

Machine Learning per la Fisica Applicata e la Fisica delle Alte Energie

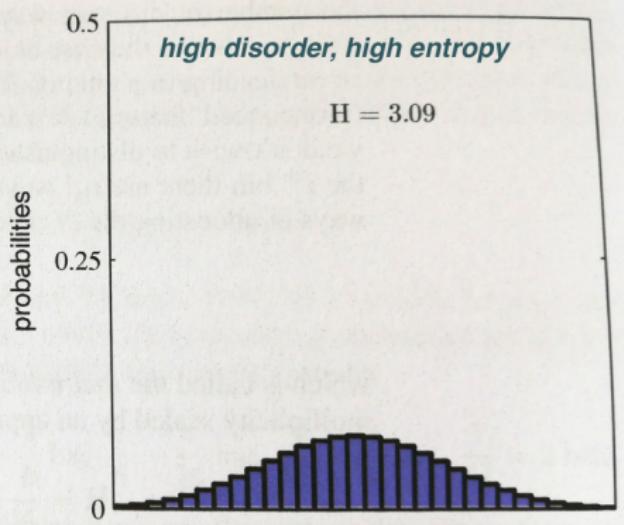
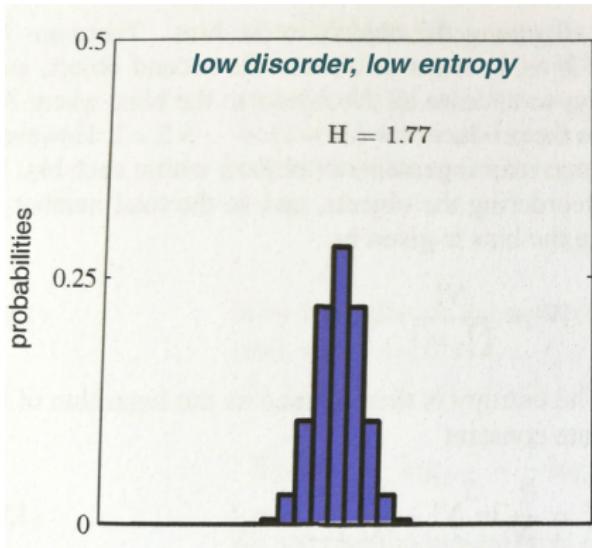
Lezione 24: Generative Adversarial Neural Networks

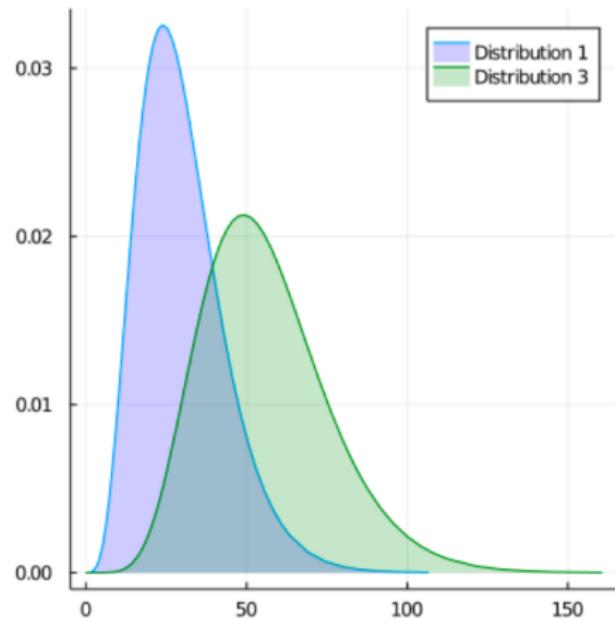
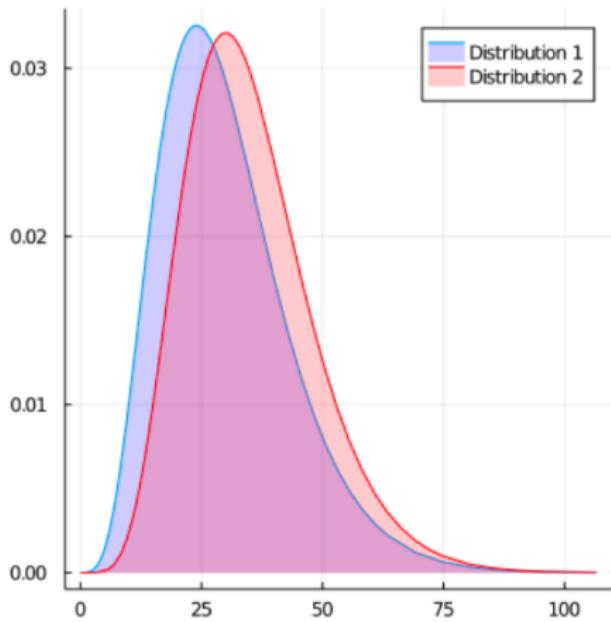
Emanuele R. Nocera

