Pushing the limits of latent fingerprint identification with synthetic data

IFPC 2025 Conference

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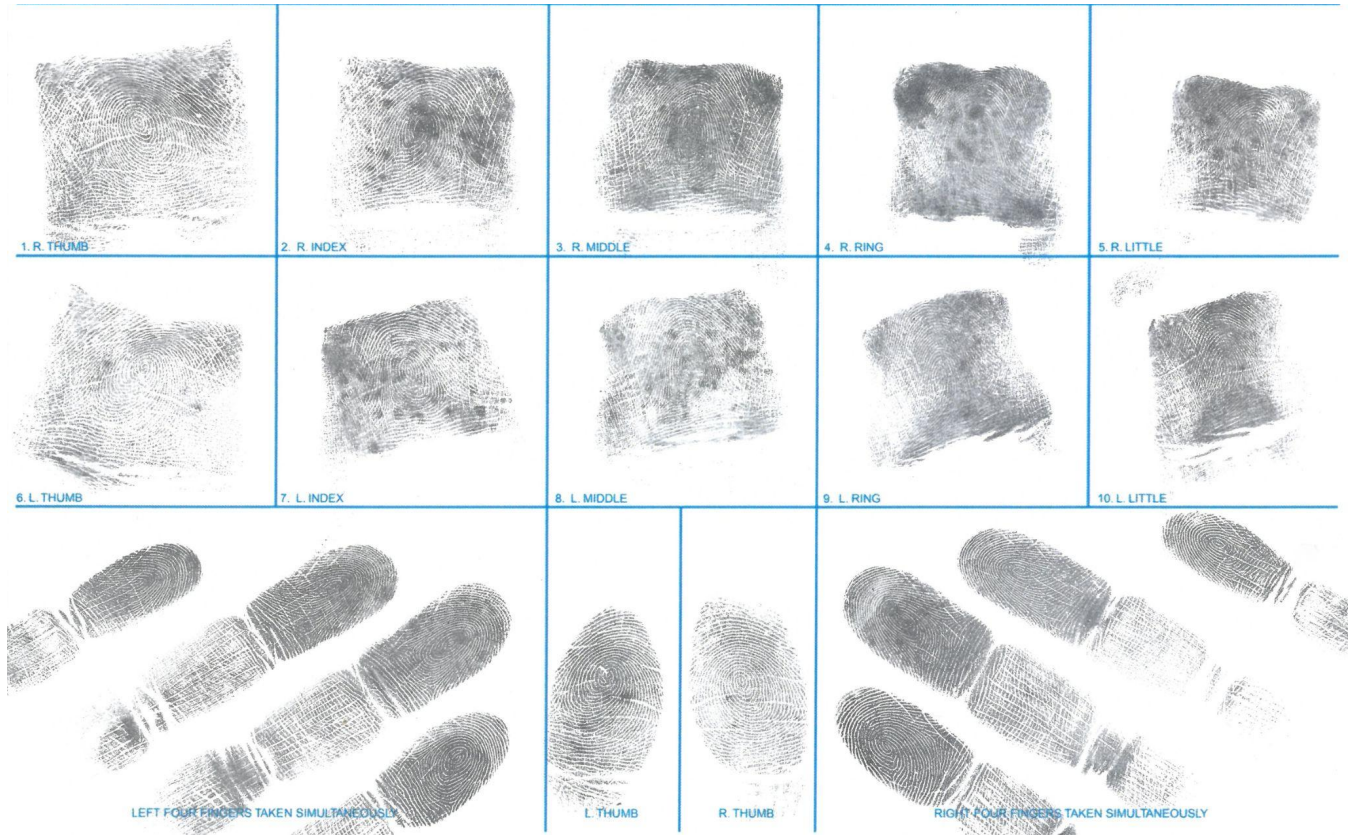
INNOVATRICS

Motivation

- Images of latent fingerprints are scarce
- Often they are confidential
    - part of an investigation (ongoing or closed)
- Matching pairs (latent - plain) are difficult to get

