Convolutional Autoencoder

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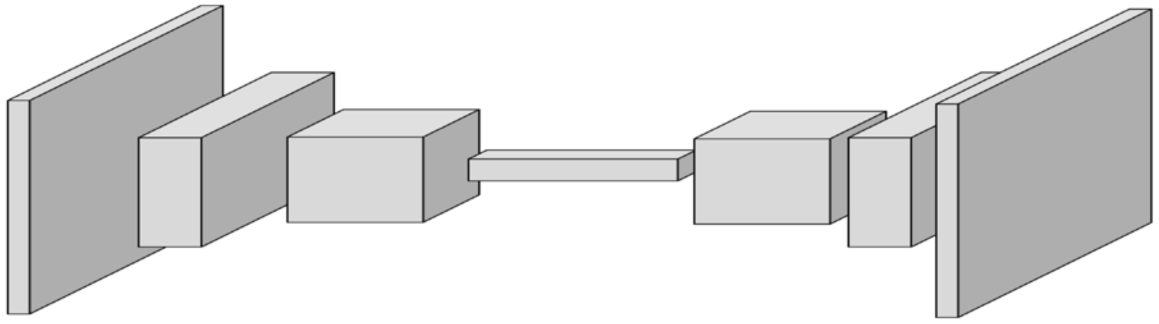
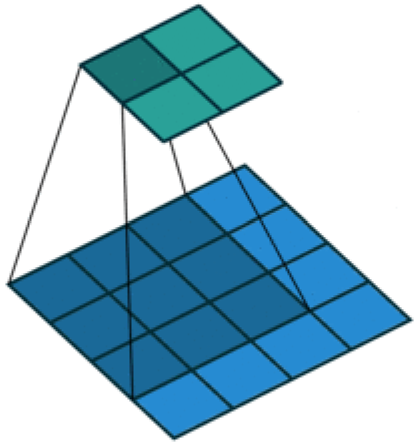
Convolutional Autoencoder

- Convolutional autoencoder extends the basic structure of the simple autoencoder by changing the fully connected layers to convolution layers.
  - the size of the input layer is also the same as output layers
  - the network of encoder change to convolution layers
  - the network of decoder change to transposed convolutional layers
    - A transposed 2-D convolution layer upsamples feature maps.
    - This layer is sometimes incorrectly known as a "deconvolution" or "deconv" layer.
    - This layer is the transpose of convolution and does not perform deconvolution.