10 gennaio 2023

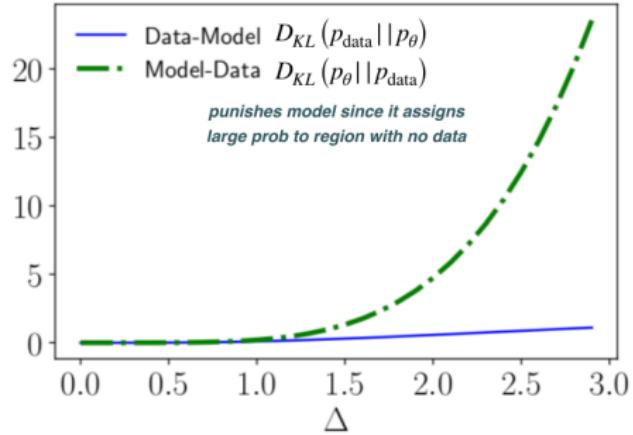
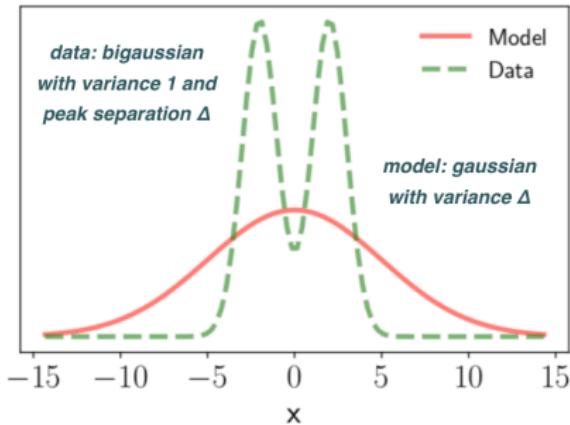


