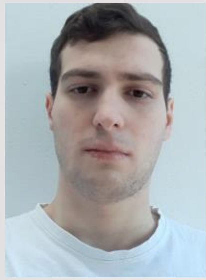
TITAN-ARGOS-TOSCA meeting - 7/6/2024

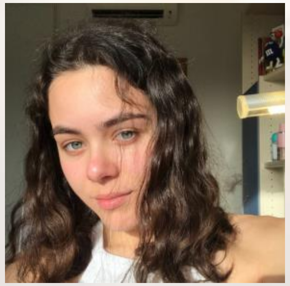
FORTH, Crete

Hallucinations & Sparsity in Image Inpainting

Greg Tsagkatakis

Institute of Computer Science, FORTH
Computer Science Department, University of Crete





Konstantinos Zafeirakis

Manolis Kariotakis

Xristina Kopidaki

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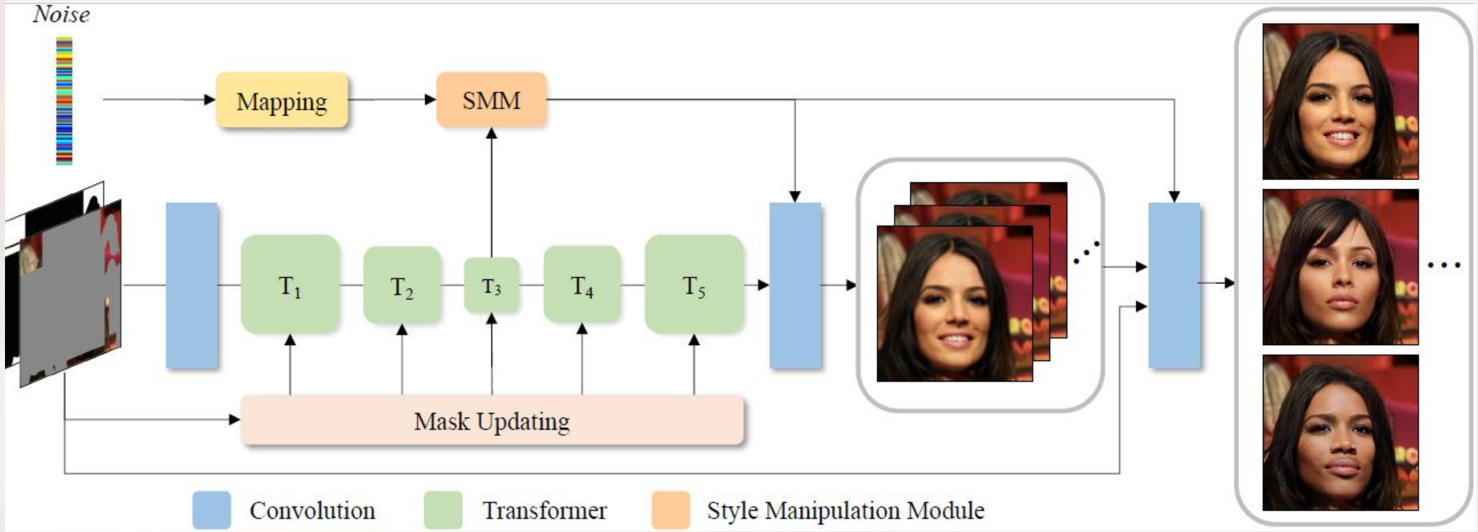
Image Inpainting



Li, Wenbo, Zhe Lin, Kun Zhou, Lu Qi, Yi Wang, and Jiaya Jia. "Mat: Mask-aware transformer for large hole image inpainting." In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, pp. 10758-10768. 2022.

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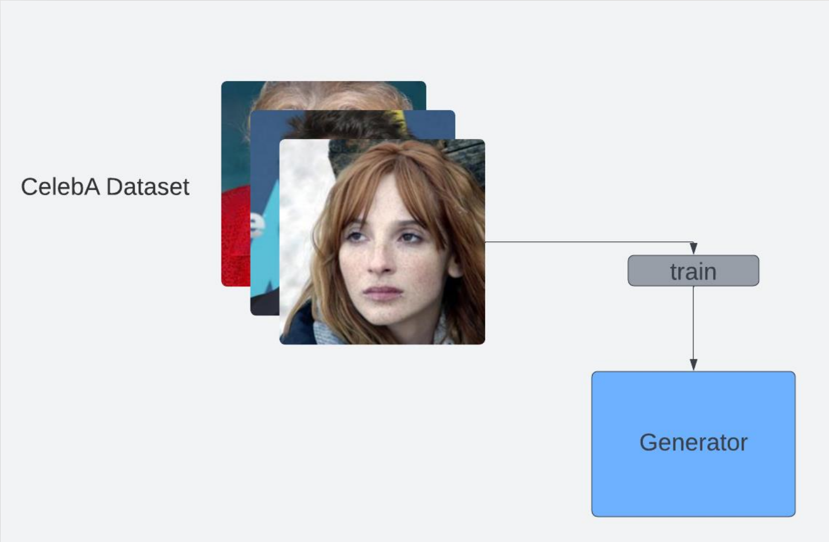
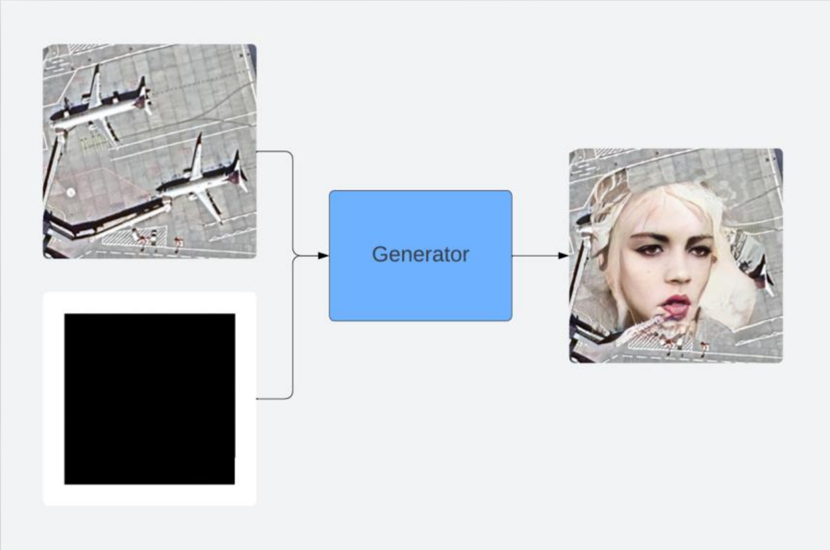
Hallucinations





Training w/ CelebA

Inference w/ UCMerced

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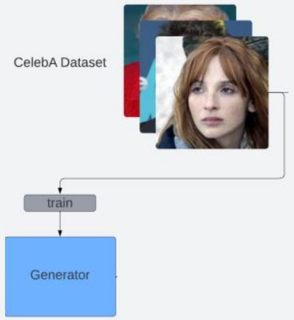
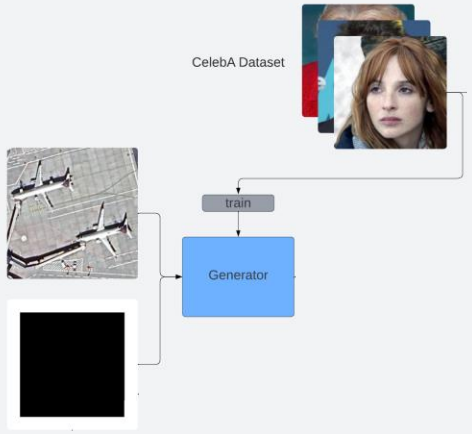
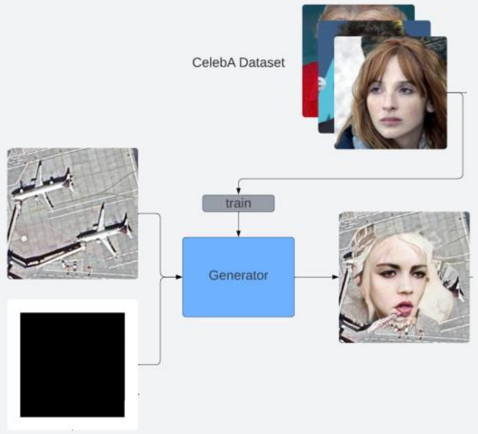
Proposed Scheme



