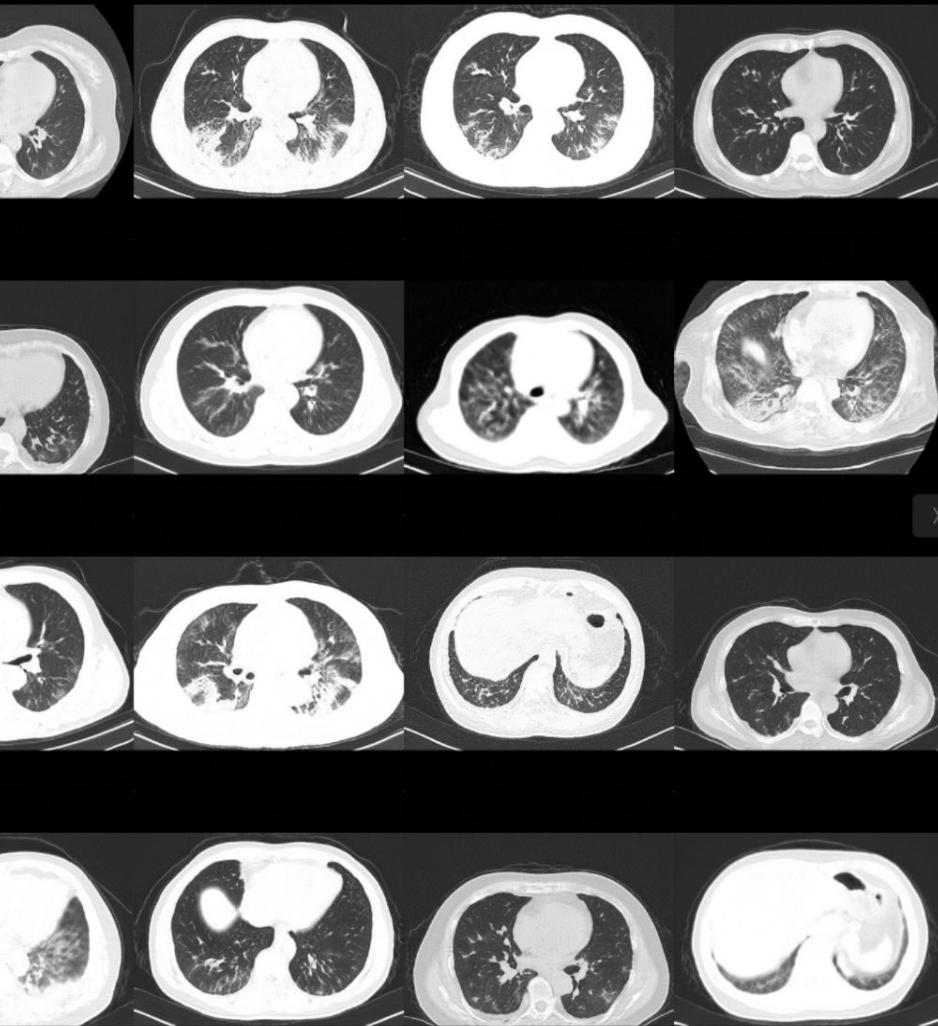


Generating Medical Images with GAN and GANsformer

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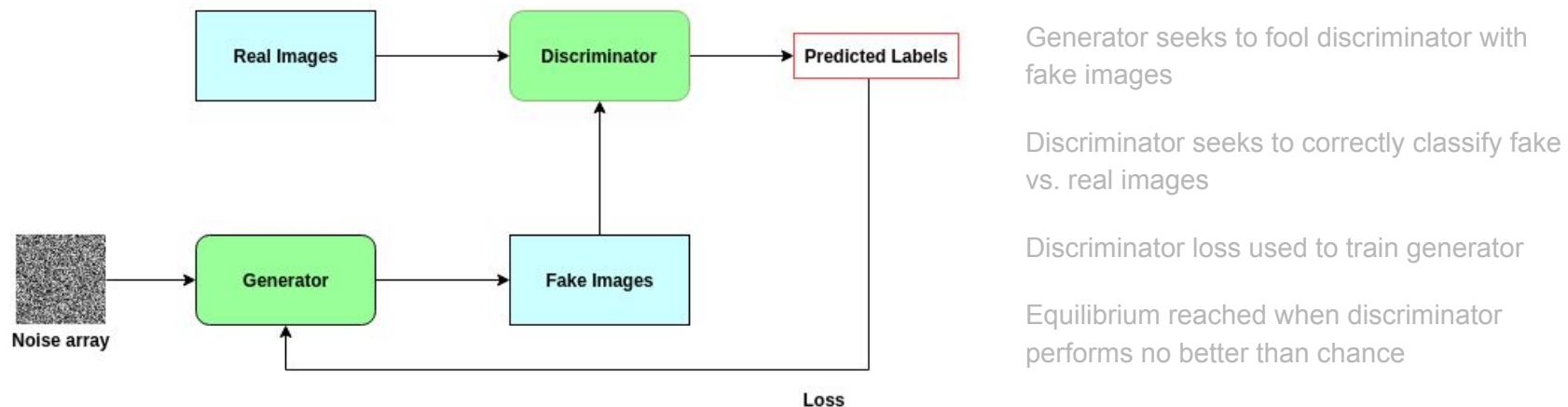
DCGAN

GANsformer

Next steps

What is a GAN or Generative Adversarial Network?

- Architecture that generates plausible images from noise, based on training from real images.
- Goal is images realistic enough to fool professionals in visual Turing test.
- Two CNNs (a generator and a discriminator) compete to outperform the other.



Why it matters (in the domain of medical imaging)

- Images are used to predict or diagnose disease.
- Machine learning models augment professional opinion.
- However, models require large amounts of data to be trained.
- Challenges are:
 - Not enough *available* data (e.g., such as because of privacy concerns).
 - Data is not of high enough quality (e.g., low resolution).
 - Data is not correct modality (e.g., CT vs MRI).
 - Radiation from injections for imaging (e.g., CT).
- GANs can:
 - Generate images to circumvent privacy concerns and are *increasingly* able to reflect the quality and diversity of real images.
 - Augment existing images (e.g., increase resolution).
 - Reduce doses of radioactive imaging agents while producing the same quality.

In the news just a few days ago...

Subtle Medical and Bayer Collaborate to Advance Deep Learning Research to Harness the Power of AI in Medical Imaging

The collaboration has the potential to impact the quality and efficiency of contrast-enhanced MRI exams.