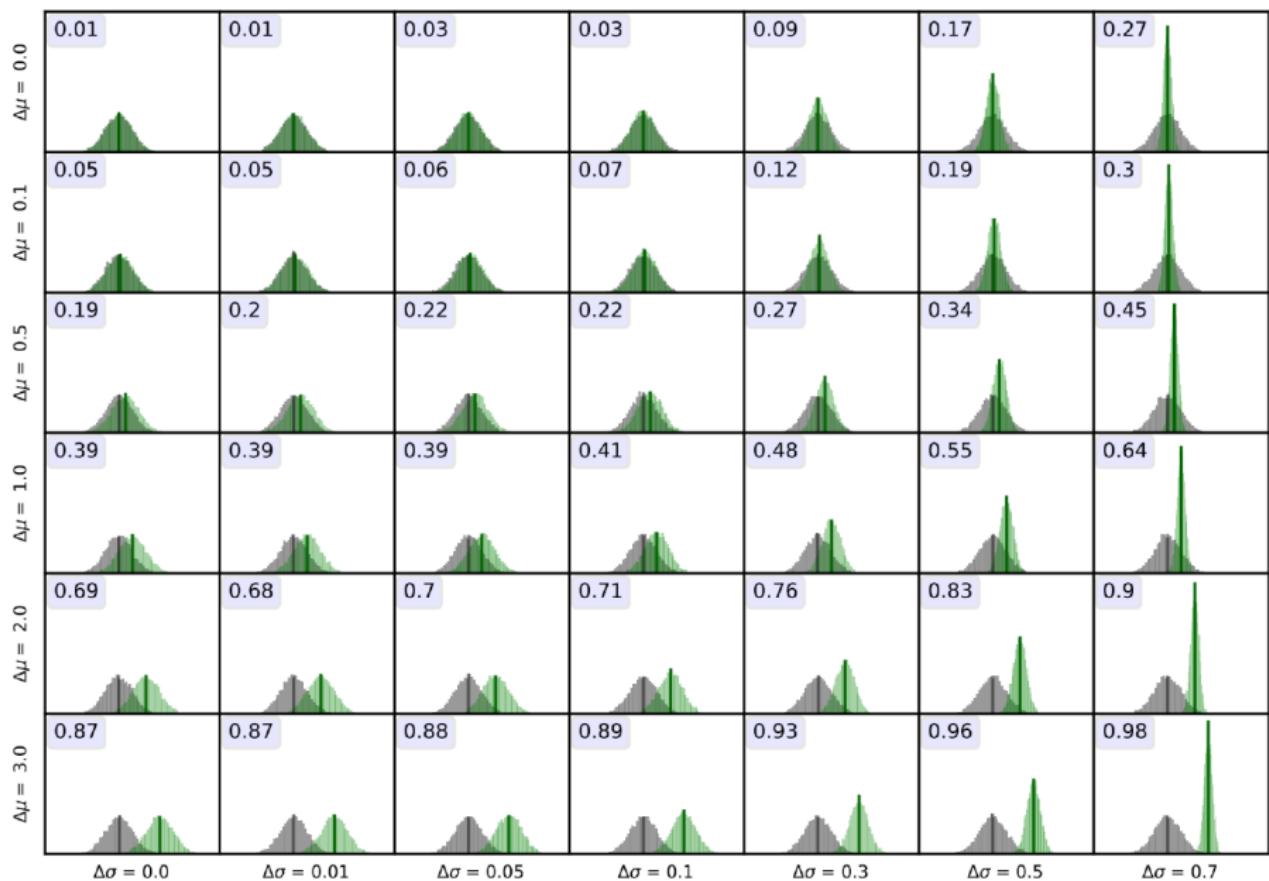
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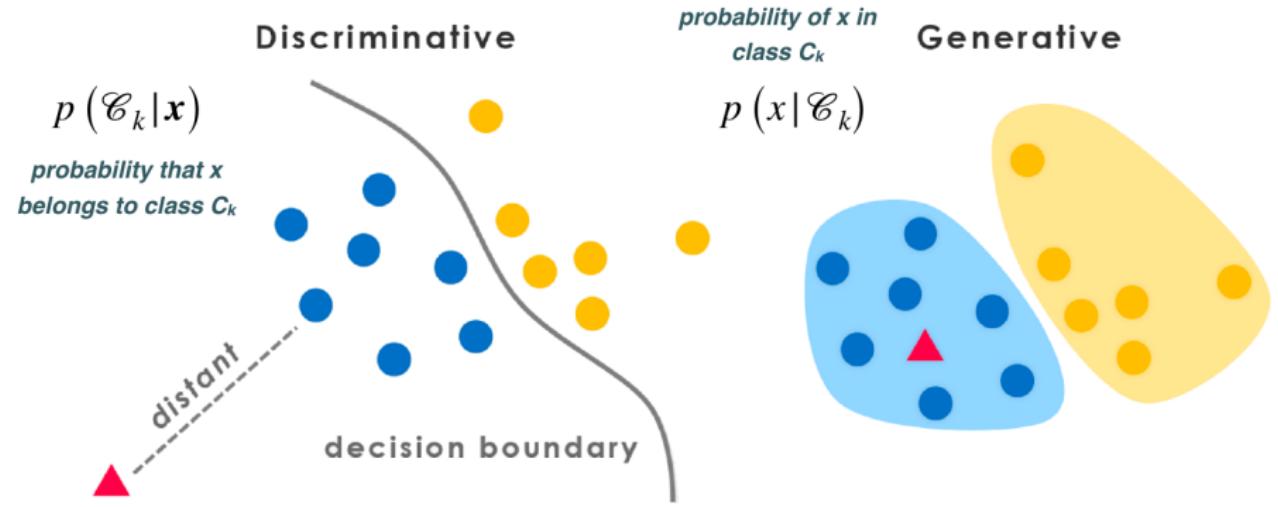




