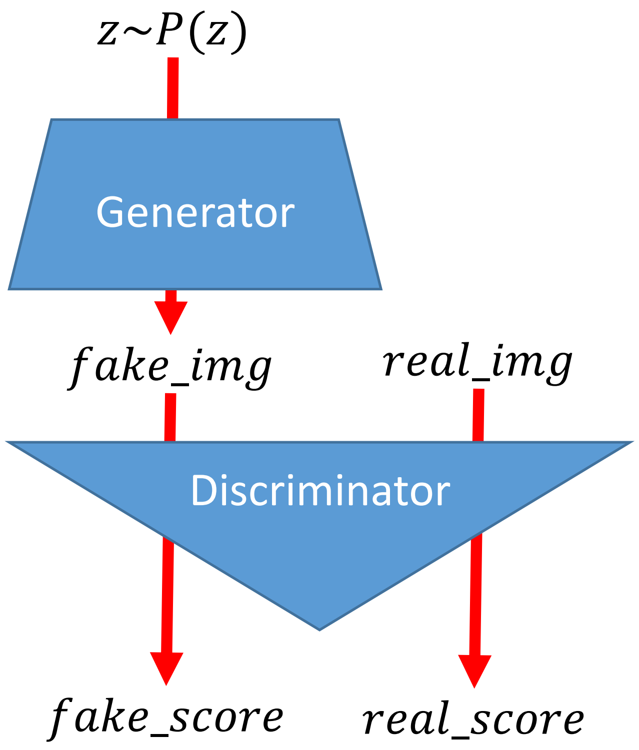
InfoGAN

助教：來俊聖
製作：鄧駿智、來俊聖

Standard GAN

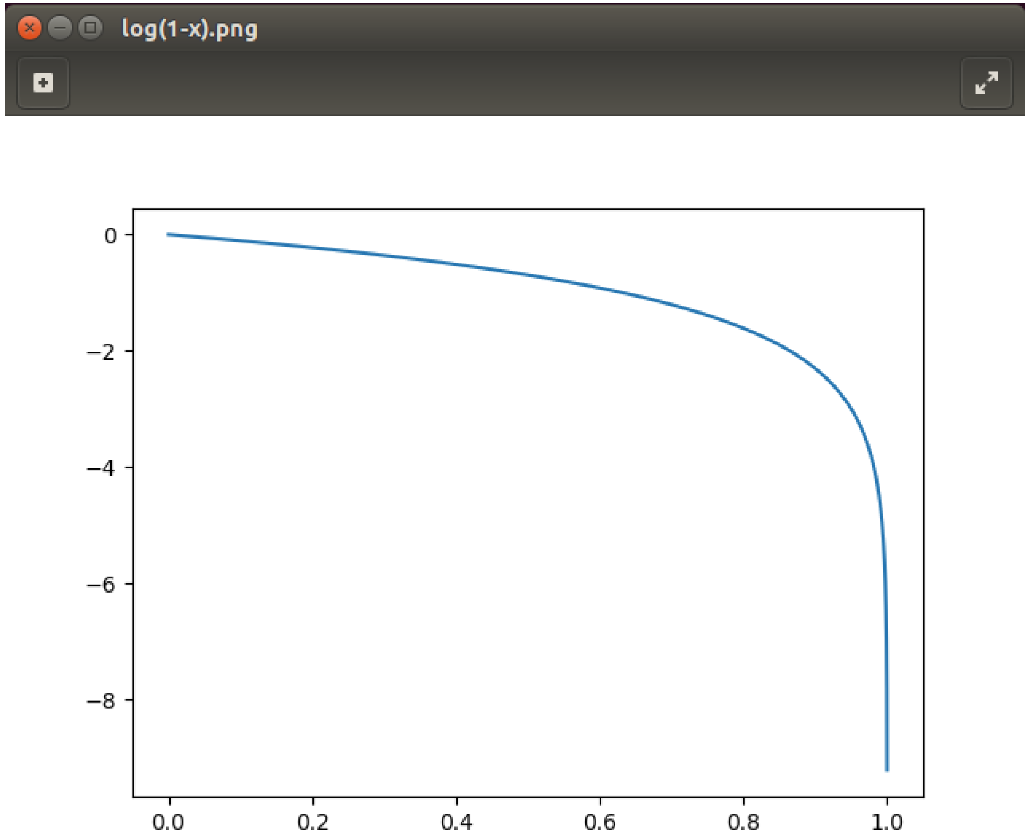


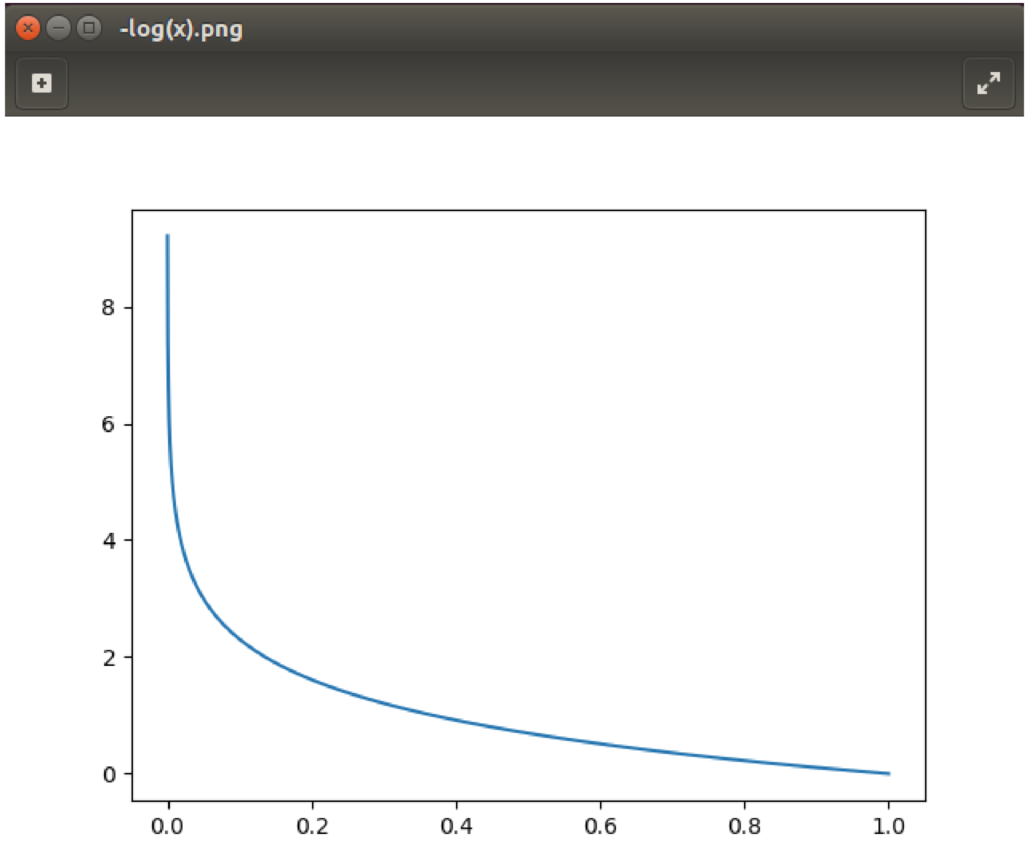
$$L_D = -\log\left(\mathrm{D}(I_{real})\right) - \log\left(1 - D\left(G(z)\right)\right)$$

$$\begin{cases} L_G = \log\left(1 - D\left(G(z)\right)\right) \\ L_G = -\log\left(D\left(G(z)\right)\right) \end{cases}$$

