



[Home Page](#)

[Title Page](#)

[Contents](#)

[◀◀](#) [▶▶](#)

[◀](#) [▶](#)

[Page 1 of 15](#)

[Go Back](#)

[Full Screen](#)

[Close](#)

[Quit](#)

# Generative Adversarial Networks

Sumantra Dutta Roy

Department of Electrical Engineering  
Indian Institute of Technology Delhi  
Hauz Khas, New Delhi - 110 016, INDIA.

<http://www.cse.iitd.ac.in/~sumantra>

sumantra@ee.iitd.ac.in



Home Page

Title Page

Contents

« ▶

◀ ▶

Page 2 of 15

Go Back

Full Screen

Close

Quit

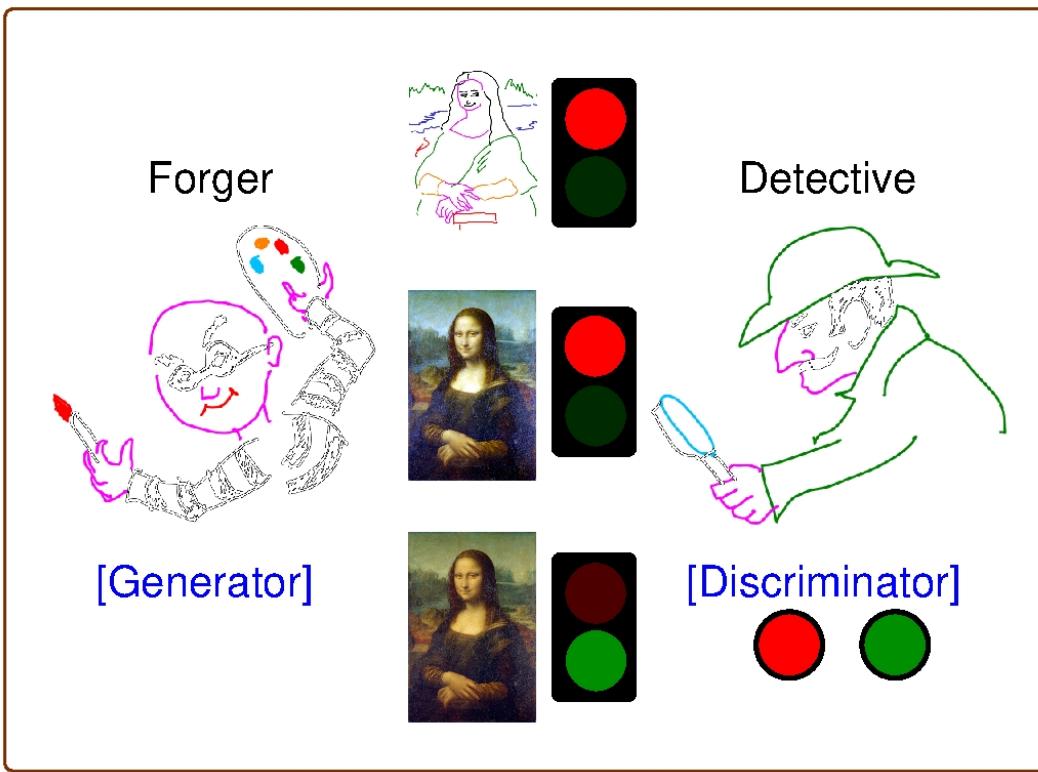
# The basic GAN concept

[https://upload.wikimedia.org/wikipedia/commons/f/fe/Ian\\_Goodfellow.jpg](https://upload.wikimedia.org/wikipedia/commons/f/fe/Ian_Goodfellow.jpg)



- **Ian J. Goodfellow [1987-]**
- **[I. J. Goodfellow *et al.*, NIPS'14]**
- **[J. Schmidhuber'91], [O. Neimitalo'10], [Li, Gauci, Gross'13]**