$$\Delta = 2.0$$

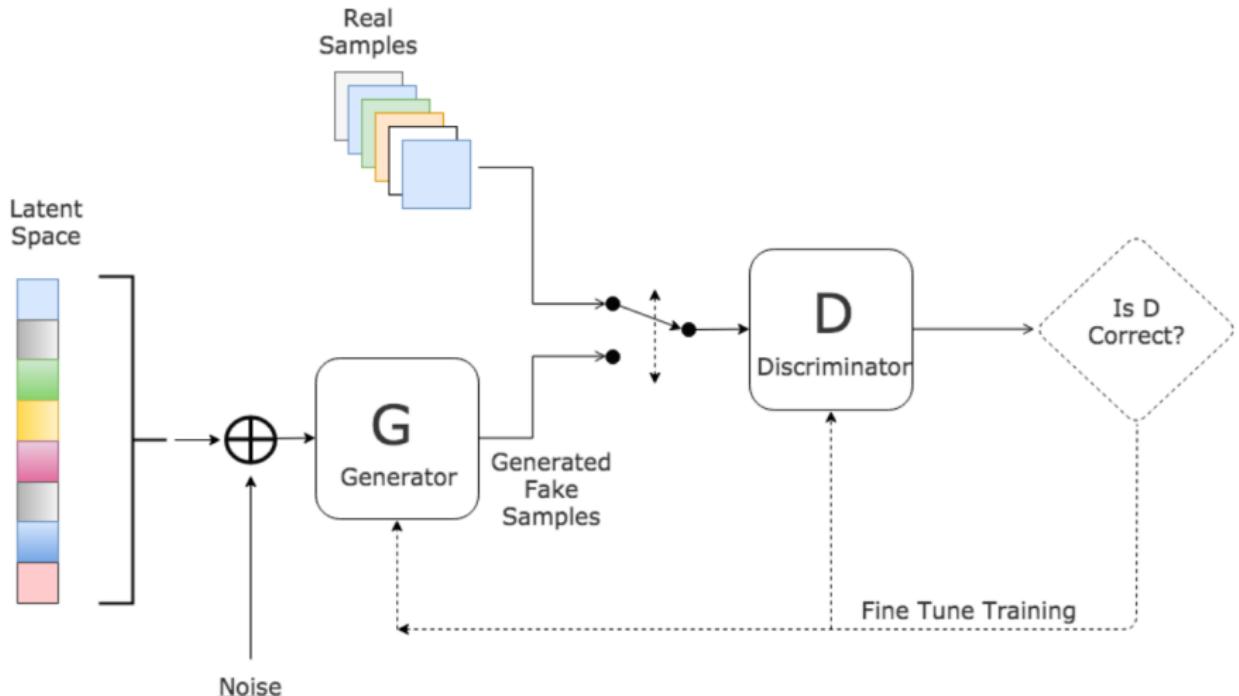








Generative Adversarial Network



for *epochs* $1, \dots, N$ **do**

for *discriminator steps* $1, \dots, k$ **do**

- Sample minibatch of size m from the real input sample: $\{x_r^{(1)}, \dots, x_r^{(m)}\}$
- Sample minibatch of size m from the latent space: $\{z^{(1)}, \dots, z^{(m)}\}$
- Perform gradient **ascent** on discriminator:

$$\begin{aligned}\nabla_{\phi} V(G_{\theta}, D_{\phi}) = & \frac{1}{m} \nabla_{\phi} \sum_{i=1}^m \log D_{\phi}(x_r^{(i)}) \\ & + \frac{1}{m} \nabla_{\phi} \sum_{i=1}^m \log (1 - D_{\phi}(G_{\theta}(z^{(i)})))\end{aligned}$$

end

for *generator steps* $1, \dots, l$ **do**

- Sample minibatch of size m from the latent space: $\{z^{(1)}, \dots, z^{(m)}\}$
- Perform gradient **descent** on generator:

$$\nabla_{\theta} V(G_{\theta}, D_{\phi}) = \frac{1}{m} \nabla_{\theta} \sum_{i=1}^m \log (1 - D_{\phi}(G_{\theta}(z^{(i)})))$$

end

end

Generated Data

initial training

Discriminator

Real Data



intermediate training



long training



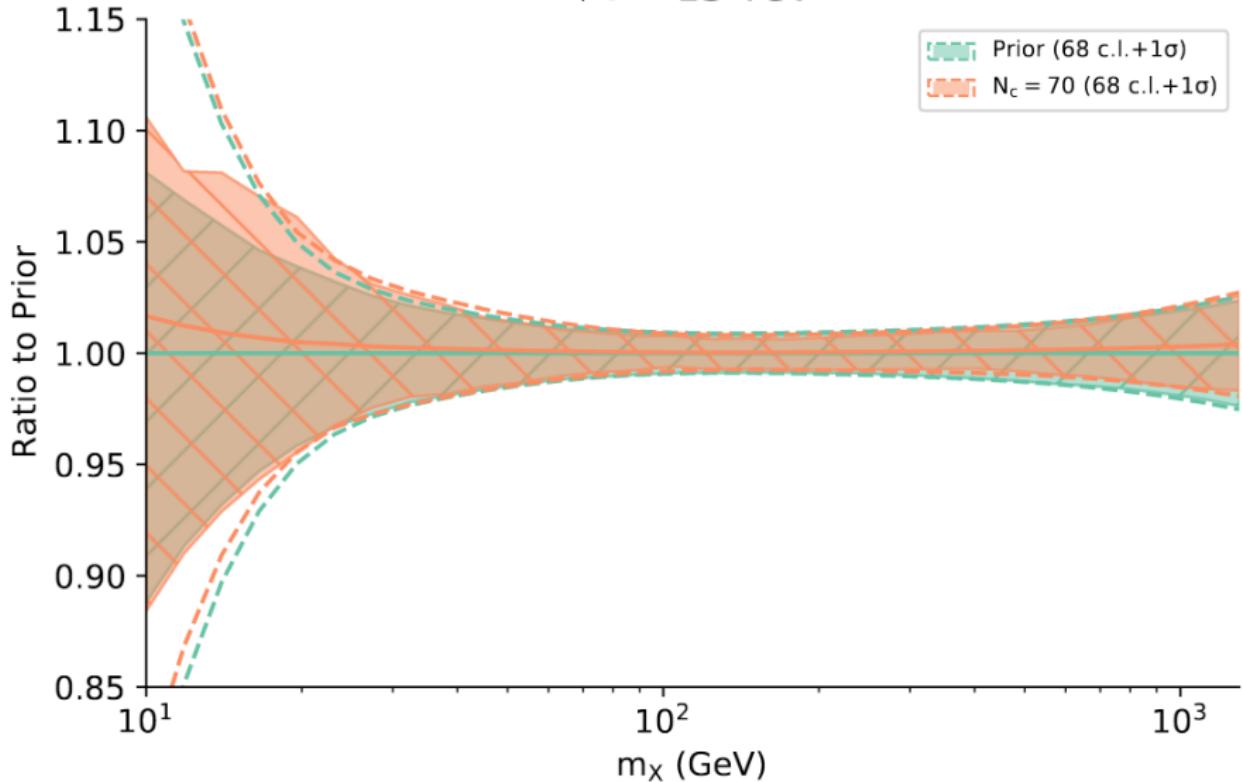
convergence!!

