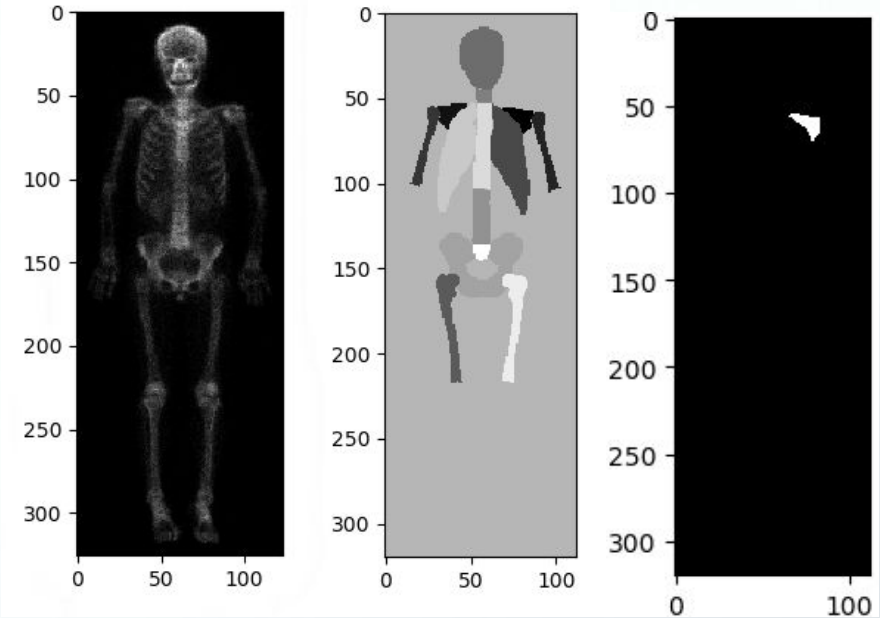
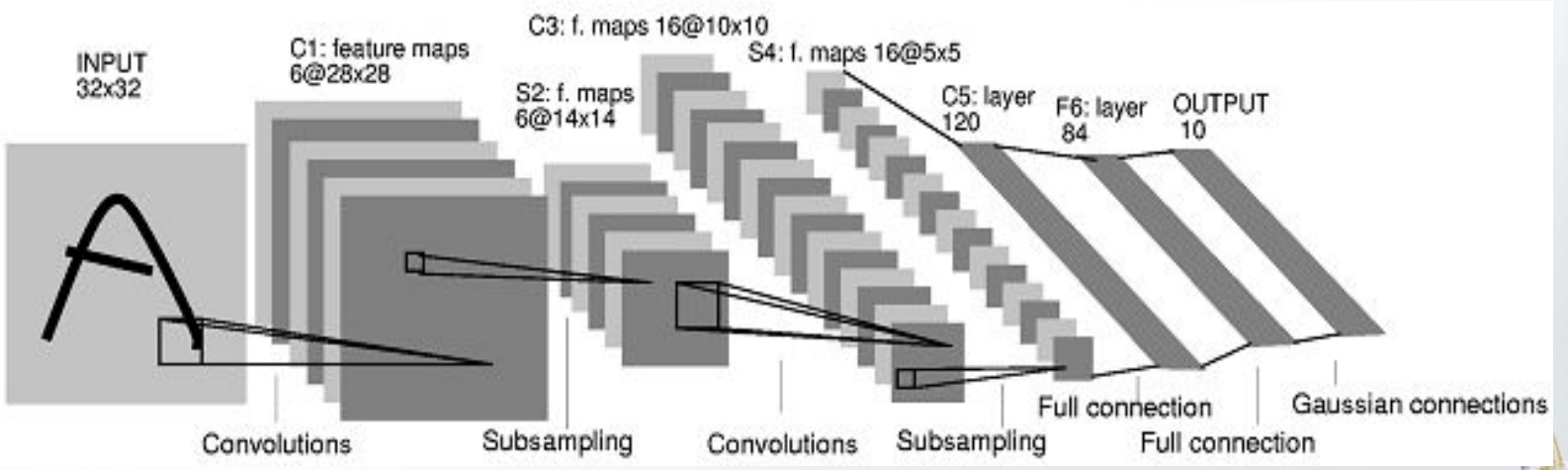
Semantic Segmentation of the Sekleton in Bone Scintigraphy Images with Convolutional Neural Networks