[https://upload.wikimedia.org/wikipedia/commons/e/ec/Mona\\_Lisa%2C\\_by\\_Leonardo\\_da\\_Vinci%2C\\_from\\_C2RMF\\_retouch.jpg](https://upload.wikimedia.org/wikipedia/commons/e/ec/Mona_Lisa%2C_by_Leonardo_da_Vinci%2C_from_C2RMF_retouch.jpg)





Home Page

Title Page

Contents

« ▶

◀ ▶

Page 3 of 15

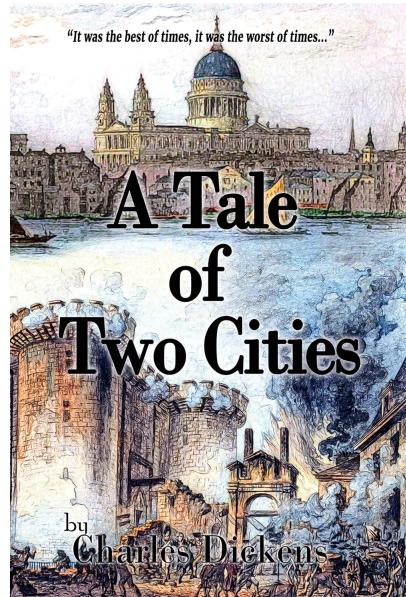
Go Back

Full Screen

Close

Quit

<https://m.media-amazon.com/images/I/91-J0ie5SmL..SL1500..jpg>



# A Tale of Two (Atro)Cities!

- Generative Models: Sampling: new point in input space ( $\sim$ GMM)
- Gen: new samples, Disc: real/fake
- 0-Sum Adv game, till Disc fooled 50%
- Disc can be discarded post-training
- GANs use both bow-tie & contractive
  - Bow-tie: o/p, i/p same dim: Generator
  - Simple Example: Auto-Encoder
  - Contractive: 2-class classifier: Discriminator
  - Simple Example: Convolutional NN (Oxymoron)
  - Neither ‘convolution’, nor ‘neural network’ [00:48]