NEWS PROVIDED BY
[Subtle Medical](#) →
Nov 28, 2021, 07:15 ET

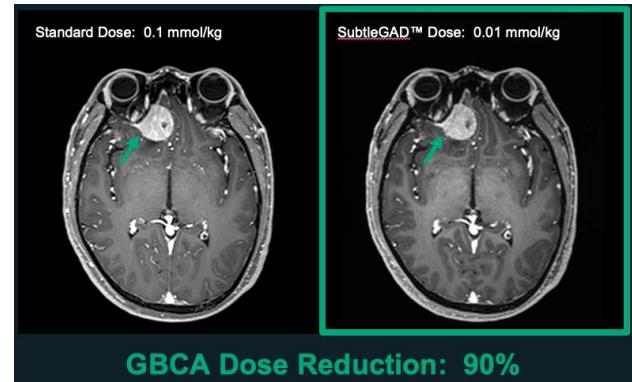
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MENLO PARK, Calif., Nov. 28, 2021 /PRNewswire/ -- Subtle Medical, a leading healthcare technology company, and Bayer,

<https://www.prnewswire.com/news-releases/subtle-medical-and-bayer-collaborate-to-advance-deep-learning-research-to-harness-the-power-of-ai-in-medical-imaging-301432567.html>

Application is to “improve quality of accelerated and low dose imaging”

i.e., to permit images with lower doses of radioactive agents



Dataset: COVIDX CT-2A from Kaggle

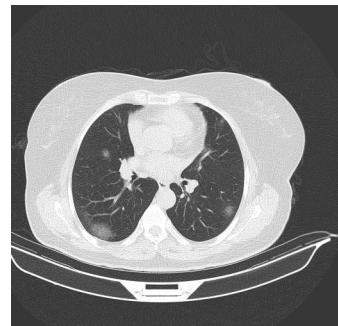
CT-2 Scans of lungs of normal patients, patients with pneumonia, and patients with COVID-19

Image distribution:

Type	Normal	Pneumonia	COVID-19	Total
train	35996	25496	82286	143778
val	11842	7400	6244	25486
test	12245	7395	6018	25658

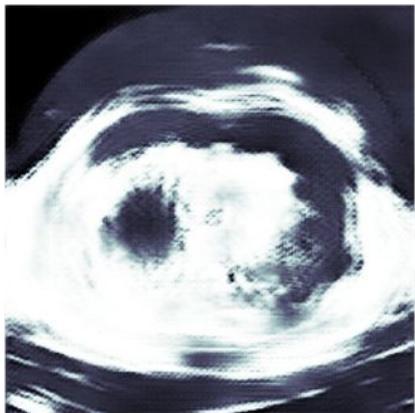
<https://www.kaggle.com/hgunraj/covidxct>

Covid patient scan

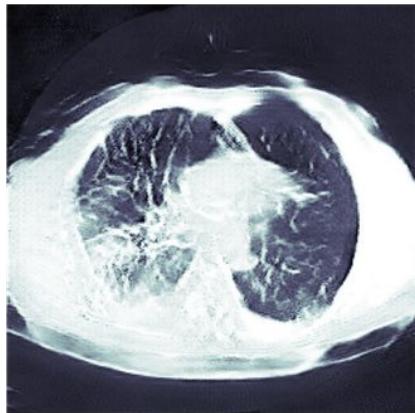


Preliminary Results with DCGAN

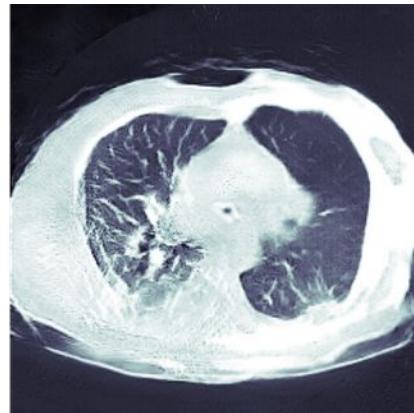
Epoch 1



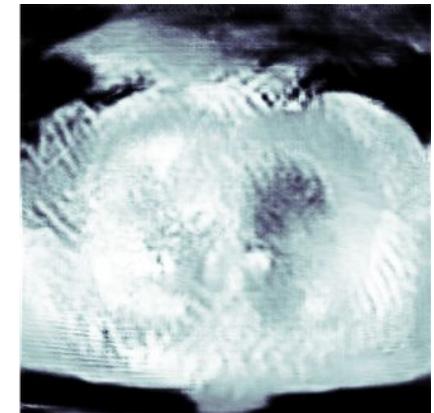
Epoch 15



Epoch 40



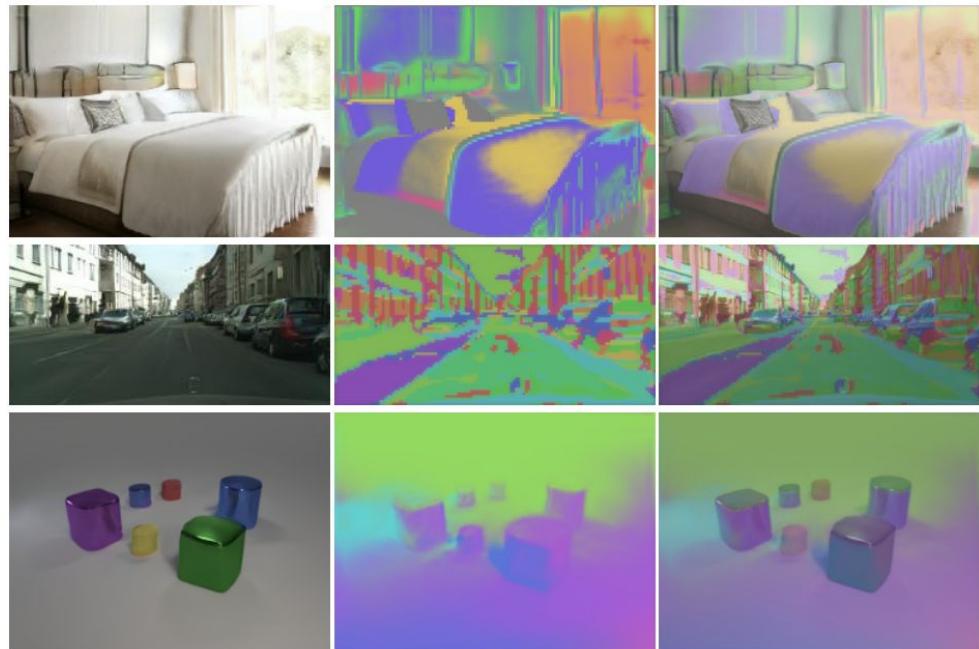
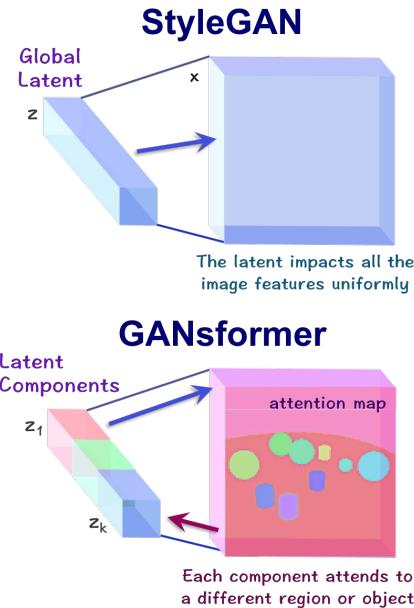
Epoch > 40



Base DCGAN Tweaks:

Soft labeling \\ Adam optimizer \\ Increased size of latent variable vector (50->100) \\ Increased size of convolutional filters \\ Changed to gaussian noise sampling

What is a GANsformer? How is it different?



