FACE IMAGE OCCLUSION RESTORATION

Ahmet Melek - Introduction to Biometrics Project Final Presentation

PURPOSE & DATA

- Regenerating the blocked regions of face photographs.
- Synthetic occlusions for training.
- Using black & white images.

DATA

- Changed the Dataset to aligned UTK Dataset
- Occluded:
  - Half Face (4000 images)
  - Unconstrained Eyes (13000 images)

QUICK SUMMARY

- Old Problems:
  - Some layers do not take input.
  - Discriminator Loss does not change.
  - GPU memory problems.
- Solved old problems.
- Used many different:
  - Configurations on loss types
  - Batching methods
  - Learning rates and optimizers,
  - Data groups
- Often came across a mode collapse.

UTILIZED METHODS

- Proposed to use strides instead of pooling. Saw that pooling is used a lot. Used pooling in the progress.
  - Learned that I was wrong, after many trainings. (sparse gradients)
- Used L2 loss in the final experiment. Used GAN loss in all experiments.
- Focus on whole image.
- Google Colab.

UTILIZED METHODS

- Minibatch technique
- Isolated minibatch technique

- Dloss = cross_ent(disc_out,disc_label)
- Gloss = (1-log(Dloss))

Reverse Loss Vs Unique Loss

- Dloss = cross_ent(disc_out,disc_label)
- Gloss = cross_ent(gan_out,gan_label)

- Used Adam as optimizer

- Soft Labels vs Hard Labels
  - Normal Distribution, Std = 0.1

FIRST VERSIONS

- Tried to modify already implemented GANs

-Rowel Atienza
-Siraj Raval
-eriklindernoran

-Always got an error-

- Then started from scratch:

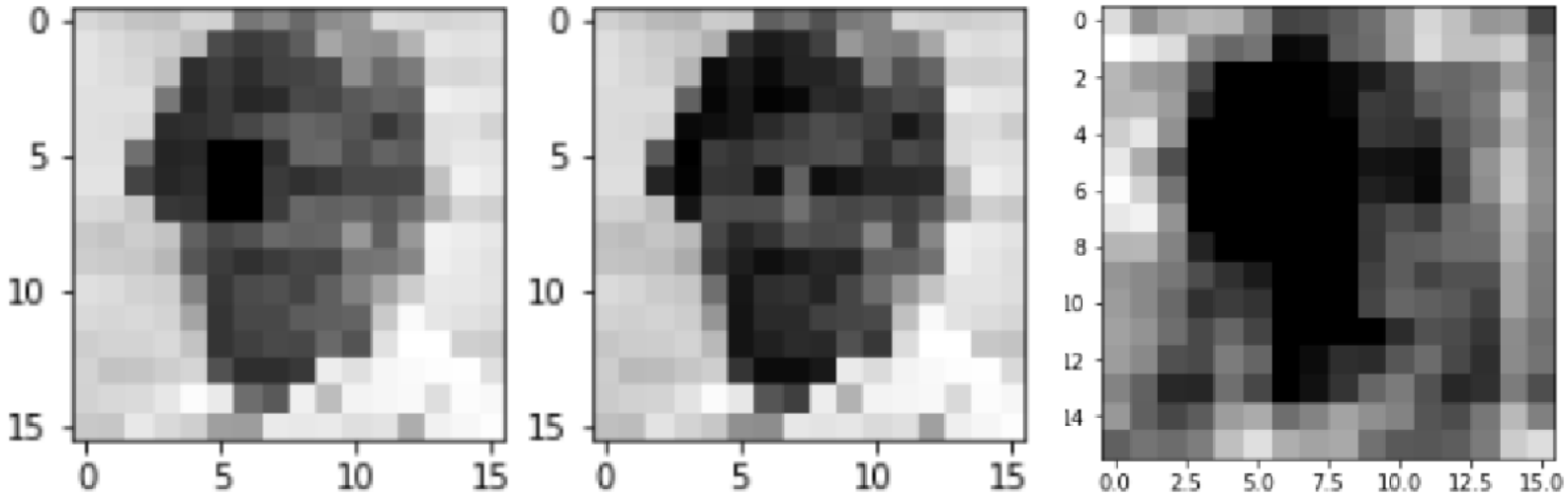
-One layered, dense GAN
-One layered Conv-GAN
…

LATER VERSIONS

- After first versions I continued to improve the “from scratch” models.

In this presentation, I show these models’ results.

RESULTS – TEST – V1.0



Learning Rates:
Generator: 0.00010 Disc: 0.00015

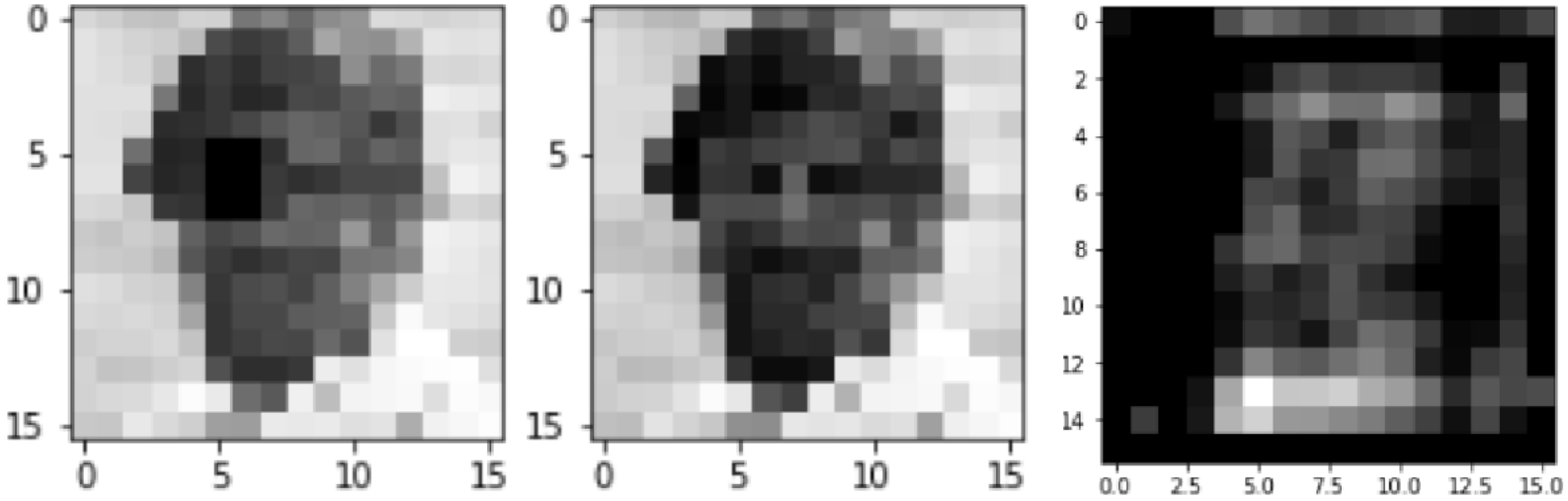
One Layered Generator
One Layered Discriminator

Resolution of Input: Very Low (16x16)*
Number of Input: 1800
Occlusion Size: Small

