



Japan Science and  
Technology Agency



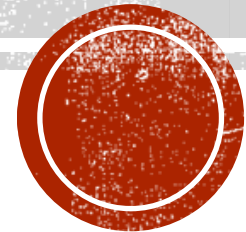
Sakura Science  
Exchange Program

# ROAD EXTRACTION FROM SATELLITE IMAGES [DEEPLABV3+]

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# INTRODUCTION

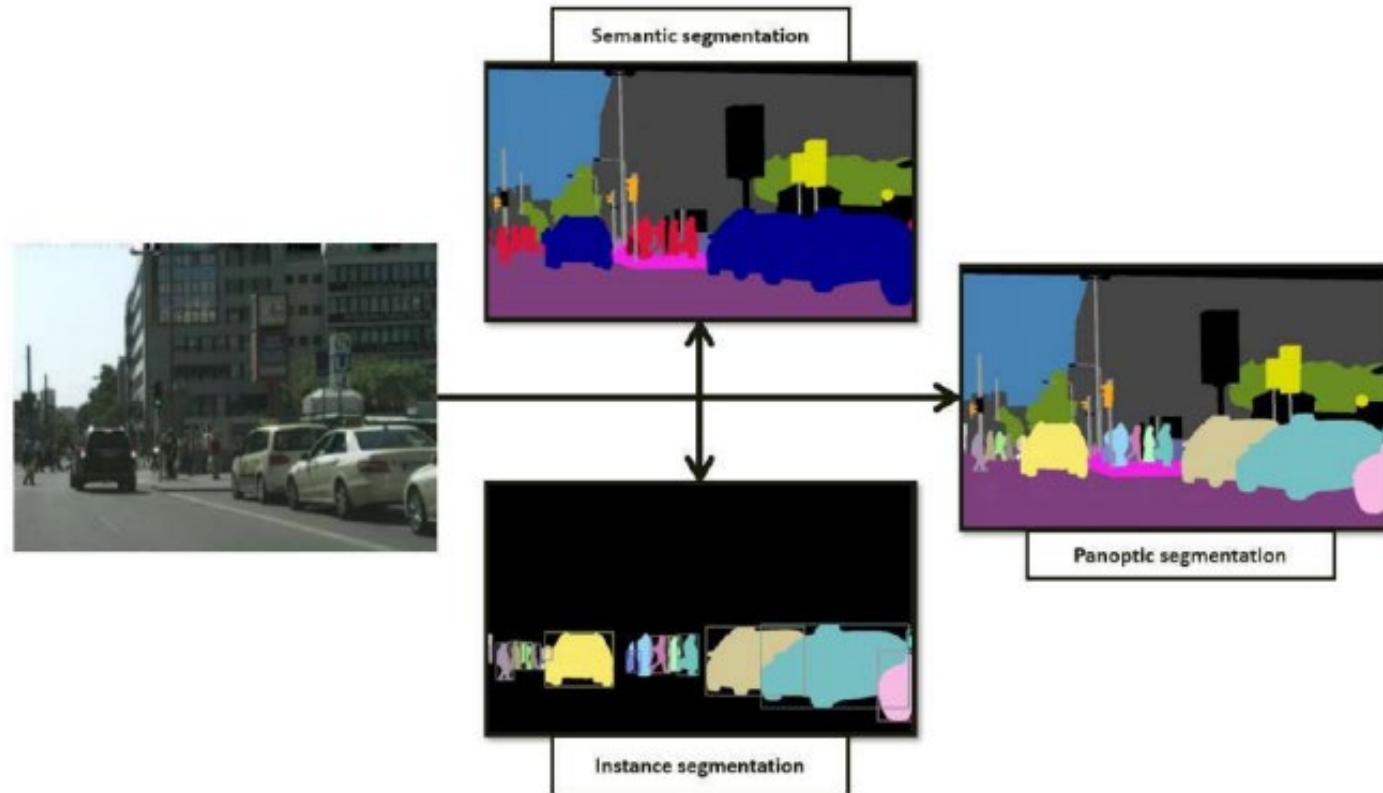
- Image segmentation is a computer vision task that involves dividing an image into multiple segments or regions with similar visual properties. The goal of image segmentation is to identify and label different objects or regions of interest within an image, allowing for a more detailed understanding of its contents.