tf.nn.conv2d

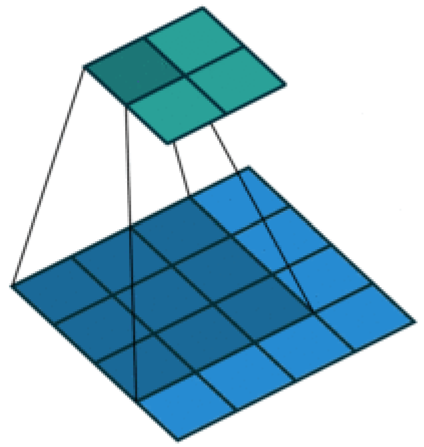
- encoder
- padding



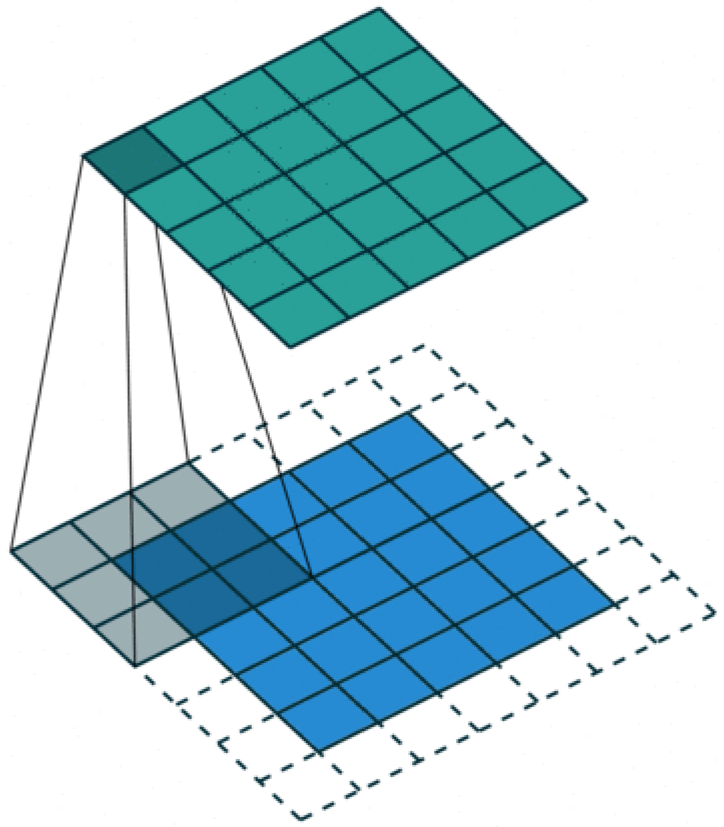
padding = ‘VALID’
strides = [1, 1, 1, 1]

tf.nn.conv2d

- encoder
- padding



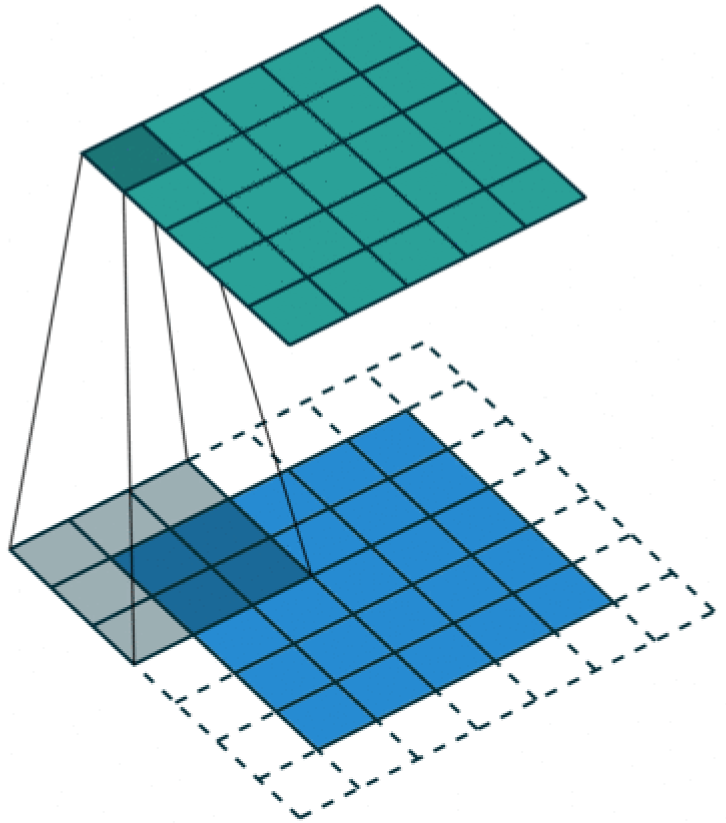
padding = ‘VALID’
strides = [1, 1, 1, 1]