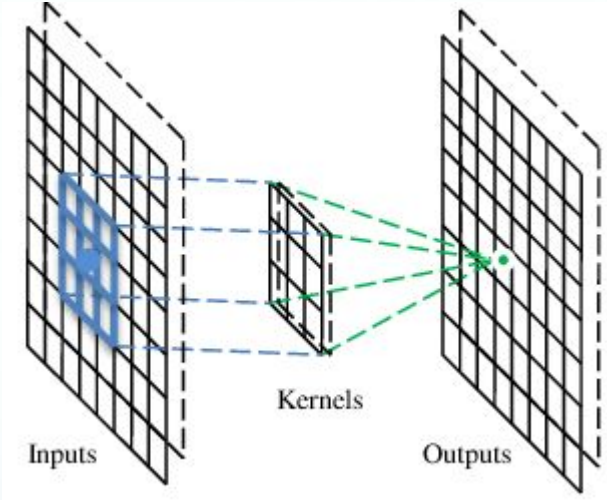
Problem Description



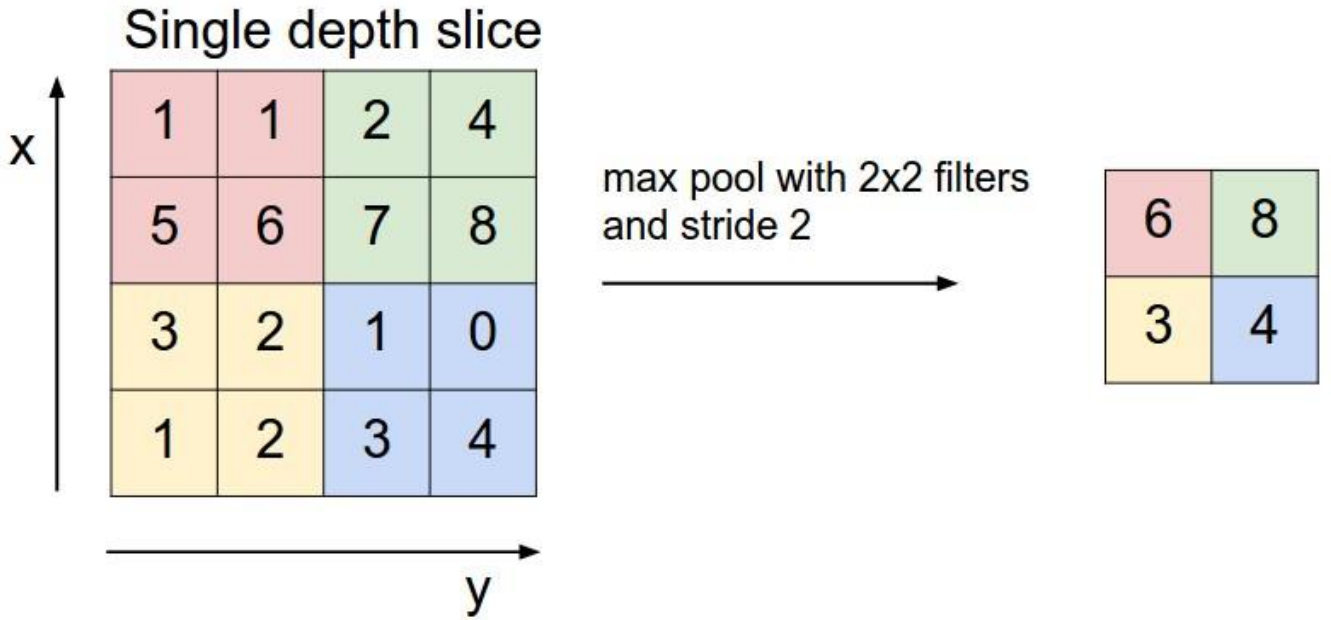
Convolutional Neural Networks



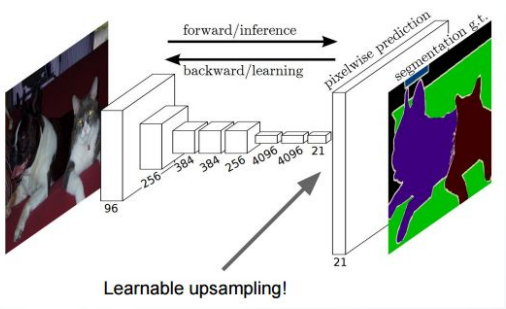
Convolutional Layer

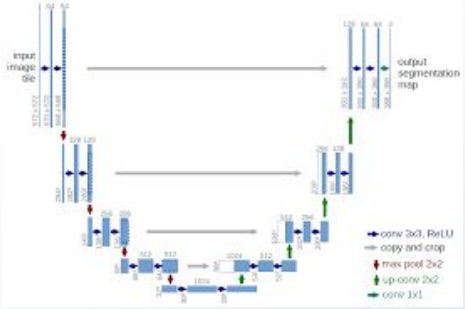


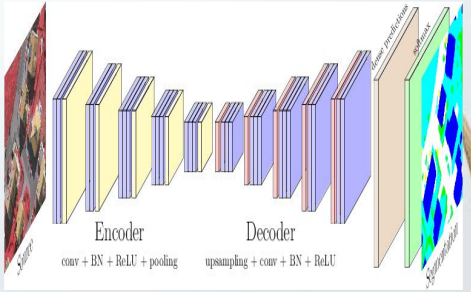
Max Pooling


Single depth slice
