Semantic segmentation

Semantic segmentation datasets are used to train a model to classify every pixel in an image. There are
a wide variety of applications enabled by these datasets such as background removal from images, stylizing
images, or scene understanding for autonomous driving. This guide will show you how to apply transformations
to an image segmentation dataset.

Before you start, make sure you have up-to-date versions of `albumentations` and `cv2` installed:

```
pip install -U albumentations opencv-python
```

Albumentations is a Python library for performing data augmentation
for computer vision. It supports various computer vision tasks such as image classification, object
detection, segmentation, and keypoint estimation.

This guide uses the Scene Parsing dataset for segmenting
and parsing an image into different image regions associated with semantic categories, such as sky, road, person, and bed.

Load the `train` split of the dataset and take a look at an example:

```
>>> from datasets import load_dataset

>>> dataset = load_dataset("scene_parse_150", split="train")
>>> index = 10
>>> dataset[index]
{'image': <PIL.JpegImagePlugin.JpegImageFile image mode=RGB size=683x512 at 0x7FB37B0EC810>,
 'annotation': <PIL.PngImagePlugin.PngImageFile image mode=L size=683x512 at 0x7FB37B0EC9D0>,
 'scene_category': 927}
```

The dataset has three fields:

- `image`: a PIL image object.
- `annotation`: segmentation mask of the image.
- `scene_category`: the label or scene category of the image (like “kitchen” or “office”).

Next, check out an image with:

```
>>> dataset[index]["image"]
```

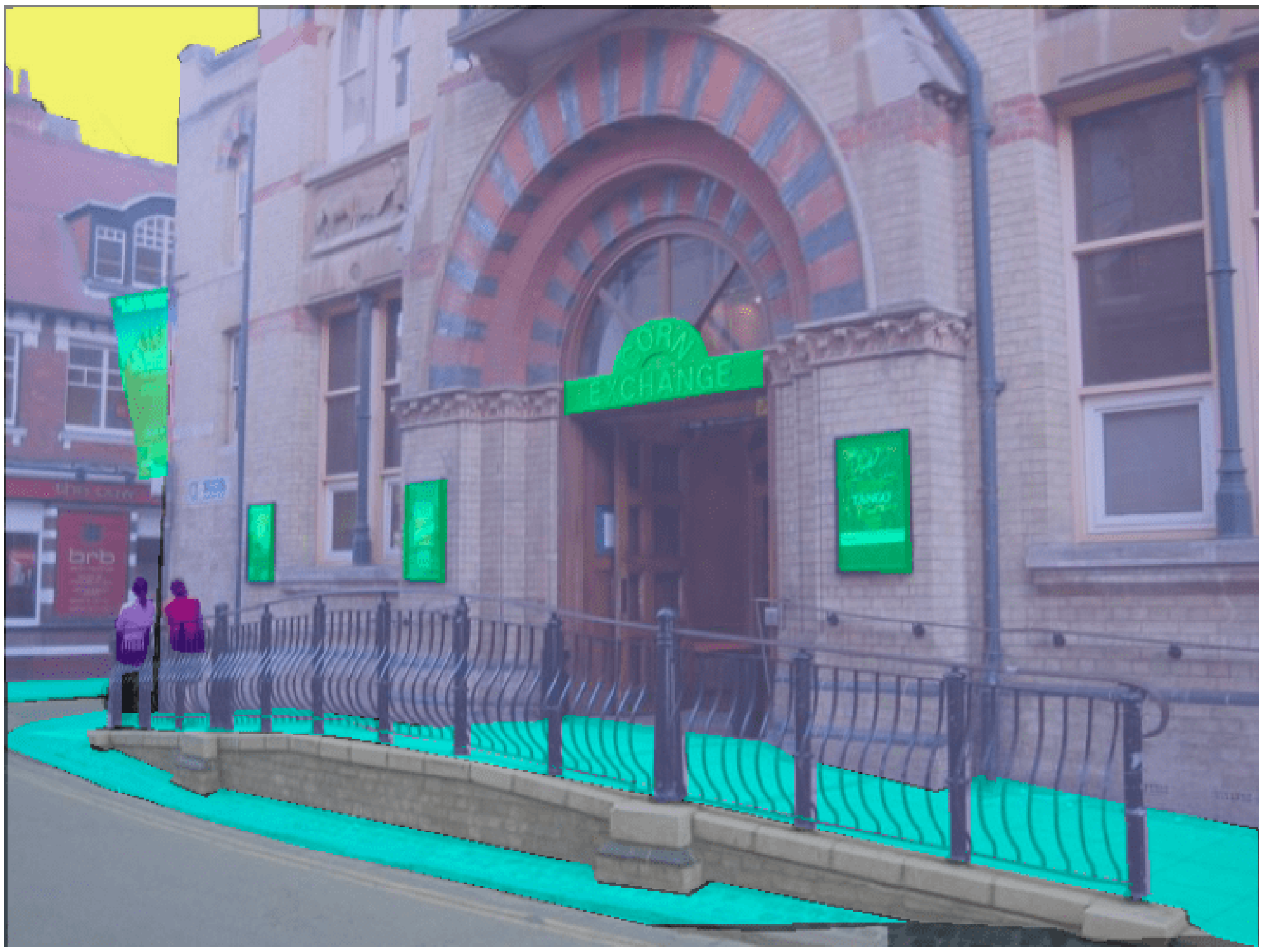
Similarly, you can check out the respective segmentation mask:

```
>>> dataset[index]["annotation"]
```