Image classification vs Object detection vs Image Segmentation



# INTRODUCTION



[Panoptic Segmentation: A Review](#)



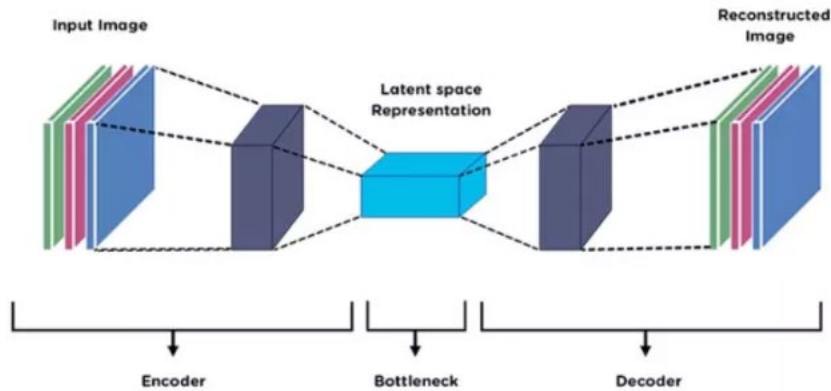
# INTRODUCTION

## ■ **The Challenge of Road Extraction**

- **Complex Backgrounds:** Satellite images often contain diverse terrains, vegetation, and man-made structures, making it difficult to distinguish roads from other elements.
- **Varying Road Types:** Roads come in different shapes, sizes, and patterns, including highways, streets, and dirt roads, which increases the complexity of the segmentation task.
- **Illumination and Weather Conditions:** Changes in lighting conditions and weather can affect the appearance of roads in satellite images, leading to variations in color and texture.
- **Scale and Resolution:** Satellite images may have varying scales and resolutions, requiring the model to generalize well across different dataset.



# METHODOLOGY



**Encoder:** A layer that extracts images through a series of increasingly narrow and deep filters.

**Decoder:** A layer mask that scales the output of the encoder to a segmentation mask similar to the pixel resolution of the input image.

