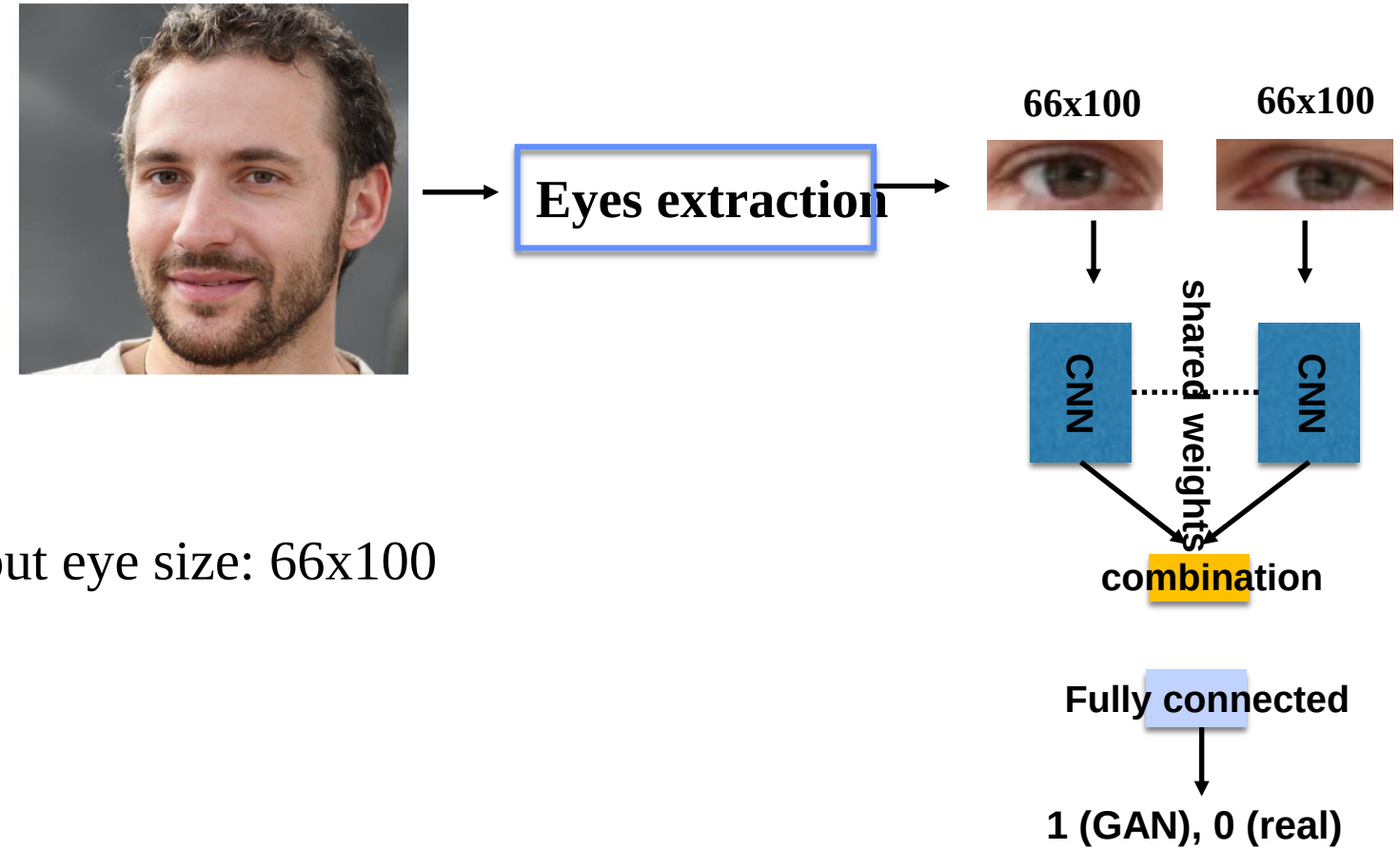
Synthetic Image Detection

UNISI (Purdue Subteam)