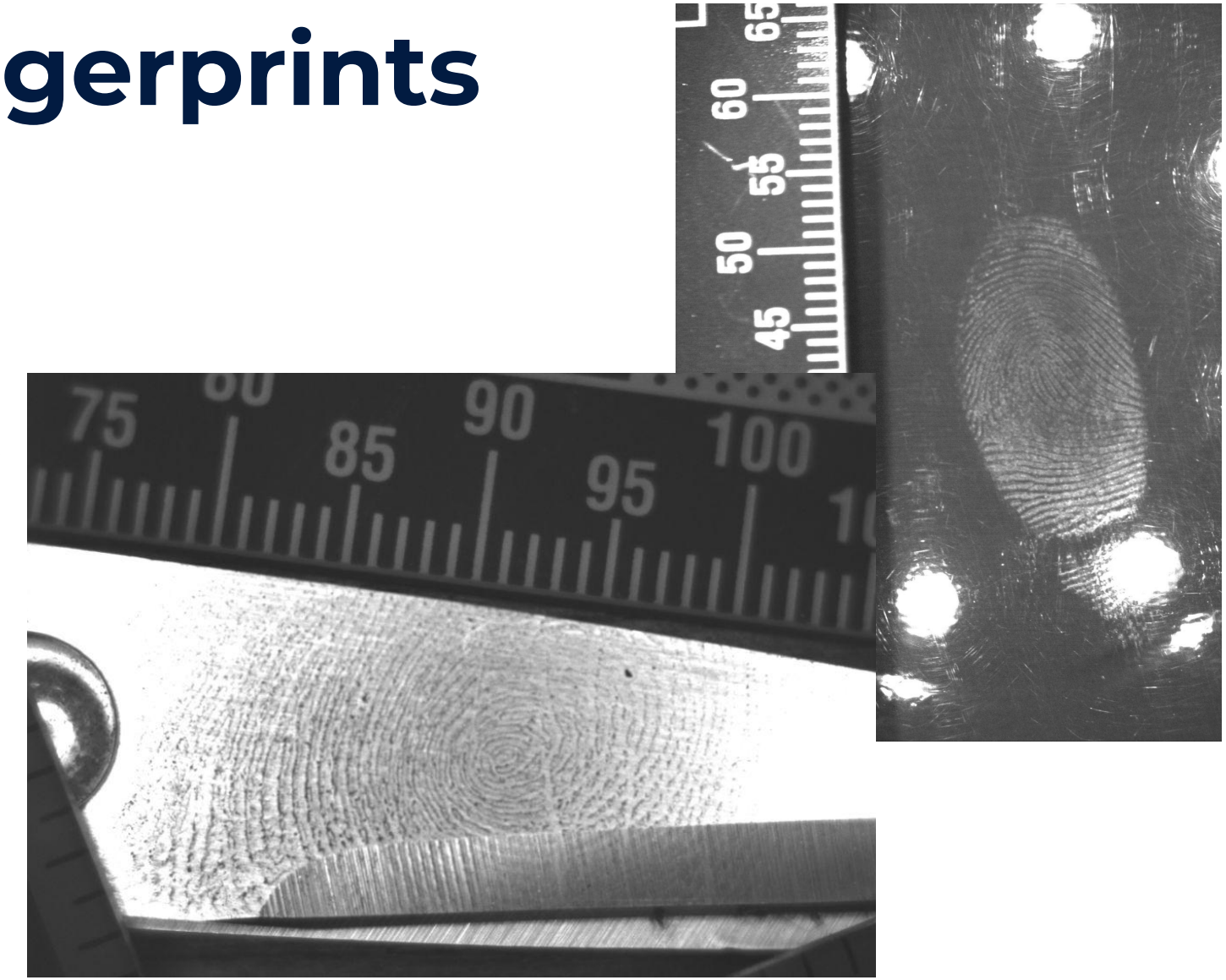
Known Fingerprints

- Acquired using ink or digital scanners
- Controlled environment
- Constant DPI
- Less diverse