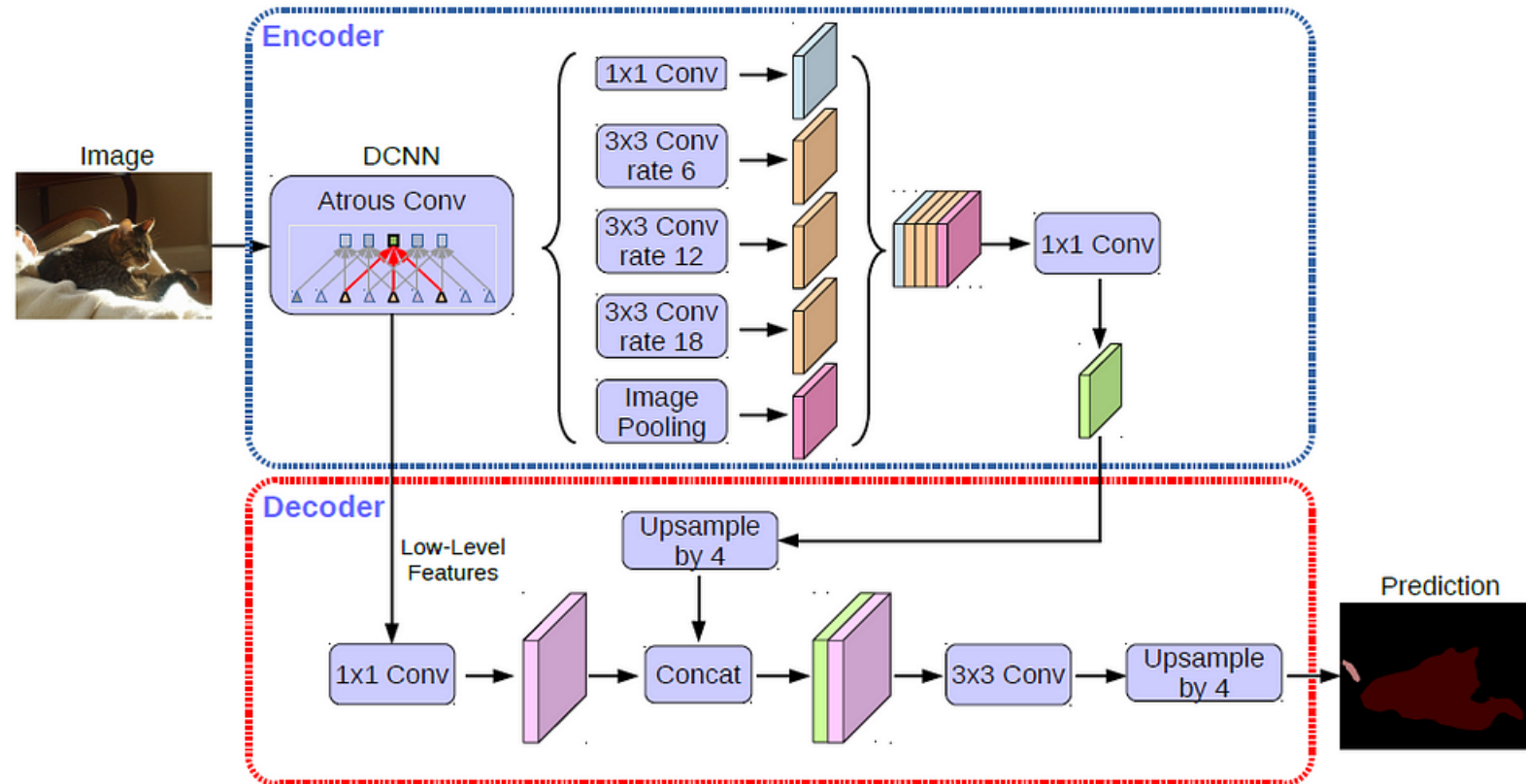


Image Source: DeepLabV3+ [Liang-Chieh Chen et al.]



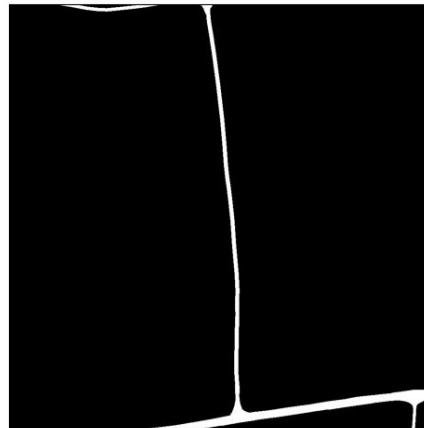
# METHODOLOGY

- Dataset
  - Train : 5603
  - Validation : 623
  - Test : 550
  - Epoch : 5

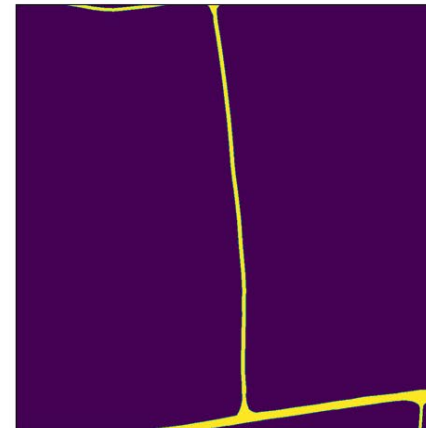
Original Image



Ground Truth Mask



One Hot Encoded Mask





# METHODOLOGY : LOSS FUNCTION

- Intersection Over Union (IoU)

IoU is the primary metric to evaluate model accuracy.

