Adversarial Fisher Vectors For Unsupervised Representation Learning

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Question: Does a GAN learn representations of data?

Answer: Yes

Question: Do you need an encoder in order to do so?

Answer: No

Energy Based Model view of GANs

The discriminator **D** is the negative energy function

The generator **G** approximates the density given by **D**

The EBM can adopt the same training procedure as a GAN

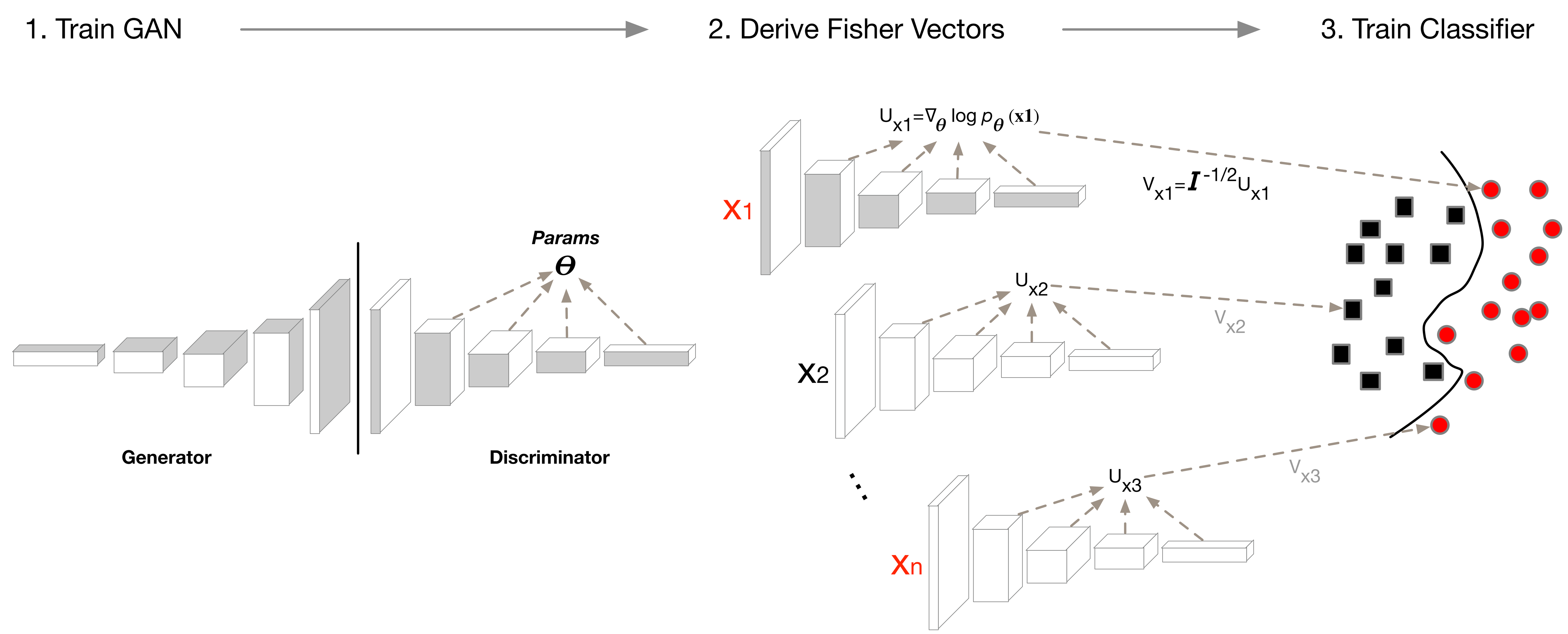
Adversarial Fisher Vectors

Fisher Vector represents an example x by the desired change of parameters given a density model: $\nabla_\theta \log p_\theta(x)$

We let $p_\theta(x) = \frac{e^{D_\theta(x)}}{\int_x e^{D_\theta(x)} dx}$, and assume **G** approximates $p_\theta(x)$

$$V_{\mathbf{x}} = (diag(\mathcal{I})^{-\frac{1}{2}})U_{\mathbf{x}}$$

$$U_{\mathbf{x}} = \nabla_\theta D(\mathbf{x};\theta) - \mathrm{E}_{\mathbf{z}\sim p(\mathbf{z})} \nabla_\theta D(G(\mathbf{z});\theta),\ \mathcal{I} = \mathrm{E}_{\mathbf{z}\sim p(\mathbf{z})}[U_{G(\mathbf{z})} U^T_{G(\mathbf{z})}].$$



State of The Art Linear Classification Results

Method	CIFAR10	CIFAR100	Method	#Features
Examplar CNN [29]	84.3	-	Unsupervised	-
DCGAN [38]	82.8	-	Unsupervised	-
Deep Infomax [39]	75.6	47.7	Unsupervised	1024
RotNet Linear [30]	81.8	-	Self-Supervised	∼25K
AET Linear [32]	83.3	-	Self-Supervised	∼25K
D-pool-128-50000	65.3	-	Unsupervised	512
AFV-128-50000	86.2	-	Unsupervised	1.5M
AFV-128-50000 + augment	87.1	-	Unsupervised	1.5M
AFV-256-50000 + augment	88.5	-	Unsupervised	5.9M
AFV-256-50000 + C100 + augment	**89.1**	**67.8**	Unsupervised	5.9M
D + BN supervised training	92.7	70.3	Supervised	-

References

- **EBM vs GAN:** Generative Adversarial Networks as Variational Training of Energy Based Models, Zhai et al.
- **Fisher Vectors**: Exploiting Generative Models in Discriminative Classifiers, Jaakkola and Haussler