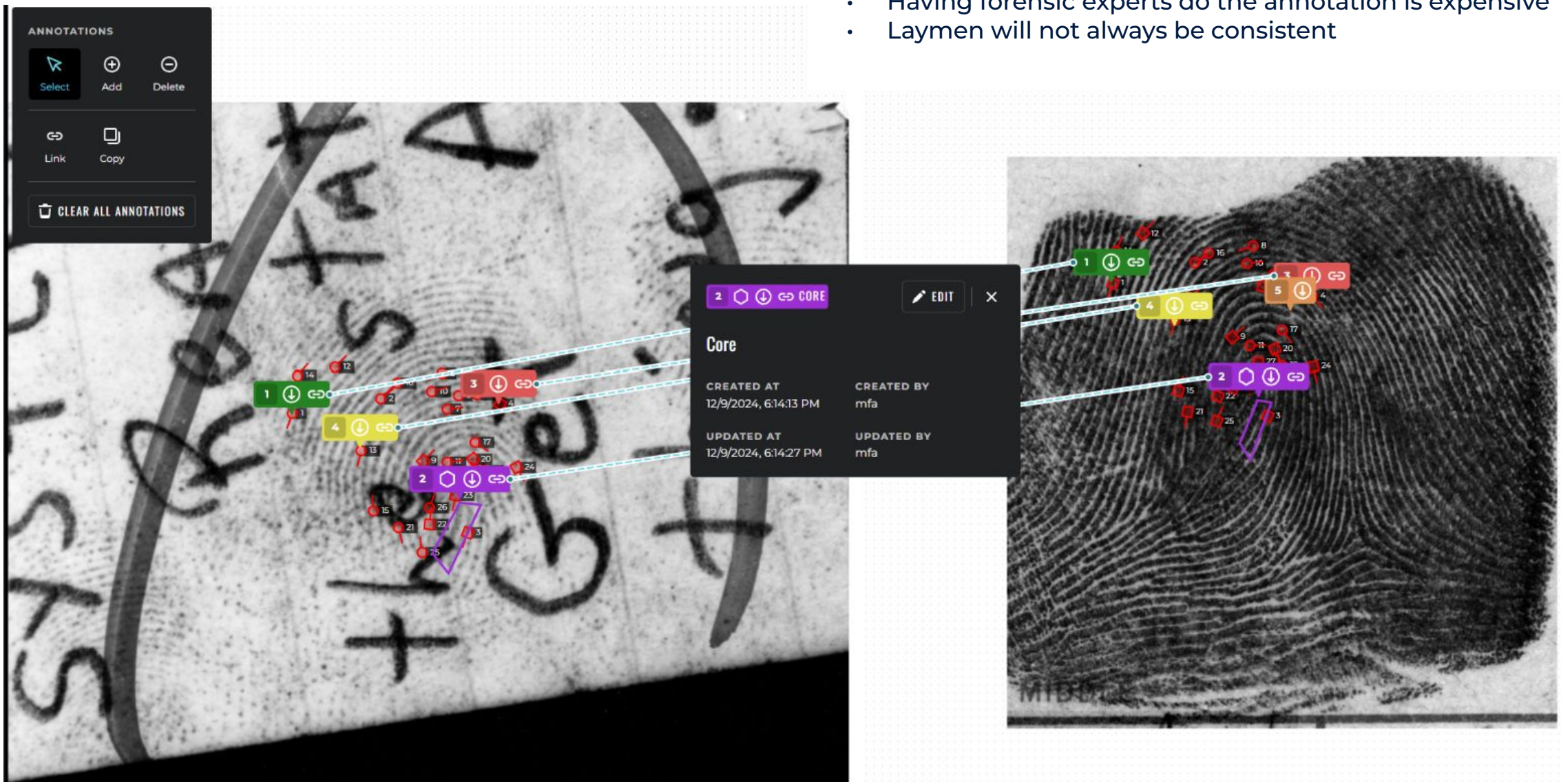


Unknown Fingerprints

- Diverse backgrounds
- Partial information
- Acquired using different techniques



