Few-shot Learning
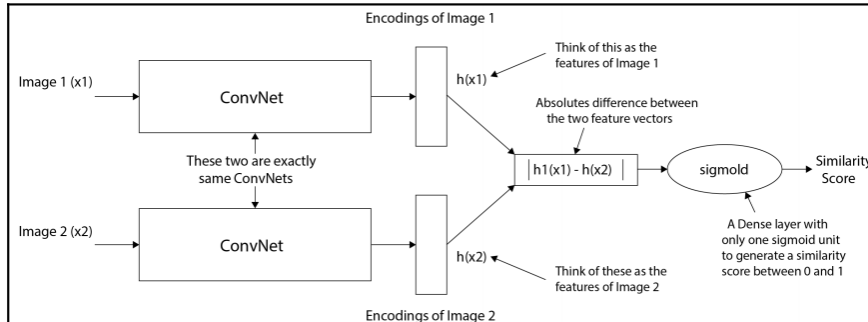
Reference: https://www.packtpub.com/product/modern-computer-vision-with-pytorch/9781839213472

An N-shot K-class classification is where there are N images each for the k classes to train the network.

Dataset
Training dataset: 38 different persons and each has 10 sample images.

Testing dataset: 3 different persons with 10 images each

Network Architecture

```python
class SiameseNetwork(nn.Module):
    def __init__(self):
        super(SiameseNetwork, self).__init__()
        self.features = nn.Sequential(
            convBlock(1, 4),
            convBlock(4, 8),
            convBlock(8, 8),
            nn.Flatten(),
            nn.Linear(8 * 100 * 100, 500), nn.ReLU(inplace=True),
            nn.Linear(500, 500), nn.ReLU(inplace=True),
            nn.Linear(500, 5)
        )

    def forward(self, input1, input2):
        output1 = self.features(input1)
        output2 = self.features(input2)
        return output1, output2
```

Contrastive Loss

```python
class ContrastiveLoss(nn.Module):
    """
    Contrastive loss function.
    Based on: http://yann.lecun.com/exdb/publis/pdf/hadsell-chopra-lecun-06.pdf
    """

    def __init__(self, margin=2.0):
        super(ContrastiveLoss, self).__init__()
        self.margin = margin

    def forward(self, output1, output2, label):
        euclidean_distance = F.pairwise_distance(
            output1, output2, keepdim=True)
        loss_contrastive = torch.mean((1-label) * torch.pow(euclidean_distance, 2) +
                                (label) * torch.pow(torch.clamp(self.margin - euclidean_distance, min=0.0), 2))
        acc = ((euclidean_distance > 0.6) == label).float().mean()
        return loss_contrastive, acc
```

The margin is similar to SVM where we want it as big as possible to better separate two different classes. After passing the two images into the Siamese Network, we can calculate Euclidean distance between images. The loss penalizes for having a high Euclidean distance between images of the same label and for having a low Euclidean distance compare to the margin for images having different labels.

Result