We can also add a color palette on the
segmentation mask and overlay it on top of the original image to visualize the dataset:

After defining the color palette, you should be ready to visualize some overlays.

```python
>>> import matplotlib.pyplot as plt

>>> def visualize_seg_mask(image: np.ndarray, mask: np.ndarray):
...     color_seg = np.zeros((mask.shape[0], mask.shape[1], 3), dtype=np.uint8)
...     palette = np.array(create_ade20k_label_colormap())
...     for label, color in enumerate(palette):
...         color_seg[mask == label, :] = color
...     color_seg = color_seg[..., ::-1]  # convert to BGR

...     img = np.array(image) * 0.5 + color_seg * 0.5  # plot the image with the segmentation map
...     img = img.astype(np.uint8)

...     plt.figure(figsize=(15, 10))
...     plt.imshow(img)
...     plt.axis("off")
...     plt.show()


>>> visualize_seg_mask(
...      np.array(dataset[index]["image"]),
...      np.array(dataset[index]["annotation"])
... )
```



Now apply some augmentations with `albumentations`. You'll first resize the image and adjust its brightness.

```
>>> import albumentations

>>> transform = albumentations.Compose(
...     [
...         albumentations.Resize(256, 256),
...         albumentations.RandomBrightnessContrast(brightness_limit=0.3, contrast_limit=0.3, p=0.
...     ]
... )
```

Create a function to apply the transformation to the images:

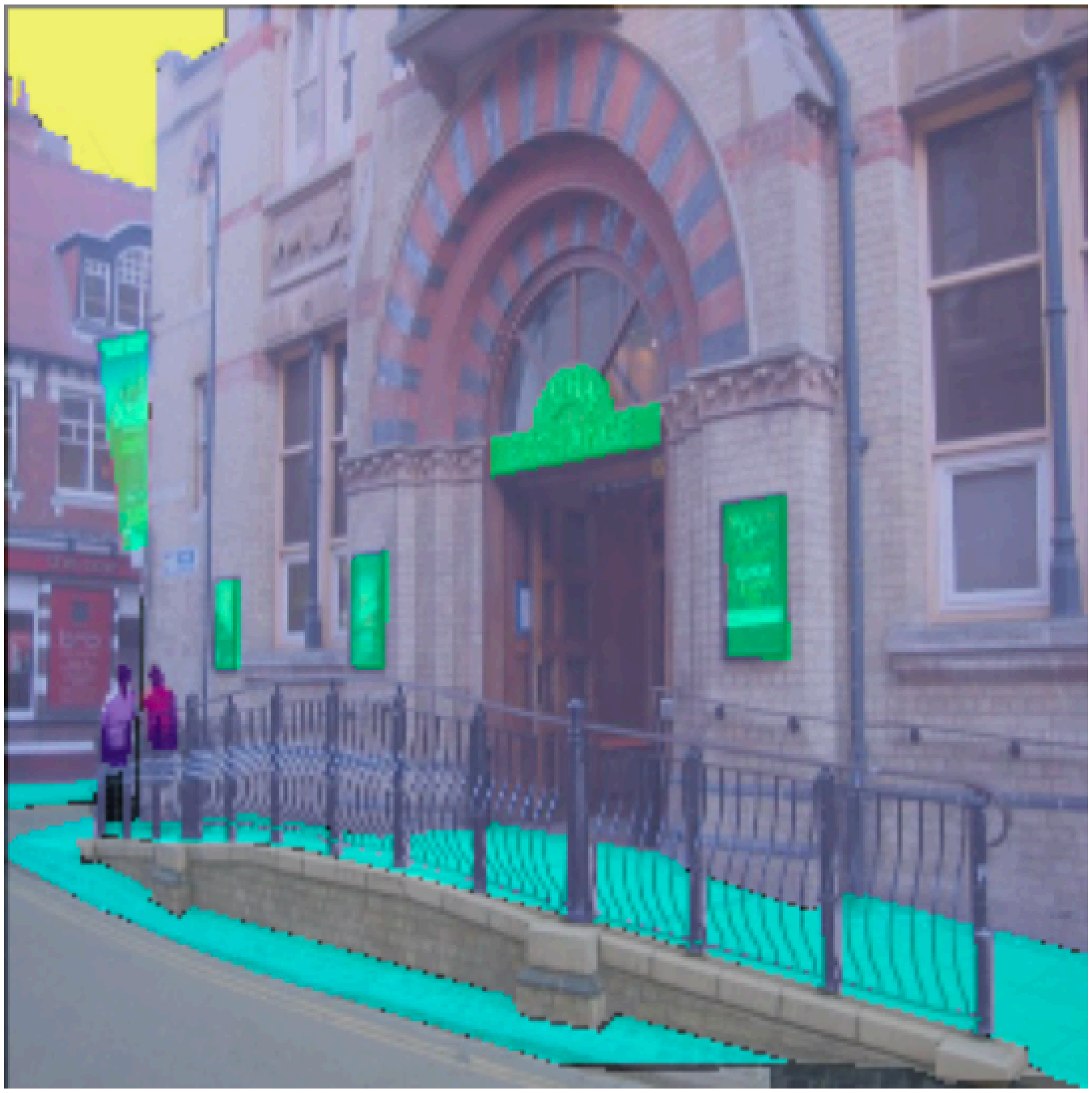
```
>>> def transforms(examples):
...     transformed_images, transformed_masks = [], []
...
...     for image, seg_mask in zip(examples["image"], examples["annotation"]):
...         image, seg_mask = np.array(image), np.array(seg_mask)
...         transformed = transform(image=image, mask=seg_mask)
...         transformed_images.append(transformed["image"])
...         transformed_masks.append(transformed["mask"])
...
...     examples["pixel_values"] = transformed_images
...     examples["label"] = transformed_masks
...     return examples
```

Use the set_transform() function to apply the transformation on-the-fly to batches of the dataset to consume less disk space:

```
>>> dataset.set_transform(transforms)
```