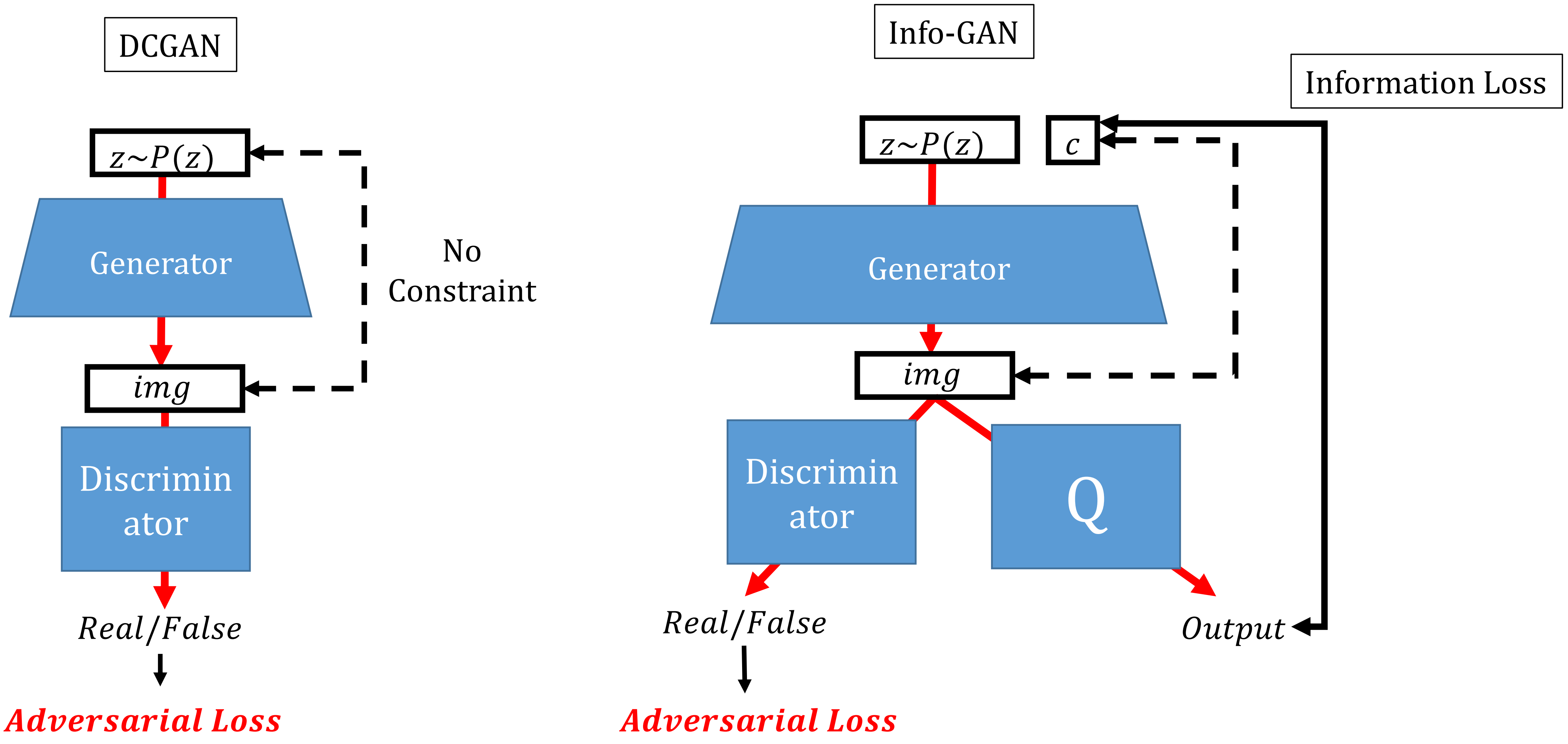
In this lab, you can use either of them, but you should tell me which one you use in your report.