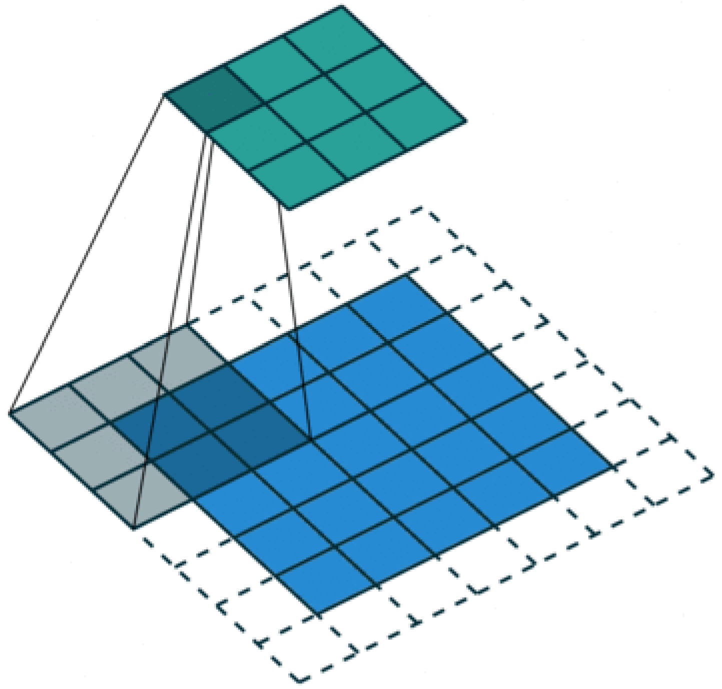
padding = ‘SAME’
strides = [1, 1, 1, 1]

tf.nn.conv2d

- encoder
- stride



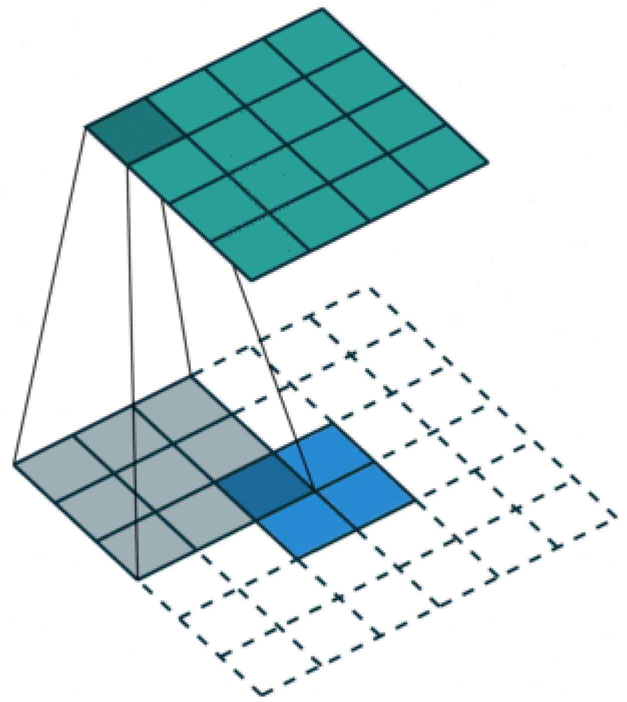
padding = ‘SAME’
strides = [1, 1, 1, 1]



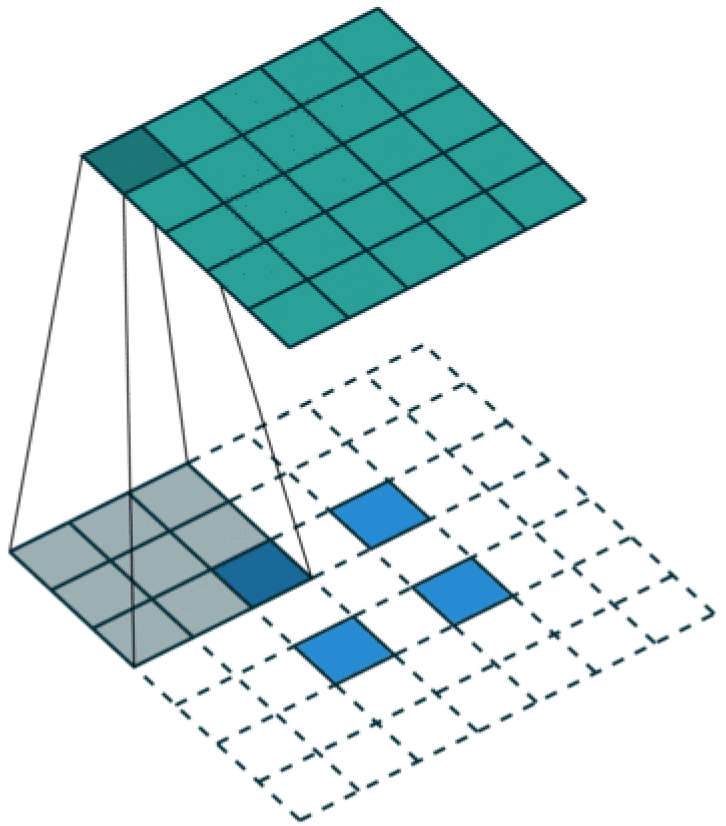
padding = ‘SAME’
strides = [1, 2, 2, 1]