- Annotating latent fingerprints is difficult
- Having forensic experts do the annotation is expensive
- Laymen will not always be consistent



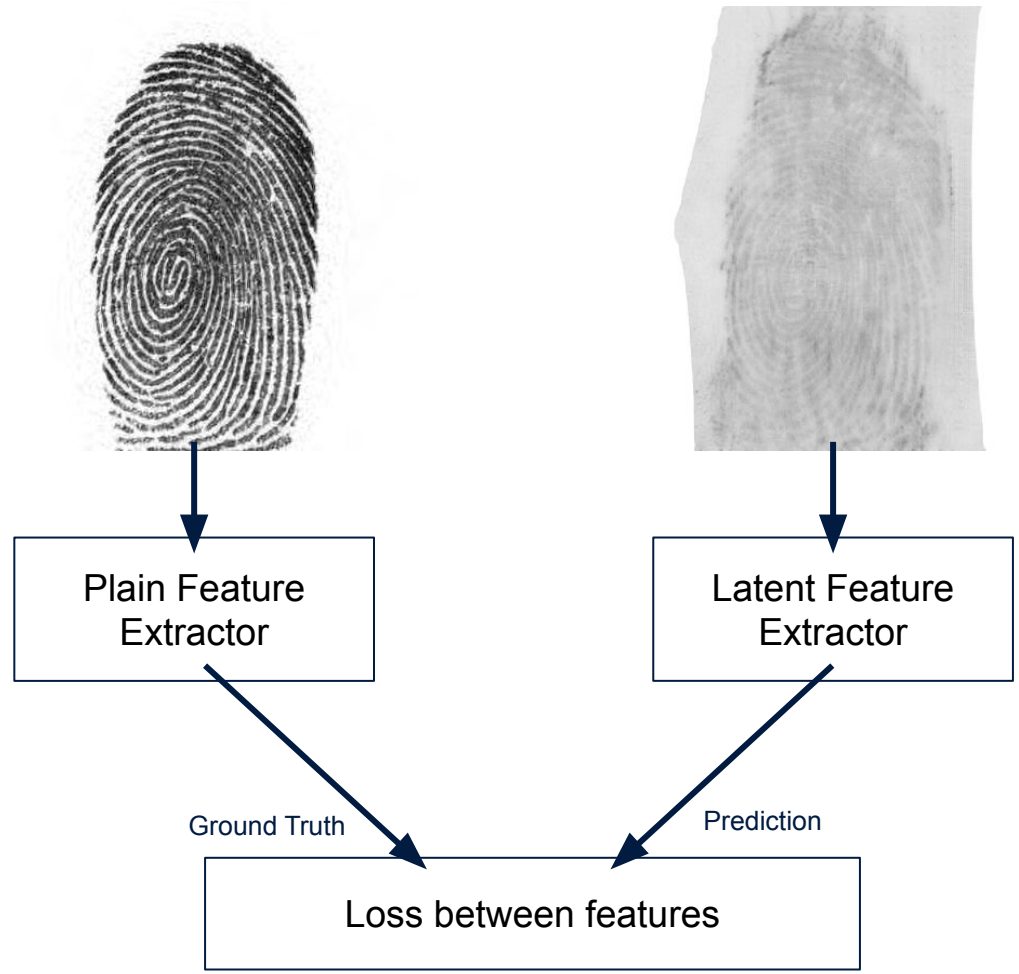
Our Approach

Our Approach

- **Train on purely synthetic latent images**
- We acknowledge lot of research on synthetic fingerprint generation
    - Cycle-GAN-based approaches
    - Diffusion-based approaches
    - Procedural approaches

