(Conditional) Variational Autoencoders

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ABSTRACT

A report on Variational Autoencoders and their Conditional variant.

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1. Autoencoders

An autoencoder is a type of neural network where we encode an input **x** to a latent representation **z** we then pass this latent representation to a decoder whose task is to reconstruct the output from the latent variable **z.**

2. Variational Autoencoders (VAE)

```
def vae_loss_function(x_recon, x, mu, log_var, loss_type='BCE'):
    """
    Calculates the VAE loss (Negative ELBO).
    """
    # 1. Reconstruction Loss

    # Ensure inputs are flattened for consistent loss calculation
    # across different architectures

    x_recon_flat = x_recon.view(x_recon.size(0), -1)
    x_flat = x.view(x.size(0), -1)

    if loss_type == 'BCE':
        # For MNIST (Sigmoid output, [0, 1] data)
        # Use reduction='sum'
        # TODO
        RECON_LOSS = torch.nn.functional.binary_cross_entropy(x_recon_flat, x_fla
                                                              reduction='sum')
    elif loss_type == 'MSE':
        # For other data types (e.g., Tanh output, [-1, 1] data)
        # TODO
        RECON_LOSS = torch.nn.functional.mse_loss(x_recon_flat, x_flat,
                                                  reduction='sum')
    else:
        raise ValueError("Invalid loss type")
```

3. Conditional Variational Autoencoders (cVAE)

Some more text.