Image Segmentation [Implementation]

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Task Introduction

- **Carvana**\(^1\) (online used car startup) Image Masking Challenge

  ![Image Masking Challenge](image)

  - **Goal:** develop an algorithm that automatically removes the photo studio background
  - **Challenge**
    - rotating photo with 16 standard images of each vehicle
    - bright reflections and cars with similar colors as the background
  - **Practical usage**
    - Make online used car sales more effective and efficient by displaying car-related pixels only

Carvana Dataset

- Training set
  - 100,064 images (6,254 cars) + corresponding masks
  - Each car has 16 images (different angles)
- Test set
  - 5,088 images (318 cars) + corresponding masks
  - Each car has 16 images
Applied NN Models

U-Net [ronneberger et al. 2015]

SegNet [badrinarayanan et al. 2017]

FCN [long et al. 2015]

Pytorch, Cuda
Evaluation Results

• Metric
  - Dice coefficient (pixel-wise): \( DSC = \frac{2|P \cap GT|}{|P| + |GT|} \)
  - IoU (pixel-wise): \( IoU = \frac{|P \cap GT|}{|P \cup GT|} \)
  - Accuracy (pixel-wise): \( Acc = \frac{|P \cap GT|}{|GT|} \)

• Results

<table>
<thead>
<tr>
<th>Model</th>
<th>Dice coefficient</th>
<th>IoU</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-Net</td>
<td>0.9884</td>
<td>0.9568</td>
<td>0.9760</td>
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<tr>
<td>FCN</td>
<td>0.9709</td>
<td>0.9512</td>
<td>0.9715</td>
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<tr>
<td>SegNet</td>
<td>0.9509</td>
<td>0.9320</td>
<td>0.9213</td>
</tr>
</tbody>
</table>
Demonstration

U-Net

FSN

SegNet
Conclusion

• Among the three neural network models, U-Net produces the overall best performance on the Carvana Dataset.

• Existing methods can well distinguish between object pixels and other pixels, e.g., all achieve more than 90% accuracy and IoU.
Future Work

• We hope to implement more Transformer-based models on practical image segmentation tasks

• We consider other downstream tasks such as Segment salt deposits beneath the Earth's surface.