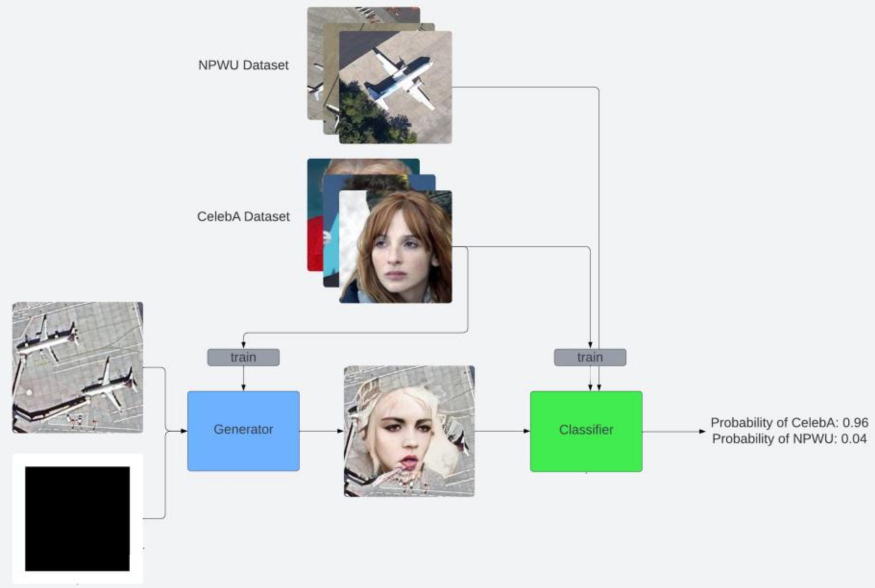
Proposed Scheme



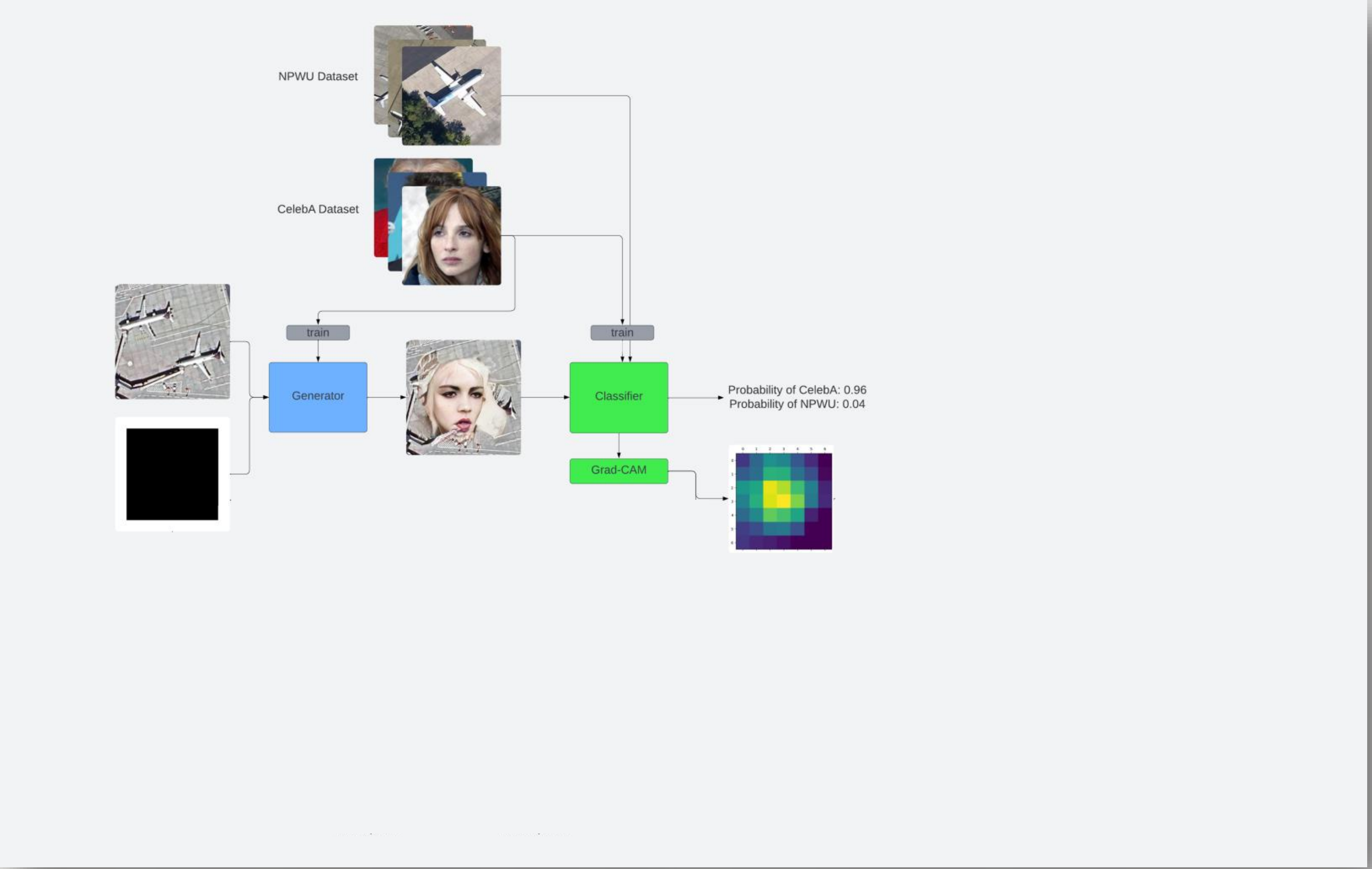
Proposed Scheme



Proposed Scheme



Proposed Scheme



