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Answer the following questions briefly (no more than a few sentences), and provide output images where requested.

Show final results from training both your GAN and LSGAN (give the final 4x4 grid of images for both):
GAN:

Iter: 24500, D: 1.241, G:1.004



LSGAN:

Iter: 24500, D: 0.1544, G:0.393



Discuss any differences you observed in quality of output or behavior during training of the two GAN models.

- Differences in quality of output
 - GAN: There is a generated image in second row, which seems not like a cat, it's basically all black
 - LSGAN: There are possible mode collapse in LSGAN, the output cats looks similar

- Differences in behavior
 - GAN: After 10 epochs, we can observe reasonable fake cat images
 - LSGAN: takes more epochs to make great fake cat images, about 30 epochs

Do you notice any instances of mode collapse in your GAN training (especially early in training)? Show some instances of mode collapse (if any) from your training output.

- Yes, there is mode collapse in early training
- Samples:

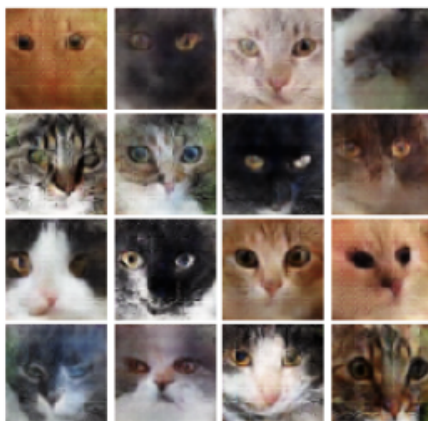
Iter: 2250, D: 0.7617, G:1.446 Iter: 4250, D: 1.301, G:1.008



Discuss briefly how/whether spectral normalization helps generate higher quality images in your implementation. Ideally, you should show samples from models with and without normalization.

- Spectral normalization helps generate higher quality images
 - With batch normalization, the outputs are in some way twisted.
 - Spectral normalization don't seem to have this issue
- With batch normalization:
 - GAN

Iter: 24500, D: 1.127, G:3.23



- LSGAN

Iter: 24500, D: 0.04648, G:0.438



- With spectral normalization:

- GAN

Iter: 24500, D: 1.241, G:1.004



- LSGAN

Iter: 24500, D: 0.1544, G:0.393



Extra credit: If you completed the extra credit for this portion, explain what you did (describing all model changes and hyperparameter settings) and provide output images.