Epoch Count:
1000 epochs

*Out of Memory Errors

RESULTS – TEST – V1.1



Learning Rates:
Generator: 0.00010 Disc: 0.00015

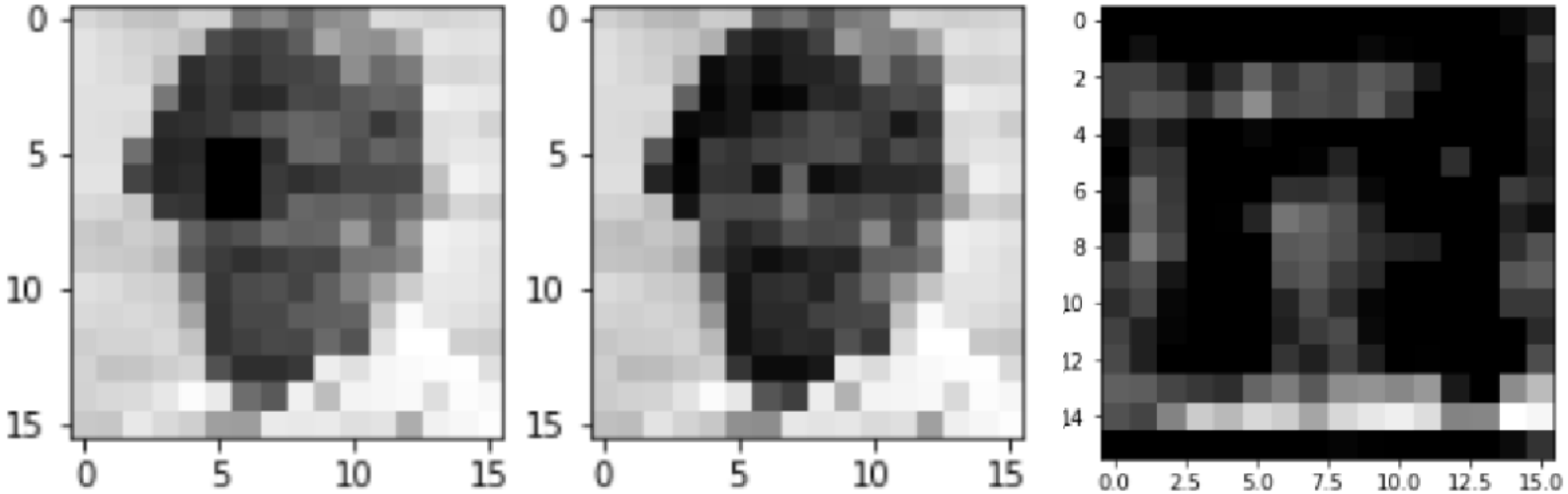
Three Layered Generator
Three Layered Discriminator

Resolution of Input: Very Low (16x16)*
Number of Input: 1800
Occlusion Size: Small

Epoch Count:
10 epochs**

*Out of Memory Errors
**Just to try

RESULTS – TEST – V1.1.2



Resolution of Input: Very Low (16x16)*
Number of Input: 1800
Occlusion Size: Small

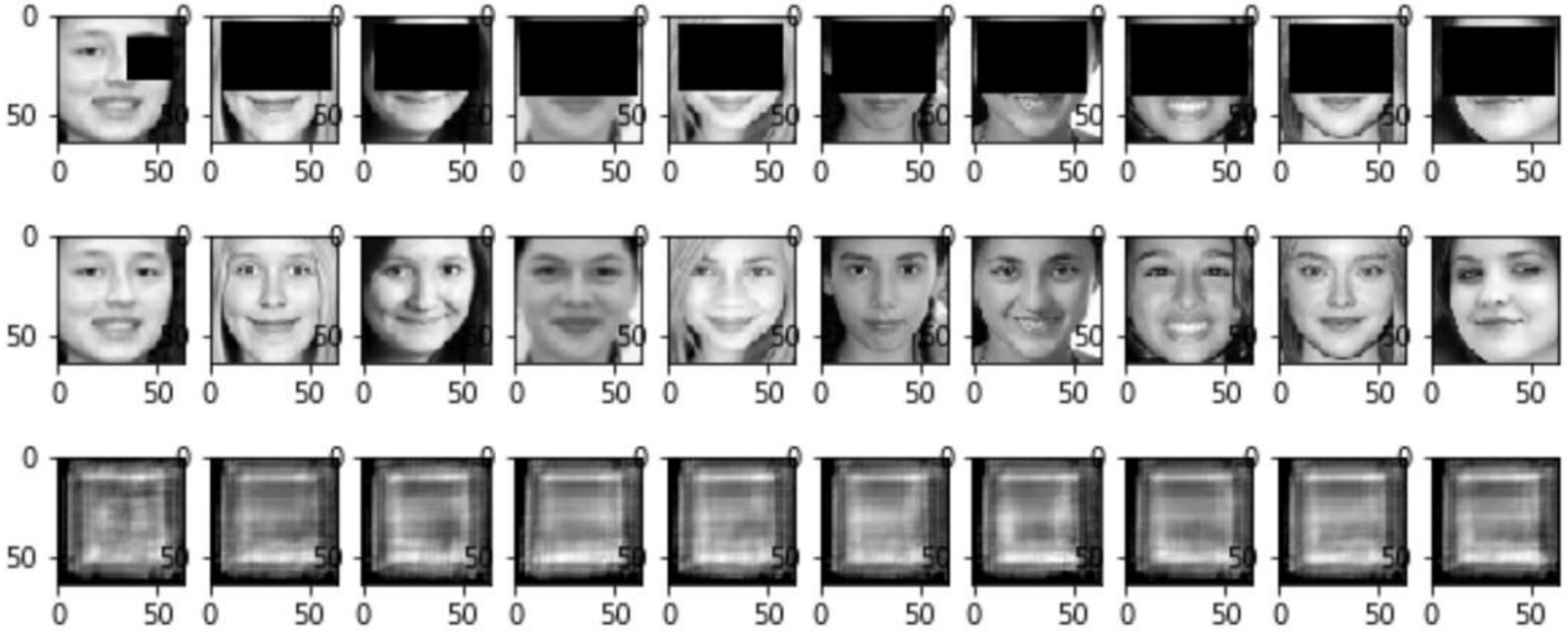
Learning Rates:
Generator: 0.00010 Disc: 0.00015

Epoch Count:
46 epochs**

*Out of Memory Errors
****Resource Exh Errors**
(due to eval())

Three Layered Generator
Three Layered Discriminator

RESULTS – TEST – V2.6



Learning Rates:
Generator: 0.00010 Disc: 0.00010

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

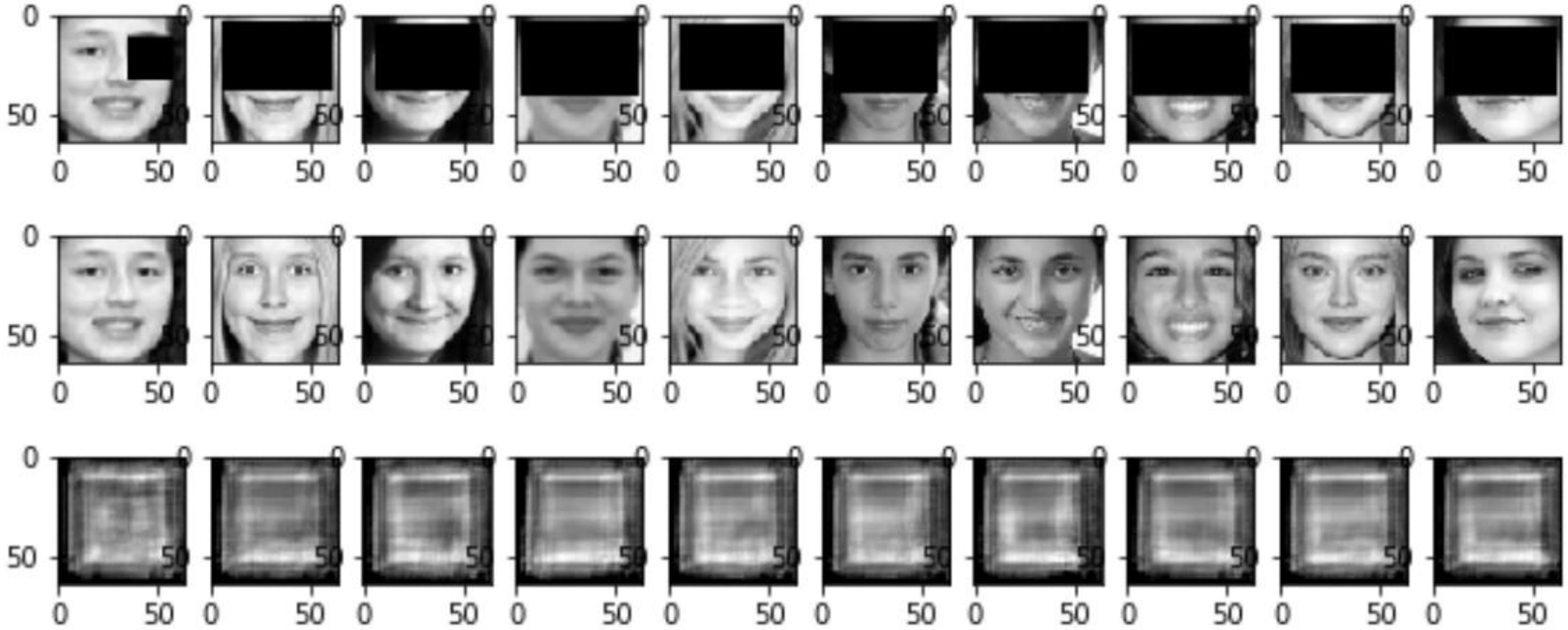
Eight Layered Generator
Six Layered Discriminator