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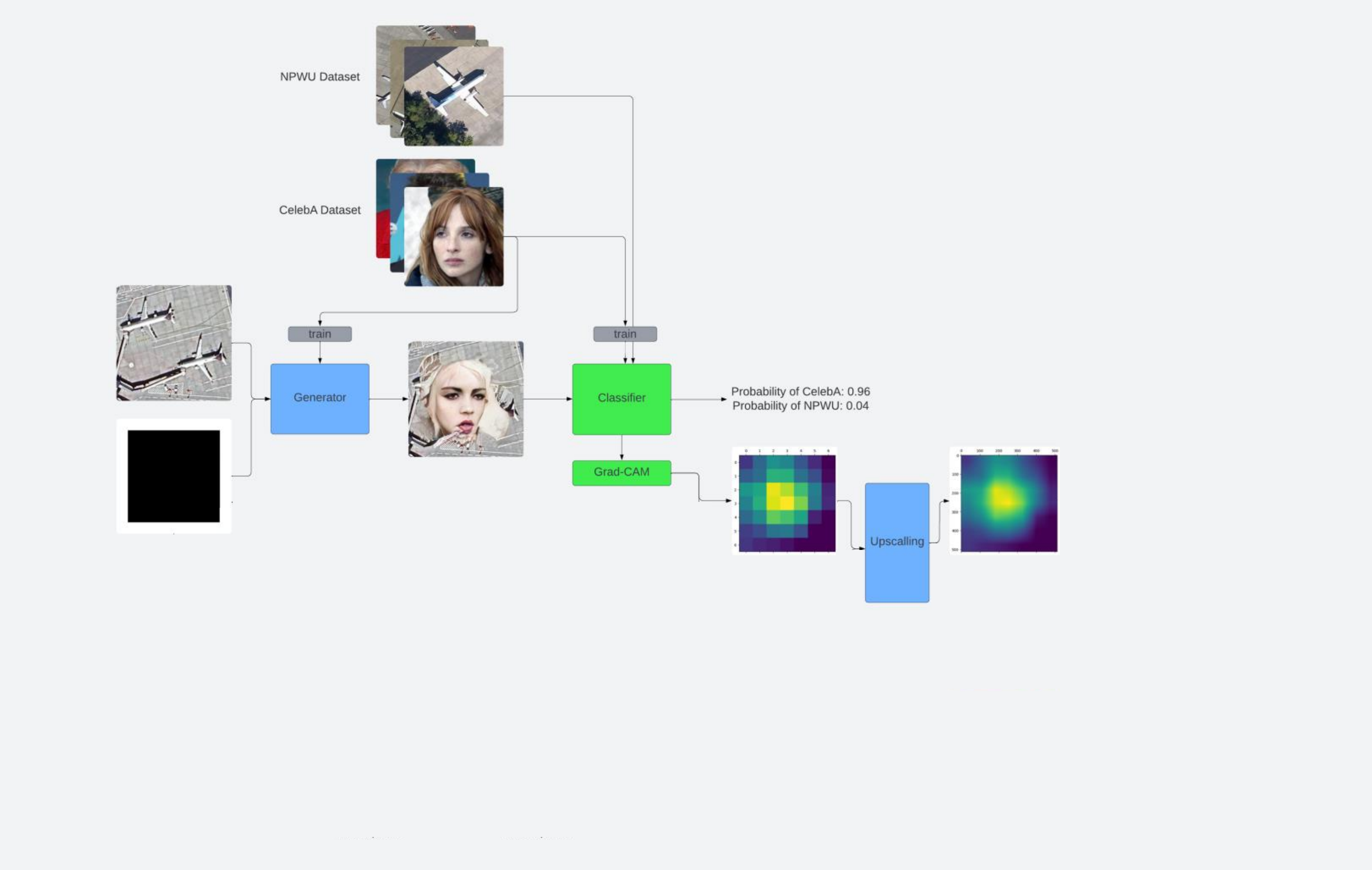
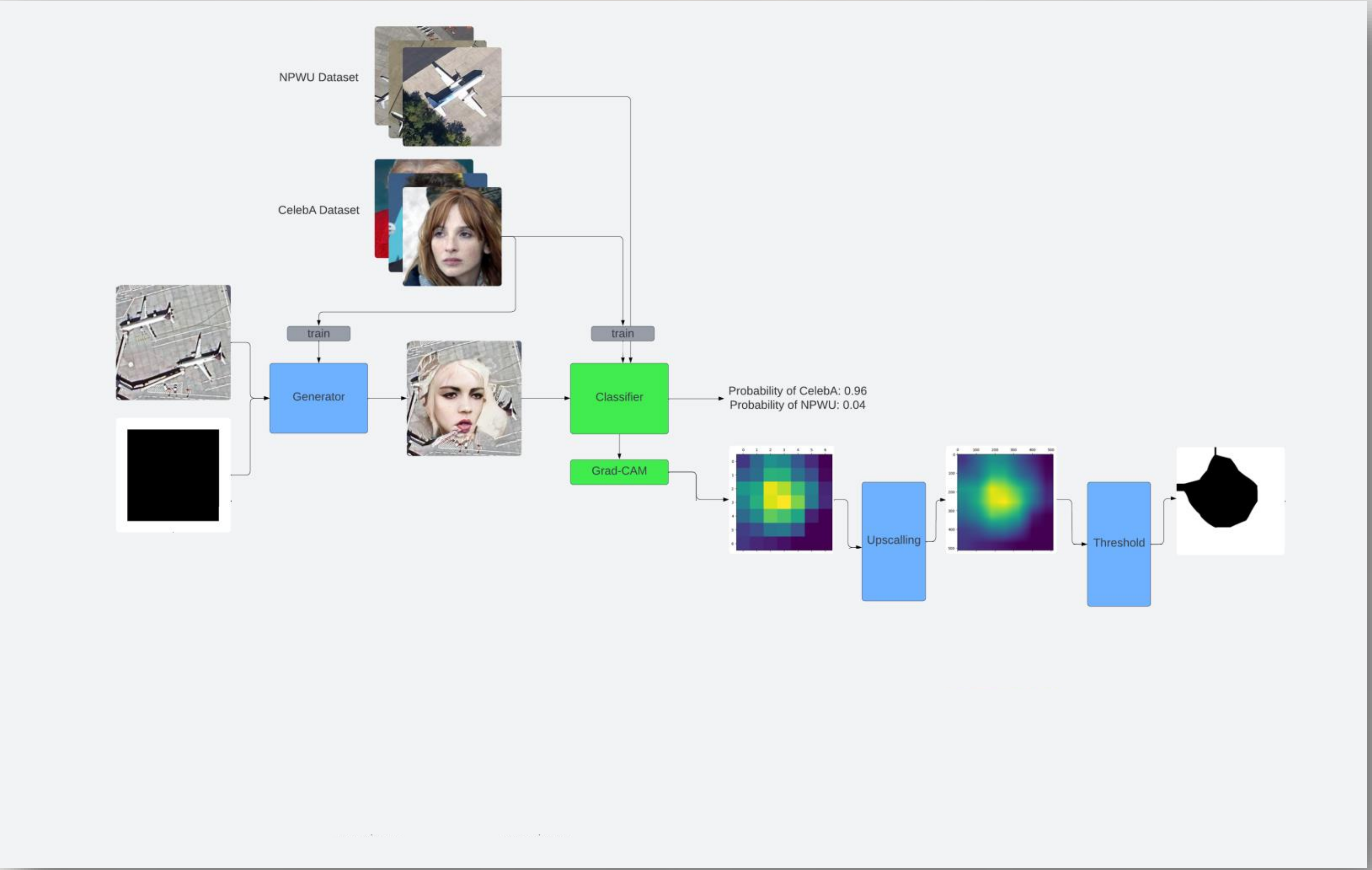
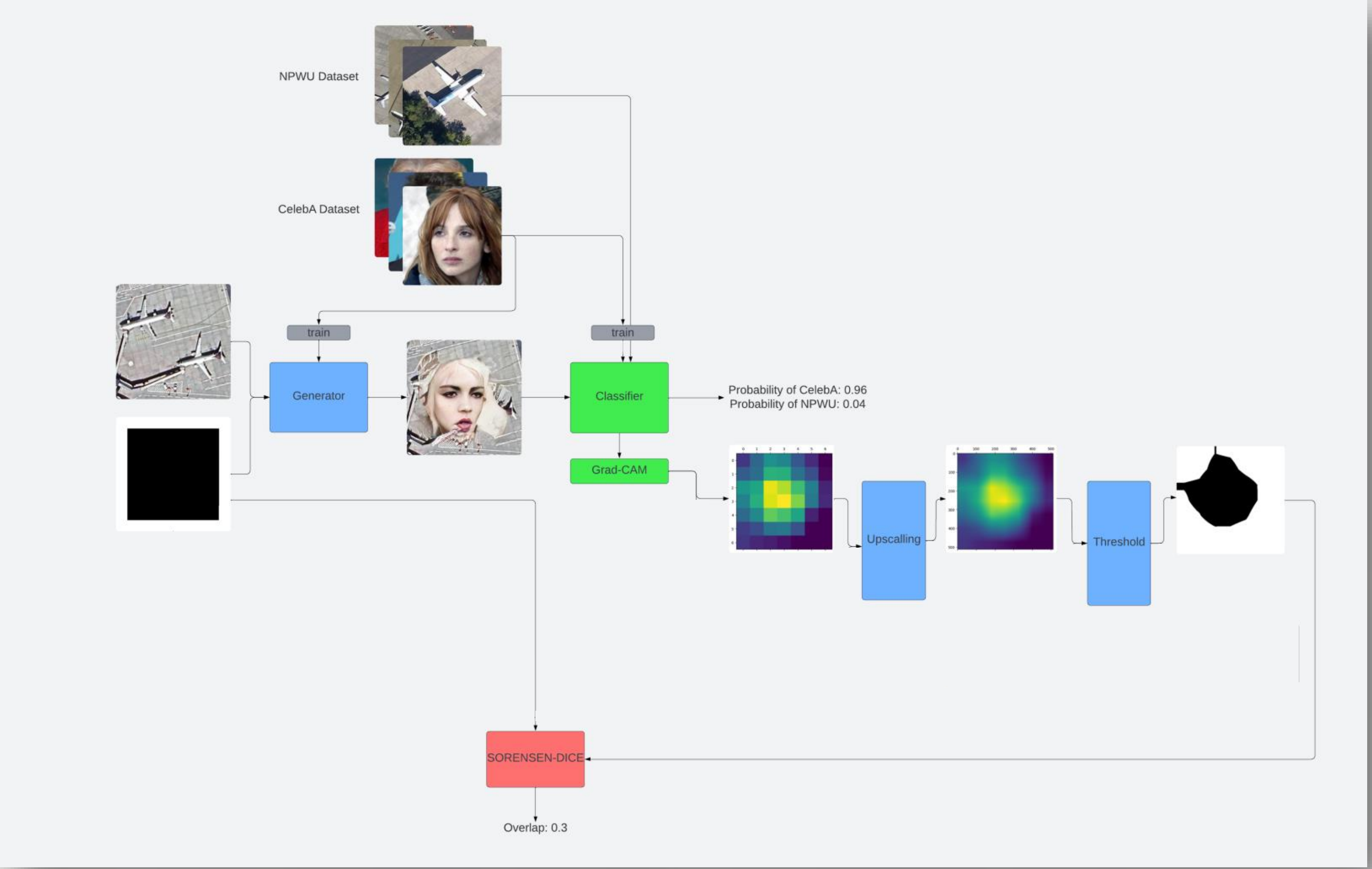
Proposed Scheme



