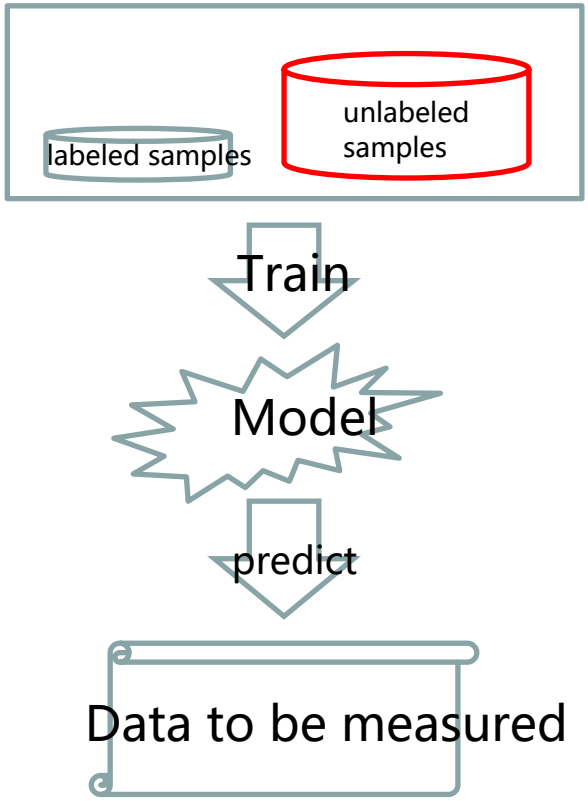
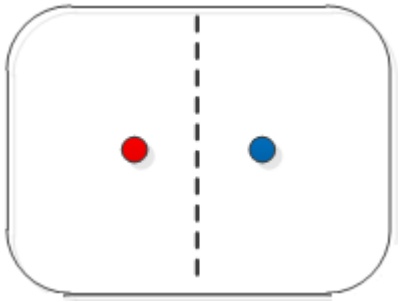
Report by Shijia Chai

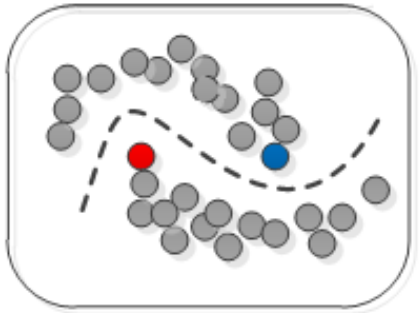
- Definition of semi-supervised learning



Supervised learning: using labeled samples



Semi-supervised learning: using labeled and unlabeled samples



use unlabeled samples to estimate the distribution of data

Note: Chai Shijia is the first author of this article

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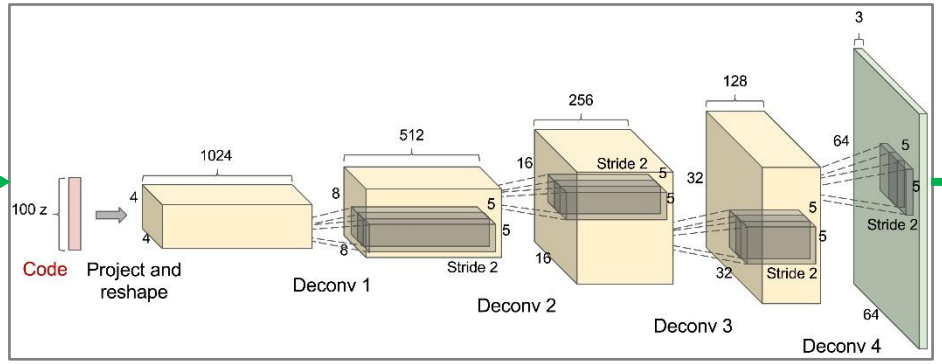
- A powerful tool for estimating data distribution: Generative Adversarial Net(GAN)