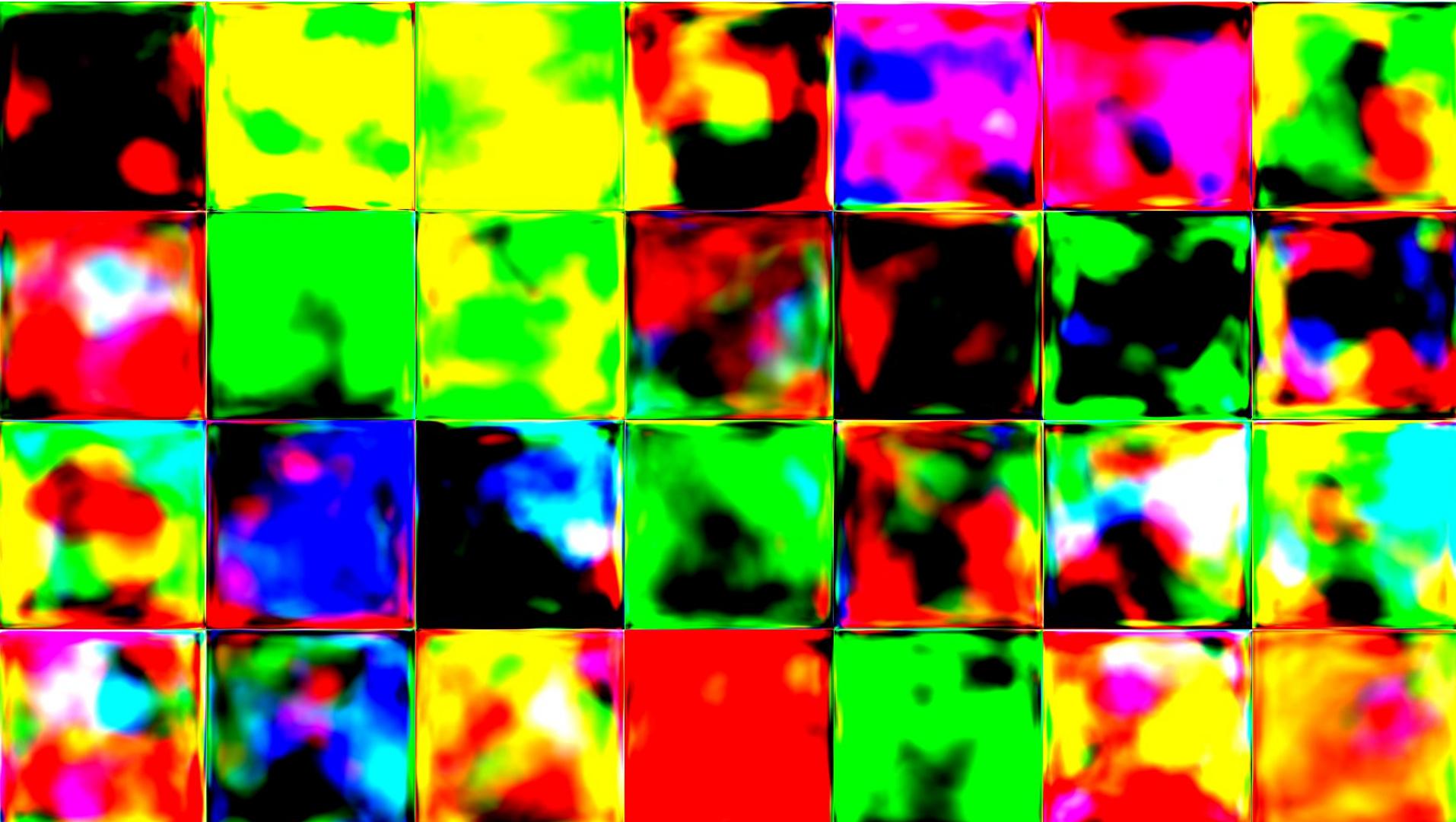
GANsformer Challenges and Results

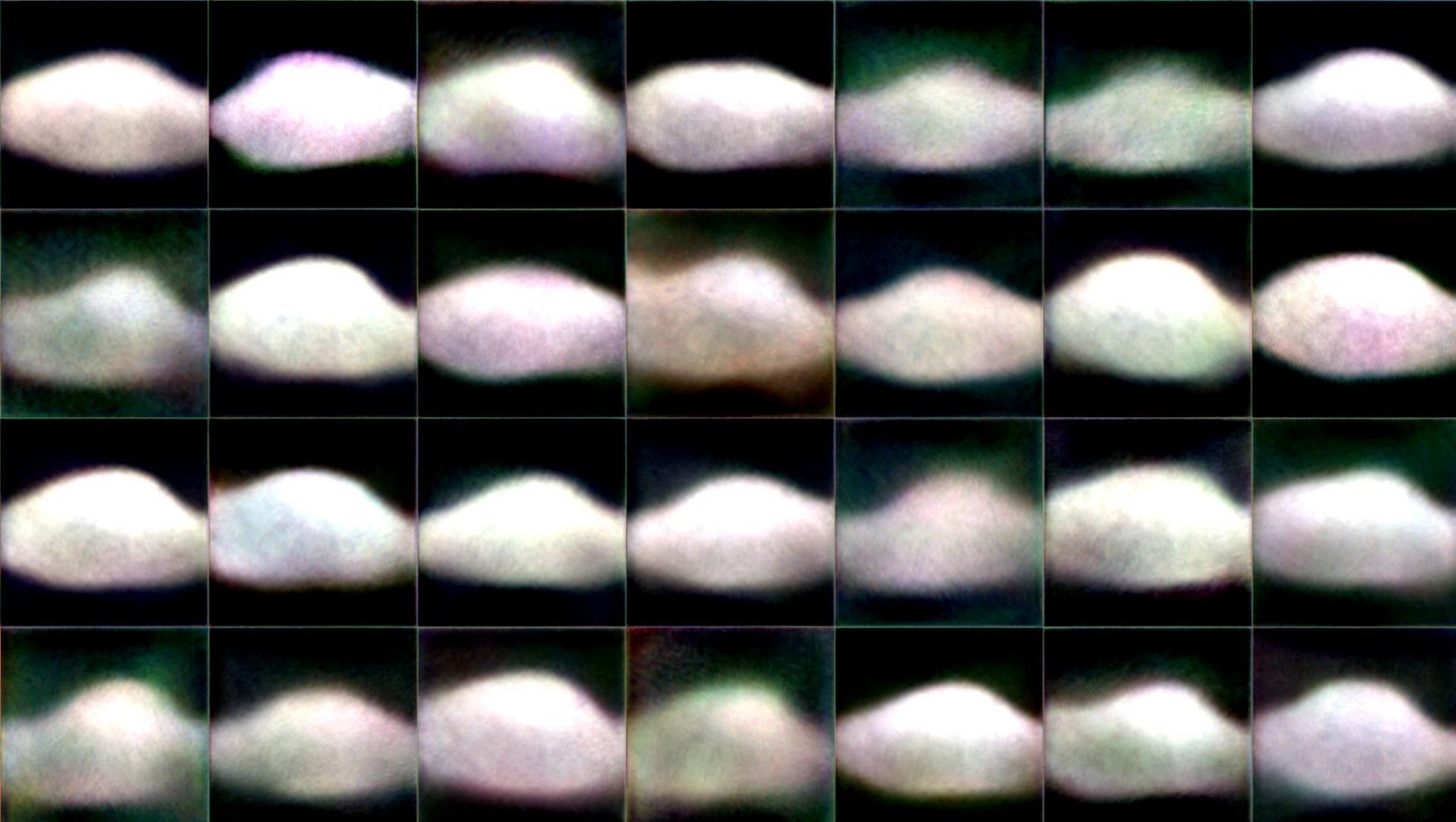
Challenges:

- Training Time
- Computational Resources
- Limited Data \\ CT Head Images