Home Page

Title Page

Contents

◀ ▶

◀ ▶

Page 4 of 15

Go Back

Full Screen

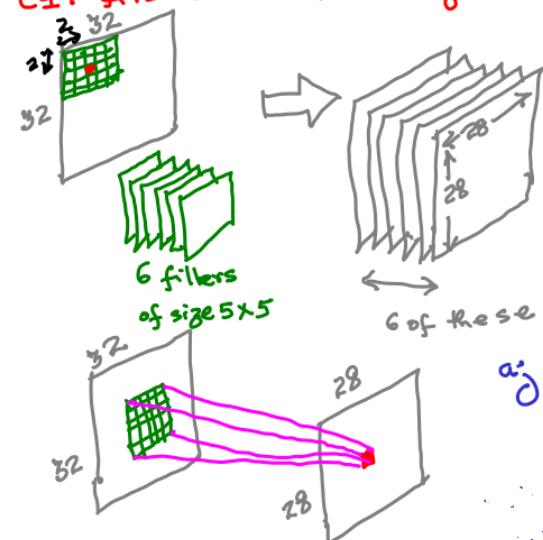
Close

Quit

# Contractive: Discriminator

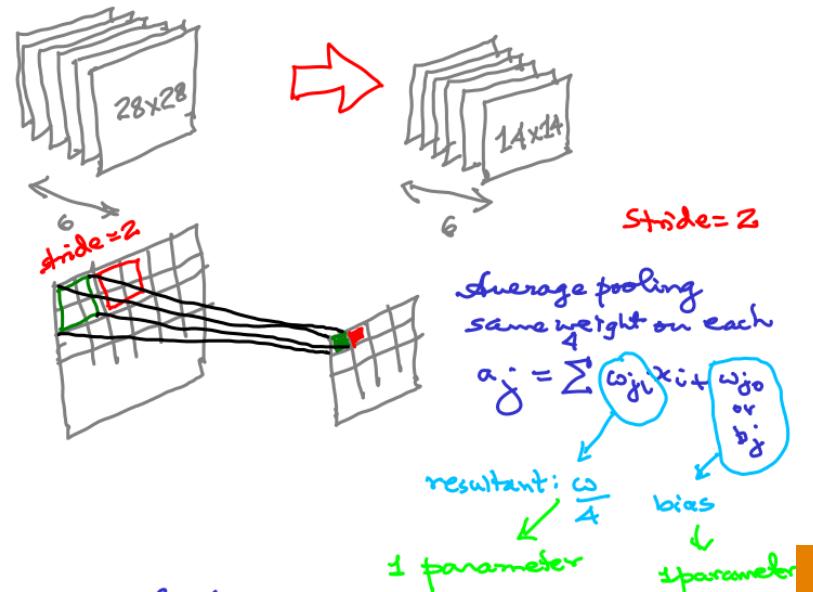
## LeNet-5 DETAILS

C1: first convolutional layer



$$a_j = \sum_{i=1}^{25} w_{ji}^{(1)} x_i + w_{j0}^{(1)} \text{ (bias)}$$

Second layer (S2) "Sub-sampling" or Average Pooling layer



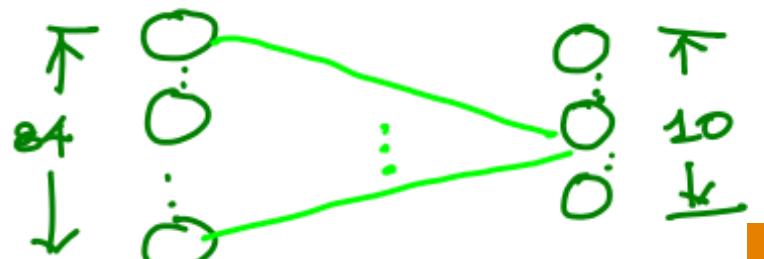
⑤ "C5" 5th layer, C  $\Rightarrow$  convolution

"Flattening"

16 of these  $5 \times 5 \times 16 = 400$  pixels (s4)

each of these is connected to all layers in S4.

⑦ Output layer





# Bow-tie: Autoencoder

[Home Page](#)

[Title Page](#)

[Contents](#)

[«](#) [»](#)

[◀](#) [▶](#)