Eyes-based GAN detector

- **A tool that looks at eye symmetries**



- Input eye size: 66x100

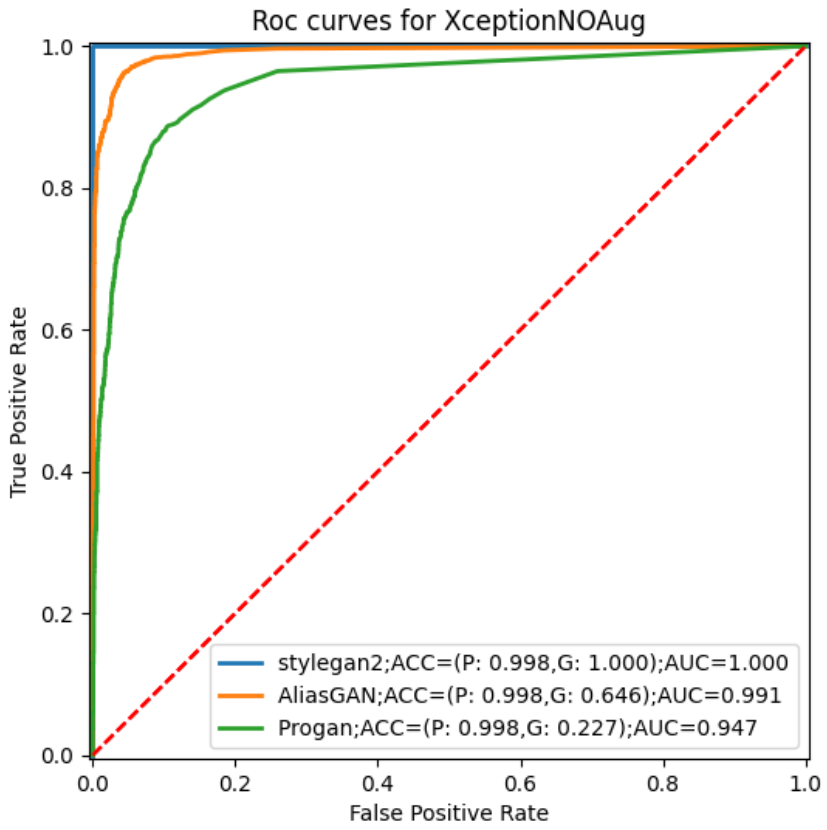
Training strategy

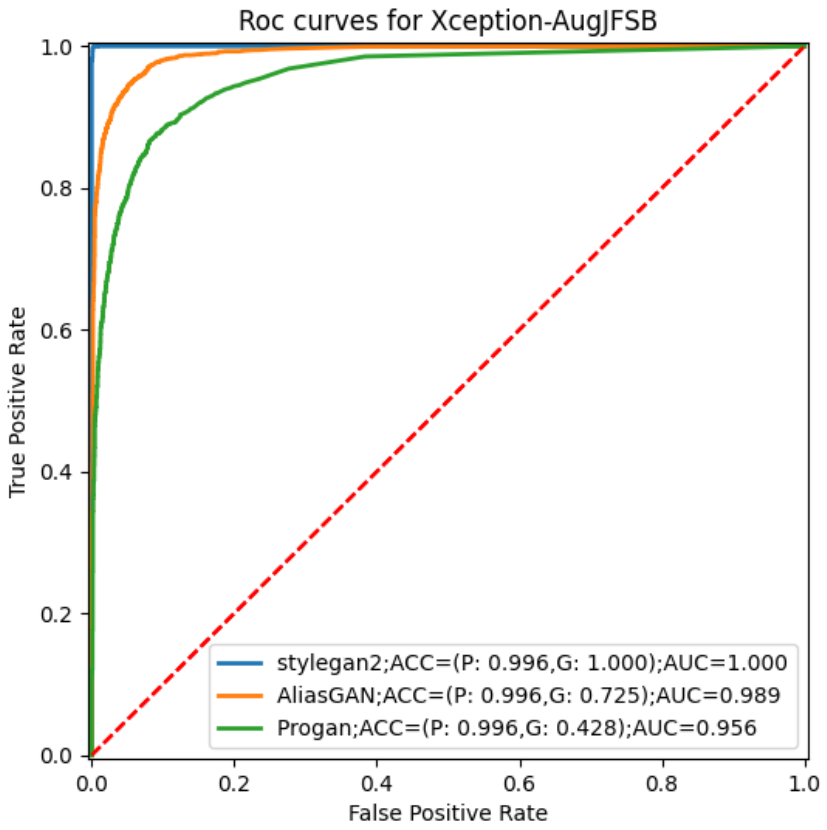
- XceptionNet architecture as backbone (best perfoming)
- Training on **StyleGAN2** images
- A large batch size was required (128) to avoid overfitting
- Without and with augmentation