Generator

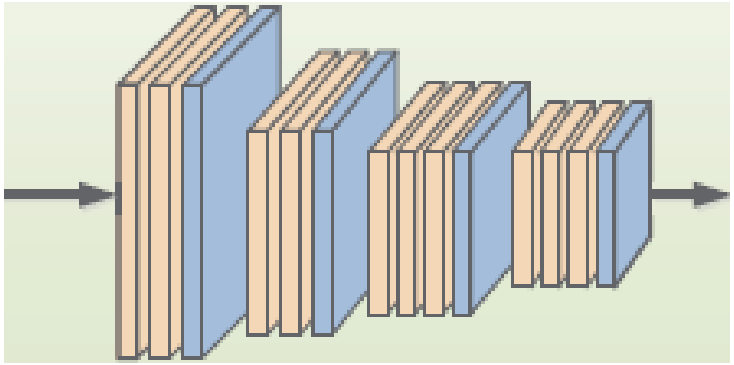
Noise



Fake data

Real data

Fake data



Discriminator

Judge whether it belongs to real data or fake data

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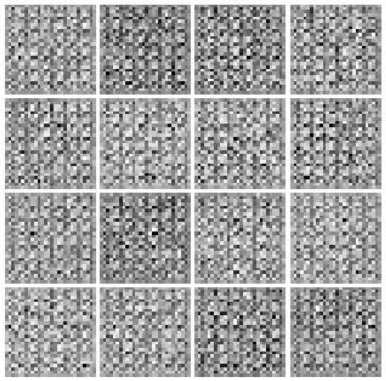
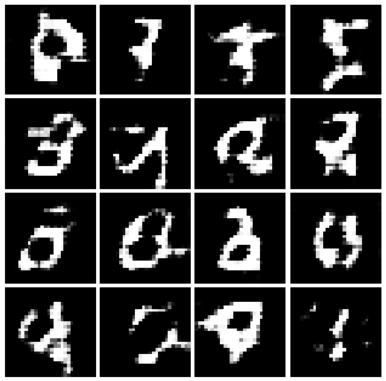
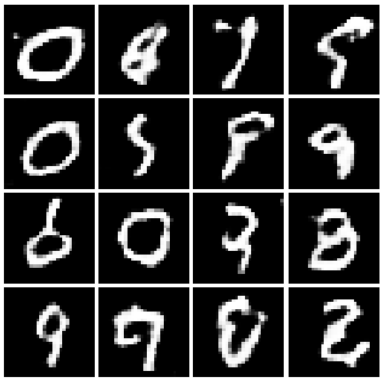
- Generated handwritten digits using GANs