Training

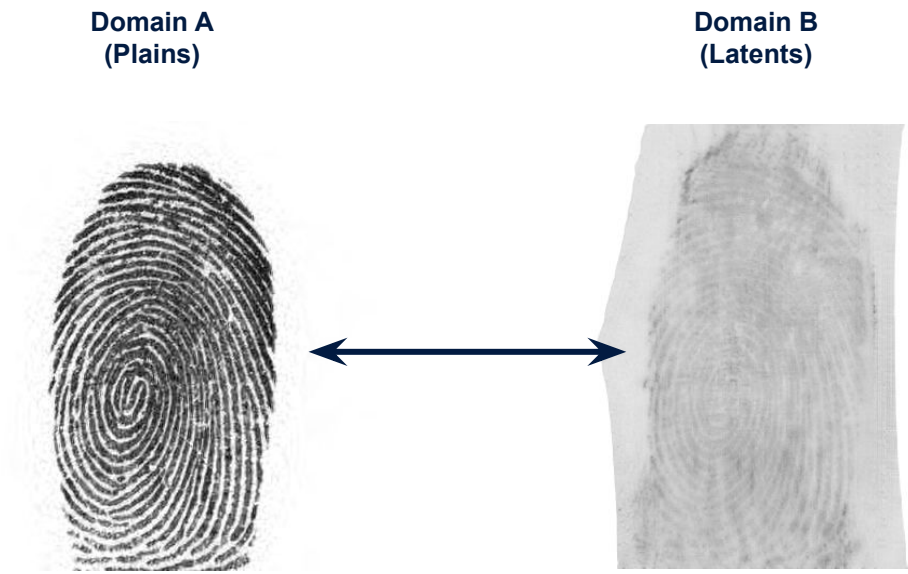
- Predict the same features from plain and latent images



Training Data

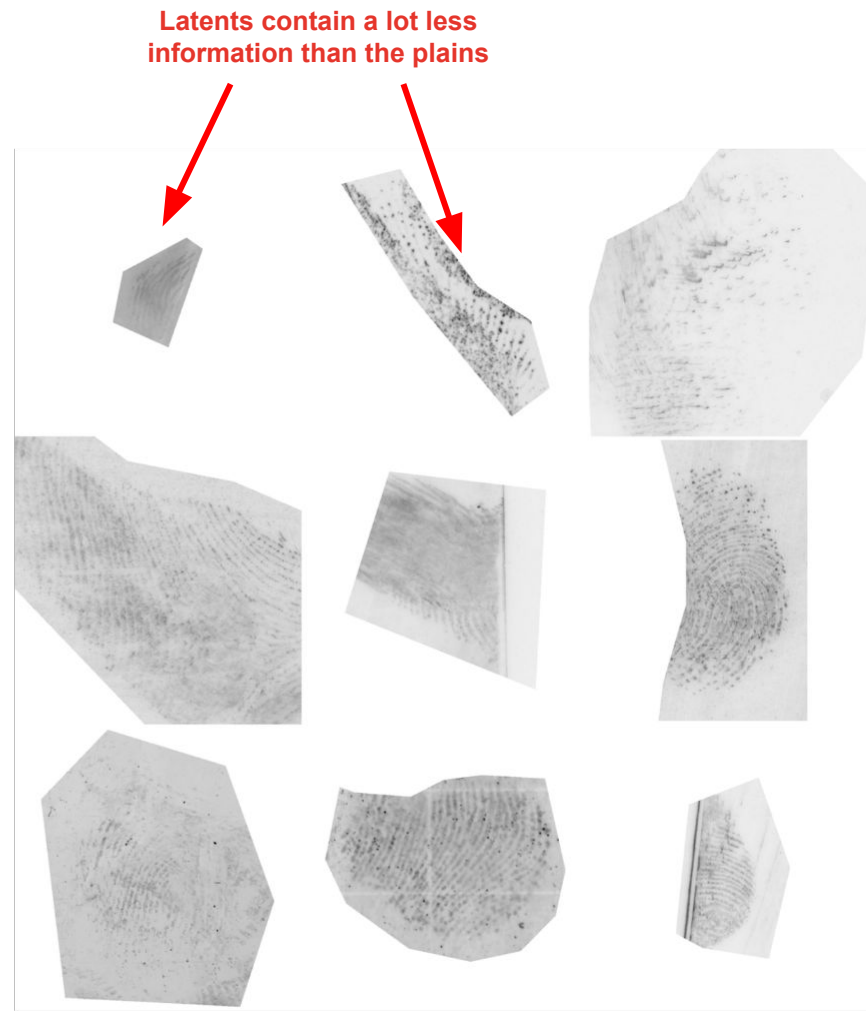
- Produce big bag of image pairs
  - Augmentation
  - GANs
  - Diffusion

