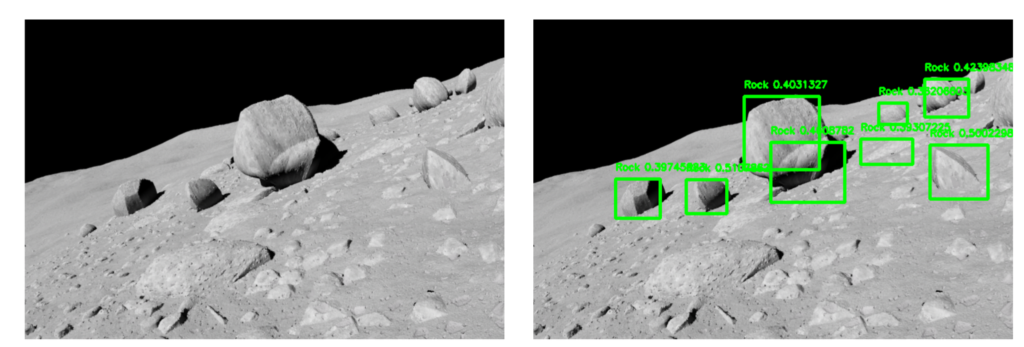


Figure 2: YOLOv2 rock detection on synthetic lunar surface image (mAP: 63.4%)

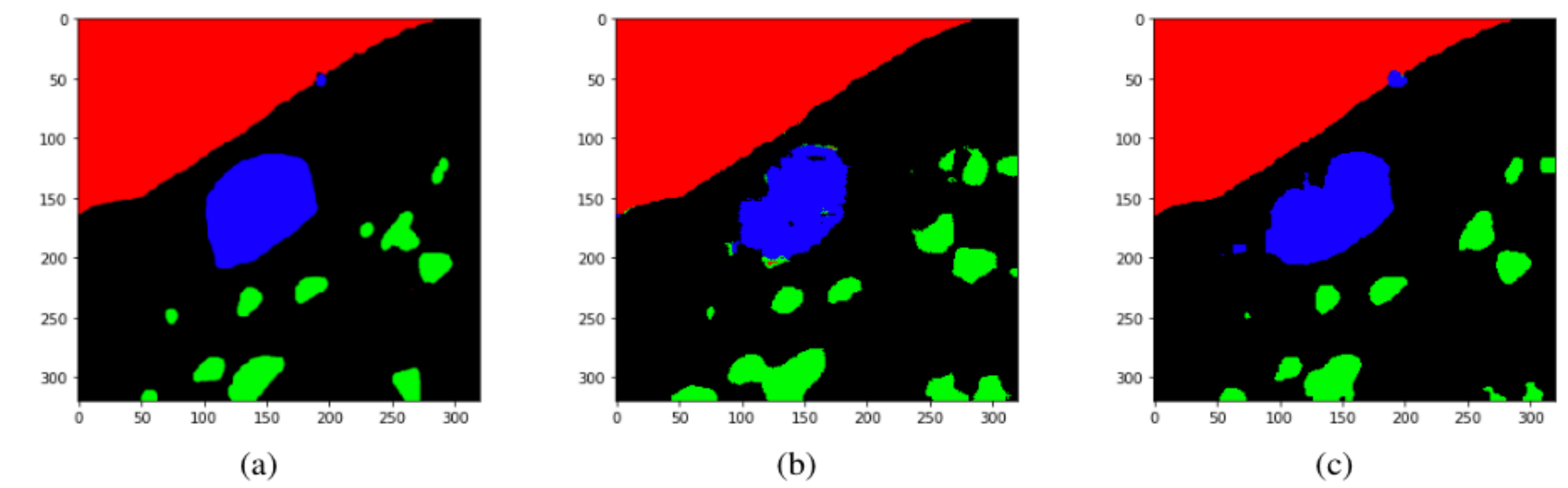



Figure 3: FCN and Deeplab comparison on validation image set of synthetic lanscapes. (a) Cleaned ground truth; (b) FCN-8s prediction; (c) DeeplabV3+ prediction.

Table 1: Results of FCN-8s and DeepLabV3+

| Model | final loss | Pixel-wise Accuracy | MeanIOU of training | MeanIOU of validation |
|---|---|---|---|---|
| FCN-8s | 0.7666 | 0.9699 | 0.8829 | 0.8275 |
| DeepLabV3+ | 0.08302 | 0.9728 | 0.8358 | 0.8232 |

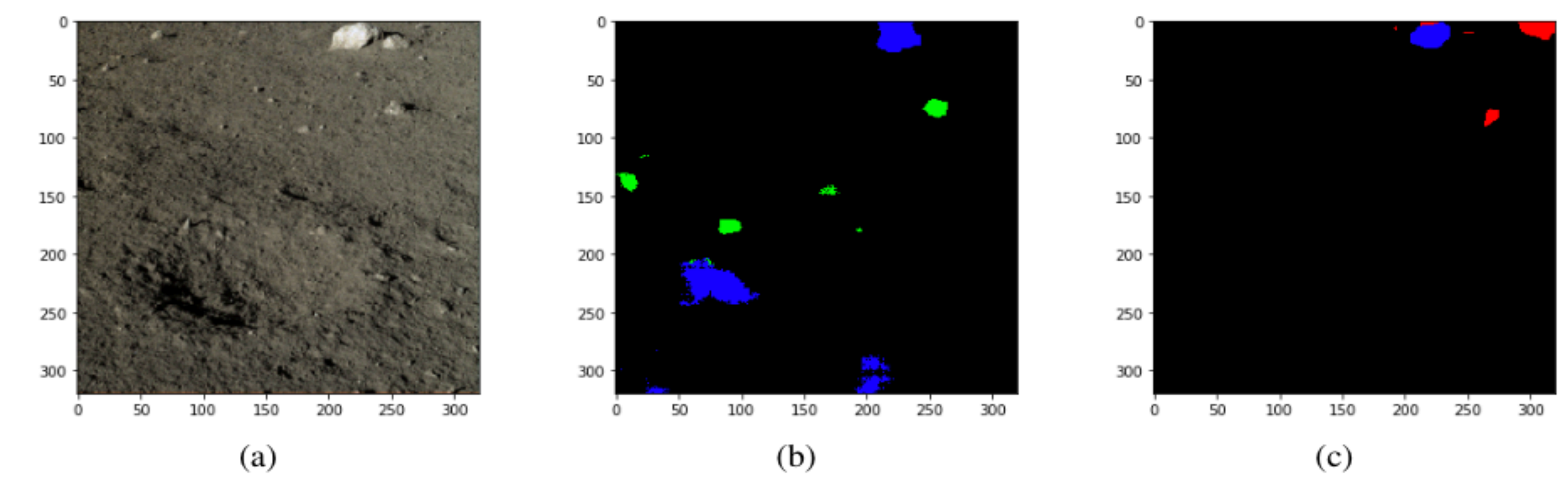



Figure 4: FCN and Deeplab comparison on real moon surface . (a) Cleaned ground truth; (b) FCN-8s prediction; (c) DeeplabV3+ prediction.

## Future Improvement

- More realistic synthetic lunar surface will help a lot.
- Data augment the synthetic image and make it more like the real one.
- Improve data label and use data from different distributions

## Reference

1. S Ghosh, N Das, I Das, and U Maulik. Understanding deep learningtechniques for image segmentation.ACM Computing Surveys (CSUR), 52(4):1–35, 2019.
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