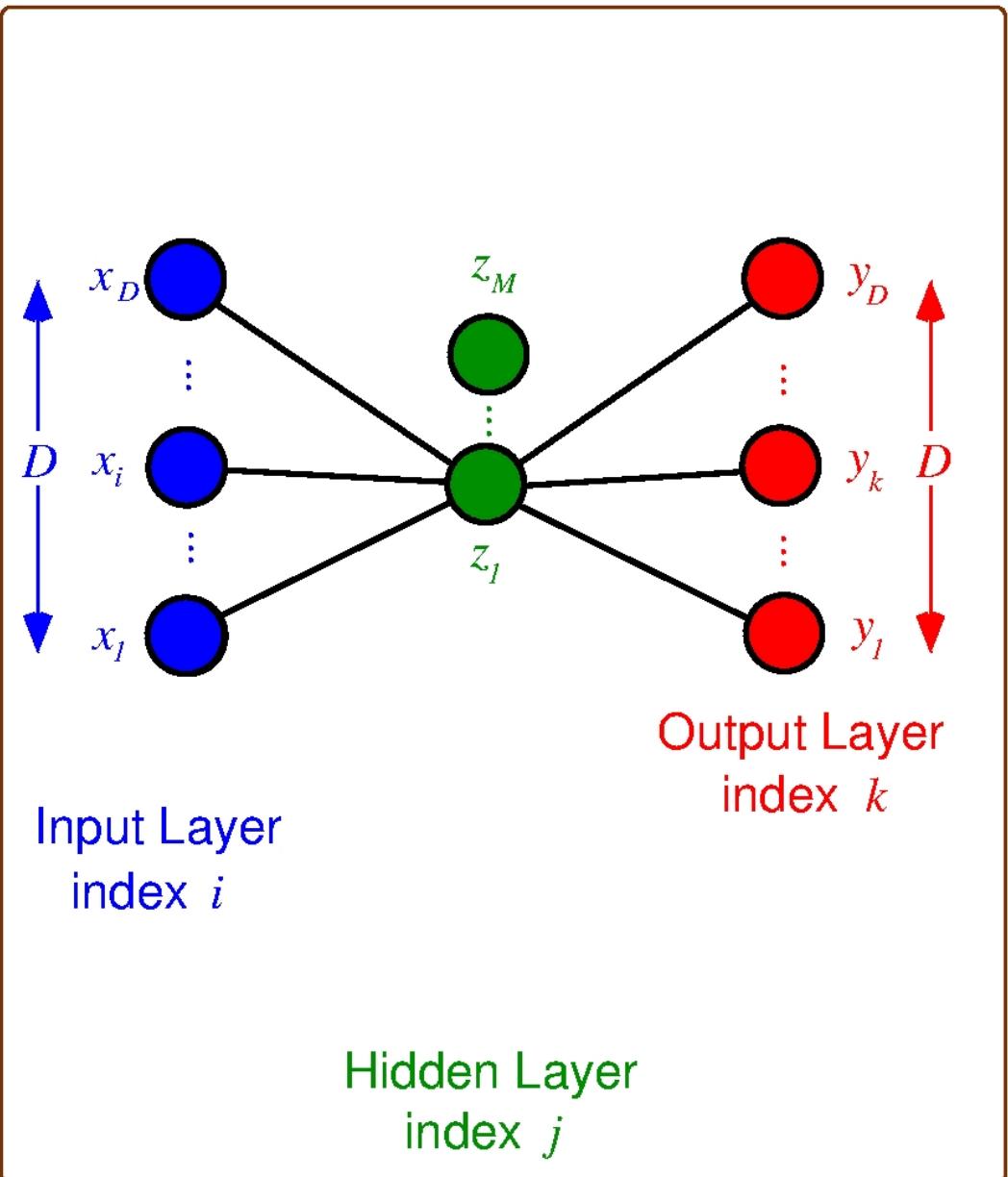
[Page 5 of 15](#)

[Go Back](#)

[Full Screen](#)

