**Objective**

Most observed astronomical objects have some overlap with neighboring objects. However, scientific measurements require isolated galaxy images. We try to perform detection and segmentation of overlapping galaxies using Mask Region-based CNN (Mask R-CNN).[2]

**Mask R-CNN**

- Framework performs object detection in parallel with generating high-quality segmentation mask on each Region of Interest (ROI).
- Backbone: ResNet-101 with Feature Pyramid Network (FPN) -> extracts ROI.
- Head: applied separately to each ROI
  - Mask -> segmentation.
- This analysis used Tensorflow, Keras implementation of the architecture.[1]

**Loss function**

\[
L = L_{cls} + L_{mask} + L_{box} + \sum_{i=0}^{s} \text{SmoothL1}(\hat{y}_i) - \sum_{i=0}^{s} \log(p_i)
\]

- Multi-task loss on each sampled ROI.

**Data**

- Simulated images of two-galaxy pairs with varied overlap.

**Example training data**

- Overlapping galaxy image
- Segmentation Mask

**Training**

- Initialize with pre-trained weights on MS COCO[4].
- Mini-batch size: 64

**Future Work**

- Network performance limited by dataset: galaxies do not have sharp edges.
- Modify end layers of network to output individual galaxies instead of segmentation maps.
- Include different kinds of sources and perform classification as well.

**Results**

- Test set mean Average Precision (mAP): 0.87

**References**

[1] https://github.com/facebookresearch/detectron2
[3] https://github.com/matterport/Mask_RCNN