x
y
1 1 2 4
5 6 7 8
3 2 1 0
1 2 3 4
max pool with 2x2 filters
and stride 2
6 8
3 4

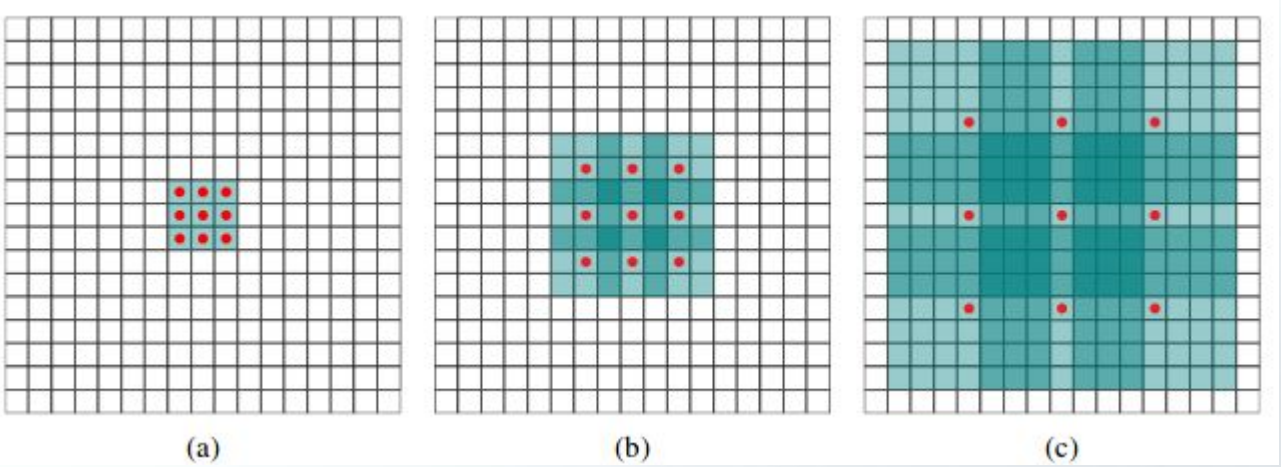
Transforming Classification networks to segmentation







Another aproch: Dilated convolutional kernels



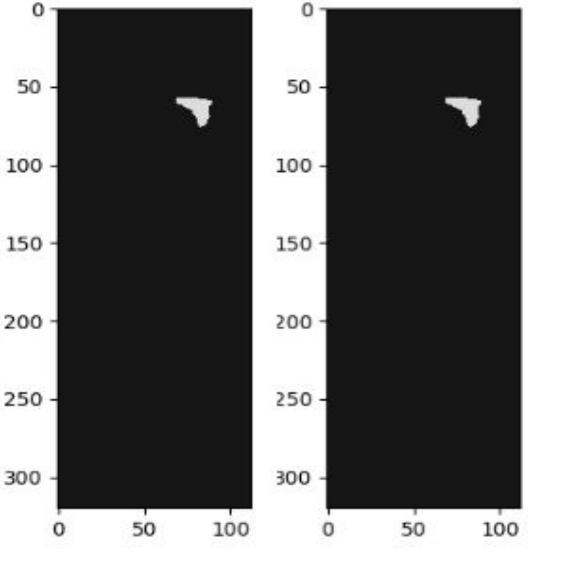
FAMILY OF DILATED NETS:

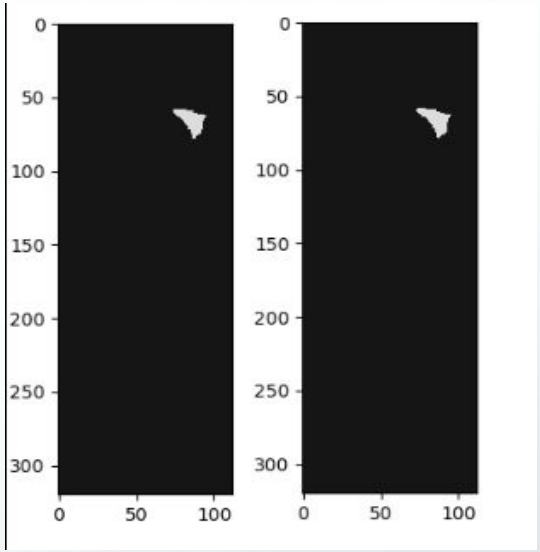
FDN-5	FDN-11	FDN-13	FDN-16
Conv3x3-64	Conv3x3-8	Conv3x3-8	Conv3x3-8
Conv3x3-64	Conv3x3-8	Conv3x3-8	Conv3x3-8
Max-Pooling	**Max-Pooling**	**Max-Pooling**	**Max-Pooling**
Conv3x3-128	Conv3x3-16	Conv3x3-16	Conv3x3-16
Conv3x3-128	Conv3x3-16	Conv3x3-16	Conv3x3-16
Max-Pooling	**Max-Pooling**	**Max-Pooling**	**Max-Pooling**
Conv1x1-1	Conv3x3-32	Conv3x3-32	Conv3x3-32
	Conv3x3-32	Conv3x3-32	Conv3x3-32
	Max-Pooling	Conv3x3-32	Conv3x3-32
	Conv3x3-64	**Max-Pooling**	**Max-Pooling**
	Conv3x3-64	Conv3x3-64	Conv3x3-64
	Max-Pooling	Conv3x3-64	Conv3x3-64
	Conv3x3-128	Conv3x3-64	Conv3x3-64
	Conv3x3-128	**Max-Pooling**	**Max-Pooling**
	Max-Pooling	Conv3x3-128	Conv3x3-128
	Conv1x1-1	Conv3x3-128	Conv3x3-128
		Conv3x3-128	Conv3x3-128
		Max-Pooling	**Max-Pooling**
		Conv1x1-1	Conv3x3-256
			Conv3x3-256
			Conv3x3-256
			Max-Pooling
			Conv1x1-1
259,137.0.	295,033.0	488,793.0	1,964,249.0
129	208	314	1034

Quantitative results

Network	Validation loss	Training Dice	Validation Dice	Test Dice
DLN-11	0.1672	0.8661	0.8466	0.8212
FDN-5	0.3026	0.7421	0.7417	0.5572
FDN-11	0.0566	0.9472	0.9459	0.9219
FDN-11e	0.0520	0.9523	0.9528	0.6039
FDN-11be	0.0559	0.9648	0.9501	0.9220
FDN-13	0.0490	0.9570	0.9526	**0.9341**
FDN-16	0.0466	0.9682	0.9546	0.9105
FDN-16e	**0.0438**	0.9842	**0.9572**	0.9286
FDN-16be	0.0533	**0.9938**	0.9481	0.9203
U-Net	0.0933	0.9523	0.9110	0.8591
URI-Net	0.0516	0.9881	0.9498	0.8289

Qualitiative results on the test set




0
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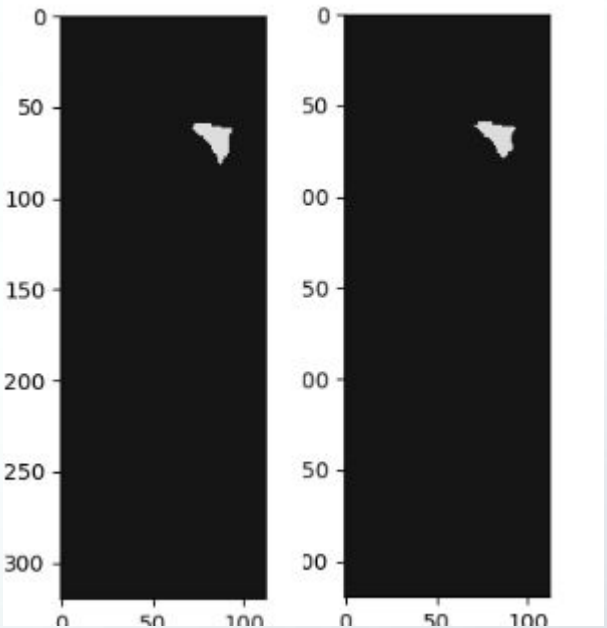
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