Plan to Overcome Challenges:

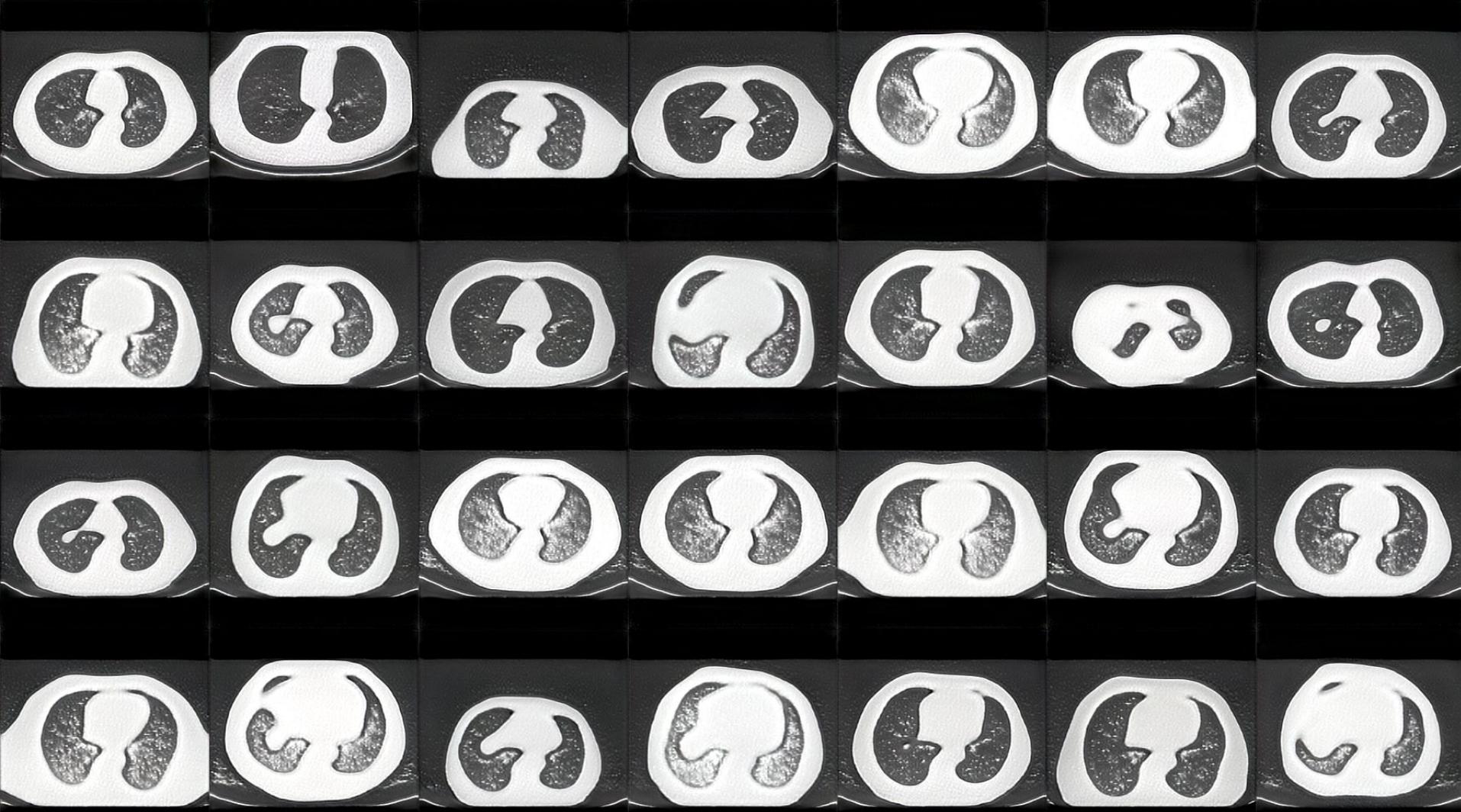
- Utilize a Large Dataset to Transfer Model to New Domain
- Once Trained on CT Scans, Finetune on Smaller Brain Images