Augmentations (in random order):

- JPEG compression with quality factor in the range [40, 99] (80% prob)
- Rescaling with factor in range [0.8, 1.3] (80% prob)
- Blurring with kernel filter 3x3 (20% prob)
- Flip, vertical and horizontal (10% prob)

Our results: generalization

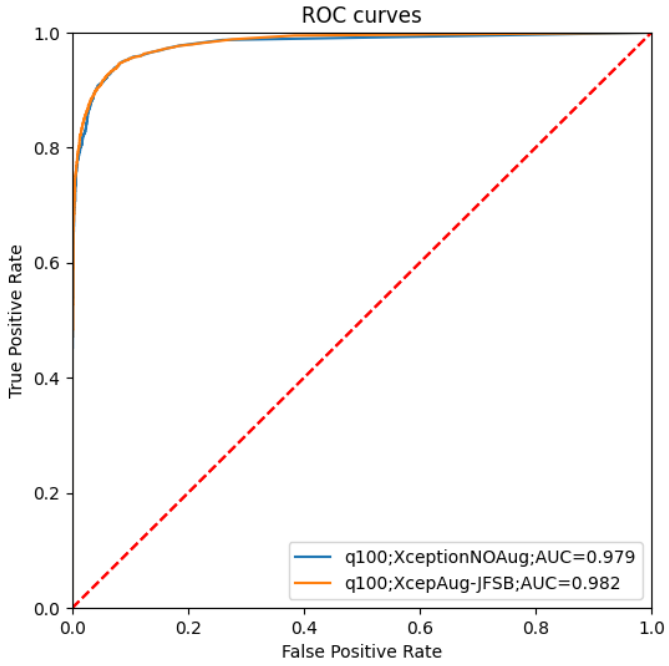




- **Good generalization to unseen architecture (ProGAN, AliasFreeGAN)**
- The feature are discriminative

Our results: calibration (on heterogeneous datasets)

- Can we find a good threshold for all the cases?
- FFHQ, Celeb-HQ (real) vs StyleGAN2, AliasGAN, ProGAN (GAN)



- TP (@FP = 5%) = 91%

Results on the task

dataset	images	True extraction	False extraction	Miss extraction
FFHQ-in-the-wild-20k	20,000	17844	-	2146
afhq-v2-test	1467	-	46	-
Metfaces-in-the-wild-test	320	280	-	40
alias_free_t_no_compression	10,000	19973	-	27
alias_free_r_no_compression	10,000	19970	-	30
alias_free_t_compression	10,000	19965	-	35
alias_free_r_compression	10,000	19966	-	34
alias-free-t-metfacesu-1024x1024	10,000	9969	-	31
alias-free-t-**afhq**v2-512x512	10,000	-	1318	-
alias-free-r-metfacesu-1024x1024	10,000	9970	-	30
alias-free-r-**afhq**v2-512x512	10,000	-	1324	
stylegan2-metfacesu-1024x1024	10,000	9939	-	61
stylegan2-ffhqu-1024x1024	10,000	9964	-	36
stylegan2-**afhqv**2-512x512	10,000	-	1162	-
stylegan2-**brecahad**-512x512	10,000	-	61	-