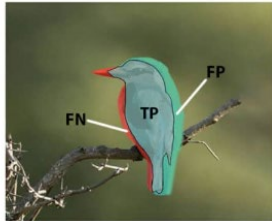
$$IoU = \frac{TP}{(TP + FP + FN)}$$



Ground Truth Mask



Predicted Mask



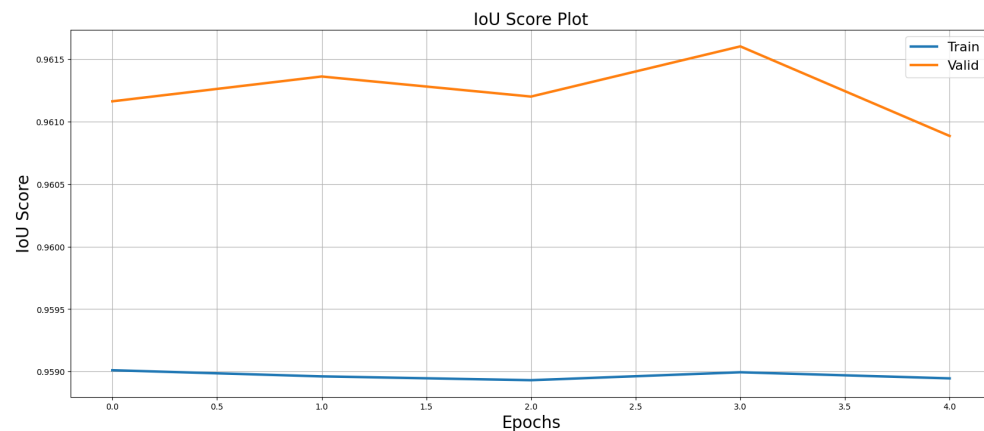
- Dice Loss

Measure of overlap widely used to assess segmentation performance when a gold standard or ground truth is available

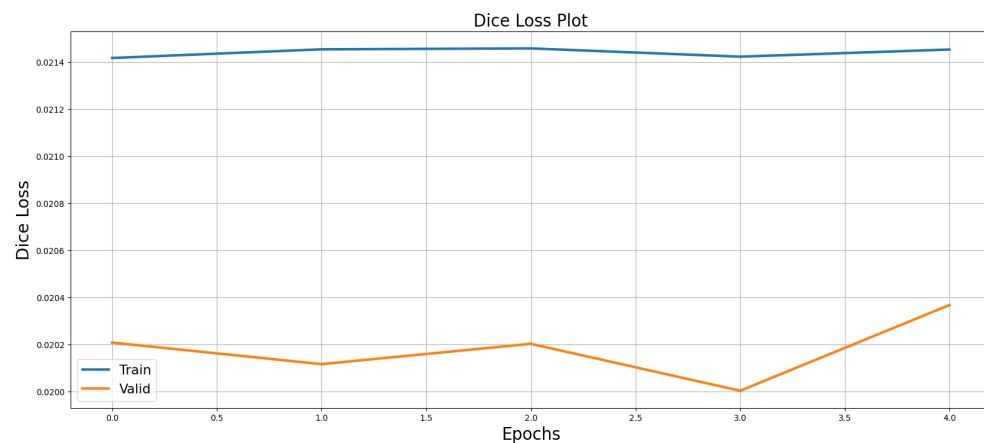
$$\text{Dice Loss} = 1 - 2 \frac{TP}{TP + FP + FN}$$