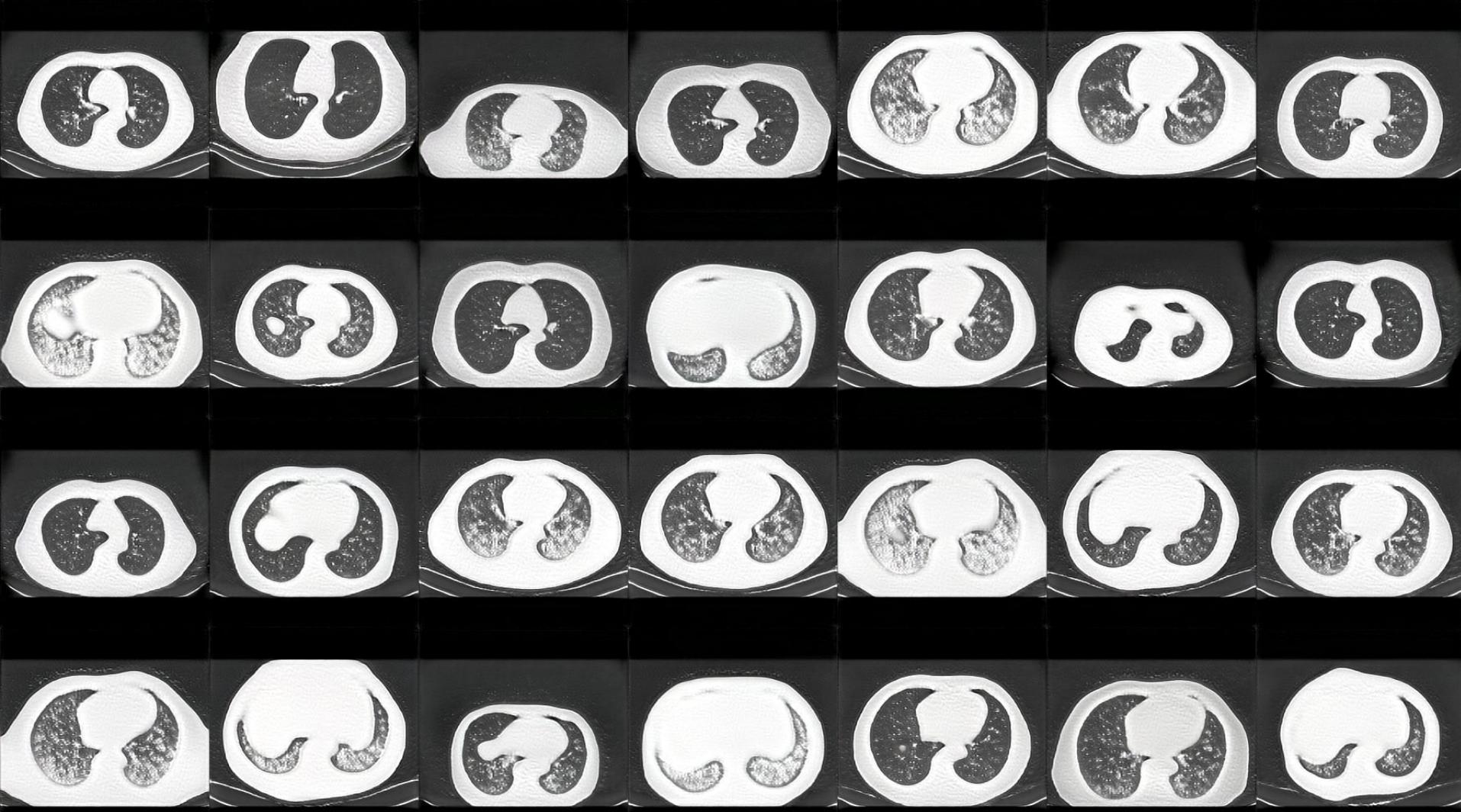


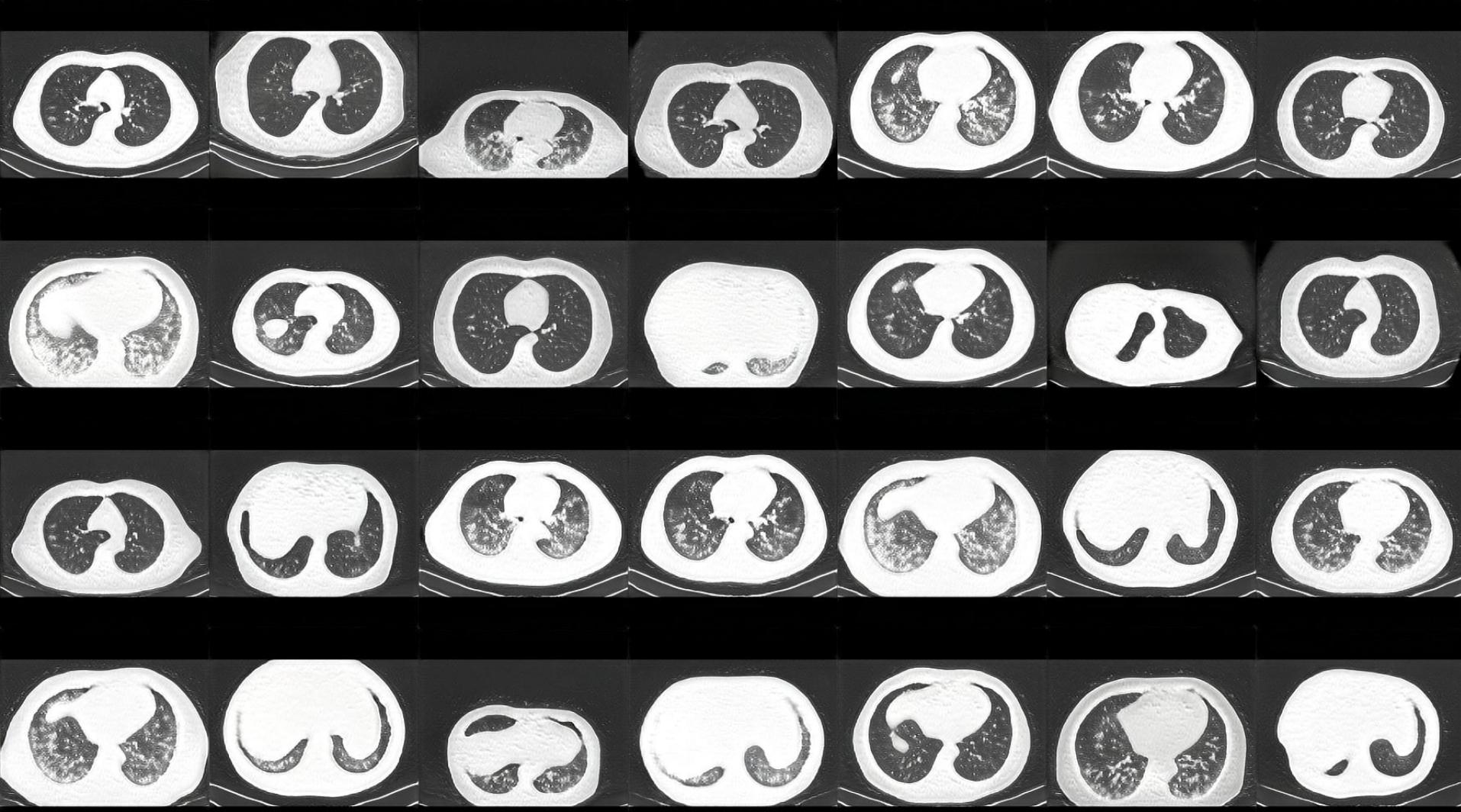