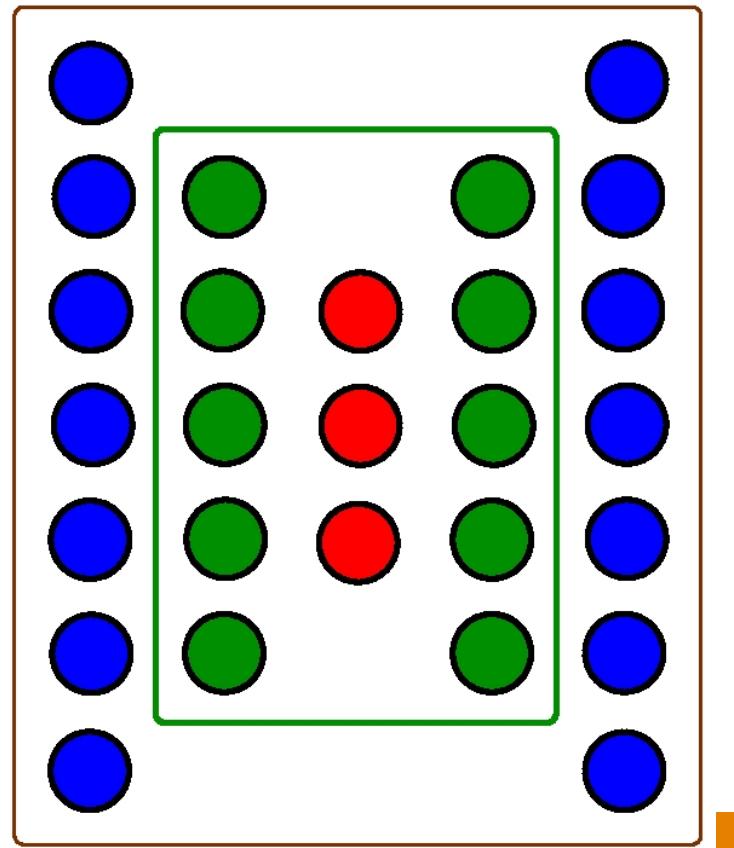
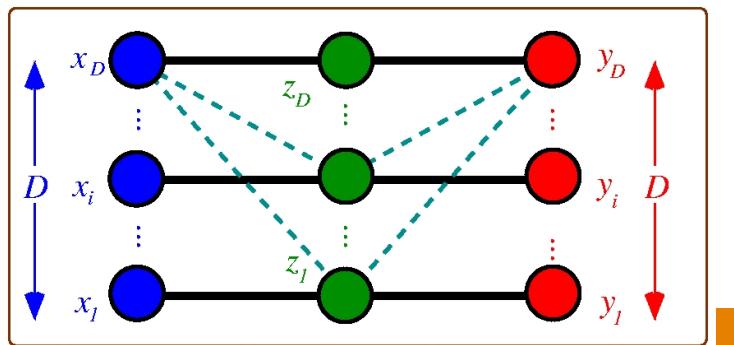
[Close](#)