Minibatch Technique: Yes
Isolated Minibatches: No

Epoch Count:
25 epochs**

*Threw out some eval()
**Very quick mode col.

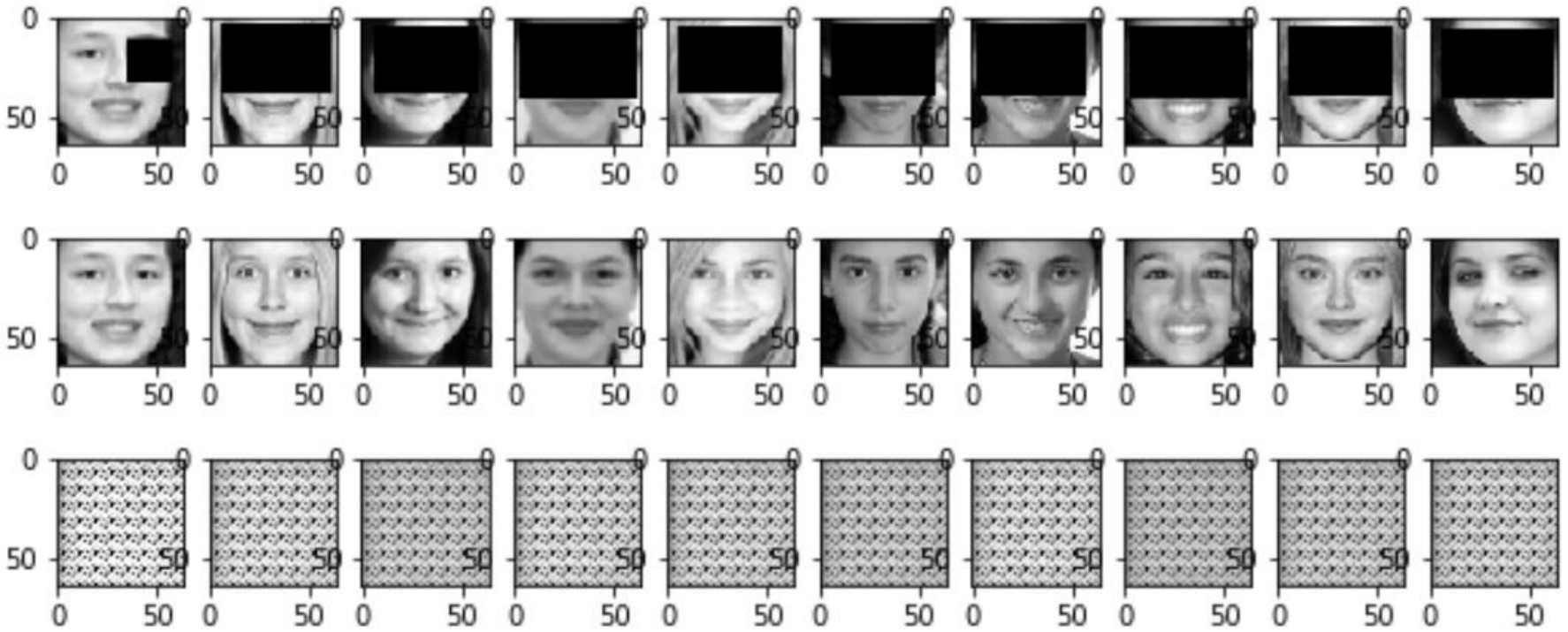
MODE COLLAPSE



Same output for every input

How to catch it: Generator loss converges to zero.

RESULTS – TEST – V2.7.1



Learning Rates:
Generator: 0.000010 Disc: 0.000010

Eight Layered Generator
Six Layered Discriminator
Bottleneck: Yes

Soft Labels: No
Soft D/Usample: Yes (no sparse)
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: No

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
Unsure, Until Mode Collapse

RESULTS – TEST – V2.7.2

Learning Rates:
Generator: 0.000010 Disc: 0.000010

Eight Layered Generator
Six Layered Discriminator
Bottleneck: Yes

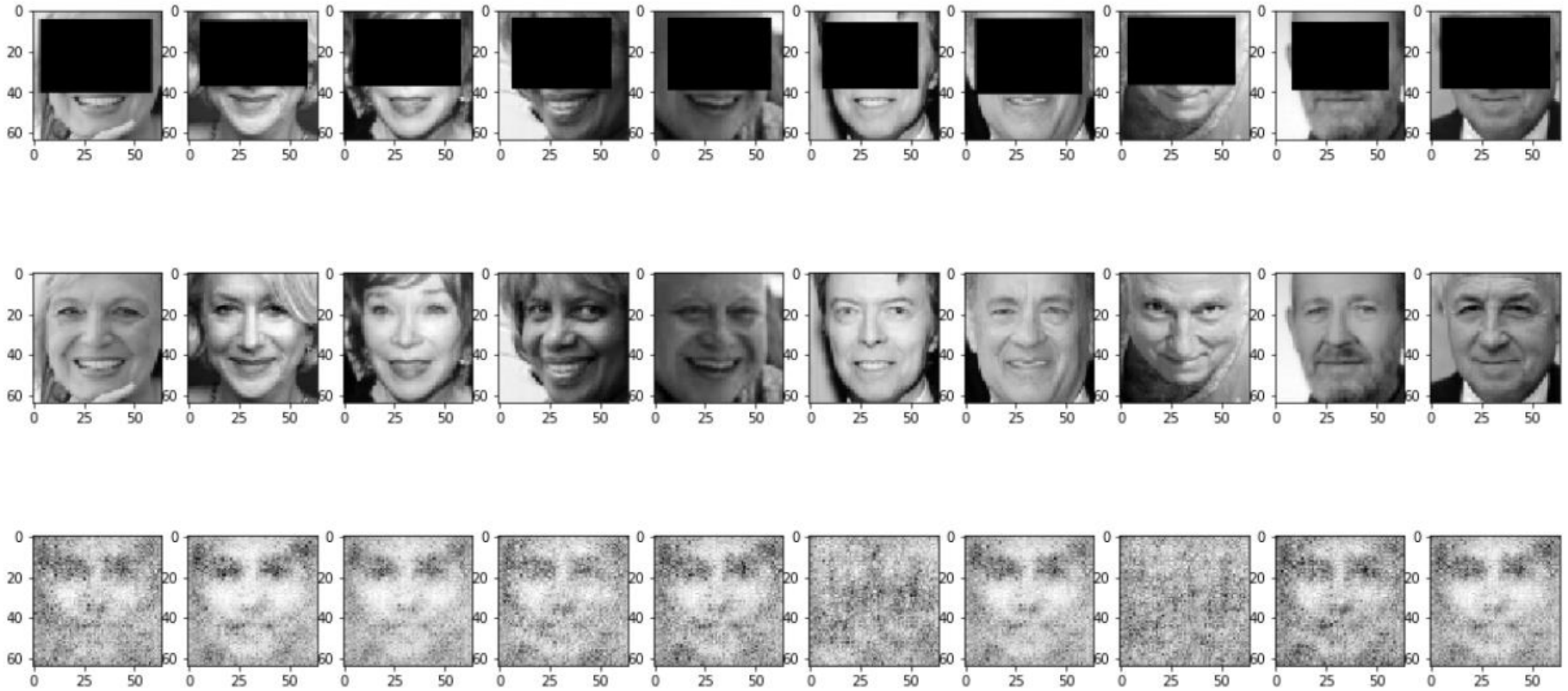
Soft Labels: No
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
305 (Saved 250 epoch version)

