CNN Model Architectures

SegNet

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_____
Layer (type)            Output Shape          Param #
================================================================
input_1 (InputLayer)      (None, 96, 320, 3)     0
_____
conv2d_1 (Conv2D)         (None, 96, 320, 64)    1792
_____
batch_normalization_1 (Batch (None, 96, 320, 64)     256
_____
activation_1 (Activation)   (None, 96, 320, 64)    0
_____
conv2d_2 (Conv2D)         (None, 96, 320, 64)    36928
_____
batch_normalization_2 (Batch (None, 96, 320, 64)     256
_____
activation_2 (Activation)   (None, 96, 320, 64)    0
_____
max_pooling2d_1 (MaxPooling2 (None, 48, 160, 64)     0
_____
conv2d_3 (Conv2D)         (None, 48, 160, 128)   73856
_____
batch_normalization_3 (Batch (None, 48, 160, 128)    512
_____
activation_3 (Activation)   (None, 48, 160, 128)   0
_____
conv2d_4 (Conv2D)         (None, 48, 160, 128)   147584
_____
batch_normalization_4 (Batch (None, 48, 160, 128)    512
_____
activation_4 (Activation)   (None, 48, 160, 128)    0
_____
max_pooling2d_2 (MaxPooling2 (None, 24, 80, 128)     0
_____
conv2d_5 (Conv2D)         (None, 24, 80, 256)    295168
_____
batch_normalization_5 (Batch (None, 24, 80, 256)     1024
_____
activation_5 (Activation)   (None, 24, 80, 256)    0
_____
conv2d_6 (Conv2D)         (None, 24, 80, 256)    590080
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batch_normalization_6 (Batch (None, 24, 80, 256)      1024
_____
activation_6 (Activation)   (None, 24, 80, 256)      0
_____
conv2d_7 (Conv2D)           (None, 24, 80, 256)      590080
_____
batch_normalization_7 (Batch (None, 24, 80, 256)      1024
_____
activation_7 (Activation)   (None, 24, 80, 256)      0
_____
max_pooling2d_3 (MaxPooling2 (None, 12, 40, 256)      0
_____
conv2d_8 (Conv2D)           (None, 12, 40, 512)      1180160
_____
batch_normalization_8 (Batch (None, 12, 40, 512)      2048
_____
activation_8 (Activation)   (None, 12, 40, 512)      0
_____
conv2d_9 (Conv2D)           (None, 12, 40, 512)      2359808
_____
batch_normalization_9 (Batch (None, 12, 40, 512)      2048
_____
activation_9 (Activation)   (None, 12, 40, 512)      0
_____
conv2d_10 (Conv2D)          (None, 12, 40, 512)      2359808
_____
batch_normalization_10 (Batc (None, 12, 40, 512)      2048
_____
activation_10 (Activation)  (None, 12, 40, 512)      0
_____
conv2d_11 (Conv2D)          (None, 12, 40, 512)      2359808
_____
batch_normalization_11 (Batc (None, 12, 40, 512)      2048
_____
activation_11 (Activation)  (None, 12, 40, 512)      0
_____
conv2d_12 (Conv2D)          (None, 12, 40, 512)      2359808
_____
batch_normalization_12 (Batc (None, 12, 40, 512)      2048
_____
activation_12 (Activation)  (None, 12, 40, 512)      0
_____
conv2d_13 (Conv2D)          (None, 12, 40, 512)      2359808
_____
batch_normalization_13 (Batc (None, 12, 40, 512)      2048
_____
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activation_13 (Activation)	(None, 12, 40, 512)	0
de_pool2d__index_1 (DePool2D	(None, 24, 80, 512)	0
conv2d_14 (Conv2D)	(None, 24, 80, 256)	1179904
batch_normalization_14 (Batc	(None, 24, 80, 256)	1024
activation_14 (Activation)	(None, 24, 80, 256)	0
conv2d_15 (Conv2D)	(None, 24, 80, 256)	590080
batch_normalization_15 (Batc	(None, 24, 80, 256)	1024
activation_15 (Activation)	(None, 24, 80, 256)	0
conv2d_16 (Conv2D)	(None, 24, 80, 256)	590080
batch_normalization_16 (Batc	(None, 24, 80, 256)	1024
activation_16 (Activation)	(None, 24, 80, 256)	0
de_pool2d__index_2 (DePool2D	(None, 48, 160, 256)	0
conv2d_17 (Conv2D)	(None, 48, 160, 128)	295040
batch_normalization_17 (Batc	(None, 48, 160, 128)	512
activation_17 (Activation)	(None, 48, 160, 128)	0
conv2d_18 (Conv2D)	(None, 48, 160, 128)	147584
batch_normalization_18 (Batc	(None, 48, 160, 128)	512
activation_18 (Activation)	(None, 48, 160, 128)	0
de_pool2d__index_3 (DePool2D	(None, 96, 320, 128)	0
conv2d_19 (Conv2D)	(None, 96, 320, 64)	73792
batch_normalization_19 (Batc	(None, 96, 320, 64)	256
activation_19 (Activation)	(None, 96, 320, 64)	0
conv2d_20 (Conv2D)	(None, 96, 320, 64)	36928