Proposed Scheme



Proposed Scheme



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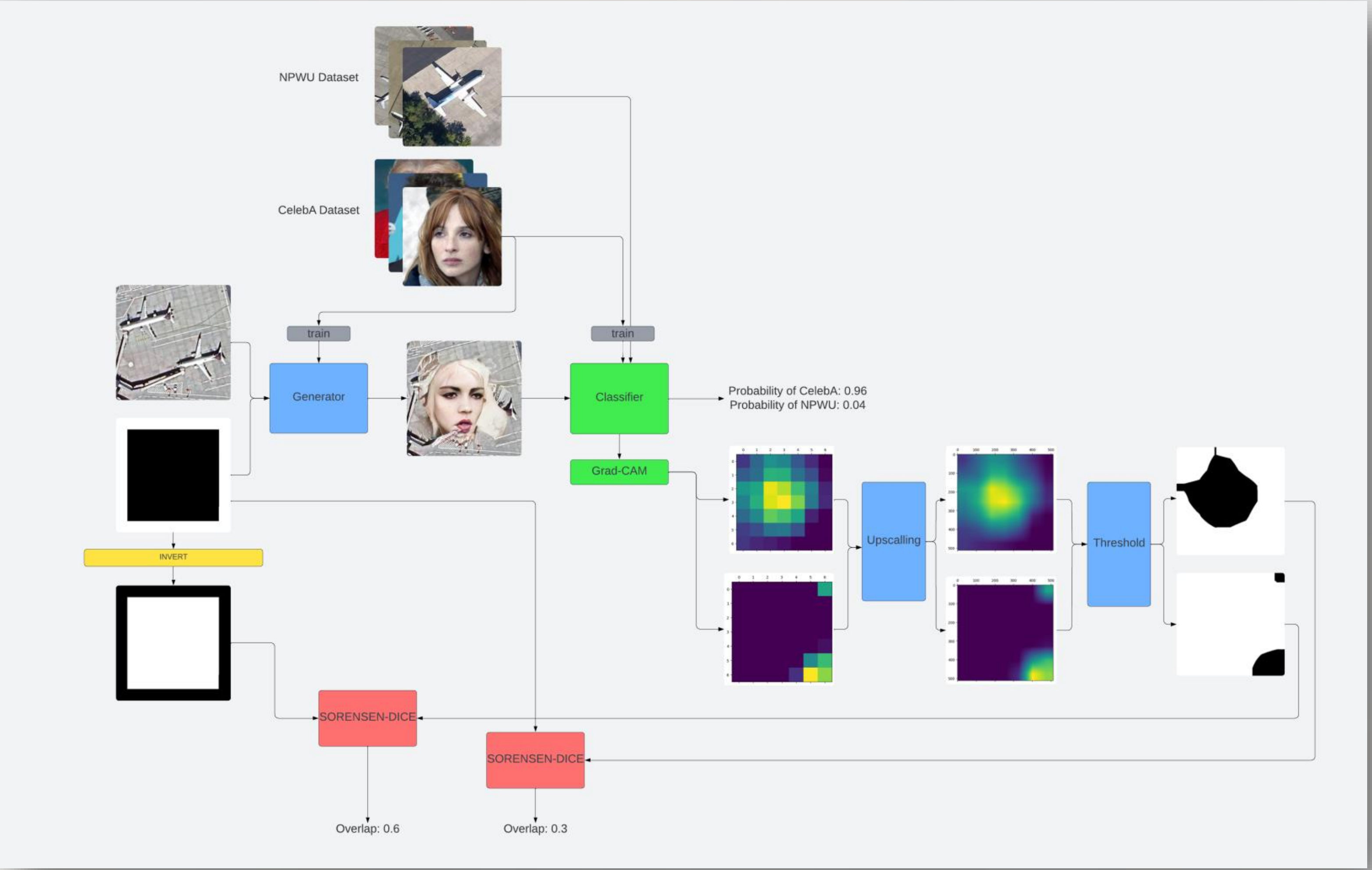
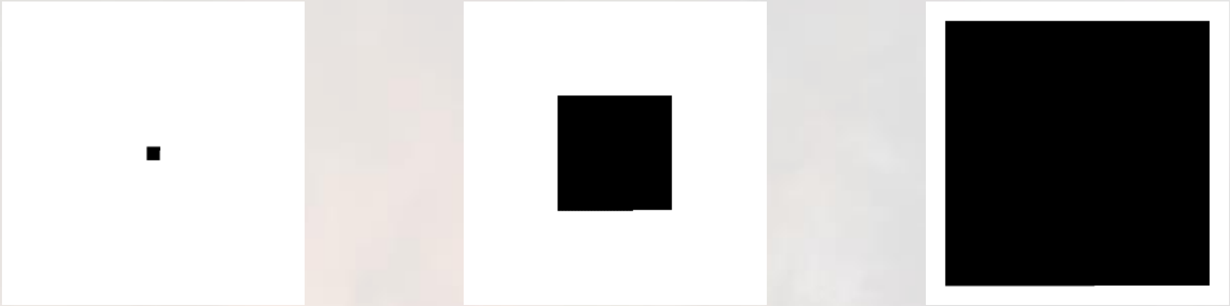
Proposed Scheme