RESULTS – TEST – V2.8



Learning Rates:
Generator: 0.000010 Disc: 0.000020

Eight Layered Generator
Six Layered Discriminator
Bottleneck: Yes

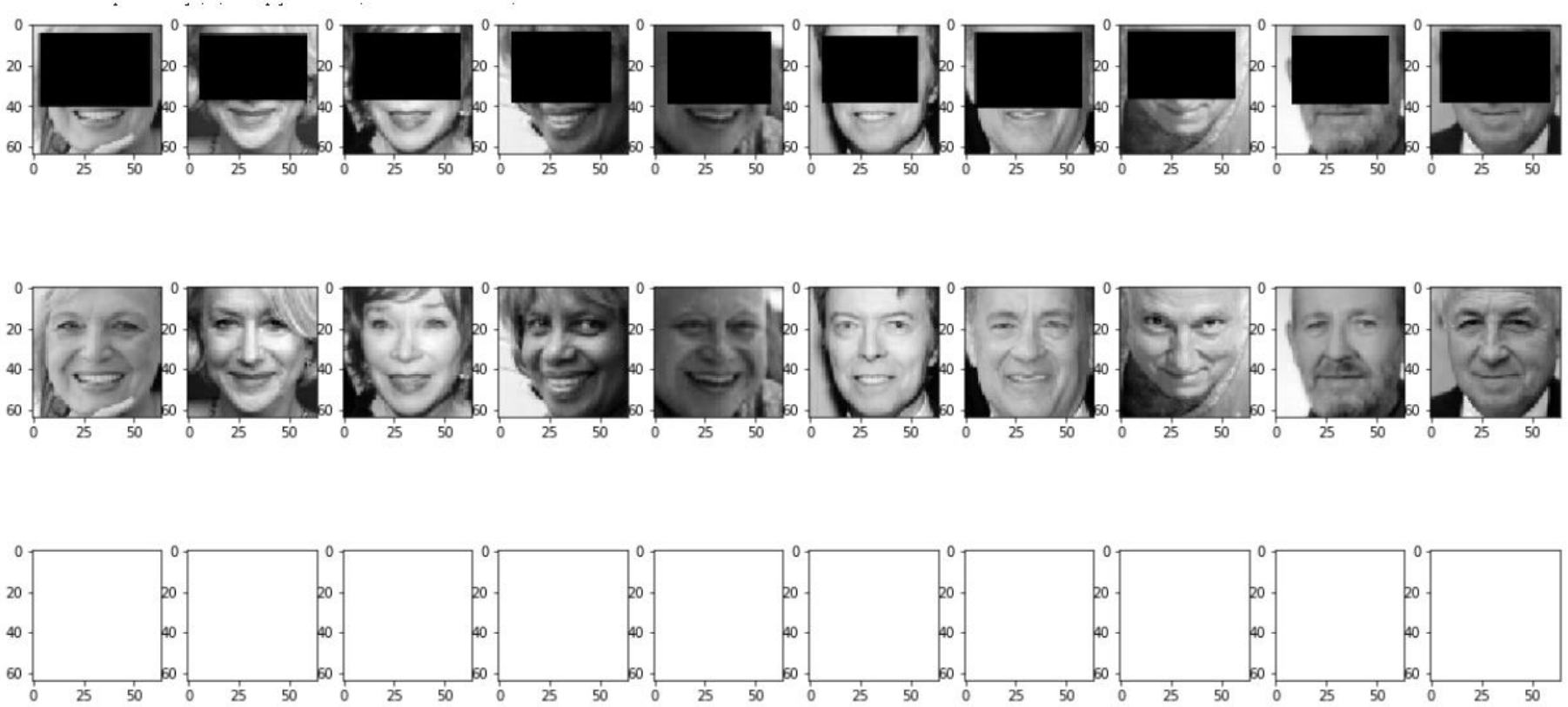
Soft Labels: Yes Salimans et. al. 2016
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
38 (Saw Mode Collapse)

RESULTS – TEST – V2.9



Learning Rates:
Generator: 0.000010 Disc: 0.000020

Eight Layered Generator
Six Layered Discriminator
Bottleneck: Yes

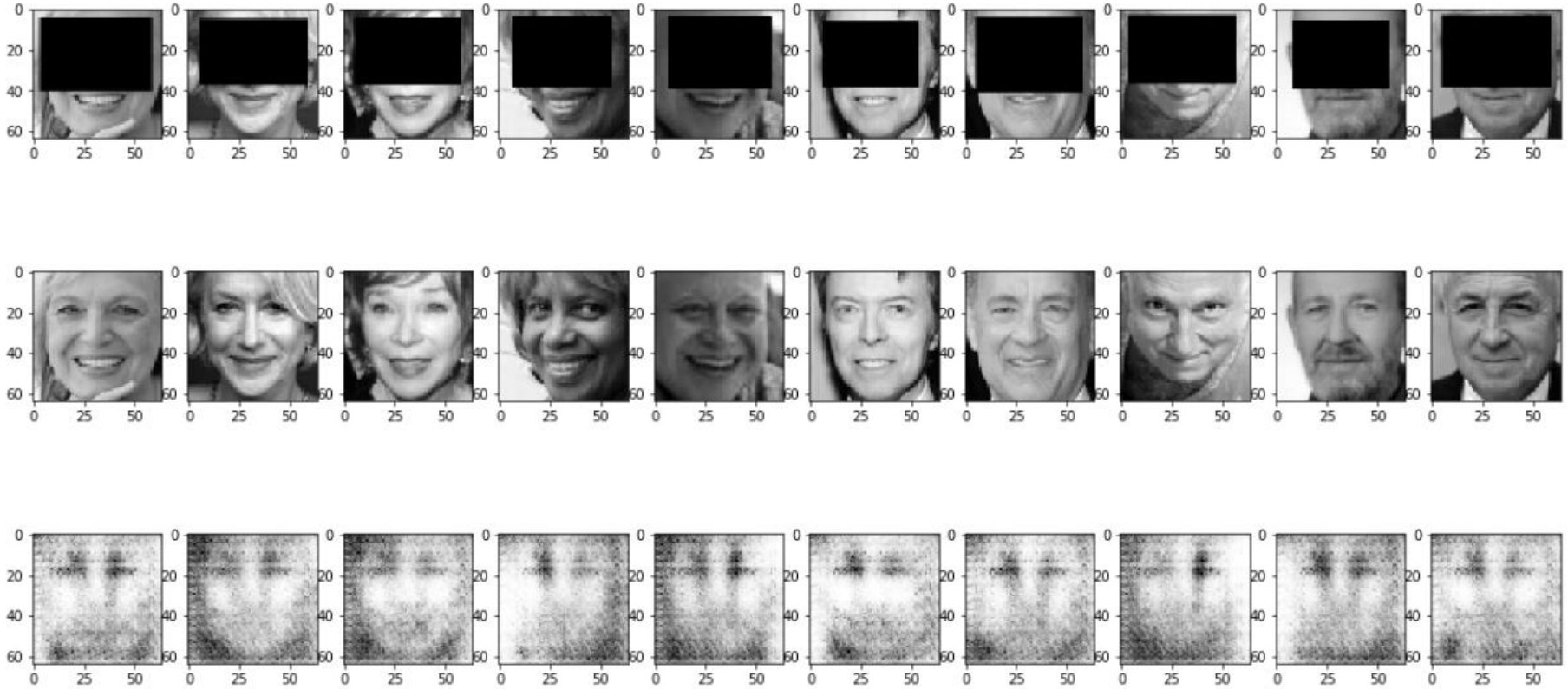
Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: Yes