Model: Siamese Xception with augmentations: JPEG (40-100), blur, flip, scaling

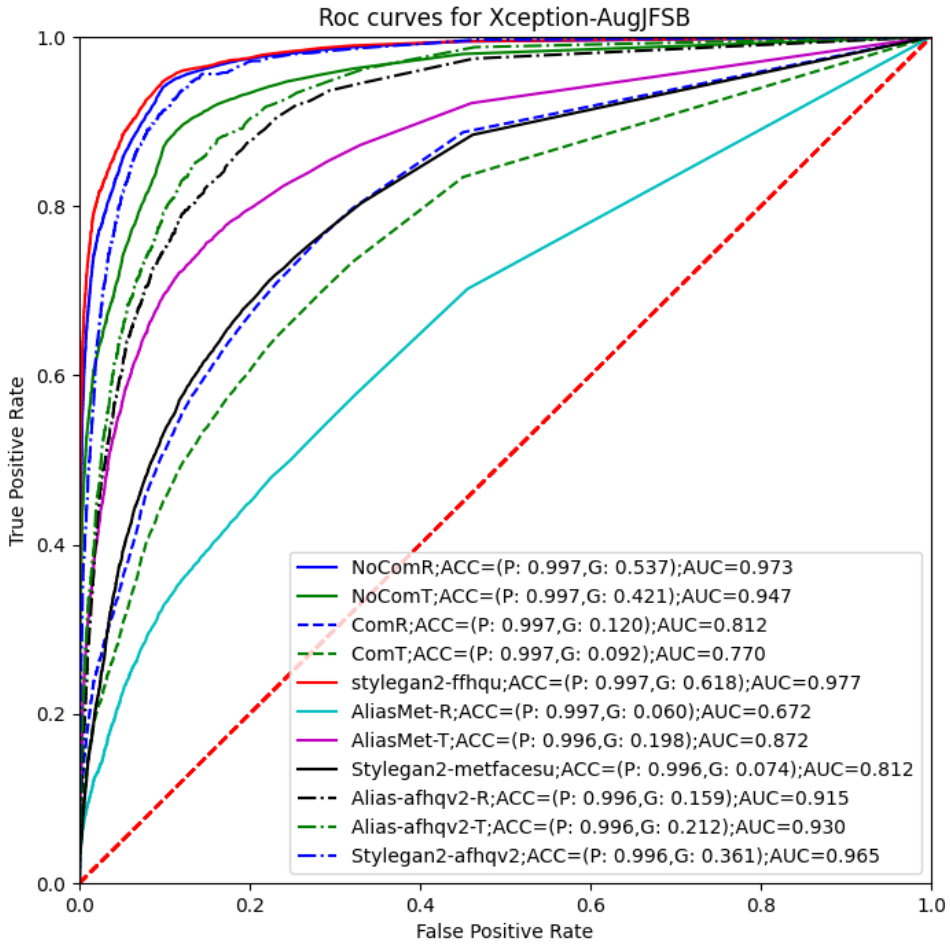
True extraction: extract from face dataset
False extraction: extract from non-face dataset
Miss extraction: missed face from face dataset
Face extractor: DLIB

Results on the task

Legend

Details for ROC curves:	Prirtine	GAN
NoComR	FFHQ-in-the-wild	alias_free_r_no_compress
NoComT	FFHQ-in-the-wild	alias_free_t_no_compress
ComR	FFHQ-in-the-wild	alias_free_r_compression
ComT	FFHQ-in-the-wild	alias_free_t_compression
stylegan2-ffhqu	FFHQ-in-the-wild	stylegan2-ffhqu-1024x1024
AliasMet-R	Metfaces-in-the-wild-test	alias-free-r-metfacesu
AliasMet-T	Metfaces-in-the-wild-test	alias-free-t-metfacesu
Stylegan2-Metfacesu	FFHQ-in-the-wild	stylegan2-metfacesu-1024x1024

Results on the task



How to improve (on-going)

- IDEA: use **eyes reflections** for GAN face detection
- Extracting corneal highlights is NOT easy
- Based on our experiments, the state-of-the-art method in [2] does not work (in the wilde)
- Next step: improve the robustness of the method in [2]
- A new method:
  - Landmark extraction (similar to [2])
  - Iris segmentation using Mask-R-CNN
  - Estimation of (internal and external) circular corneal region

[2] Hu, S., Li, Y., & Lyu, S. (2021, June). Exposing GAN-generated Faces Using Inconsistent Corneal Specular Highlights. In *ICASSP 2021-2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)* (pp. 2500-2504). IEEE.