batch_normalization_20 (Batc (None, 96, 320, 64)   256

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activation_20 (Activation)   (None, 96, 320, 64)   0

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conv2d_21 (Conv2D)   (None, 96, 320, 13)   845

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reshape_1 (Reshape)   (None, 30720, 13)   0

_____

activation_21 (Activation)   (None, 30720, 13)   0
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Total params: 17,650,445
Trainable params: 17,639,693
Non-trainable params: 10,752

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Tiny- SegNet

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(None, 96, 320, 3)	0
conv2d_1 (Conv2D)	(None, 96, 320, 64)	1792
batch_normalization_1 (Batch	(None, 96, 320, 64)	256
activation_1 (Activation)	(None, 96, 320, 64)	0
separable_conv2d_1 (Separabl	(None, 96, 320, 64)	4736
batch_normalization_2 (Batch	(None, 96, 320, 64)	256
activation_2 (Activation)	(None, 96, 320, 64)	0
max_pooling2d_1 (MaxPooling2	(None, 48, 160, 64)	0
separable_conv2d_2 (Separabl	(None, 48, 160, 128)	8896
batch_normalization_3 (Batch	(None, 48, 160, 128)	512
activation_3 (Activation)	(None, 48, 160, 128)	0
separable_conv2d_3 (Separabl	(None, 48, 160, 128)	17664
batch_normalization_4 (Batch	(None, 48, 160, 128)	512
activation_4 (Activation)	(None, 48, 160, 128)	0
max_pooling2d_2 (MaxPooling2	(None, 24, 80, 128)	0

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separable_conv2d_4 (Separabl (None, 24, 80, 256)    34176

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batch_normalization_5 (Batch (None, 24, 80, 256)    1024

_____

activation_5 (Activation)    (None, 24, 80, 256)    0

_____

separable_conv2d_5 (Separabl (None, 24, 80, 256)    68096

_____

batch_normalization_6 (Batch (None, 24, 80, 256)    1024

_____

activation_6 (Activation)    (None, 24, 80, 256)    0

_____

separable_conv2d_6 (Separabl (None, 24, 80, 256)    68096

_____

batch_normalization_7 (Batch (None, 24, 80, 256)    1024

_____

activation_7 (Activation)    (None, 24, 80, 256)    0

_____

max_pooling2d_3 (MaxPooling2 (None, 12, 40, 256)    0

_____

separable_conv2d_7 (Separabl (None, 12, 40, 512)    133888

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batch_normalization_8 (Batch (None, 12, 40, 512)    2048

_____

activation_8 (Activation)    (None, 12, 40, 512)    0

_____

separable_conv2d_8 (Separabl (None, 12, 40, 512)    267264

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batch_normalization_9 (Batch (None, 12, 40, 512)    2048

_____

activation_9 (Activation)    (None, 12, 40, 512)    0

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separable_conv2d_9 (Separabl (None, 12, 40, 512)   267264

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batch_normalization_10 (Batc (None, 12, 40, 512)   2048

_____

activation_10 (Activation)   (None, 12, 40, 512)   0

_____

separable_conv2d_10 (Separab (None, 12, 40, 512)   267264

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batch_normalization_11 (Batc (None, 12, 40, 512)   2048

_____

activation_11 (Activation)   (None, 12, 40, 512)   0

_____

separable_conv2d_11 (Separab (None, 12, 40, 512)   267264

_____

batch_normalization_12 (Batc (None, 12, 40, 512)   2048

_____

activation_12 (Activation)   (None, 12, 40, 512)   0

_____

separable_conv2d_12 (Separab (None, 12, 40, 512)   267264

_____

batch_normalization_13 (Batc (None, 12, 40, 512)   2048

_____

activation_13 (Activation)   (None, 12, 40, 512)   0

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de_pool2d__index_1 (DePool2D (None, 24, 80, 512)   0

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separable_conv2d_13 (Separab (None, 24, 80, 256)   135936

