Final Project

*** Issue date: 2021.05.20. Due date: 2020.06.15.**

I. Goal

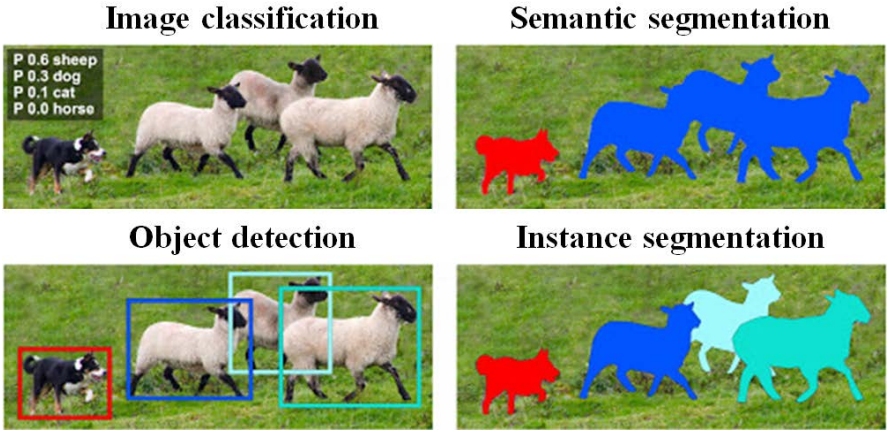
- **We are going to design a convolutional neural network for semantic segmentation of photographic images. The goal is to achieve as high as possible mean Intersection of Union (mIoU) on the test dataset**

II. Submission

- **Report:** Each student should submit a final report that summaries your attempts (even failures), network design and achieved performance (format: Microsoft Word, maximum 6 pages excluding the cover).
- **Trained network:** Each student should submit their trained network file (including the model python file).
- **More details for the submission will be announced later.**

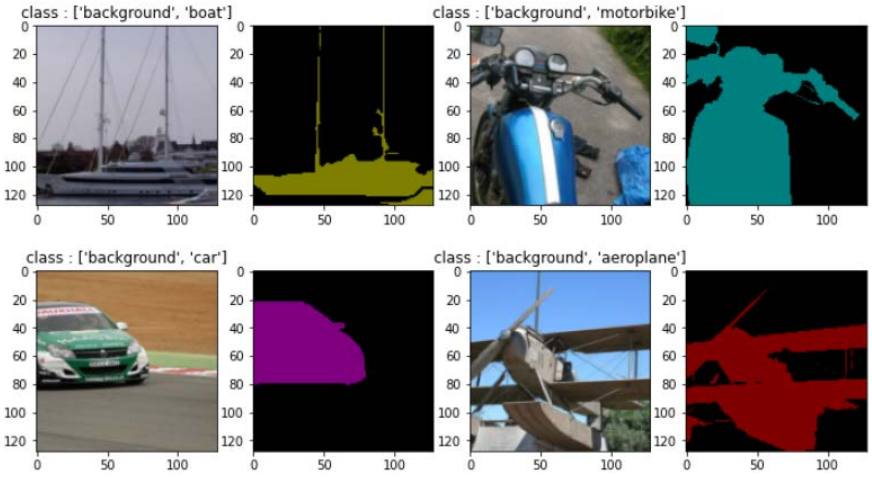
III. Problem Description

- **Image segmentation is a process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.**
- **Semantic segmentation is a type of image segmentation in which we assign labels to every pixel based on type of the object.**
  - **On the other hand, instance segmentation differs from semantic segmentation in that we assign unique label to every instance (e.g., we want to distinguish two different people in the image)**
    - **Semantic segmentation is closely related to image classification and object detection.**
  - **Image classification is a process of assigning a label to the entire image. Semantic segmentation can be considered as performing image classification for every single pixel in the image.**
  - **Object detection is a process of detecting and locating semantic objects. Typically, in object detection, we attempt to draw a bounding box for each object and classify each box.**



- **Semantic segmentation plays an important role in many vision applications. For example, it is essential for the development of a self-driving car which automatically analyzes the camera image to determine its acceleration and direction. Simply put, it would be much easier to determine those if we had a segmented image rather than just the raw camera, as shown below.**

- **In this project, we are going to design a convolutional neural network that can segment photographic images as exemplified below. Specifically, our network will take an image as the input and assign labels to each pixel.**



IV. Provided material

- **Dataset**
  - **Images:** photographic images (provided as JPG files).
  - **Labels:** labels that corresponds to the images (provided as PNG files)
- **Skeleton training code:** a sample training code (provided as an iPython notebook file with additional python files)

V. Computing

- **You are expected to run your code on Colab. Since Colab comes with a limited amount of computational resource (e.g., maximum session length of 12 hours), making an efficient use of the resource will affect the successfulness of your project. Remember that making the best out of the limited resource is often the key in real-life engineering. In that sense, we encourage you to (a) start early, (b) manage the size of the network and (c) exploit GPU acceleration.**

VI. Suggestions

- **There are many possible ways to improve the performance (mIoU on test data) of your network and below is a list of things that you may want to give a try. There also are plenty of other options. However, using a pre-trained network is NOT allowed.**
  - **Optimize the network design**
  - **Optimize the hyper-parameters**
  - **Use an appropriate optimization method**
  - **Employ data augmentation**
  - **Employ regularization method**
  - **Employ residual blocks**
  - **Employ learning rate scheduler**

VII. Grading

- **Followings will be taken into account for grading your project.**
  - **The logical and experimental flow that led to your final design is the most important. For example, if you just include your final network design and the results, you may be given a very low grade even if you achieve good performance on test data. It means you should include non-final attempts in the report and more importantly, how you moved from an earlier attempt to the next attempt (and the reason for the shift) should be described.**
  - **The mIoU on the test data will be accounted for grading.**
  - **The number of methods that you have incorporated in your final design will be accounted for grading. In your report, clearly describe the methods that you have employed.**

VIII. Acknowledgement

- **The sample training code was prepared by our TAs Changyeop Shin and Seungjae Han, grad students in NICA Lab.**