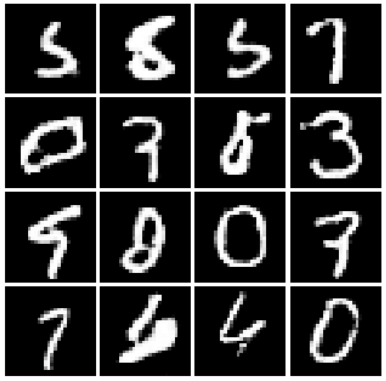
0 iteration



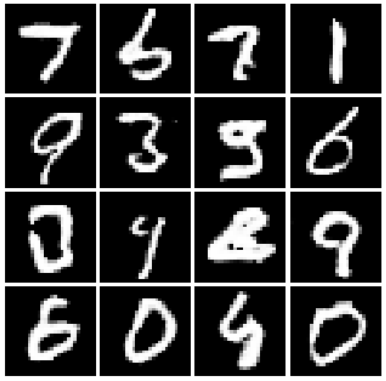
5000 iterations



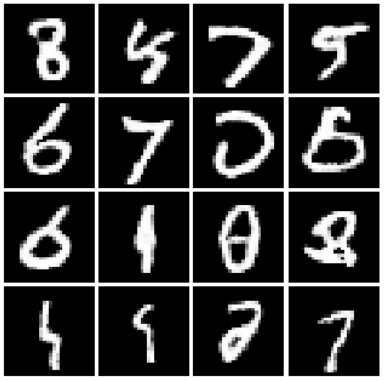
20000 iterations



50000 iterations



100000 iterations



200000 iterations

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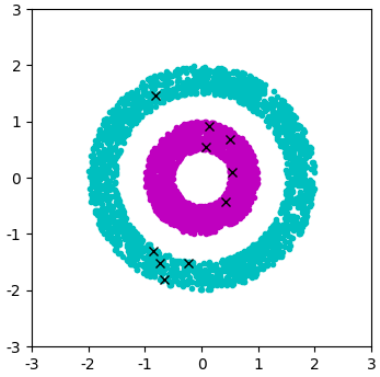
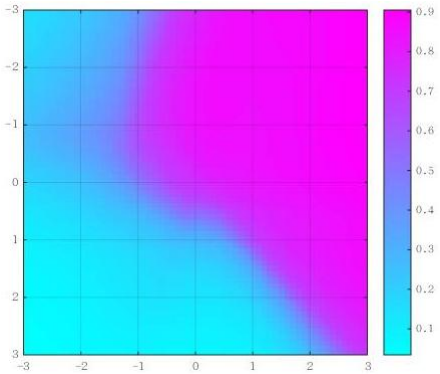
- Semi-supervised learning