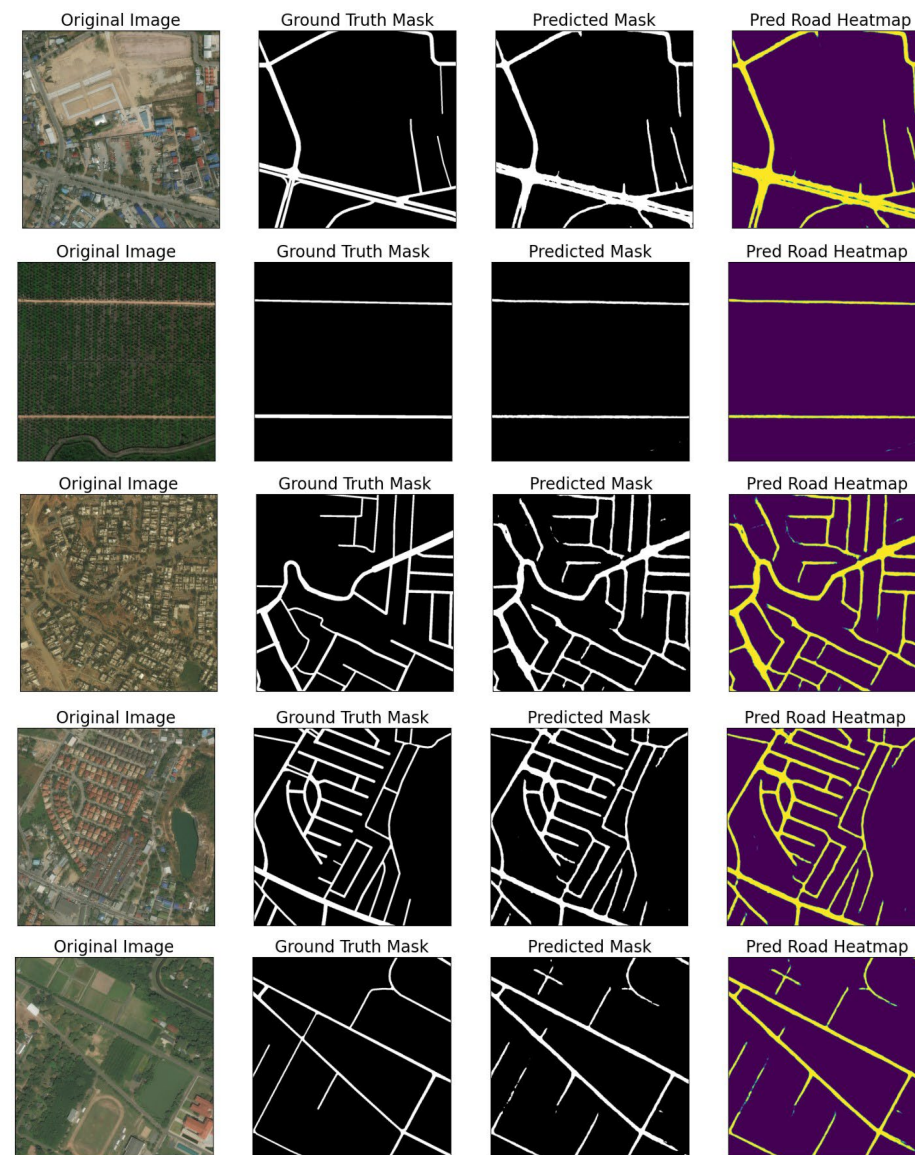
# RESULT



Mean IoU Score : 0.0204



Mean Dice Loss : 0.9614





# DISCUSSION

Road extraction from satellite images using DeepLabV3+ is a powerful and promising approach, offering accurate and efficient segmentation results. However, addressing the challenges of complex backgrounds, varying road types, and robustness to changing conditions remains an ongoing research area. With further advancements and improvements in deep learning models, road extraction will continue to play a vital role in various remote sensing application.





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# THANK YOU