tf.nn.conv2d_transpose

- decoder
- stride



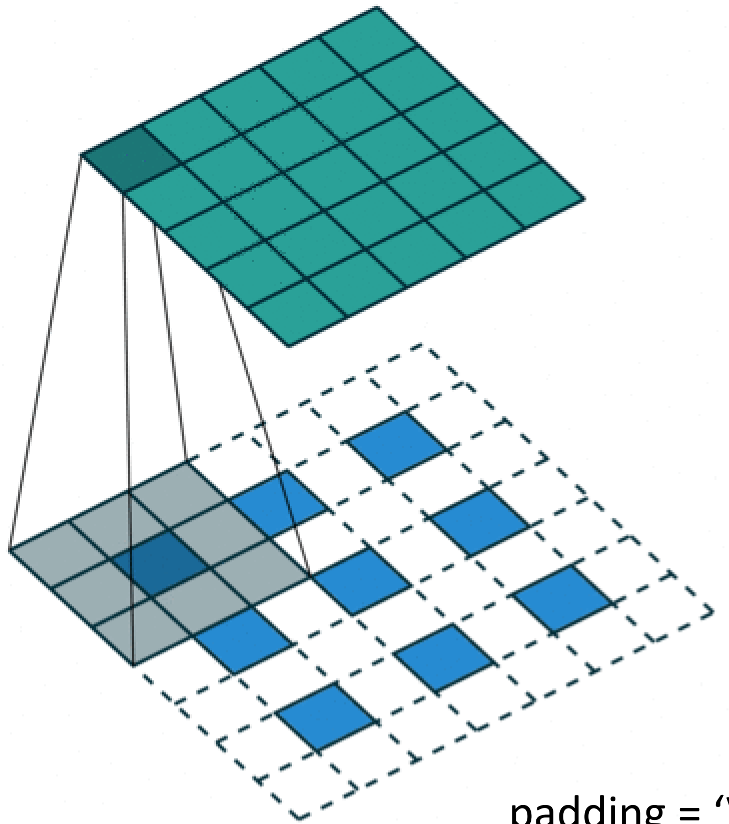
padding = ‘VALID’
no strides



padding = ‘VALID’
strides = 2

tf.nn.conv2d_transpose

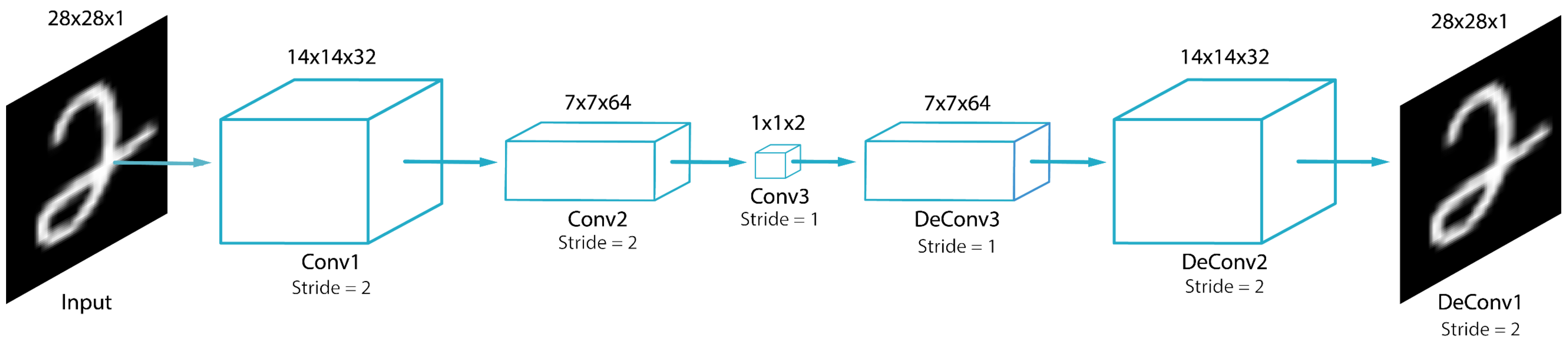
- decoder
- stride



padding = ‘VALID’
strides = 2

CAE Implementation

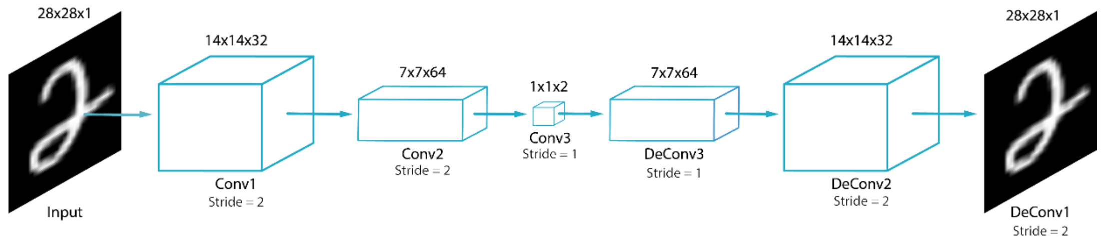
- Fully convolutional
- Note that no dense layer is used