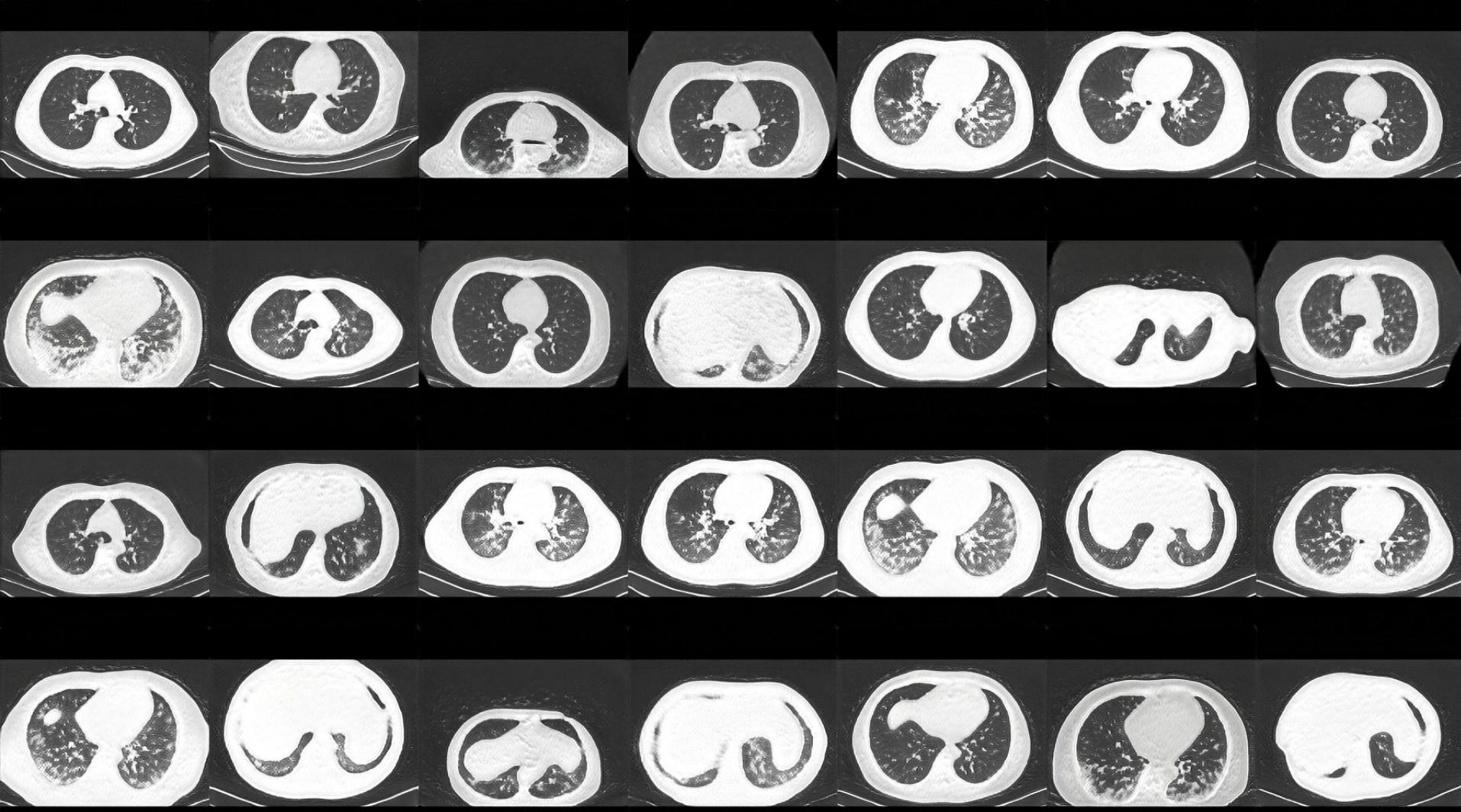


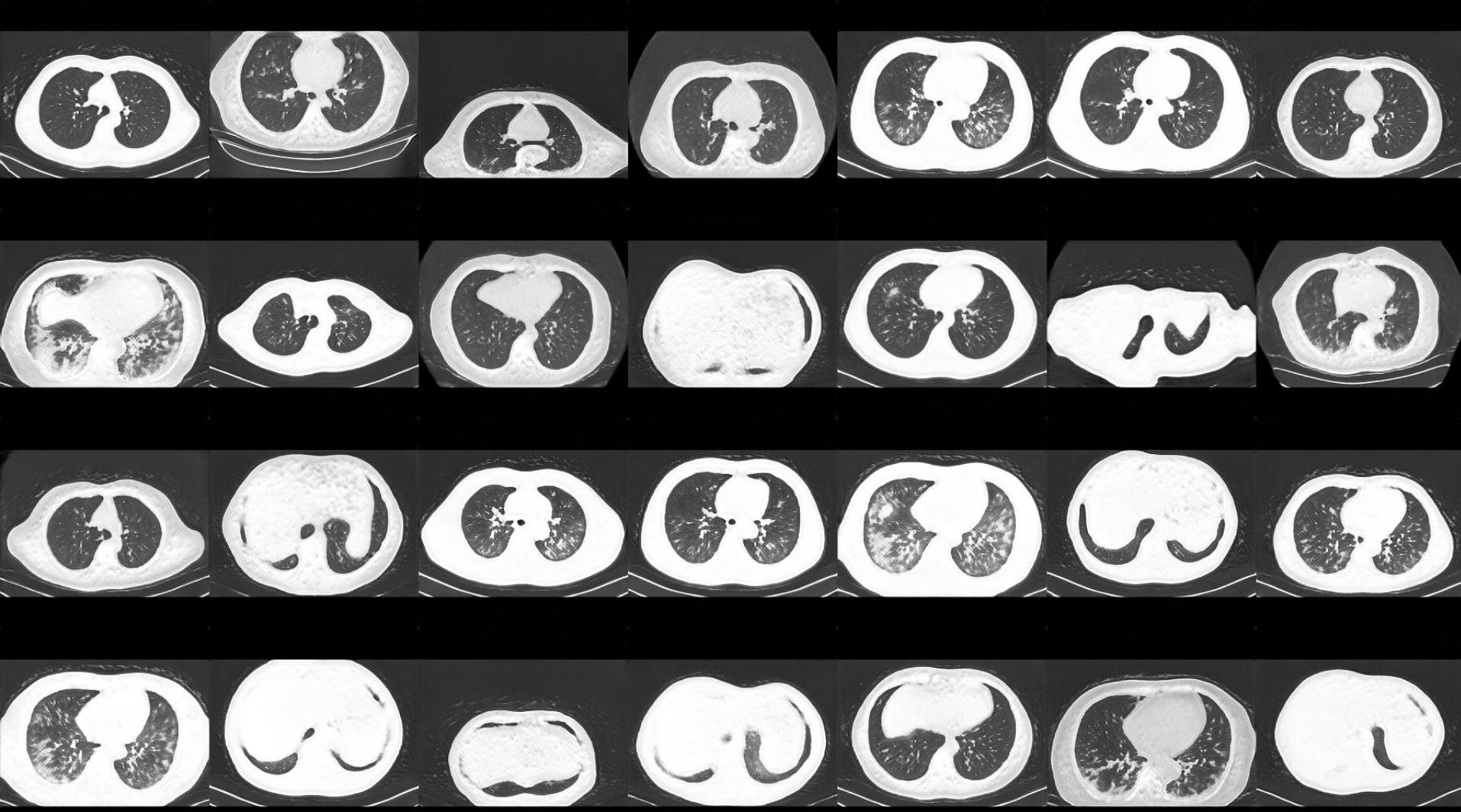