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
64 (Saw Constant test loss during training)

RESULTS – TEST – V3.0



Learning Rates:
Generator: 0.000010 Disc: 0.000020

Six Layered Generator
Three Layered Discriminator
Bottleneck: No

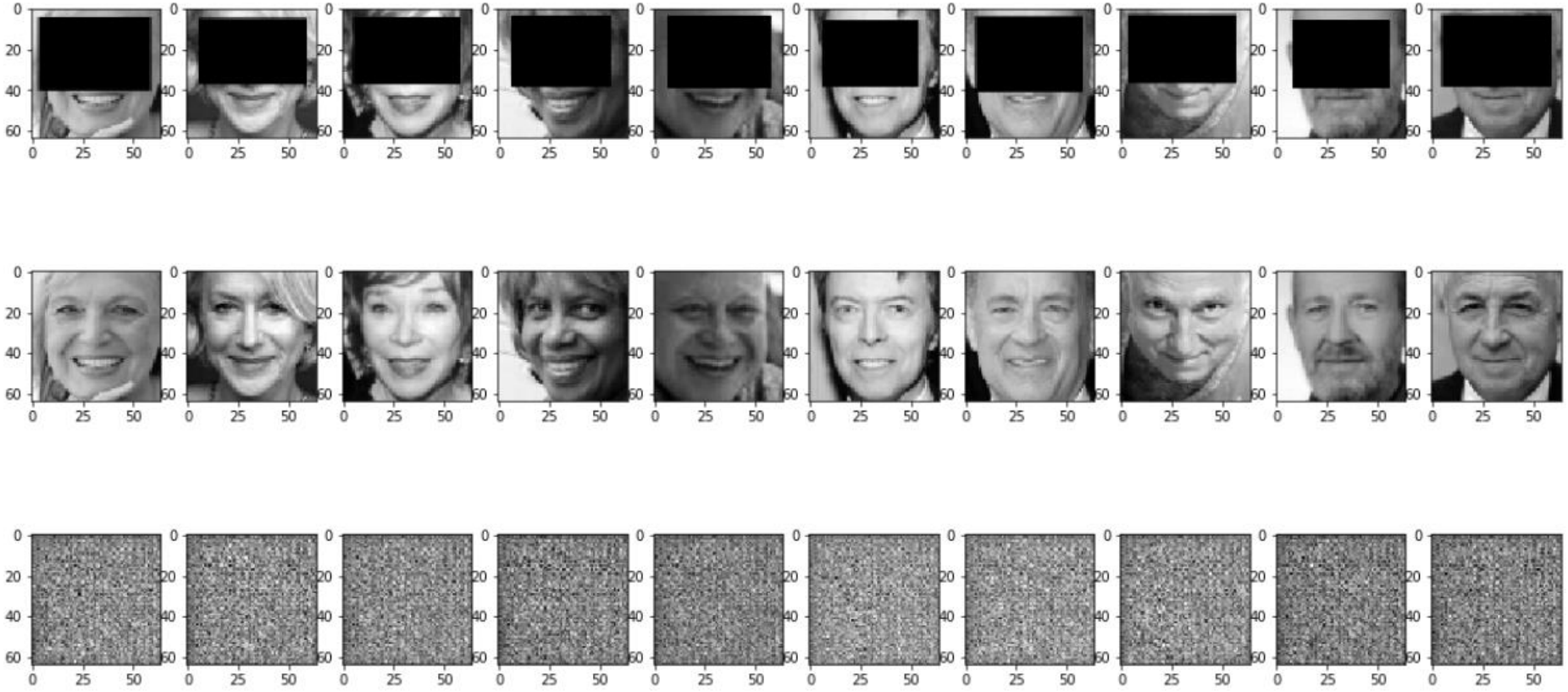
Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
633 (Saved 250 and 500 versions)

RESULTS – TEST – V3.1



Used a lot of Dropout

Learning Rates:
Generator: 0.000010 Disc: 0.000020

Eight Layered Generator
Four Layered Discriminator
Bottleneck: No

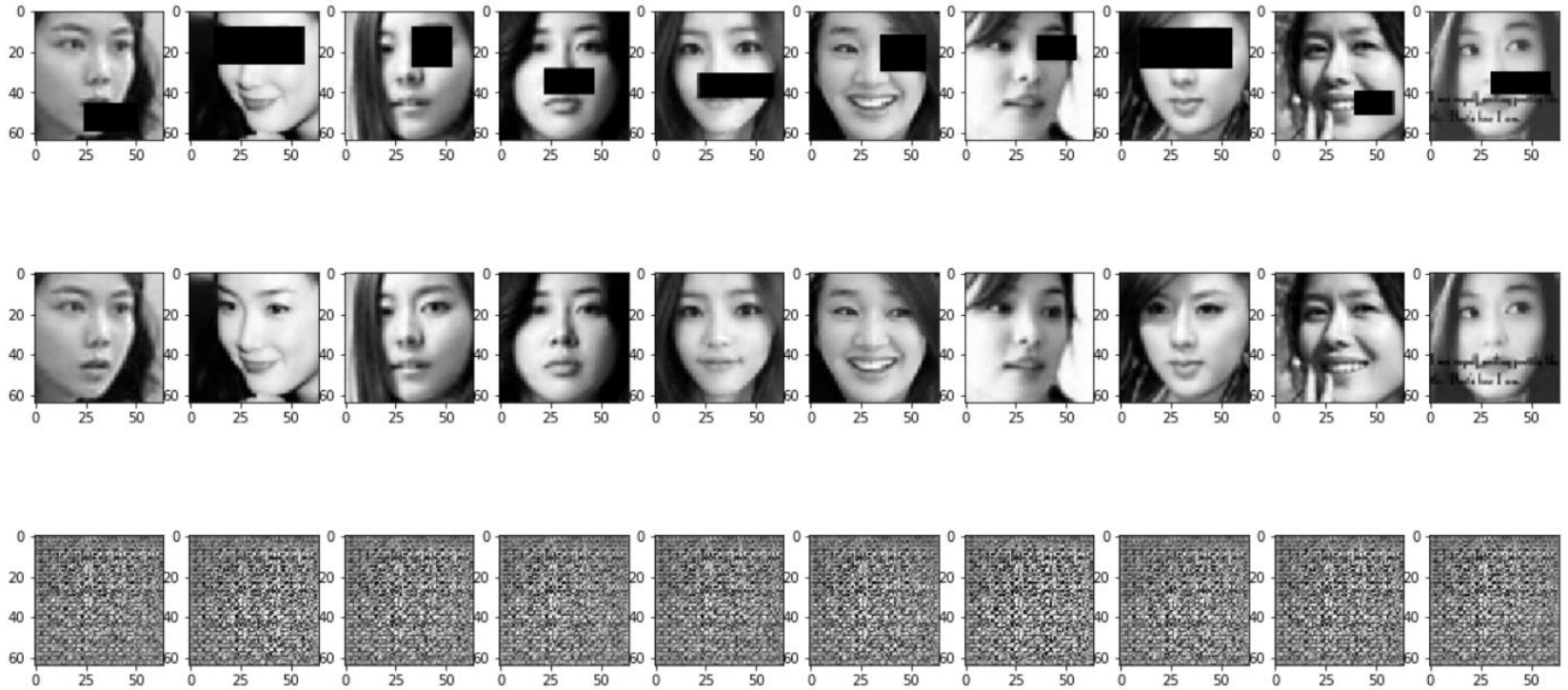
Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
30

RESULTS – TEST – V3.2



Unconstrained the occlusion process to obtain more data.