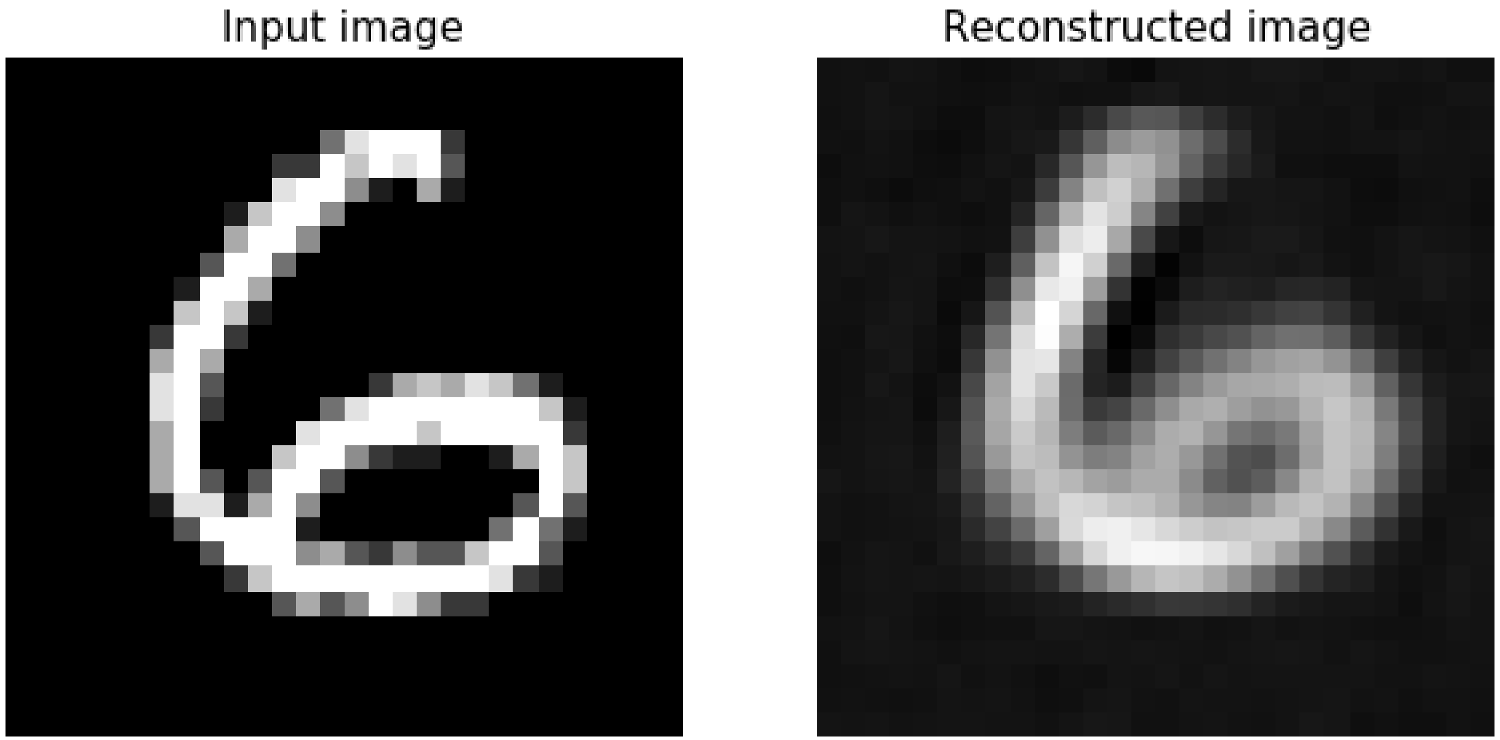
CAE Implementation

```python
def encoder(x):
    ## First convolution layer
    conv1 = tf.layers.conv2d(inputs = x,
                             filters = 32,
                             kernel_size = [3, 3],
                             padding = "SAME",
                             activation = tf.nn.relu)
    maxp1 = tf.layers.max_pooling2d(inputs = conv1,
                                    pool_size = [2, 2],
                                    strides = 2)

    ## Second convolution layer
    conv2 = tf.layers.conv2d(inputs = maxp1,
                             filters = 64,
                             kernel_size = [3, 3],
                             padding = "SAME",
                             activation = tf.nn.relu)
    maxp2 = tf.layers.max_pooling2d(inputs = conv2,
                                    pool_size = [2, 2],
                                    strides = 2)

    conv3 = tf.layers.conv2d(inputs = maxp2,
                             filters = 2,
                             kernel_size = [7, 7],
                             padding = "VALID",
                             use_bias = False)

    return conv3
```

```python
def decoder(latent):
    deconv3 = tf.layers.conv2d_transpose(inputs = latent,
                                         filters = 64,
                                         kernel_size = [7, 7],
                                         padding = 'VALID',
                                         activation = tf.nn.relu)

    ## First deconvolution layer
    deconv2 = tf.layers.conv2d_transpose(inputs = deconv3,
                                         filters = 32,
                                         kernel_size = [14, 14],
                                         strides = (2, 2),
                                         padding = 'SAME',
                                         activation = tf.nn.relu)

    ## Second deconvolution layer
    deconv1 = tf.layers.conv2d_transpose(inputs = deconv2,
                                         filters = 1,
                                         kernel_size = [28, 28],
                                         strides = (2, 2),
                                         padding = 'SAME')

    return deconv1
```



Reconstruction Result


Input image
Reconstructed image