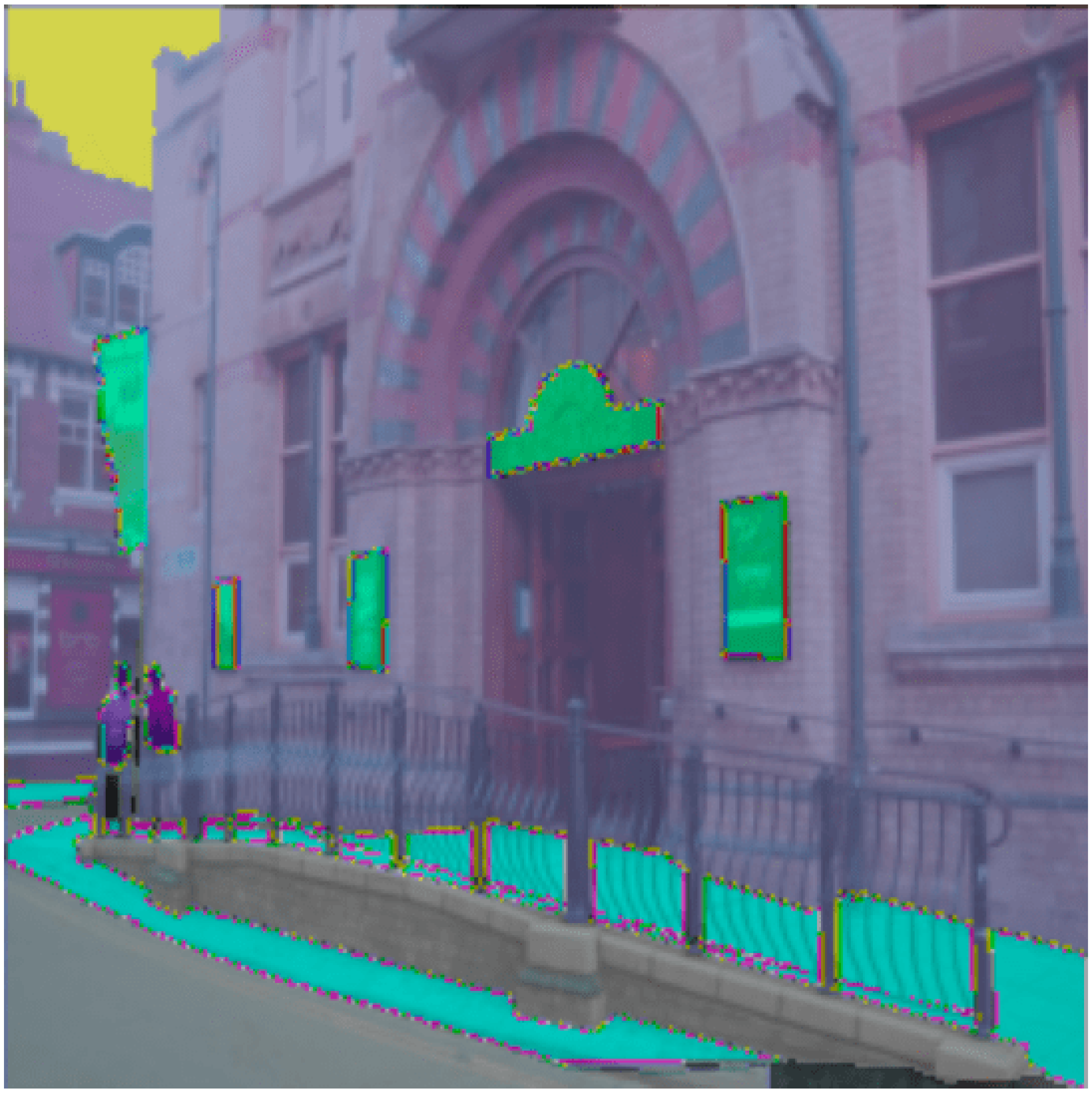
You can verify the transformation worked by indexing into the `pixel_values` and `label` of an example:

```
>>> image = np.array(dataset[index]["pixel_values"])
>>> mask = np.array(dataset[index]["label"])

>>> visualize_seg_mask(image, mask)
```



In this guide, you have used `albumentations` for augmenting the dataset. It's also possible to use `torchvision` to apply some similar transforms.

```
>>> from torchvision.transforms import Resize, ColorJitter, Compose

>>> transformation_chain = Compose([
...     Resize((256, 256)),
...     ColorJitter(brightness=0.25, contrast=0.25, saturation=0.25, hue=0.1)
... ])
>>> resize = Resize((256, 256))

>>> def train_transforms(example_batch):
...     example_batch["pixel_values"] = [transformation_chain(x) for x in example_batch["image"]]
...     example_batch["label"] = [resize(x) for x in example_batch["annotation"]]
...     return example_batch

>>> dataset.set_transform(train_transforms)

>>> image = np.array(dataset[index]["pixel_values"])
>>> mask = np.array(dataset[index]["label"])

>>> visualize_seg_mask(image, mask)
```



> [!TIP]
> Now that you know how to process a dataset for semantic segmentation, learn
> [how to train a semantic segmentation model](#)
> and use it for inference.