[Quit](#)





# Bow-tie: Autoencoder (contd)■



[Home Page](#)

[Title Page](#)

[Contents](#)

[«](#) [»](#)

[◀](#) [▶](#)

Page 6 of 15

[Go Back](#)

[Full Screen](#)

[Close](#)

[Quit](#)



Home Page

Title Page

Contents

« ▶

◀ ▶

Page 7 of 15

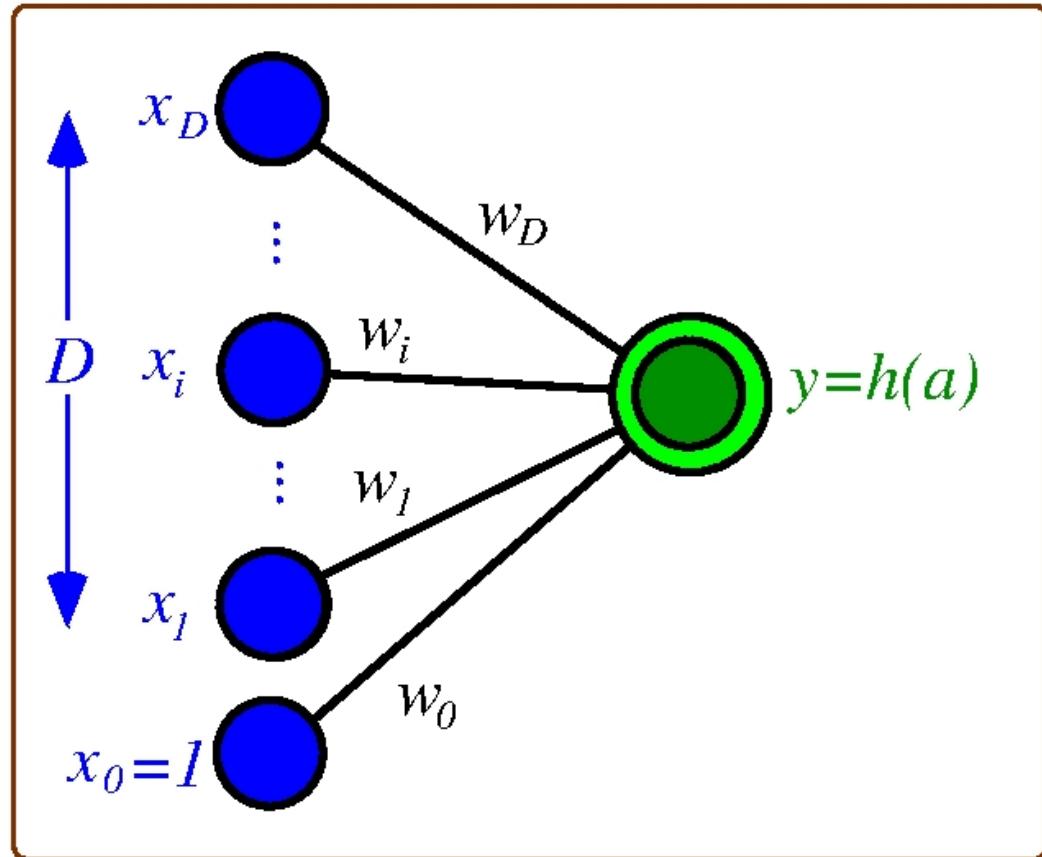
Go Back

Full Screen

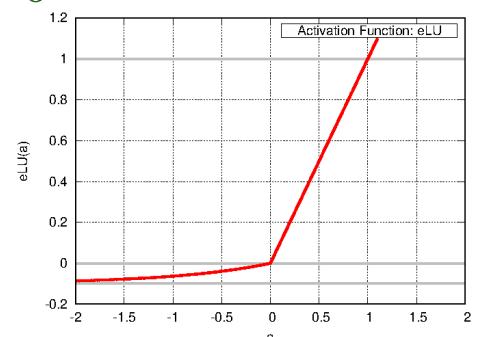
Close

Quit

# Serrano's Perceptron-like NNs



- A single-layer NN
- #neurons? [04:00]
- $h(a)$ ?  $\sigma(a)$
- $y = \mathbf{w}^T \mathbf{x}_i + b$  or  $w_0$
- $b/w_0$ : bias/thresh



- Act fn:  $\sigma$ ,  $tanh$ , ReLU, Leaky ReLU, eLU, Swish
- $\text{LeakyReLU}(a, \alpha) \triangleq \max(\alpha a, a)$ ,  $\alpha \in (0, 1)$
- $eLU(a, \alpha) \triangleq \begin{cases} a, & a > 0 \\ \alpha(e^a - 1), & a \leq 0 \end{cases}$  [00:50]



Home Page

Title Page

Contents

« ▶

◀ ▶

Page 8 of 15

Go Back

Full Screen

Close

Quit

# Angels & Demons: \s & Noise

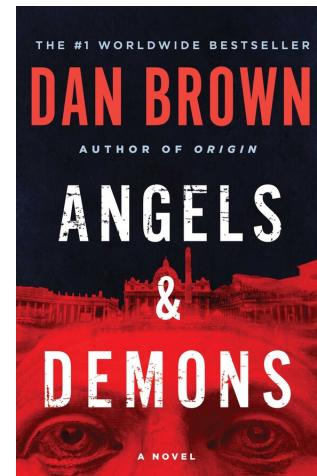
[https://d28hgpr18am2if.cloudfront.net/book\\_images/onix/cvr9780743493468/angels-demons-9780743493468\\_xlg.jpg](https://d28hgpr18am2if.cloudfront.net/book_images/onix/cvr9780743493468/angels-demons-9780743493468_xlg.jpg)

Backslash ( $2 \times 2$  images/matrix): [1:18][0:37,02:07]

0.75	0.00	1.00	0.25	1.00	0.00	0.75	0.00
0.00	0.75	0.25	0.75	0.00	1.00	0.25	0.75

Noise:

0.25	0.00	0.25	1.00	0.75	0.50	1.00	1.00
1.00	0.75	0.50	0.75	0.75	0.00	0.00	0.75



- Building the Discriminator, by hand
- 1 possible fn:  $\sum \text{Main Diag} - \sum \text{Other}$

$$\begin{array}{|c|c|} \hline 1.00 & 0.00 \\ \hline 0.00 & 1.00 \\ \hline \end{array} = +2.00 \quad \begin{array}{|c|c|} \hline 0.25 & 1.00 \\ \hline 0.50 & 0.75 \\ \hline \end{array} = -0.50$$

- Backslash: high response, noise: low