Standard GAN Loss





Info-GAN

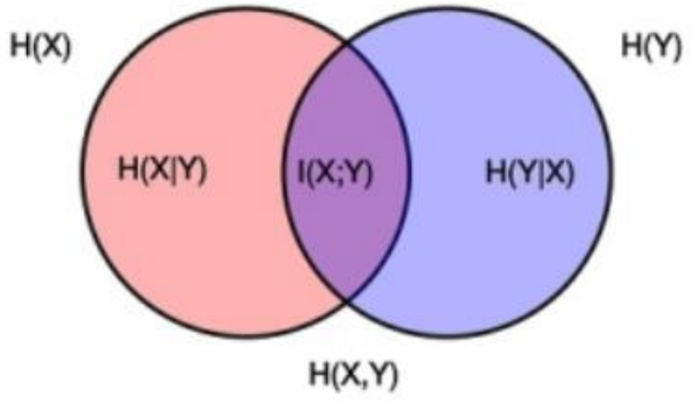

DCGAN
$z{\sim}P(z)$
Generator
img
Discriminator
$Real/False$
Adversarial Loss
No Constraint
Info-GAN
Information Loss
$z{\sim}P(z)$
c
Generator
img
Discriminator
Q
$Real/False$
Adversarial Loss
$Output$

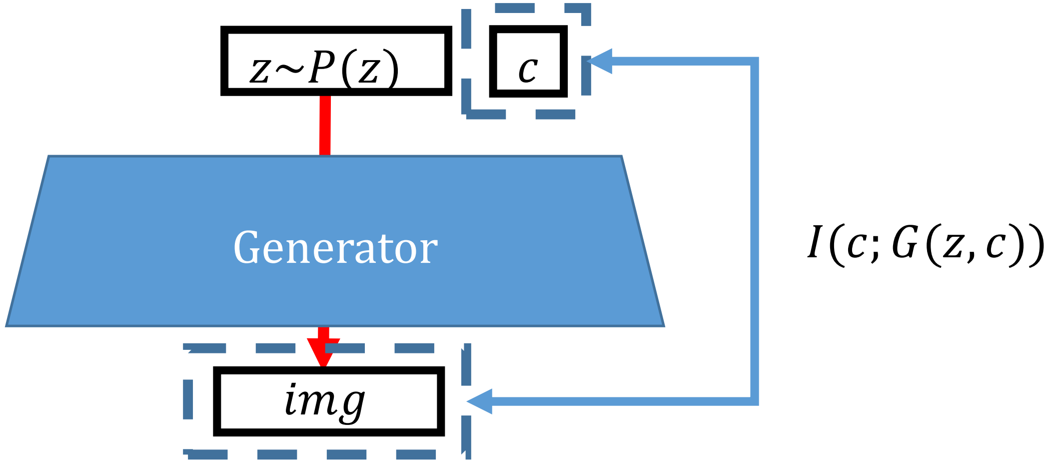
Info-GAN

In Information Theory:
Mutual Information: I(X;Y) = H(X)-H(X|Y) = H(Y)-H(Y|X)

$$\boxed{\mathrm{H(Y)} = -\sum_{y} \log p(y) p(y)}$$

$$I(X;Y) = H(X) - H(X \mid Y) = H(Y) - H(Y \mid X)$$





Info-GAN pf.

I(c;G(z, c)) = H(c)-H(c|G(z,c))

$$=E_{x\sim G(z,c)}\left[E_{c'\sim P(c|x)}[logP(c'|x)]\right] + \mathrm{H(c)}$$

$$=E_{x\sim G(z,c)}\left[D_{KL}(P(\cdot\,|x)||Q(\cdot\,|x)) + E_{c'\sim P(c|x)}[logQ(c'|x)]\right] + \mathrm{H(c)}$$

