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Question: Consider the BiGAN and its loss function. Show that, in order t...

Consider the BiGAN and its loss function. Show that, in order to fool a perfect discriminator D, BiGAN encoder E and generator G must invert each other. That is, $G(E(x)) = x$ and $E(G(z)) = z$

Expert Answer



Ujjwal Sharma answered this
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We will try to do this using Contradiction. Let us assume that for some area X, the inversion is not possible.

$$\begin{aligned}
 R^0 &:= \{(x, z) \in \Omega : z = E(x) \wedge x \in R_x^0\} \\
 &\text{We assume deterministic E and G.} \\
 P_{E(X)} &= P_{G(Z)} \quad (\text{Property of BiGAN}) \\
 P_X(R_x^0) &= \int_{R_x^0} p(x) \mathbb{1}_{\{x \in R_x^0\}} dx \\
 &= \int_{R_x^0} p(x) \mathbb{1}_{\{(x, E(x)) \in R^0\}} dx \\
 &= P_{E(X)}(R^0) \\
 &= P_{G(Z)}(R^0) \\
 &= \int_{R^0} p_z(z) \mathbb{1}_{\{(G(z), z) \in R^0\}} dz \\
 &= \int_{R^0} p_z(z) \mathbb{1}_{\{z = E(G(z)) \wedge G(z)\}} dz \\
 &= \int_{R^0} p_z(z) \mathbb{1}_{\{z = E(G(z)) \wedge G(z)\}} dz \\
 &= 0
 \end{aligned}$$

Here we see the region R_X has 0 measure over the region and this implies that the inversion property applies. So, we can reject the main statement and accept that encoder E and generator G must invert each other in BiGAN.

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