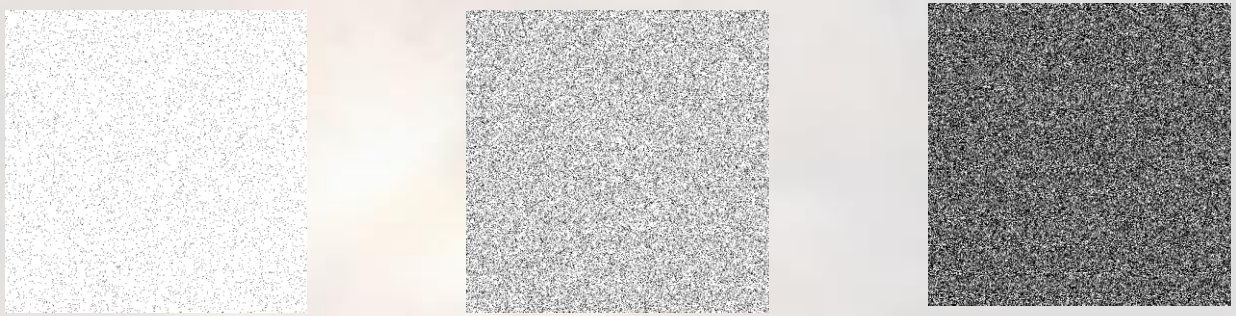


Masks

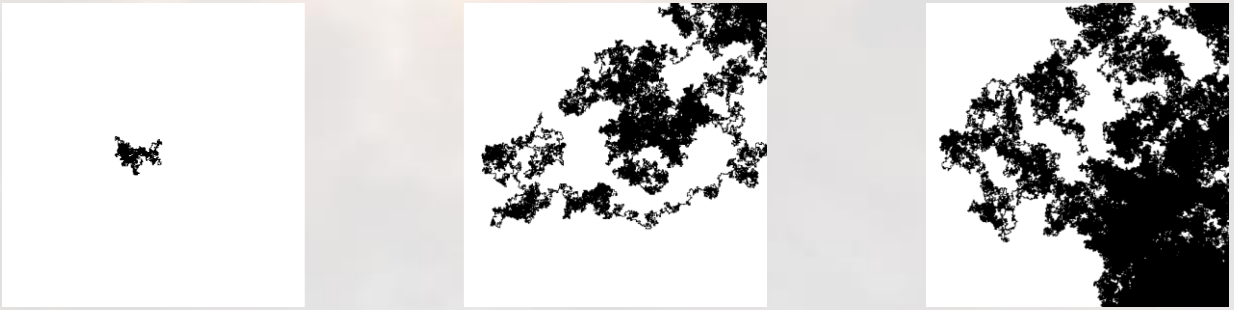
- Rectangular



- Random



- Irregular



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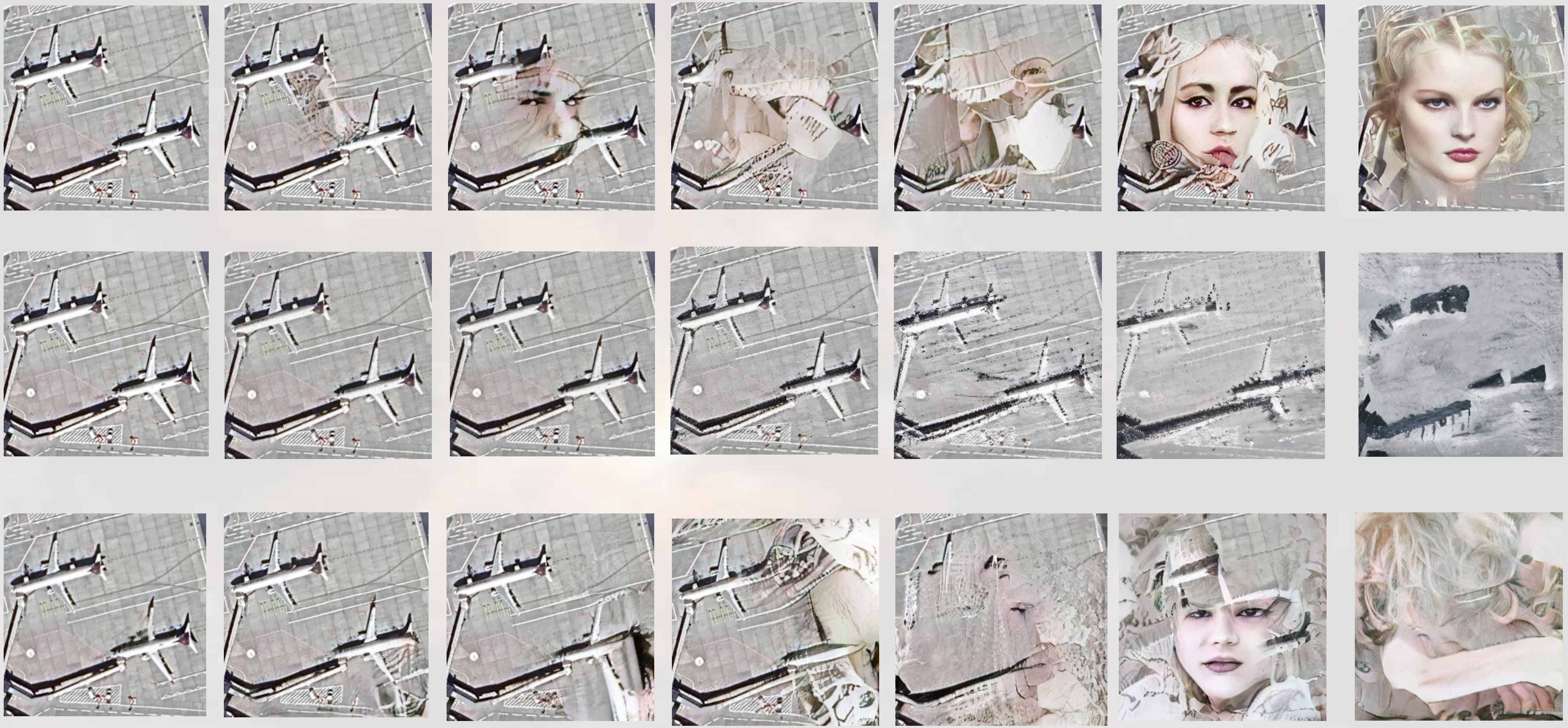
Inpainting with Masks

- Rectangular
- Random
- Irregular



Masking 10% 20% 30% 40% 50% 60% 70%

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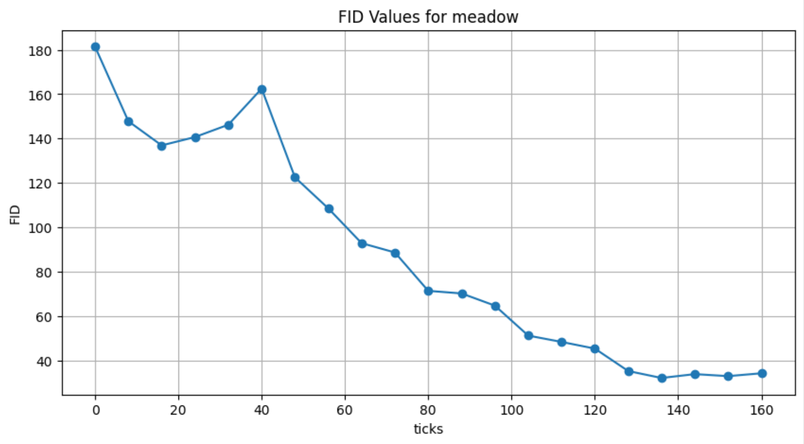
Training & Evaluation scenarios

- Modules
  - Generator – Inpainter: Mask-Aware Transformer for Large Hole Image Inpainting, CVPR 2022
  - Classifier – Detector: MobileNetV2 (ResNet)

- Scenario #1
  - Generator w/ CelebA
  - Classifier /w CelebA and NPWU (dense residential)
  - Input: NPWU (medium residential)



- Scenario #2
  - Generator w/ CelebA
  - Classifier /w CelebA and NPWU (dense residential)
  - Input: UCMerced (airport)

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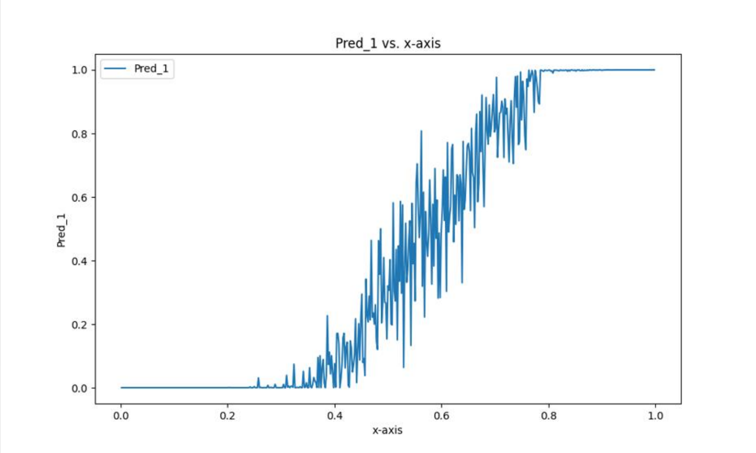
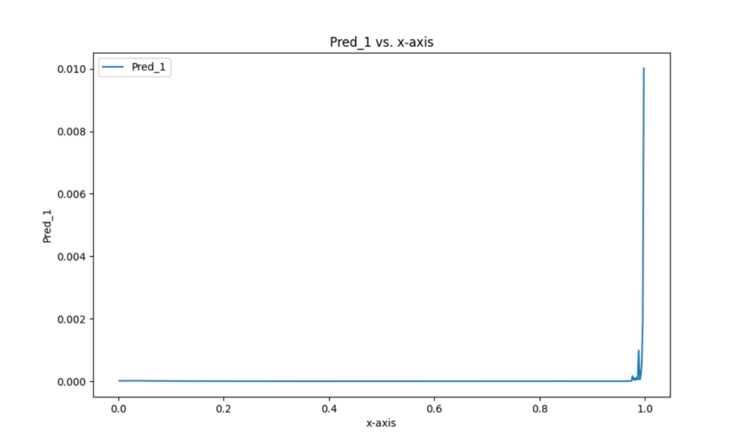
Initial Results