Un mio parente

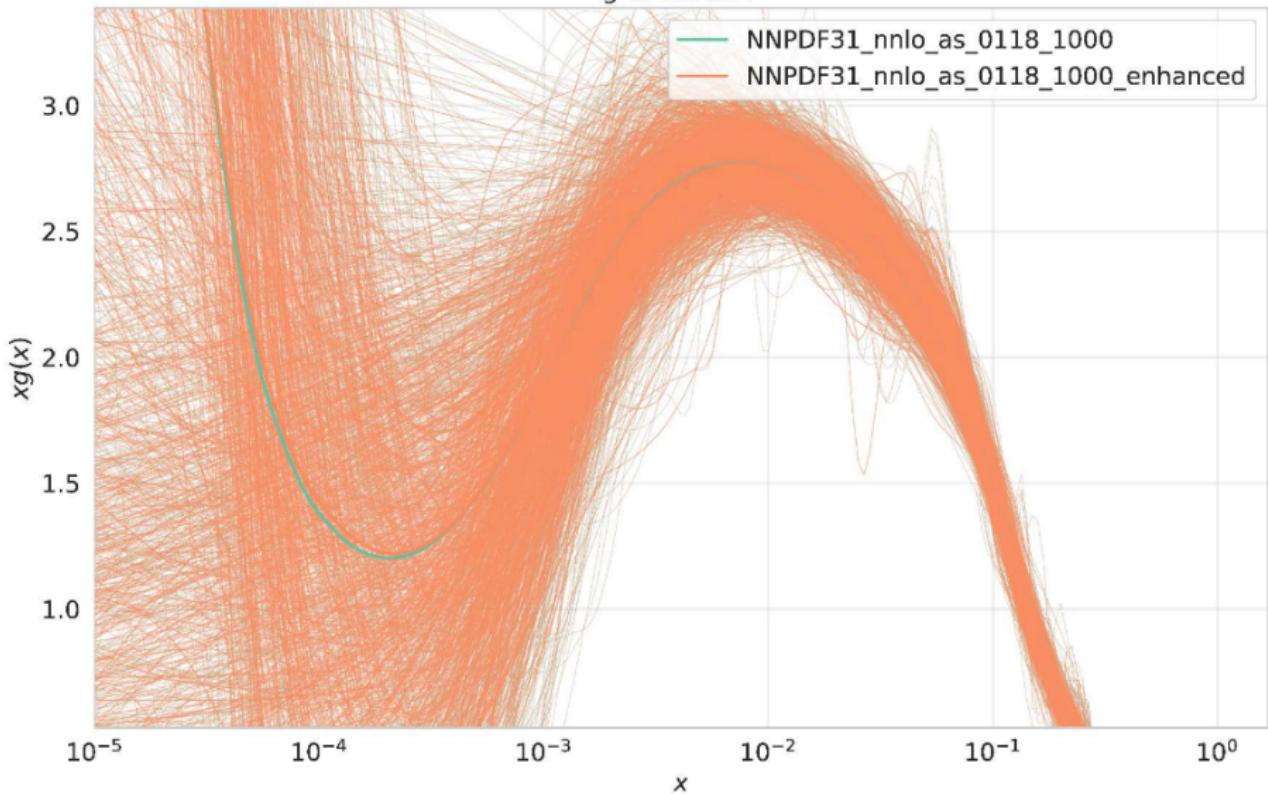
Un po' di arte

gg luminosity
 $\sqrt{s} = 13$ TeV

Prior (68 c.l.+1 σ)
 $N_c = 70$ (68 c.l.+1 σ)



g at 1.6 GeV



compressor vs. pyCompressor performance