Added one more layer to each model.
(8m parameters)

Learning Rates:
Generator: 0.00010 Disc: 0.00020

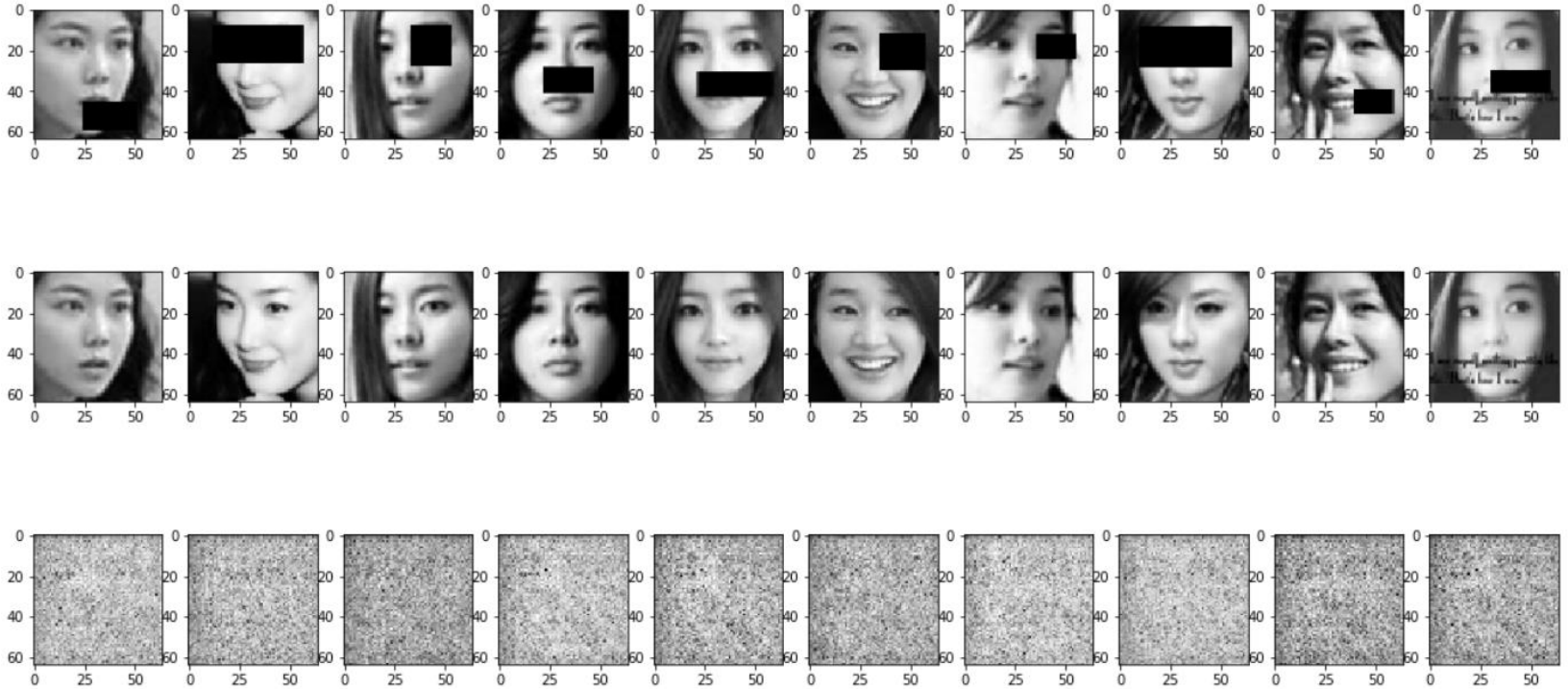
Ten Layered Generator
Five Layered Discriminator
Bottleneck: No

Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 13195 (200x64 batch)
Occlusion Size: Eyes
Epoch Count:
23

RESULTS – TEST – V3.2.2



Unconstrained occlusion to obtain more data.

(8m parameters)

Learning Rates:
Generator: 0.00010 Disc: 0.00020

Ten Layered Generator
Five Layered Discriminator
Bottleneck: No

Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

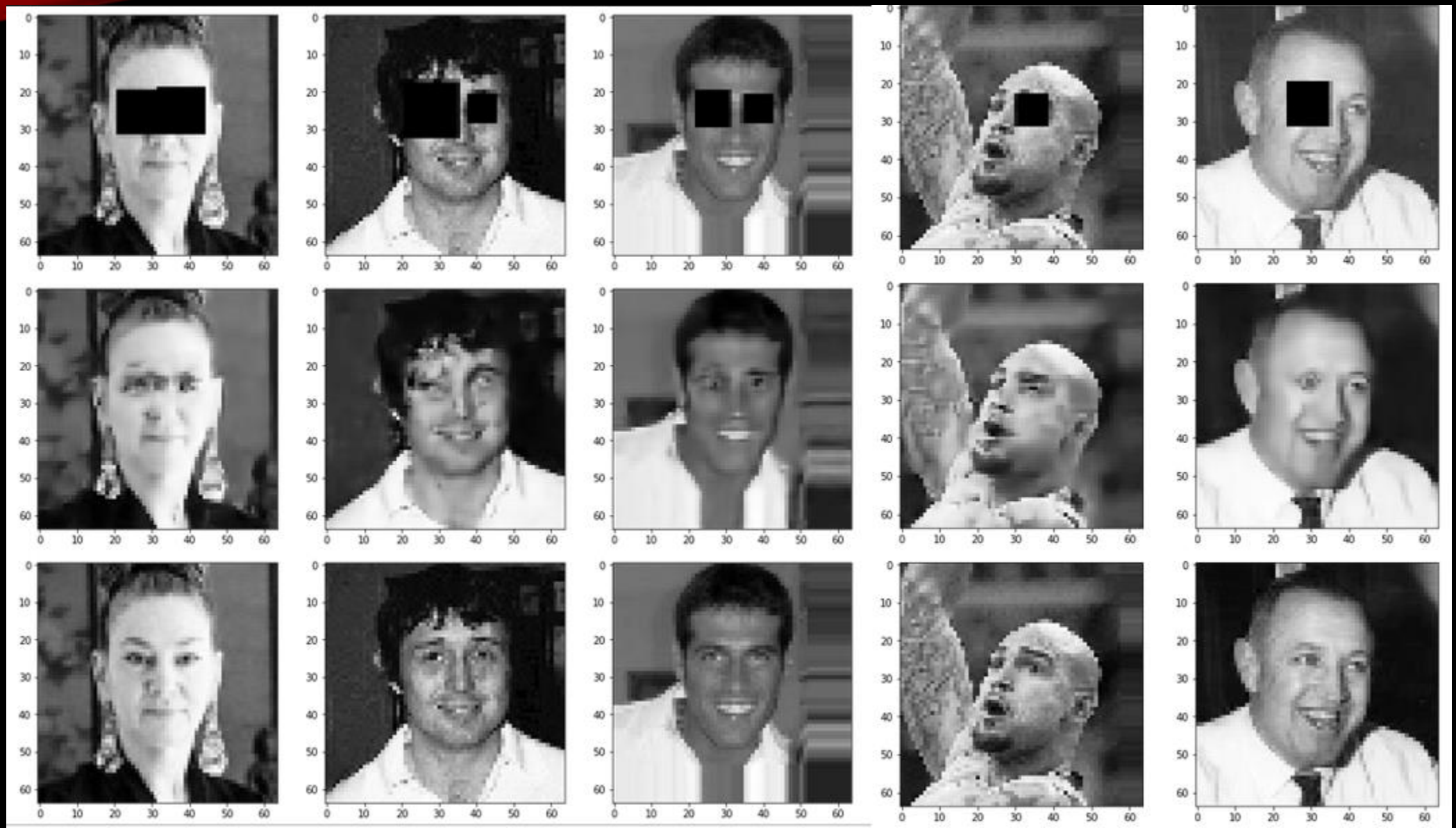
Resolution of Input: Medium (64x64)*
Number of Input: 13195 (65x64 batch)
Occlusion Size: Eyes