- We have no real matching pairs
  - Unpaired image translation



Training Data

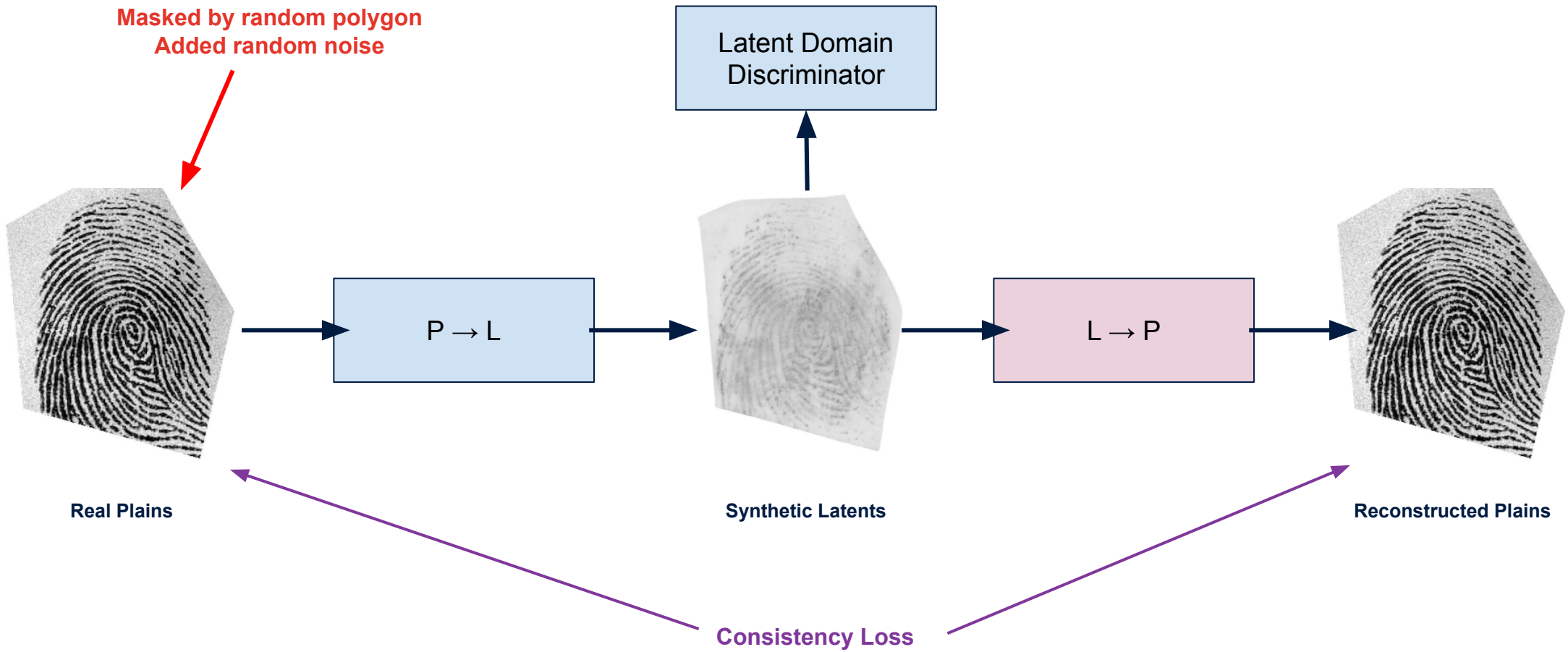
Real Plains



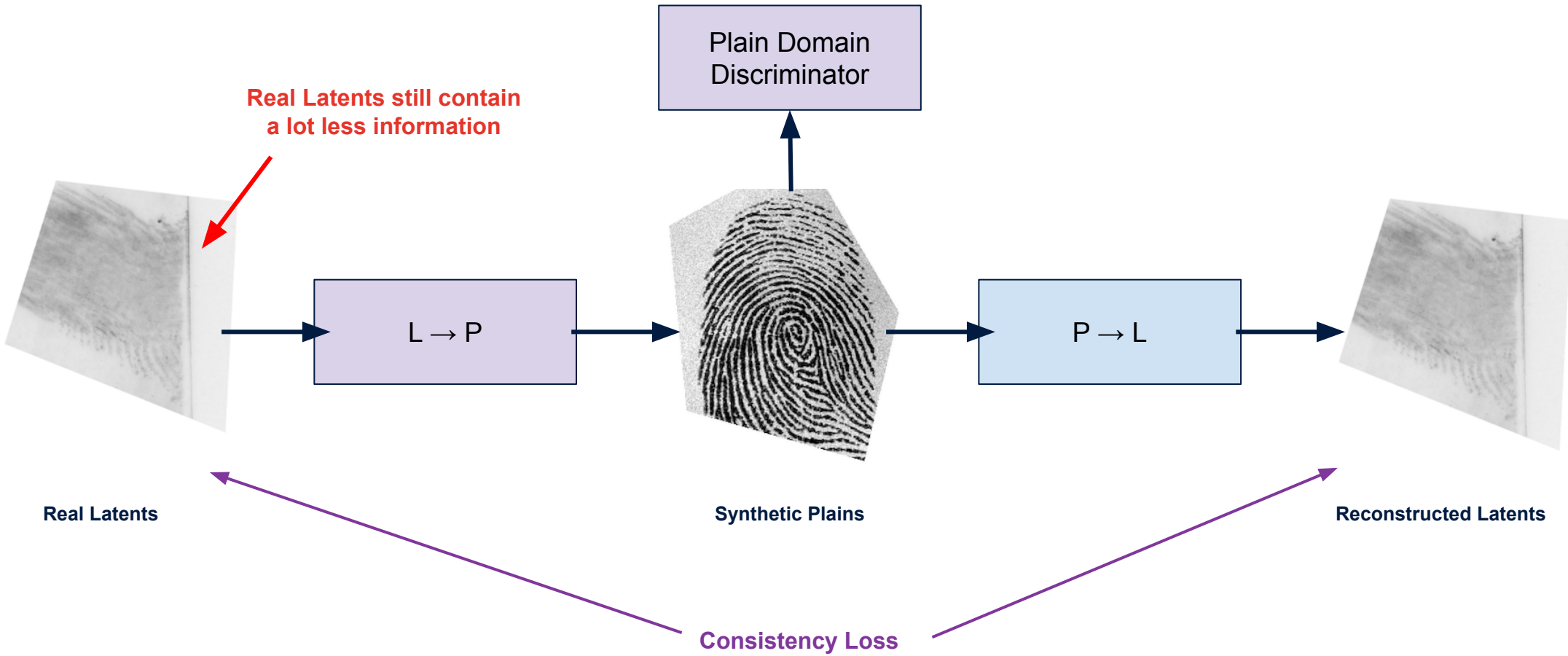
Real Latents (SD302)