_____

batch_normalization_14 (Batc (None, 24, 80, 256)   1024

_____

activation_14 (Activation)   (None, 24, 80, 256)   0

_____

separable_conv2d_14 (Separab (None, 24, 80, 256)   68096

batch_normalization_15 (Batc	(None, 24, 80, 256)	1024
activation_15 (Activation)	(None, 24, 80, 256)	0
separable_conv2d_15 (Separab	(None, 24, 80, 256)	68096
batch_normalization_16 (Batc	(None, 24, 80, 256)	1024
activation_16 (Activation)	(None, 24, 80, 256)	0
de_pool2d__index_2 (DePool2D	(None, 48, 160, 256)	0
separable_conv2d_16 (Separab	(None, 48, 160, 128)	35200
batch_normalization_17 (Batc	(None, 48, 160, 128)	512
activation_17 (Activation)	(None, 48, 160, 128)	0
separable_conv2d_17 (Separab	(None, 48, 160, 128)	17664
batch_normalization_18 (Batc	(None, 48, 160, 128)	512
activation_18 (Activation)	(None, 48, 160, 128)	0
de_pool2d__index_3 (DePool2D	(None, 96, 320, 128)	0
separable_conv2d_18 (Separab	(None, 96, 320, 64)	9408
batch_normalization_19 (Batc	(None, 96, 320, 64)	256
activation_19 (Activation)	(None, 96, 320, 64)	0

separable_conv2d_19 (Separab (None, 96, 320, 64)   4736

_____

batch_normalization_20 (Batc (None, 96, 320, 64)   256

_____

activation_20 (Activation)   (None, 96, 320, 64)   0

_____

conv2d_2 (Conv2D)   (None, 96, 320, 13)   845

_____

reshape_1 (Reshape)   (None, 30720, 13)   0

_____

activation_21 (Activation)   (None, 30720, 13)   0

===

Total params: 2,035,149

Trainable params: 2,024,397

Non-trainable params: 10,752

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FCN

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	(None, 224, 224, 3)	0	
block1_conv0 (Conv2D)	(None, 224, 224, 64)	1792	input_1[0][0]
batch_normalization_1 (BatchNorm	(None, 224, 224, 64)	256	block1_conv0[0][0]
activation_1 (Activation)	(None, 224, 224, 64)	0	batch_normalization_1[0][0]
block1_conv1 (Conv2D)	(None, 224, 224, 64)	36928	activation_1[0][0]
batch_normalization_2 (BatchNorm	(None, 224, 224, 64)	256	block1_conv1[0][0]
activation_2 (Activation)	(None, 224, 224, 64)	0	batch_normalization_2[0][0]
max_pooling2d_1 (MaxPooling2D)	(None, 112, 112, 64)	0	activation_2[0][0]
block2_conv0 (Conv2D)	(None, 112, 112, 128)	73856	max_pooling2d_1[0][0]
batch_normalization_3 (BatchNorm	(None, 112, 112, 128)	512	block2_conv0[0][0]
activation_3 (Activation)	(None, 112, 112, 128)	0	batch_normalization_3[0][0]
block2_conv1 (Conv2D)	(None, 112, 112, 128)	147584	activation_3[0][0]
batch_normalization_4 (BatchNorm	(None, 112, 112, 128)	512	block2_conv1[0][0]
activation_4 (Activation)	(None, 112, 112, 128)	0	batch_normalization_4[0][0]
max_pooling2d_2 (MaxPooling2D)	(None, 56, 56, 128)	0	activation_4[0][0]

block3_conv0 (Conv2D)	(None, 56, 56, 256)	295168	max_pooling2d_2[0][0]
batch_normalization_5 (BatchNorm	(None, 56, 56, 256)	1024	block3_conv0[0][0]
activation_5 (Activation)	(None, 56, 56, 256)	0	batch_normalization_5[0][0]
block3_conv1 (Conv2D)	(None, 56, 56, 256)	590080	activation_5[0][0]
batch_normalization_6 (BatchNorm	(None, 56, 56, 256)	1024	block3_conv1[0][0]
activation_6 (Activation)	(None, 56, 56, 256)	0	batch_normalization_6[0][0]
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590080	activation_6[0][0]
batch_normalization_7 (BatchNorm	(None, 56, 56, 256)	1024	block3_conv2[0][0]
activation_7 (Activation)	(None, 56, 56, 256)	0	batch_normalization_7[0][0]
max_pooling2d_3 (MaxPooling2D)	(None, 28, 28, 256)	0	activation_7[0][0]
block4_conv0 (Conv2D)	(None, 28, 28, 512)	1180160	max_pooling2d_3[0][0]
batch_normalization_8 (BatchNorm	(None, 28, 28, 512)	2048	block4_conv0[0][0]
activation_8 (Activation)	(None, 28, 28, 512)	0	batch_normalization_8[0][0]
block4_conv1 (Conv2D)	(None, 28, 28, 512)	2359808	activation_8[0][0]
batch_normalization_9 (BatchNorm	(None, 28, 28, 512)	2048	block4_conv1[0][0]
activation_9 (Activation)	(None, 28, 28, 512)	0	batch_normalization_9[0][0]

block4_conv2 (Conv2D)   (None, 28, 28, 512)   2359808   activation_9[0][0]