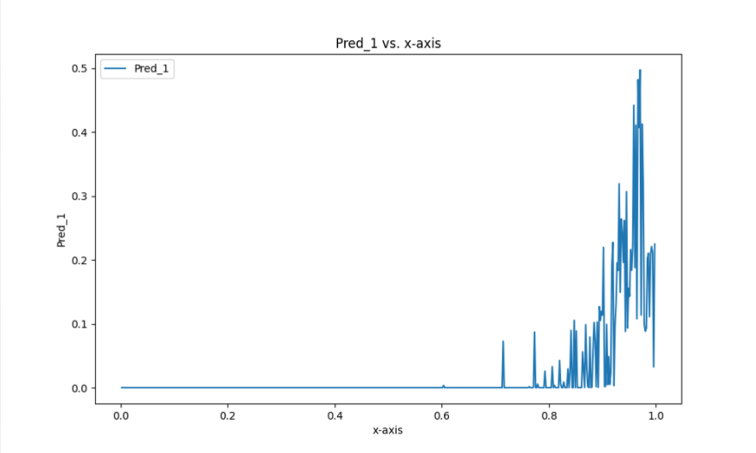
Rectangular



Random



Irregular



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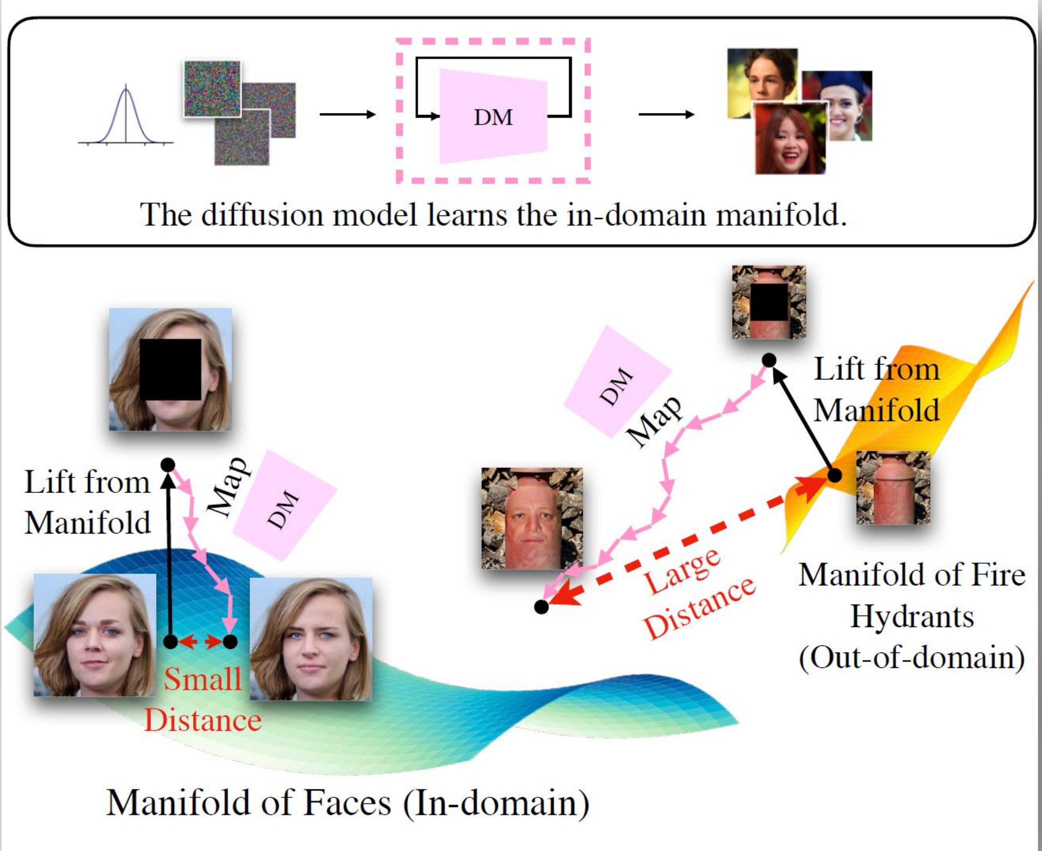
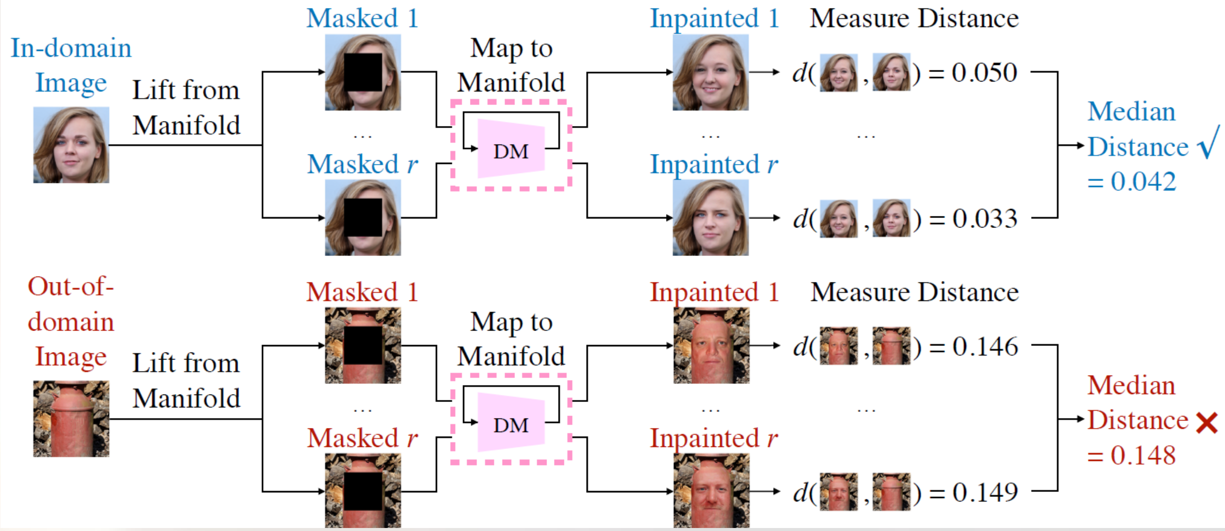
Related approaches





Liu, Zhenzhen, et al. "Unsupervised out-of-distribution detection with diffusion inpainting." Int. Conference on Machine Learning. 2023.

Leveraging Sparse Input and Sparse Models: Efficient Distributed Learning in Resource-Constrained Environments

Emmanouil Kariotakis[1,2], Grigorios Tsagkatakis[2,3], Panagiotis Tsakalides[2,3], Anastasios Kyrillidis[4]
[1]ESAT-STADIUS, KU Leuven, [2]Institute of Computer Science - FORTH, [3]Department of Computer Science, University of Crete, [4]Department of Computer Science, Rice University
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CPAL 2024
January 03-06

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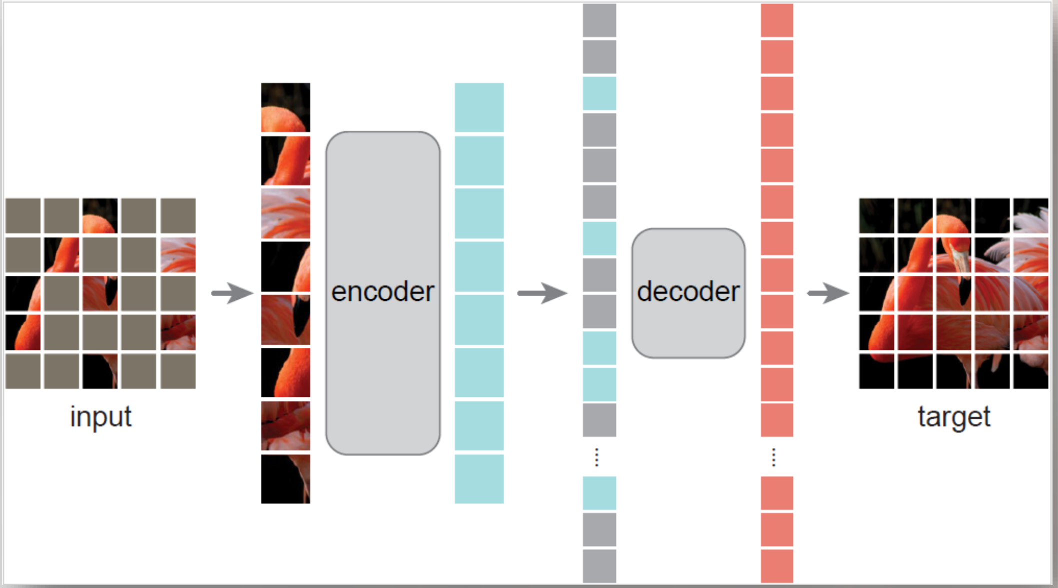
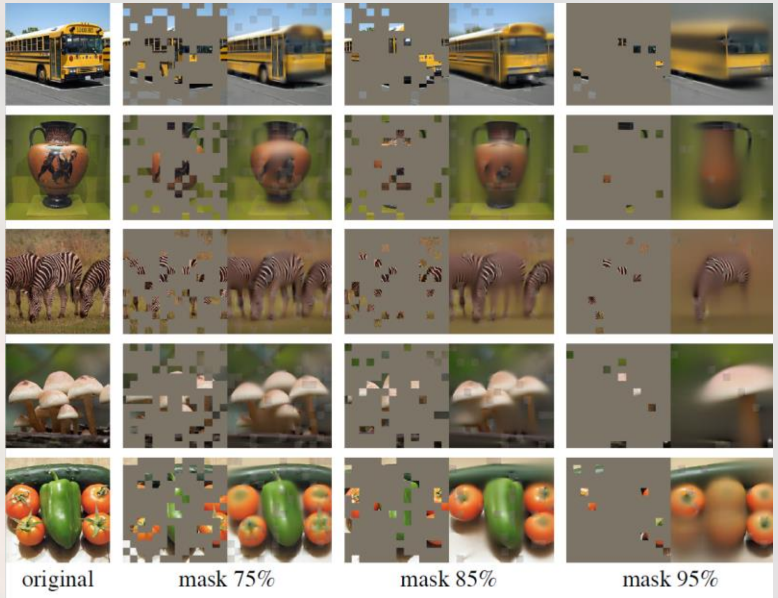
Masked Autoencoders (MAE)





Kaiming He, Xinlei Chen, Saining Xie, Yanghao Li, Piotr Dollár, and Ross Girshick. Masked autoencoders are scalable vision learners. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, pages 16000–16009, 2022.

