On the Impact of Lossy Image and Video Compression on the Performance of Deep Convolutional Neural Network Architectures

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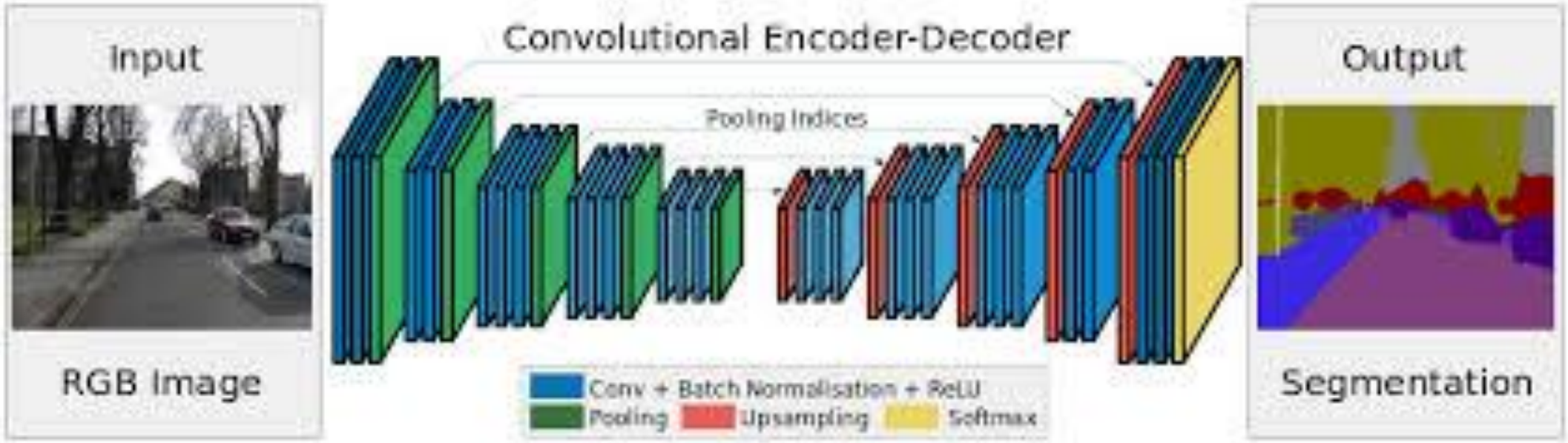
What is Lossy Compression?

- JPEG
- H.264
- Removal of information

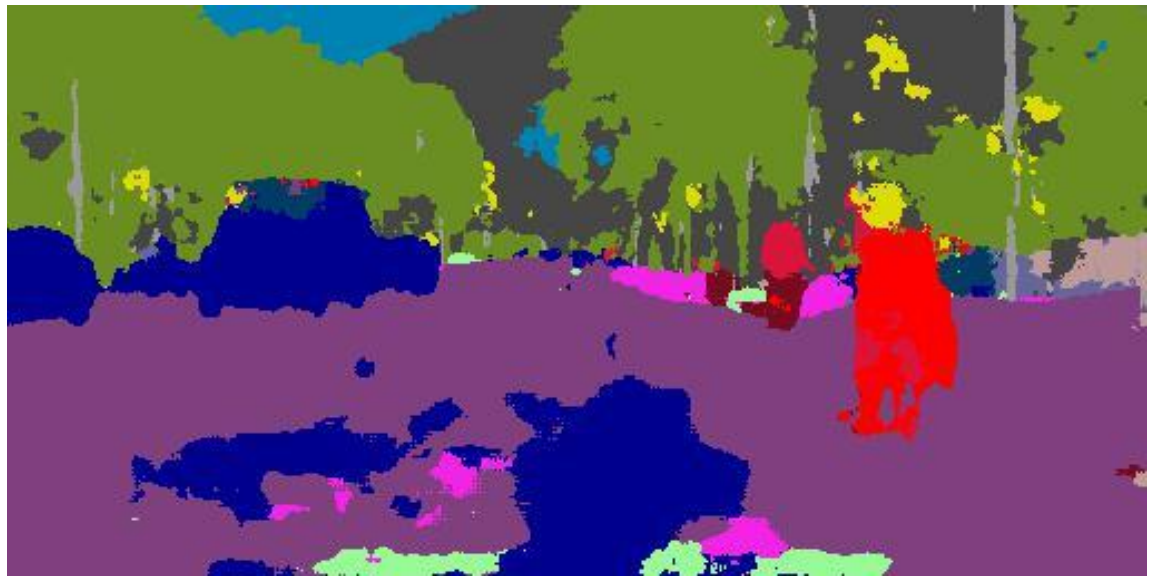
5 networks for 5 domains
2 goals

- Segmentation (SegNet)
- Depth estimation (GAN)
- Pose estimation (end-to-end CNN)
- Object detection (region-based CNN)
- Human action recognition (two-stream)

Segmentation with SegNet



V. Badrinarayanan, A. Kendall, and R. Cipolla, “Segnet: A deep convolutional encoder-decoder architecture for image segmentation,” Computing Research Repository, vol. abs/1511.00561, 2015



Compression Rate	global ACC	mean ACC	mIoU
95	0.911	0.536	0.454
75	0.909	0.530	0.448
50	0.904	0.523	0.438
15	0.814	0.459	0.338
10	0.794	0.421	0.304
5	0.782	0.364	0.265

Compression Rate	global ACC	mean ACC	mIoU
95	0.911	0.536	0.454
75	0.910	0.522	0.446
50	0.908	0.503	0.431
15	0.902	0.494	0.420
10	0.895	0.477	0.405
5	0.879	0.445	0.374