Epoch Count:
More than 50

Some Thoughts:

- Could not solve mode collapse in these versions.
- Obtained more meaningful results as time passed.
- Best Performance is by the AutoEncoder Model yet. (progress model)

AutoEncoder Results (Progress)

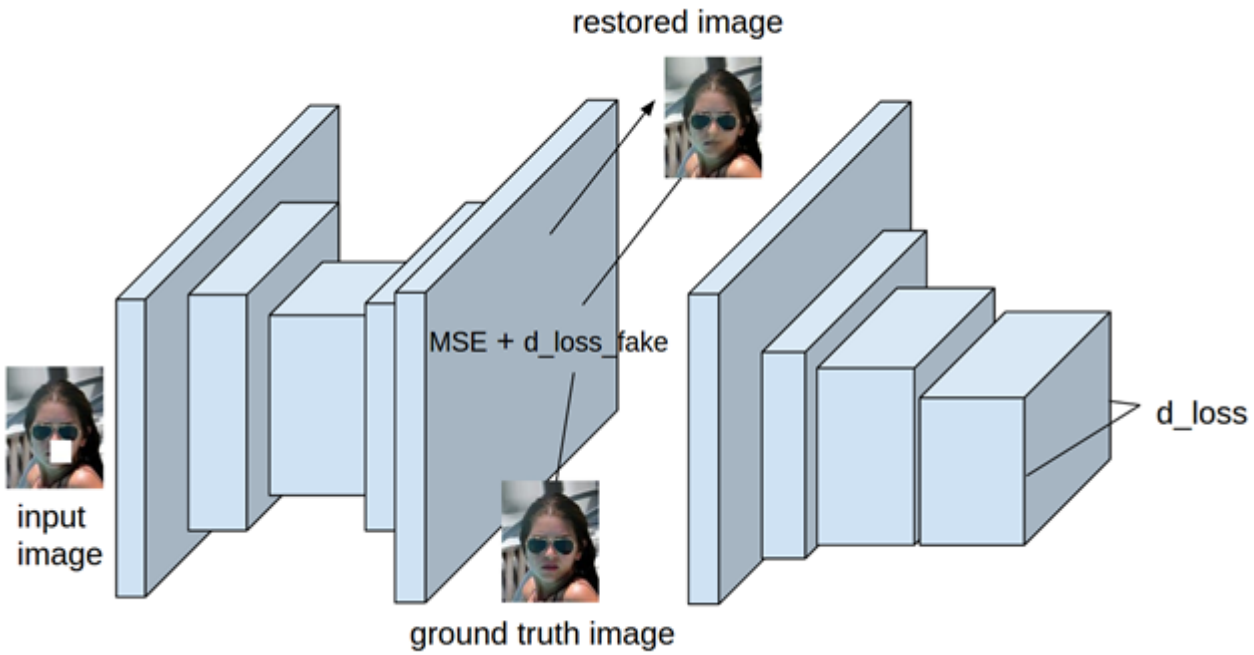


LAST EXPERIMENT:

- Let's use GAN loss and L2 loss together.

Reference:

https://www.cc.gatech.edu/~hays/7476/projects/Avery_Wenchen/



RESULTS – TEST – V3.3

(3m parameters)

Learning Rates:
Generator: 0.000010 Disc: 0.000040

Six Layered Generator
Three Layered Discriminator
Bottleneck: No

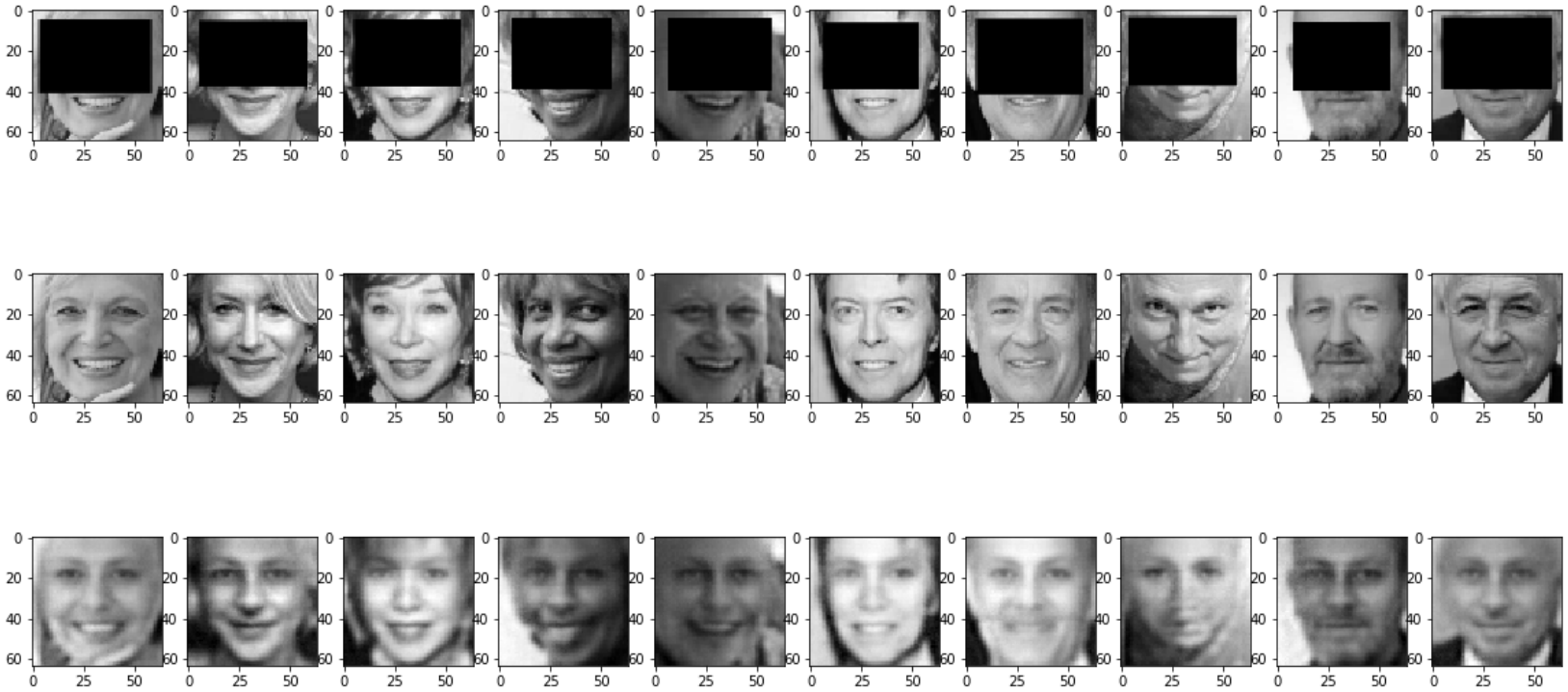
Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: No

Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

Epoch Count:
250 (Saved and shared)

RESULTS – TEST – V3.3.2



(3m parameters)