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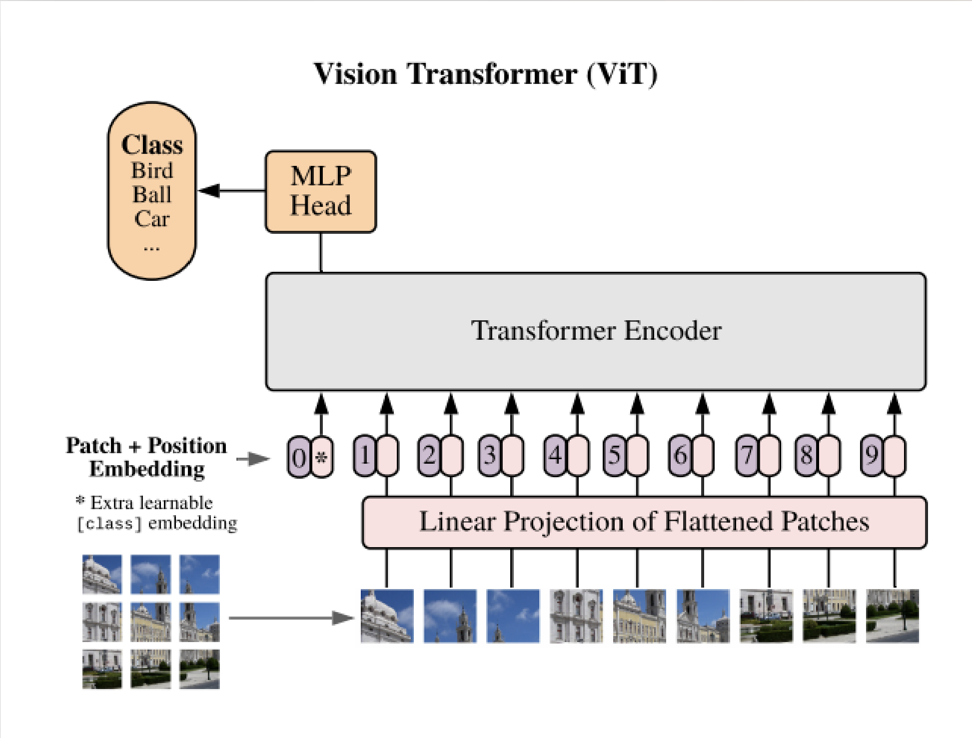
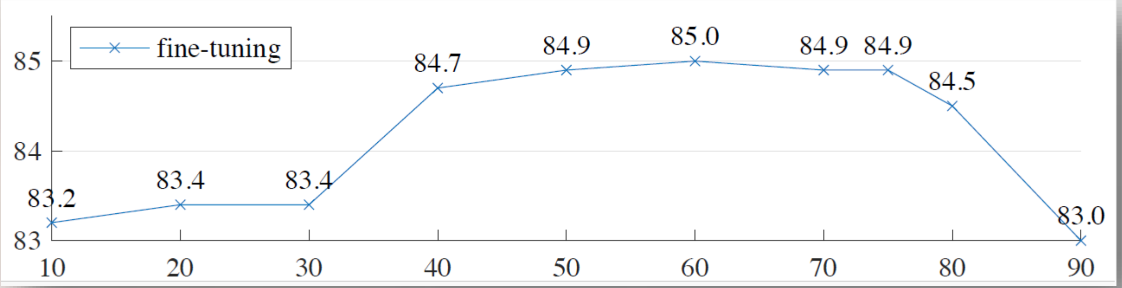
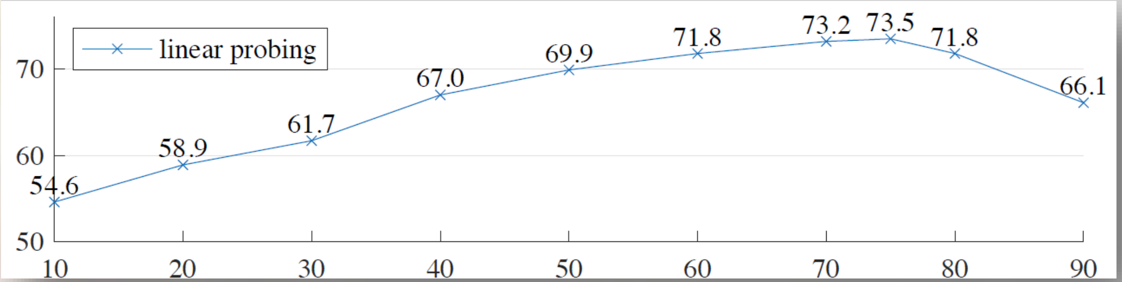
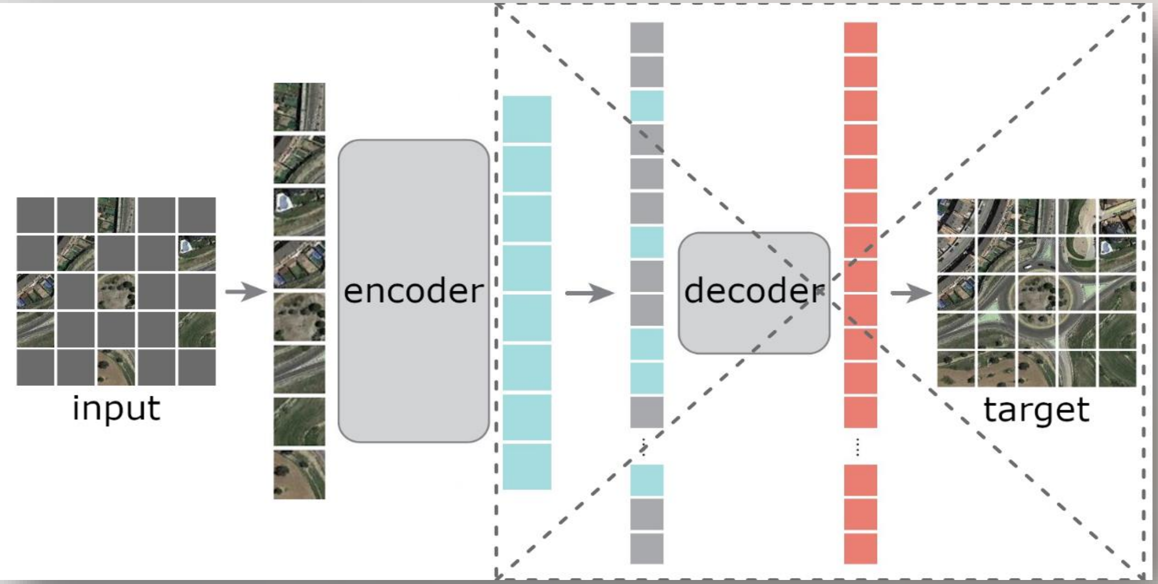
MAE for Self-supervised Learning

