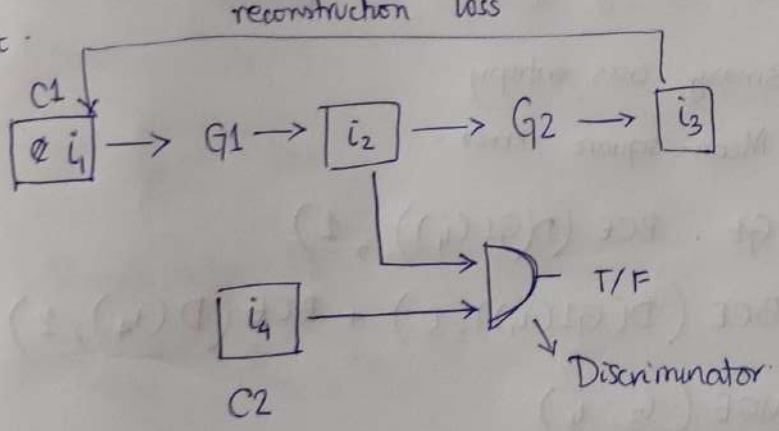
Question 4: GAN + reconstruction loss ~~term~~

3 neural networks are used.

G1 : takes input from C1 sampled images. i_1 & is expected to outputs modified image i_2 with color of category C2. { generator - 1 }

G2 : { generator - 2 } : takes image (modified) i_2 from output of G1 as input & tries to reconstruct image i_1 by producing i_3. It is expected that image i_3 is as close as possible to image i_1'.

D : Discriminator : Trains to correctly classify whether image given to it as input is from category C2 or not.



Reconstruction loss → Mean squared error between elements of two images.

This loss gradient information updates weights of both G1 as well as G2.

G1 has to create images i_2 such that discriminator fails to reject it. This component also updates weights for G1.

Discriminator has to

- correctly classify images i_4 from Q_2.
- correctly reject images i_2 from G1.

Both these components update weights for D.

Sequence of training operation is provided via code.

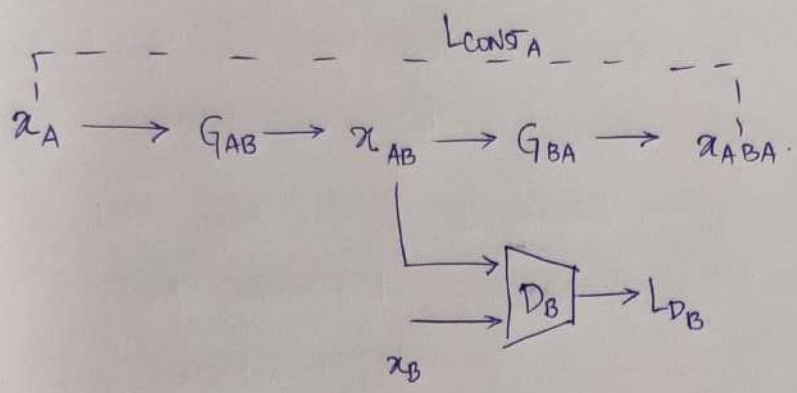
BCE - Binary cross entropy

MSE - Mean-square error.

$L1 = G1 \quad BCE\left(D(G1(i_1)), 1\right)$

$L2 = BCE\left(D(G1(i_1)), 0\right) + BCE\left(D(i_4), 1\right)$

$L3 = MSE\left(i_3, i_4\right)$



G_{AB} ($G1$) :

$$R_{G_{AB}} = \mathbb{E}_{x_A \sim A}\, d(x_A, x_{ABA})$$

$$GAN_{G_{AB}} = \mathbb{E}_{x_A \sim A} \log D_B(G_{AB}(x_A))$$

$$L_{G_{AB}} = R_{G_{AB}} + GAN_{G_{AB}}$$

G_{BA} ($G2$) :

$$R_{G_{BA}} = \mathbb{E}_{x_A \sim A}\, d(x_A, x_{ABA})$$

$$L_{G_{BA}} = R_{G_{BA}}$$

Discriminator D_B (D) :

$$L_{D_B}^{real} = \mathbb{E}_{x_B \sim B} \log D_B(x_B)$$

$$L_{D_B}^{gen} = \mathbb{E}_{x_B \sim B} \log (1 - D_B(G_{AB}(x_A)))$$

$$L_{D_B} = L_{D_B}^{real} + L_{D_B}^{gen}$$