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batch_normalization_10 (BatchNor (None, 28, 28, 512)   2048   block4_conv2[0][0]

_____

block6_conv1 (Conv2D)   (None, 28, 28, 13)   3341   max_pooling2d_3[0][0]

_____

activation_10 (Activation)   (None, 28, 28, 512)   0   batch_normalization_10[0][0]

_____

cropping2d_1 (Cropping2D)   (None, 28, 28, 13)   0   block6_conv1[0][0]

_____

block5_conv1 (Conv2D)   (None, 28, 28, 13)   6669   activation_10[0][0]

_____

cropping2d_2 (Cropping2D)   (None, 28, 28, 13)   0   cropping2d_1[0][0]

_____

add_1 (Add)   (None, 28, 28, 13)   0   block5_conv1[0][0]   cropping2d_2[0][0]

_____

up_sampling2d_1 (UpSampling2D)   (None, 56, 56, 13)   0   add_1[0][0]

_____

cropping2d_3 (Cropping2D)   (None, 56, 56, 13)   0   up_sampling2d_1[0][0]

_____

block7_conv1 (Conv2D)   (None, 56, 56, 13)   1677   max_pooling2d_2[0][0]

_____

cropping2d_4 (Cropping2D)   (None, 56, 56, 13)   0   cropping2d_3[0][0]

_____

add_2 (Add)   (None, 56, 56, 13)   0   block7_conv1[0][0]   cropping2d_4[0][0]

_____

up_sampling2d_2 (UpSampling2D)   (None, 112, 112, 13) 0   add_2[0][0]

_____

cropping2d_5 (Cropping2D)   (None, 112, 112, 13) 0   up_sampling2d_2[0][0]

_____

block8_conv1 (Conv2D)   (None, 112, 112, 13) 845   max_pooling2d_1[0][0]

_____

cropping2d_6 (Cropping2D)   (None, 112, 112, 13) 0   cropping2d_5[0][0]

_____

add_3 (Add)　　　　　　(None, 112, 112, 13)　0　　　block8_conv1[0][0]　　cropping2d_6[0][0]

_____

up_sampling2d_3 (UpSampling2D)　(None, 224, 224, 13)　0　　　add_3[0][0]

_____

conv2d_1 (Conv2D)　　　(None, 224, 224, 13)　182　　up_sampling2d_3[0][0]

_____

reshape_1 (Reshape)　　　(None, 50176, 13)　0　　　conv2d_1[0][0]

_____

activation_11 (Activation)　(None, 50176, 13)　0　　　reshape_1[0][0]
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Total params: 7,658,730

Trainable params: 7,653,354

Non-trainable params: 5,376

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Tiny-FCN

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	(None, 224, 224, 3)	0	
block1_conv0 (Conv2D)	(None, 224, 224, 64)	1792	input_1[0][0]
batch_normalization_1 (BatchNorm	(None, 224, 224, 64)	256	block1_conv0[0][0]
activation_1 (Activation)	(None, 224, 224, 64)	0	batch_normalization_1[0][0]
block1_conv1 (SeparableConv2D)	(None, 224, 224, 64)	4736	activation_1[0][0]
batch_normalization_2 (BatchNorm	(None, 224, 224, 64)	256	block1_conv1[0][0]
activation_2 (Activation)	(None, 224, 224, 64)	0	batch_normalization_2[0][0]
max_pooling2d_1 (MaxPooling2D)	(None, 112, 112, 64)	0	activation_2[0][0]
block2_conv0 (SeparableConv2D)	(None, 112, 112, 128)	8896	max_pooling2d_1[0][0]
batch_normalization_3 (BatchNorm	(None, 112, 112, 128)	512	block2_conv0[0][0]
activation_3 (Activation)	(None, 112, 112, 128)	0	batch_normalization_3[0][0]
block2_conv1 (SeparableConv2D)	(None, 112, 112, 128)	17664	activation_3[0][0]
batch_normalization_4 (BatchNorm	(None, 112, 112, 128)	512	block2_conv1[0][0]
activation_4 (Activation)	(None, 112, 112, 128)	0	batch_normalization_4[0][0]

max_pooling2d_2 (MaxPooling2D) (None, 56, 56, 128) 0   activation_4[0][0]