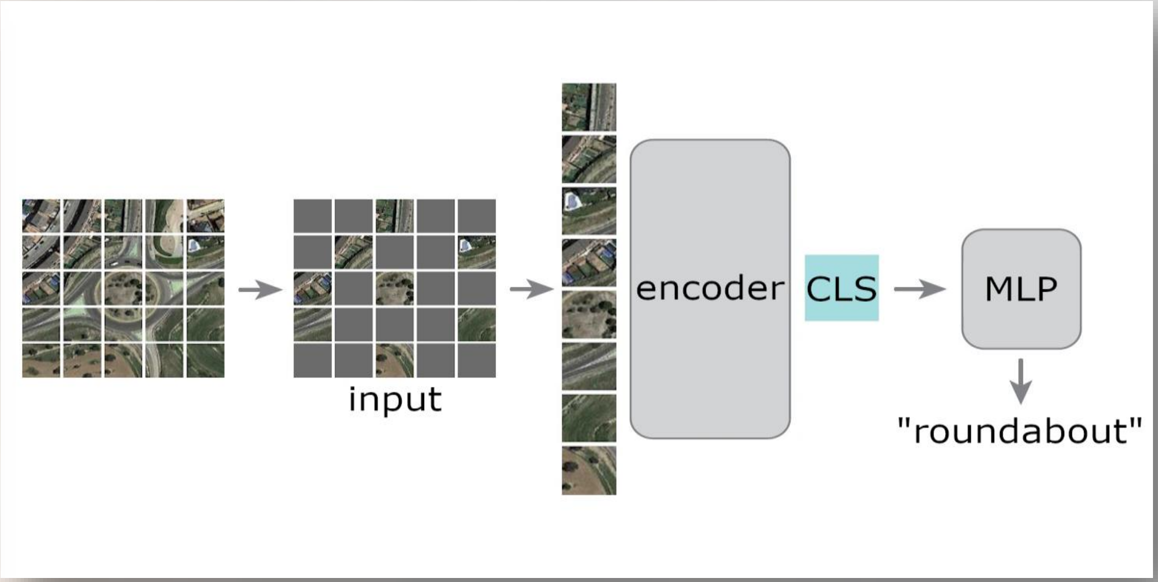




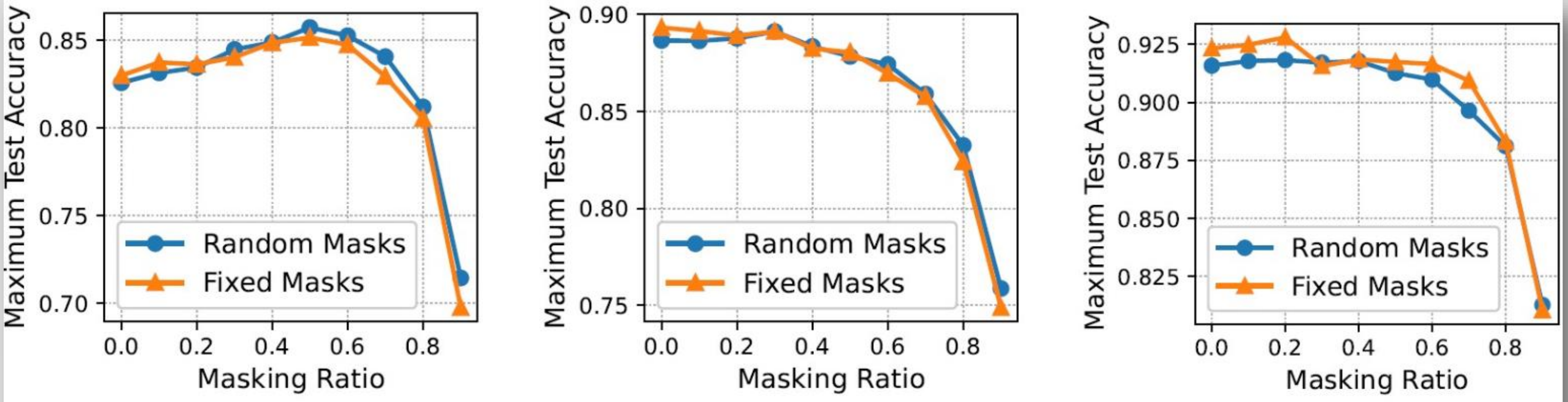


Sparsified Encoders





System Study - Random vs Fixed Masks



(a) CIFAR10 (b) RESISC45 (c) AID

System Study - Datasets Size

	Masking Ratio	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
CIFAR10	Masked Images Size (in GB)	0.205	0.184	0.164	0.143	0.123	0.102	0.082	0.061	0.041	0.020
	CLS Tokens Size (in GB)	0.1536									
	Max Accuracy	0.823	0.837	0.836	0.840	**0.848**	**0.851**	0.847	0.829	0.805	0.697
RESISC45	Masked Images Size (in GB)	7.078	6.370	5.662	4.954	4.247	3.539	2.831	2.123	1.416	0.708
	CLS Tokens Size (in GB)	0.083									
	Max Accuracy	**0.893**	**0.891**	0.889	**0.891**	0.882	0.880	0.869	0.857	0.824	0.749
AID	Masked Images Size (in GB)	12.240	11.016	9.792	8.568	7.344	6.120	4.896	3.672	2.448	1.224
	CLS Tokens Size (in GB)	0.026									
	Max Accuracy	0.923	**0.925**	**0.928**	0.916	0.918	0.917	0.916	0.909	0.883	0.810

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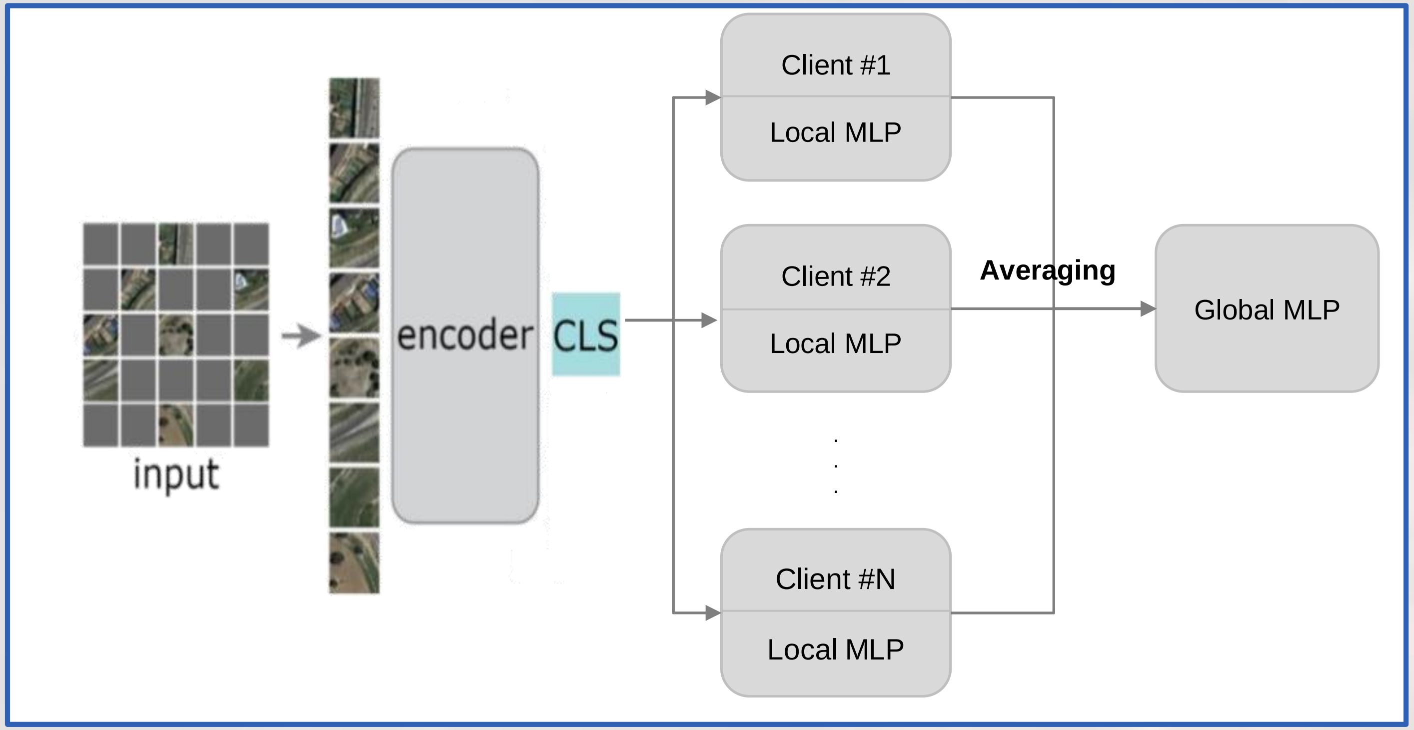
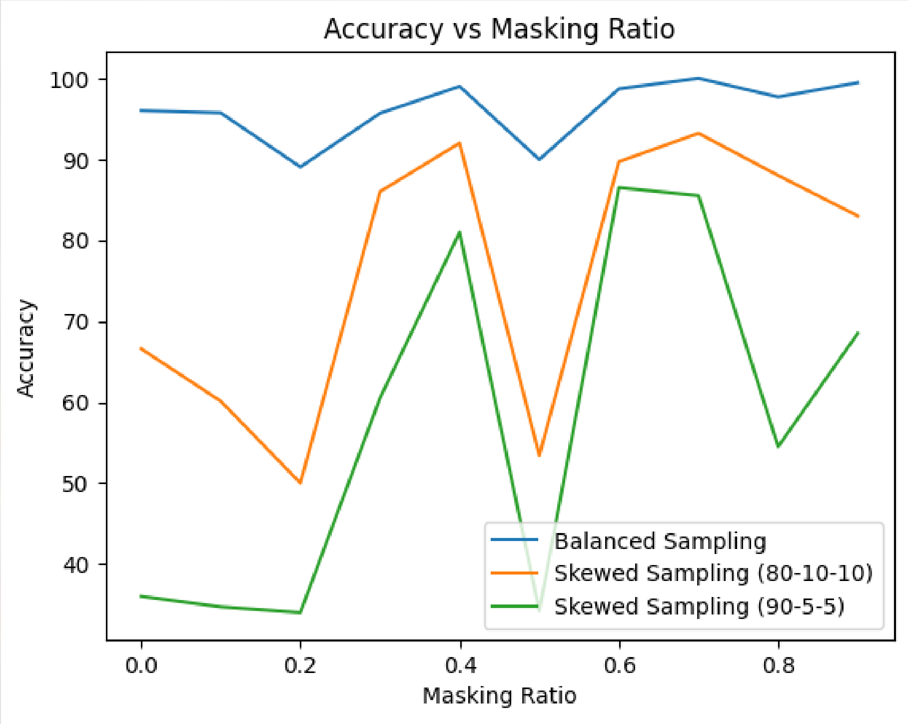
Federated Learning & Class Imbalance





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Conclusions

- Hallucinations ↔ Out-of-Distribution Detection
    - Positive vs Negative Examples
- Masking/Inpainting is an effective regularization… what about others?
- Sparsity is *extremely* beneficial
- Generative vs Discriminative models
- Classification vs Regression
- Specific applications domain??