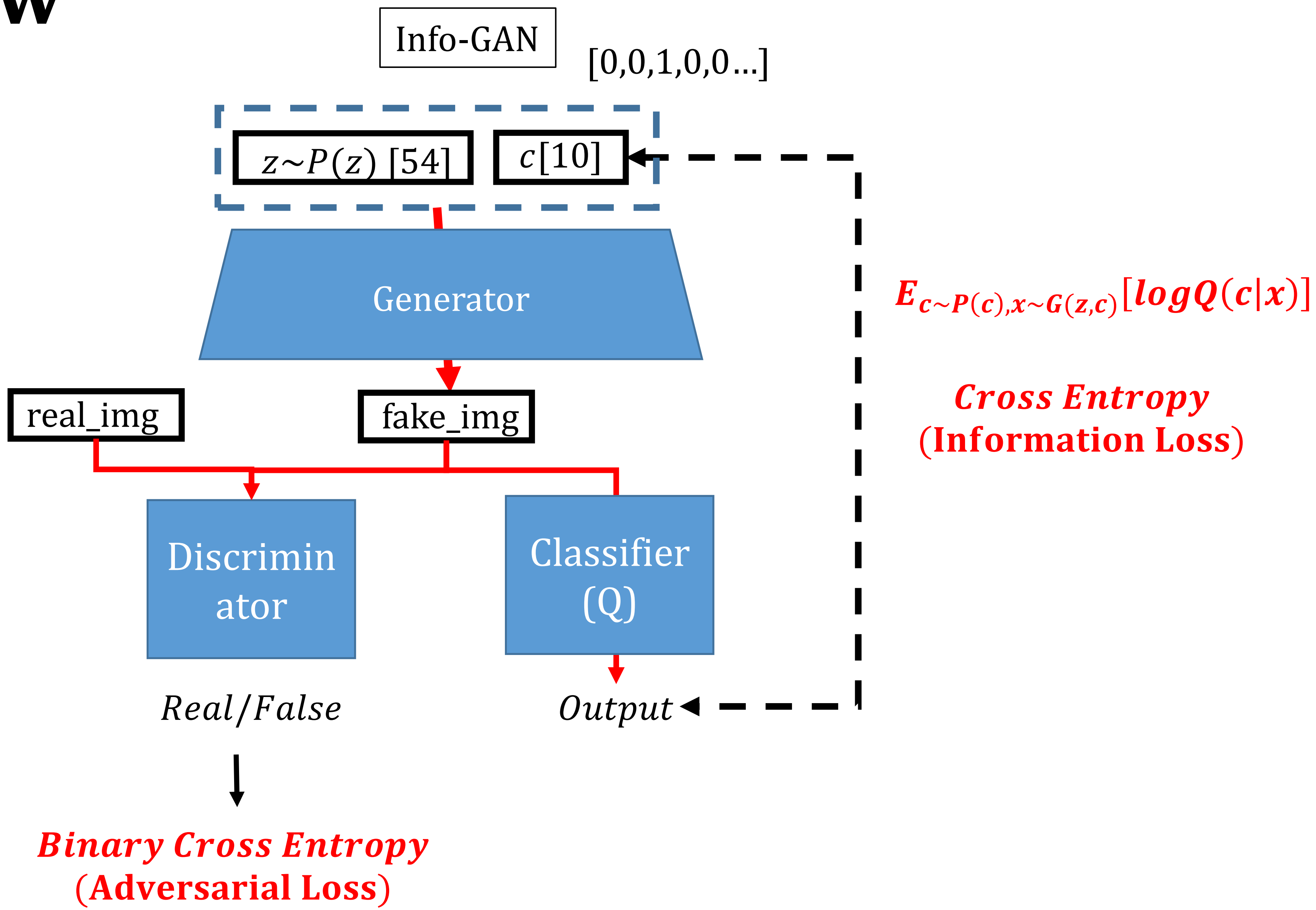
$$\geq E_{x\sim G(z,c)}\left[E_{c'\sim P(c|x)}[logQ(c'|x)]\right] + \mathrm{H(c)}$$

$$= \boldsymbol{E_{c\sim P(c),x\sim G(z,c)}[logQ(c|x)] + \mathrm{H(c)}}$$

We can increase the **lower bound of mutual Information** by other distribution!!

