CInC Flow: Characterizable Invertible 3×3 Convolution

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Characterizable Invertible Convolution (CInC)

Goal:

Design CNNs that are invertible, which can be used to build efficient and expressive normalizing flows.

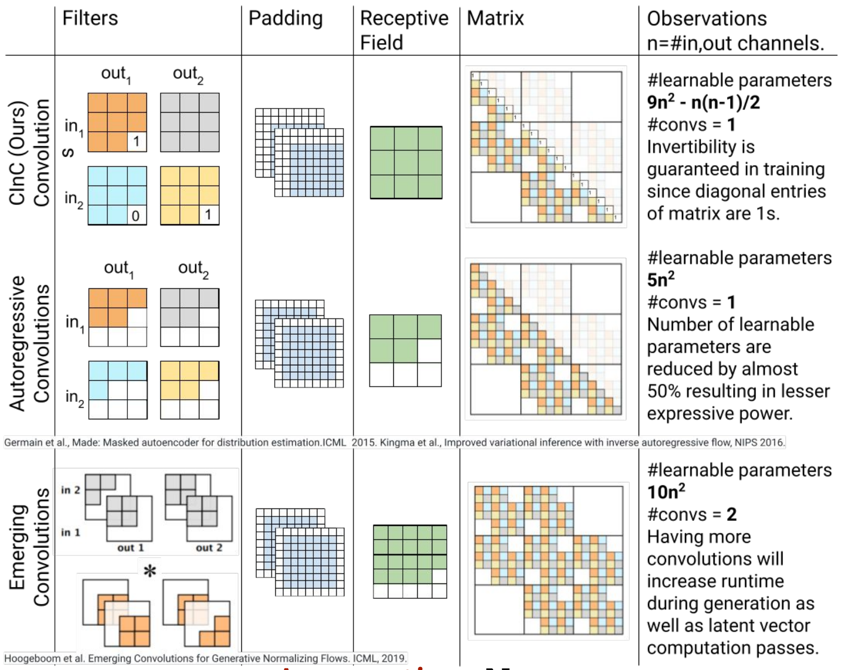
We design a convolution which

1. is guaranteed to be invertible during training,
2. has more learnable parameters leading to better expressivity,
3. and is easy to implement efficiently,
4. a new coupling method.

Characterization:

for N=1, diagonal entries of convolution matrix (M) are $K_{n,n}$ of kernel (K) with size n and input is padded(top and left) with n-1.

M is invertible iff $K_{n,n} \neq 0$.



Assumption: N, # input channels = # output channels

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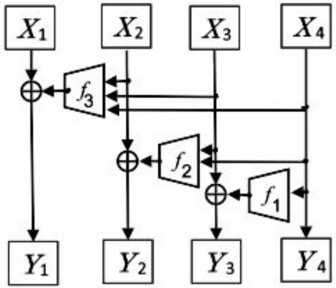
Quad-coupling (proposed):
we use a modified version of the coupling layer designed to have a bigger receptive field. Inspired from generalized Feistal (Hong et al., 2010.)



We divide the input into four blocks x_1 , x_2 , x_3, $x_4 = y_4$

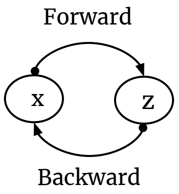
Why Quad-coupling ?

- Expressive coupling mechanism
- Flexibility

- output (y): concatenation of y_i
- f_i and g_i are learned
- component wise addition $\oplus$

Latent space (Z): by changing the z we add or remove features. Demonstrated image manipulation capabilities on the CelebA dataset which has various attributes.

Benchmark and Quantitative results:



Dataset	Sampling time (in sec) Emerging	CInC Flow
Cifar10	2.45	**1.31**
ImageNet32	4.96	**2.76**

Coupling	Emerging 3x3 Inv. conv.	Our 3x3 Inv. conv.
Affine	3.3851	3.4209
Quad	3.3612	3.3879