Depth Estimation with GAN

- We need a task decoupled from reconstructing high quality output

Compression Rate	Abs. Rel.	Sq. Rel.	RMSE
95	0.0112	0.0039	0.0588
75	0.0116	0.0039	0.0589
50	0.0123	0.0038	0.0587
15	0.0146	0.0040	0.0599
10	0.0192	0.0042	0.0617
5	0.0283	0.0060	0.0749

Compression Rate	Abs. Rel.	Sq. Rel.	RMSE
95	0.0112	0.0039	0.0588
75	0.0113	0.0035	0.0560
50	0.0103	0.0029	0.0502
15	0.0121	0.0034	0.0556
10	0.0152	0.0031	0.0528
5	0.0159	0.0040	0.0599

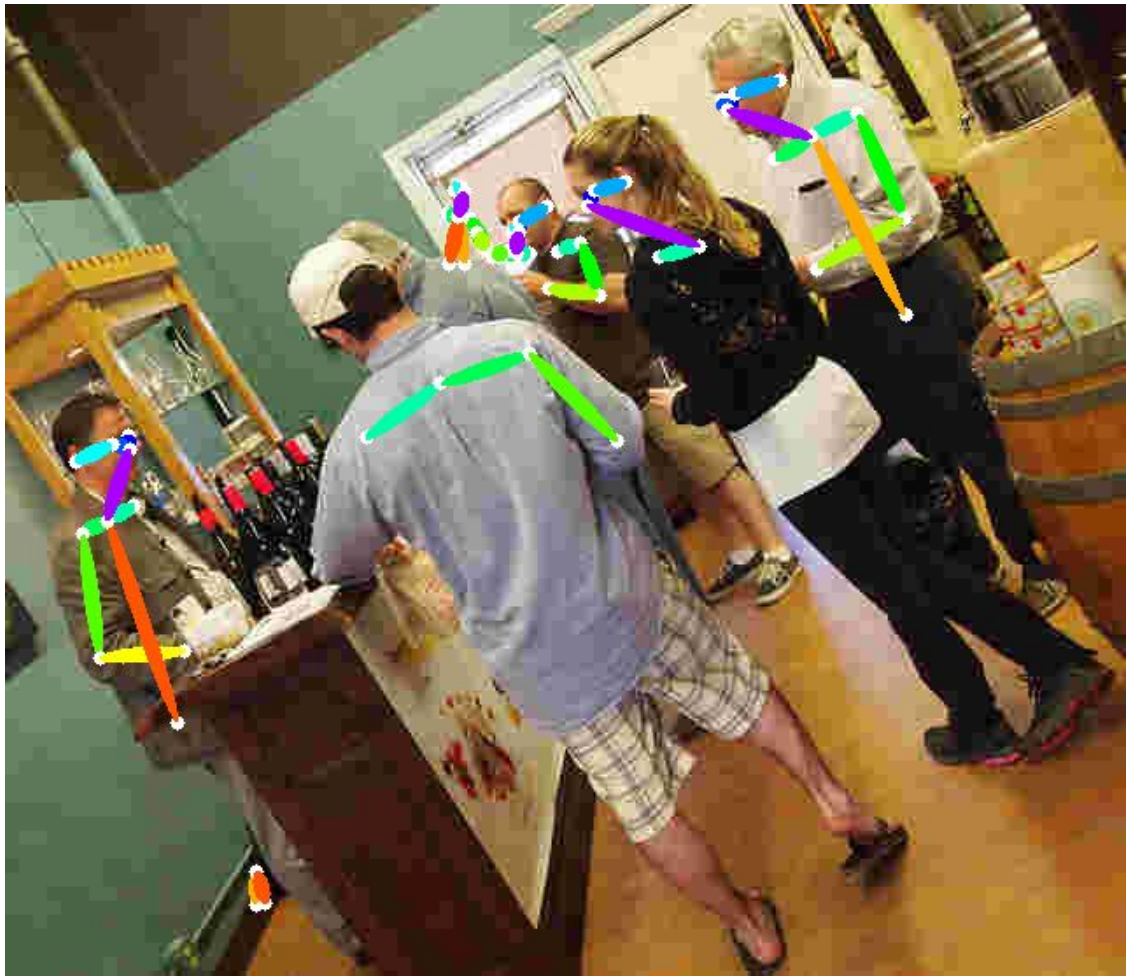
Compression Rate	mAP
95	0.703
75	0.686
50	0.666
15	0.545
10	0.442
5	0.187

Compression Rate	mAP
95	0.703
75	0.694
50	0.692
15	0.647
10	0.627
5	0.559

Object Detection with FasterRCNN

Compression Rate	mAP
95	0.711
75	0.689
50	0.655
15	0.413
10	0.323
5	0.098

Compression Rate	mAP
95	0.711
75	0.708
50	0.678
15	0.654
10	0.597
5	0.454



Human Pose Estimation

Compression Rate	Top-1 Spatial	Top-1 Motion	Top-1 Fusion
23	78.8736	70.1198	83.5485
25	78.7999	44.9225	73.6030
30	78.4563	37.3598	72.2329
40	74.5704	38.9565	70.8803
50	44.1977	15.3267	41.4777

Compression Rate	Top-1 Spatial	Top-1 Motion	Top-1 Fusion
23	78.8736	70.1198	83.5485
25	78.9056	39.7192	71.7616
30	78.5620	34.3161	70.5765
40	75.9450	9.2550	67.1227
50	62.5165	6.7300	56.2279

Human Action Recognition

Conclusions

- **Can afford to compress to 15% of the original size, across all domains**
- Networks that employ a decoder sub-network are resilient. We posit that the **up-sampling within its pooling layers are responsible for the resilience to compression.**

References

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