Learning Rates:
Generator: 0.000010 Disc: 0.000040

Six Layered Generator
Three Layered Discriminator
Bottleneck: No

Soft Labels: Yes
Soft D/Usample: Yes
Reverse Loss: No

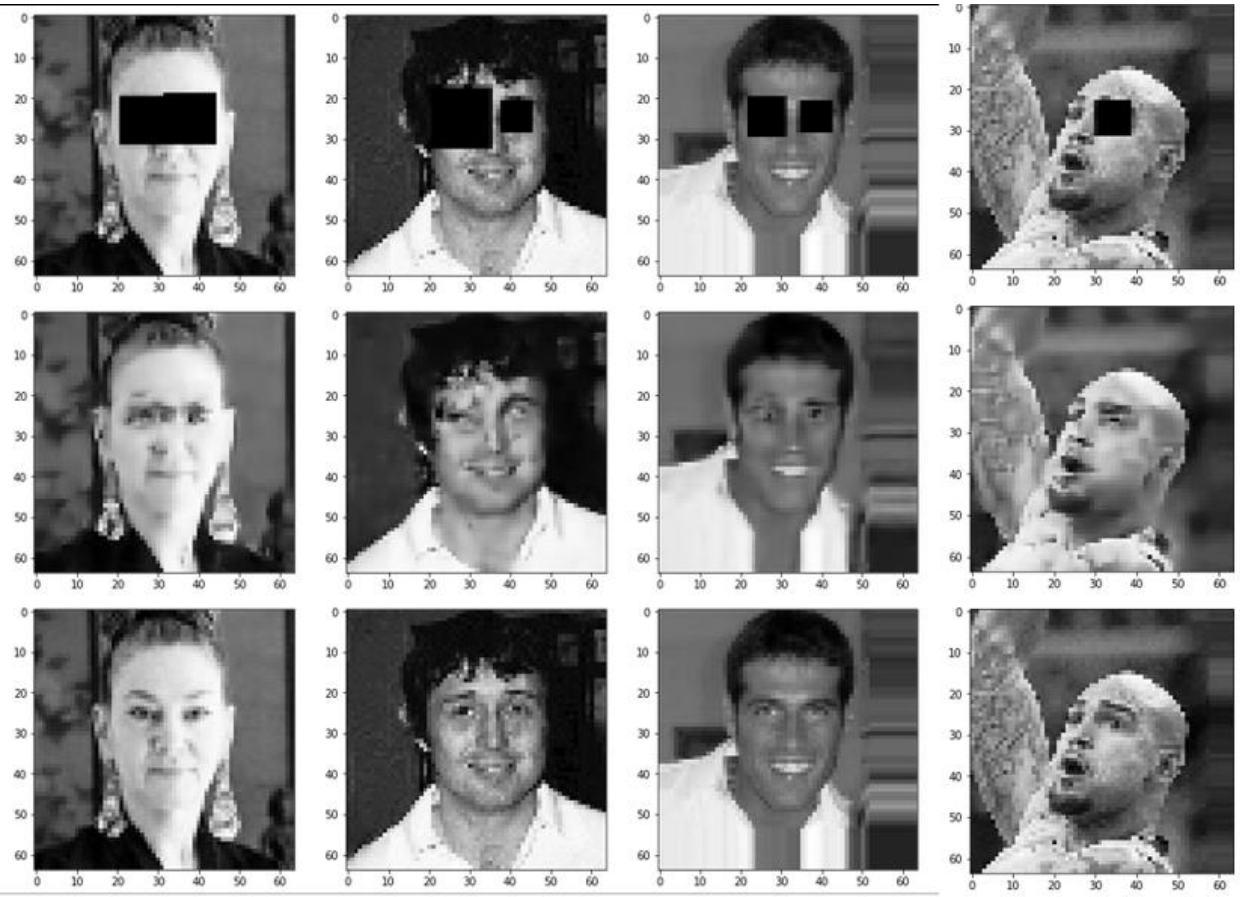
Minibatch Technique: Yes
Isolated Minibatches: Yes

Resolution of Input: Medium (64x64)*
Number of Input: 4160 (65x64 batch)
Occlusion Size: Half-Face

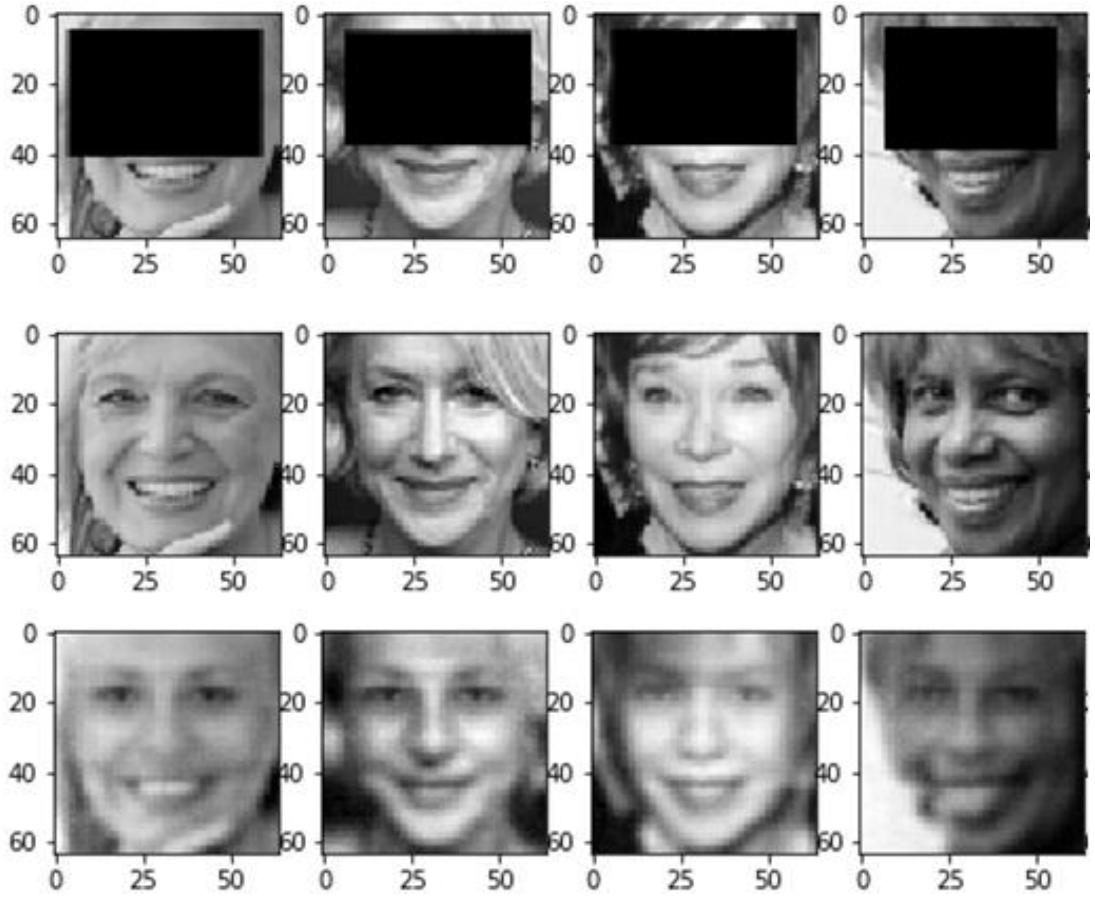
Epoch Count:
500 (Saved and shared)

Comparison of Results

Progress



Final



Final Evaluation:

- Could not obtain a result using GAN loss only. (except mode collapses)
- GAN loss + L2 loss performed better than L2 loss alone. (final vs. progress)
- Faces are still not perfectly satisfying. Increasing dataset size and model complexity may overcome this issue.

Thank You for listening.