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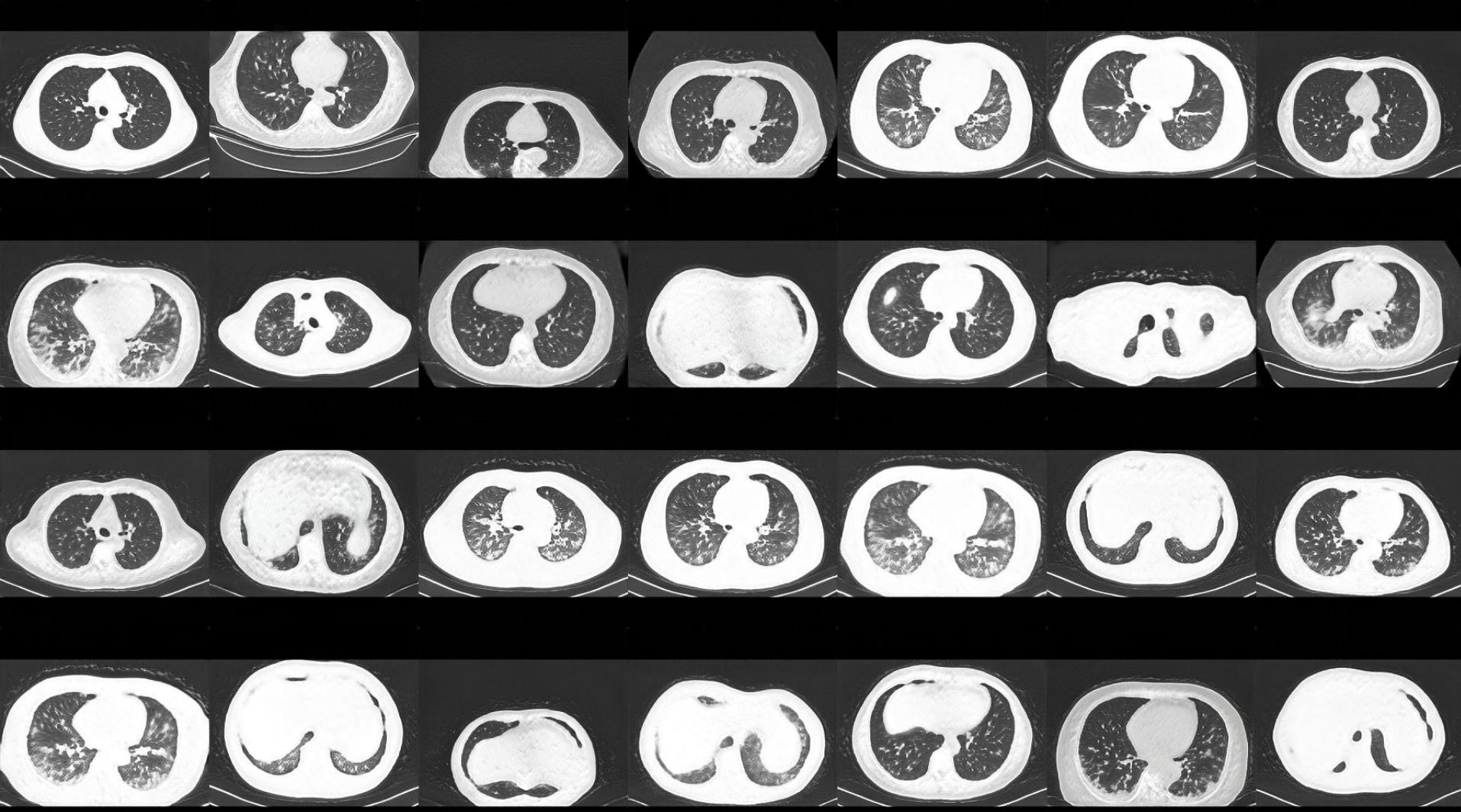