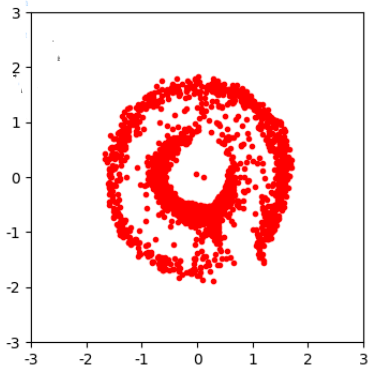
Training data set

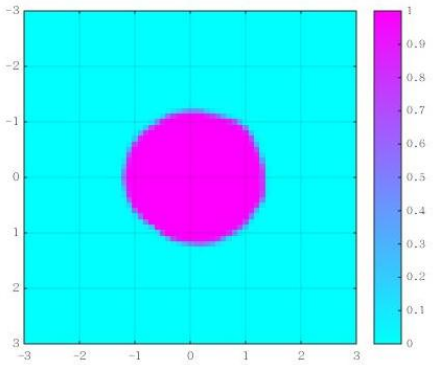


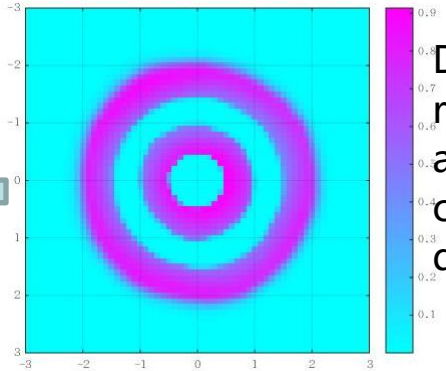


Supervised learning classification decision surface

Fake data







Discrimination result of true and false data of discriminator

Final classification decision surface

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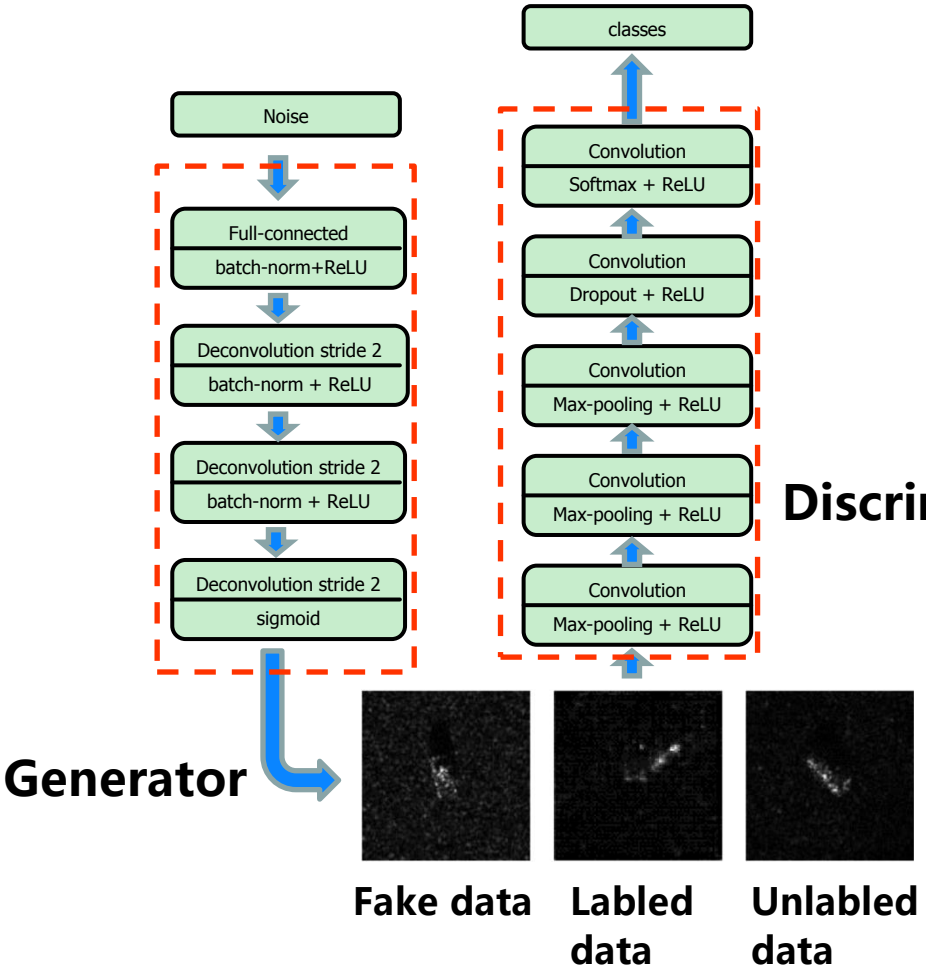
Network model



Generator Loss Function :

$$L_D = wL_S + L_U$$

$$L_S = \frac{1}{m}\sum_{i=1}^{m} H\left(y_l^i, R_K\left(D\left(x_l^i\right)\right)\right)$$

$$L_U = L_U^U + L_U^F = -\frac{1}{m}\sum_{i=1}^{m}\log\left(1 - R_l\left(D\left(x_u^i\right)\right) + \varepsilon\right)$$

$$-\frac{1}{m}\sum_{i=1}^{m}\log\left(R_l\left(D\left(G(z^i)\right)\right) + \varepsilon\right)$$

Discriminator Loss Function :

$$L_G = -\frac{1}{m}\sum_{i=1}^{m}\log\left(1 - R_l\left(D\left(z^i\right)\right) + \varepsilon\right)$$

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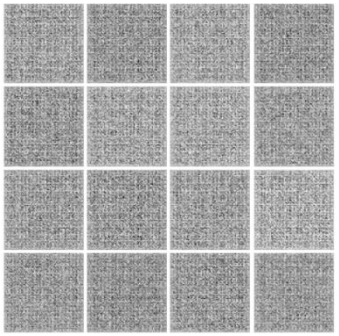
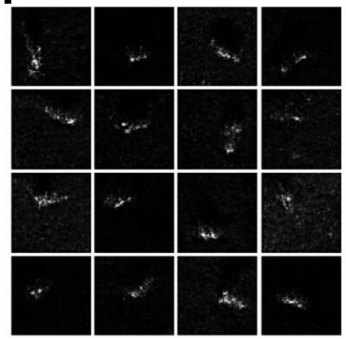
Result

MSTAR Data set, take 10 labeled samples for each class in the training set, and the rest are unlabeled samples

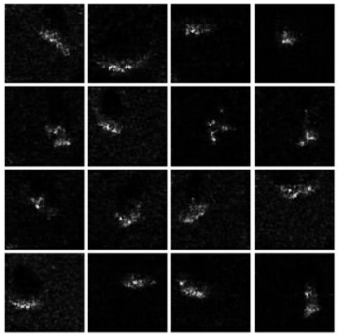
Fake data



0 iteration



10000 iteration



20000 iteration

Comparison of experimental results under more conditions

	SOC-10	SOC-20	SOC-30	EOC-10
A-ConvNet	70.76%	81.36%	87.34%	70.89%
CNN-TL-bypass	74.10%	83.09%	89.07%	71.76%
Semi-supervised learning	85.65%	89.86%	93.07%	75.50%