Info-GAN Flow

Take MNIST for example



Info-GAN Loss

Adversarial Loss

$$L_D = -\log\big(\mathrm{D}(I_{real})\big) - \log(1 - D(G(z)))$$

$$\begin{cases} L_G = \log\Big(1 - D\big(G(z)\big)\Big) \\ L_G = -\log\Big(D\big(G(z)\big)\Big) \end{cases}$$

Update D $\rightleftharpoons$ Update G/Q

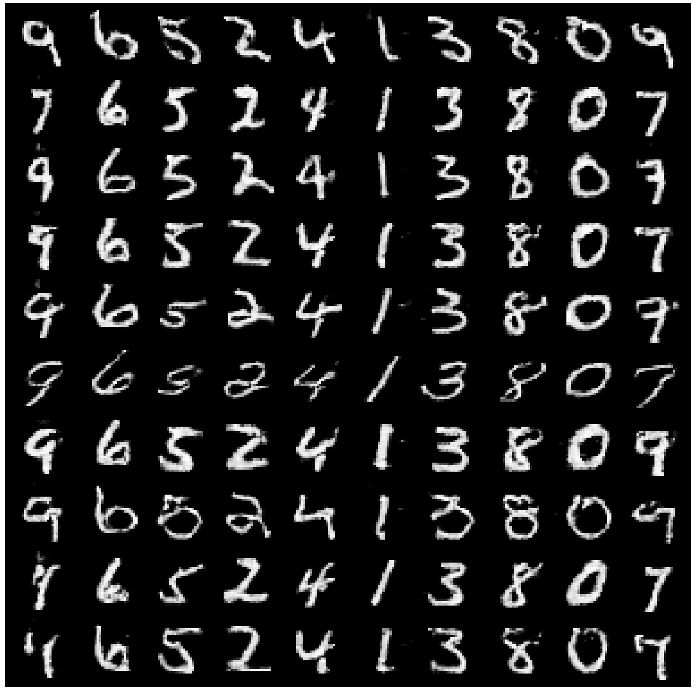
Information Loss

$$L_I(Q, G) = -\log\big(Q(c|G(z, c))\big)$$

Pseudo code

1. Update d network
    a. feed real_image into D network, compute bce loss for D network
    b. Create noise and concatenate with one-hot latent named z
    c. Feed z into the G model and generate fake_image
    d. Feed fake_image into D network, compute bce loss for D network
2. Update d network
    a. Generate fake_image like previously, feed into discriminator and compute bce loss for G network
    b. Feed fake_image into Q network, then compute classification loss (crossentropy) for G network

Expected Outputs



To do list

- Complete all model
- Complete training procedure
    - The details are at the pseudo code part.
    - You need to tune learning rate and the weight of each loss at this part.
    - If you are not familiar with this, you are welcome to check sample code online. But please make sure you understand the meaning of all code.
- Bonus
    - At this part, you need to can directly run the training script with a new model for CelebA, but you need to load data yourself.
    - Torchvision.datasets.ImageFolder will help, please check it out.

Hyper-parameters

- mnist
  1. c_size = 10
  2. z_size = 62
  3. Total epochs = 50
  4. Optimizer: Adam
- CelebA
  1. c_size = 100
  2. z_size = 128
  3. Total epochs = 10
  4. Optimizer: Adam
- All other parameters need to be tuned
- You can even change the hyper parameters above

Important Date

- Deadline: 10/30 11:59 a.m.
- Demo date: 10/30

- Zip report and source code into a .zip file and name it as DLP_LAB5_yourID_name.zip
- Email to alanlai199.cs07g@nctu.edu.tw with email title DLP_LAB5_yourID_name

Info-GAN Report Spec

MNIST

- 1. Introduction (10%)
- 2. Experiment setups: (20%)
  - A. How you implement InfoGAN
    - i. Adversarial loss
    - ii. Maximizing mutual information
  - B. Which loss function of generator you used? What's different?
- 3. Results (30%)
  - A. results of your samples
  - B. Training loss curves
- 4. Discussion (20%)
- 5. Demo (20%)
  - Show your result and explain your code
- (*optional*) Bonus: CelebA (15%)
  - Results of your samples (10%)
  - Demo (5%)