_____

block3_conv0 (SeparableConv2D) (None, 56, 56, 256) 34176   max_pooling2d_2[0][0]

_____

batch_normalization_5 (BatchNorm (None, 56, 56, 256) 1024   block3_conv0[0][0]

_____

activation_5 (Activation)   (None, 56, 56, 256) 0   batch_normalization_5[0][0]

_____

block3_conv1 (SeparableConv2D) (None, 56, 56, 256) 68096   activation_5[0][0]

_____

batch_normalization_6 (BatchNorm (None, 56, 56, 256) 1024   block3_conv1[0][0]

_____

activation_6 (Activation)   (None, 56, 56, 256) 0   batch_normalization_6[0][0]

_____

block3_conv2 (SeparableConv2D) (None, 56, 56, 256) 68096   activation_6[0][0]

_____

batch_normalization_7 (BatchNorm (None, 56, 56, 256) 1024   block3_conv2[0][0]

_____

activation_7 (Activation)   (None, 56, 56, 256) 0   batch_normalization_7[0][0]

_____

max_pooling2d_3 (MaxPooling2D) (None, 28, 28, 256) 0   activation_7[0][0]

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block4_conv0 (SeparableConv2D) (None, 28, 28, 512) 133888   max_pooling2d_3[0][0]

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batch_normalization_8 (BatchNorm (None, 28, 28, 512) 2048   block4_conv0[0][0]

_____

activation_8 (Activation)   (None, 28, 28, 512) 0   batch_normalization_8[0][0]

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block4_conv1 (SeparableConv2D) (None, 28, 28, 512) 267264   activation_8[0][0]

_____

batch_normalization_9 (BatchNorm (None, 28, 28, 512) 2048   block4_conv1[0][0]

_____

activation_9 (Activation)   (None, 28, 28, 512) 0   batch_normalization_9[0][0]

block4_conv2 (SeparableConv2D)	(None, 28, 28, 512)	267264	activation_9[0][0]
batch_normalization_10 (BatchNor	(None, 28, 28, 512)	2048	block4_conv2[0][0]
block6_conv1 (Conv2D)	(None, 28, 28, 13)	3341	max_pooling2d_3[0][0]
activation_10 (Activation)	(None, 28, 28, 512)	0	batch_normalization_10[0][0]
cropping2d_1 (Cropping2D)	(None, 28, 28, 13)	0	block6_conv1[0][0]
block5_conv1 (Conv2D)	(None, 28, 28, 13)	6669	activation_10[0][0]
cropping2d_2 (Cropping2D)	(None, 28, 28, 13)	0	cropping2d_1[0][0]
add_1 (Add)	(None, 28, 28, 13)	0	block5_conv1[0][0] cropping2d_2[0][0]
up_sampling2d_1 (UpSampling2D)	(None, 56, 56, 13)	0	add_1[0][0]
cropping2d_3 (Cropping2D)	(None, 56, 56, 13)	0	up_sampling2d_1[0][0]
block7_conv1 (Conv2D)	(None, 56, 56, 13)	1677	max_pooling2d_2[0][0]
cropping2d_4 (Cropping2D)	(None, 56, 56, 13)	0	cropping2d_3[0][0]
add_2 (Add)	(None, 56, 56, 13)	0	block7_conv1[0][0] cropping2d_4[0][0]
up_sampling2d_2 (UpSampling2D)	(None, 112, 112, 13)	0	add_2[0][0]
cropping2d_5 (Cropping2D)	(None, 112, 112, 13)	0	up_sampling2d_2[0][0]
block8_conv1 (Conv2D)	(None, 112, 112, 13)	845	max_pooling2d_1[0][0]

cropping2d_6 (Cropping2D)   (None, 112, 112, 13) 0   cropping2d_5[0][0]

_____

add_3 (Add)   (None, 112, 112, 13) 0   block8_conv1[0][0]   cropping2d_6[0][0]

_____

up_sampling2d_3 (UpSampling2D) (None, 224, 224, 13) 0   add_3[0][0]

_____

conv2d_1 (Conv2D)   (None, 224, 224, 13) 182   up_sampling2d_3[0][0]

_____

reshape_1 (Reshape)   (None, 50176, 13)   0   conv2d_1[0][0]

_____

activation_11 (Activation)   (None, 50176, 13)   0   reshape_1[0][0]
===
Total params: 895,338

Trainable params: 889,962

Non-trainable params: 5,376

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