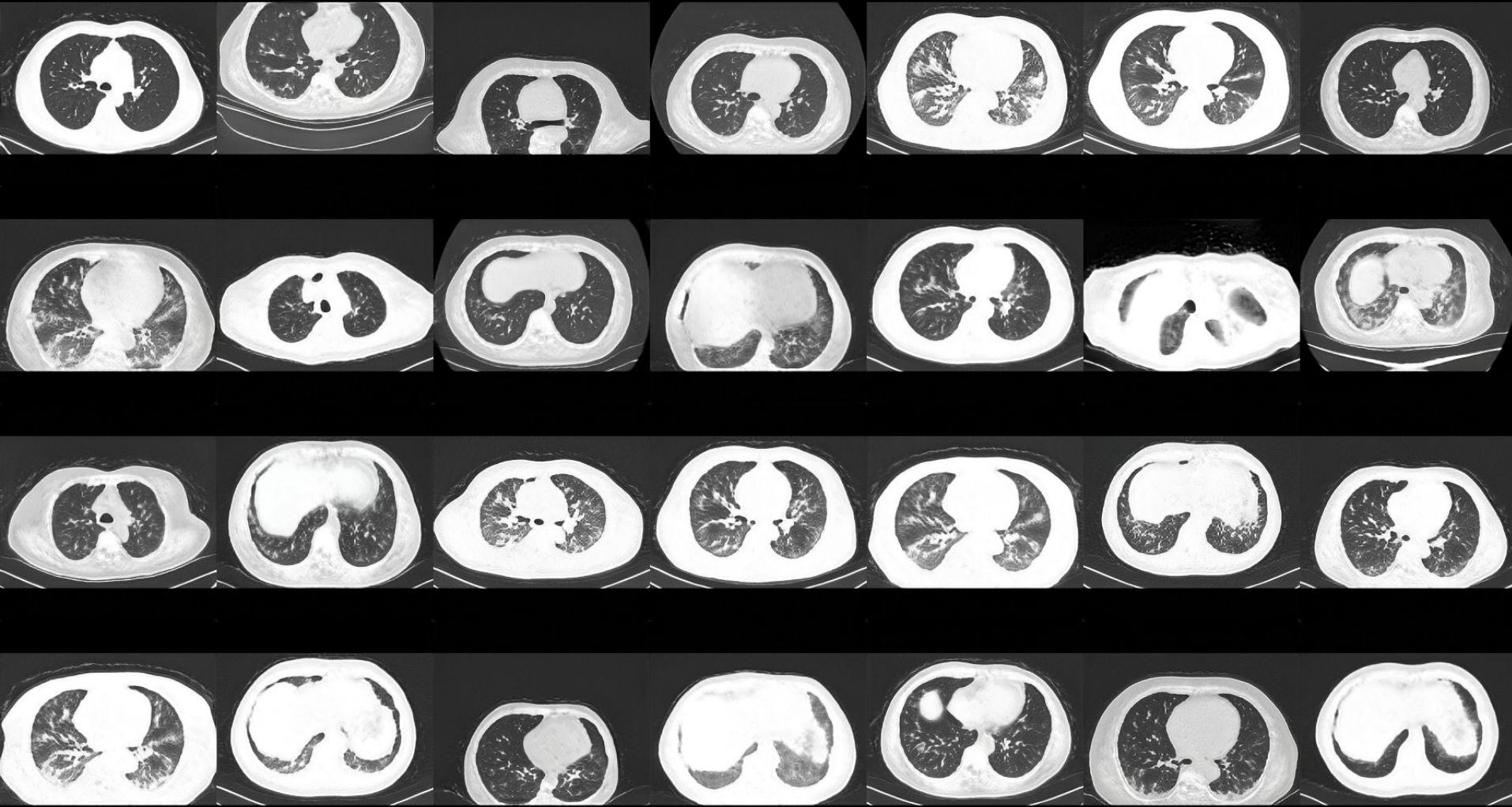




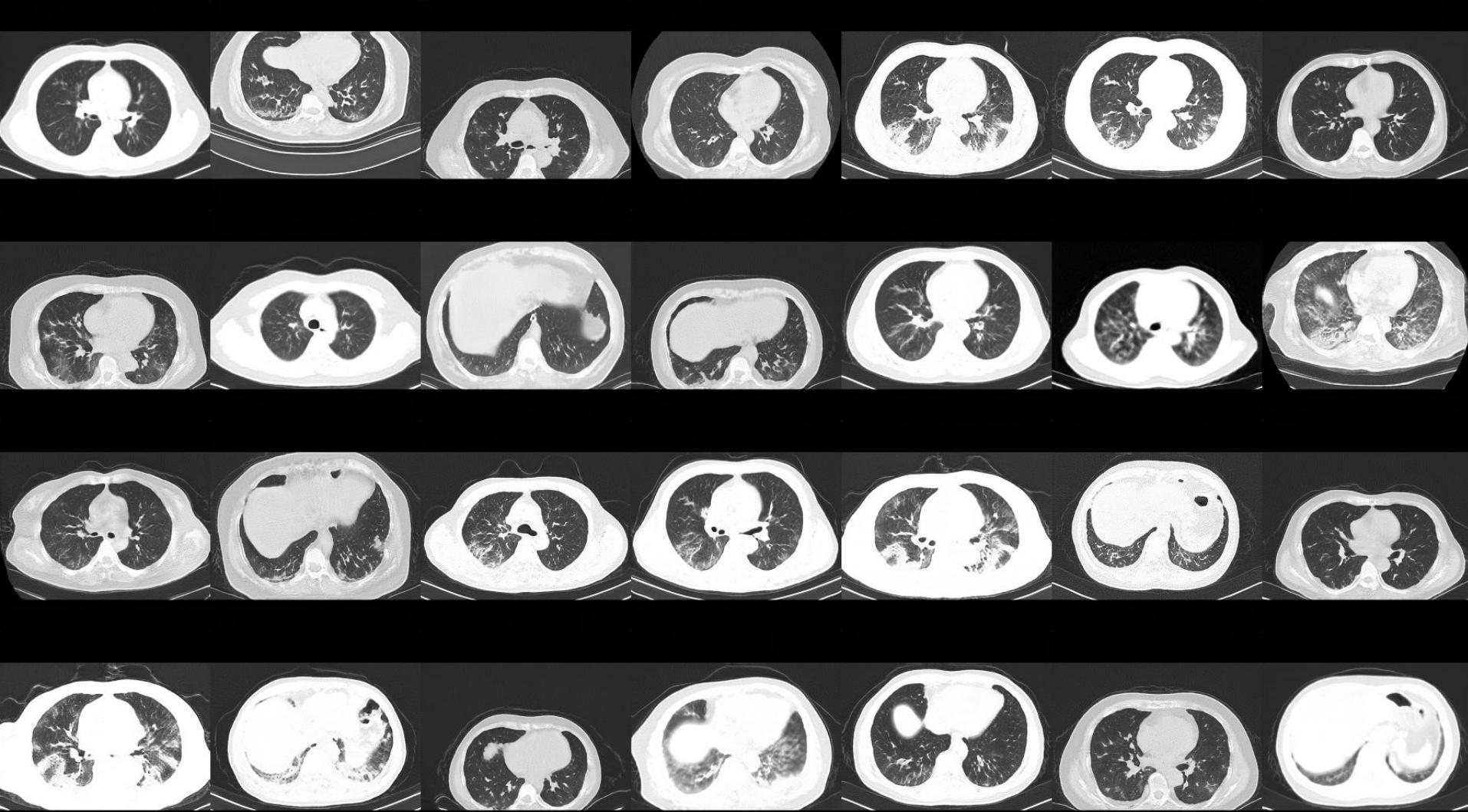








And finally... 36 Hours of Training Later



Next steps

- Using trained GANSformer model on brain CT scans.
- Using pre-trained CT classifier to test GANSformer.