Submission 1

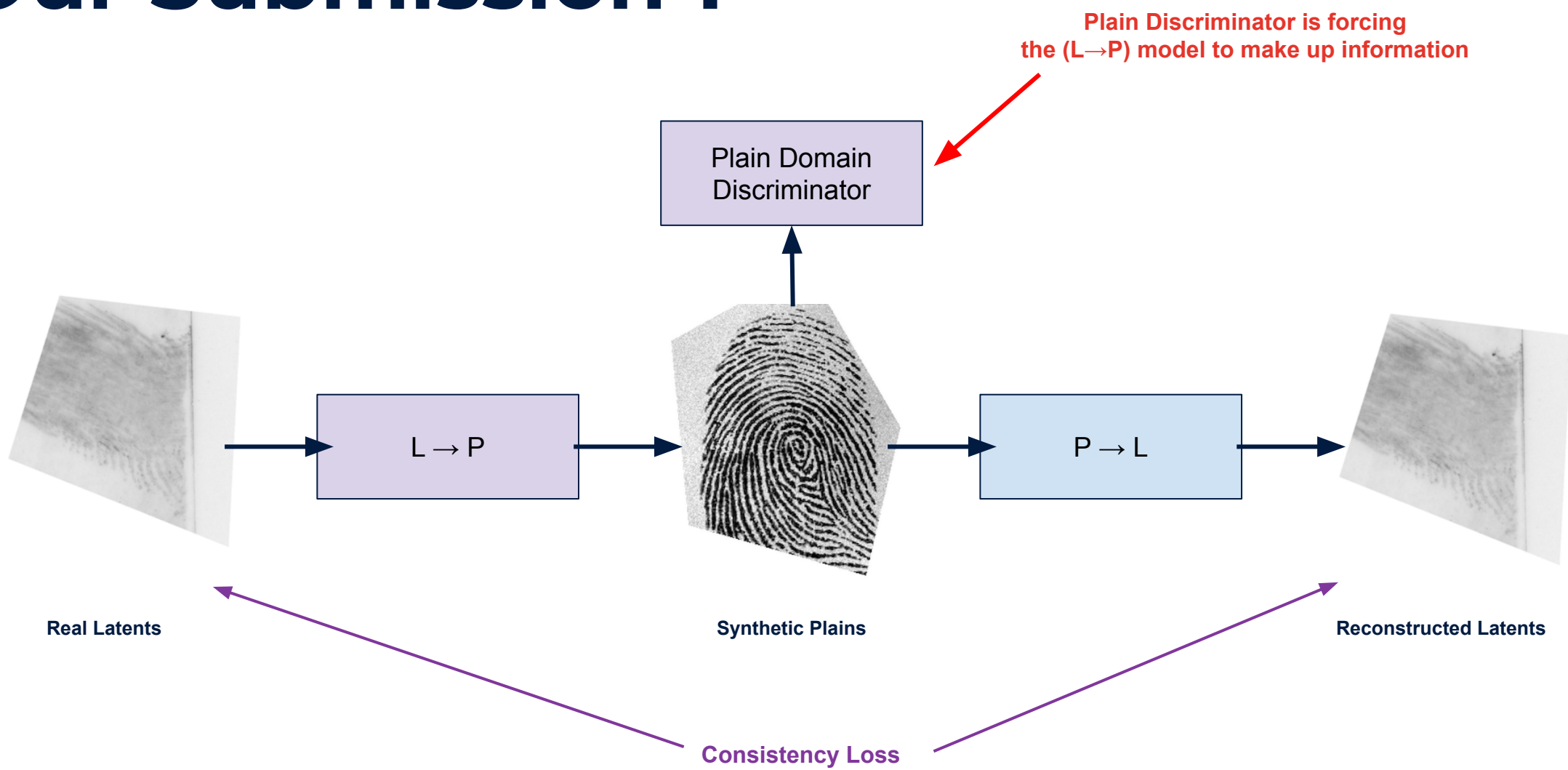
Our Submission 1



Our Submission 1



Our Submission 1



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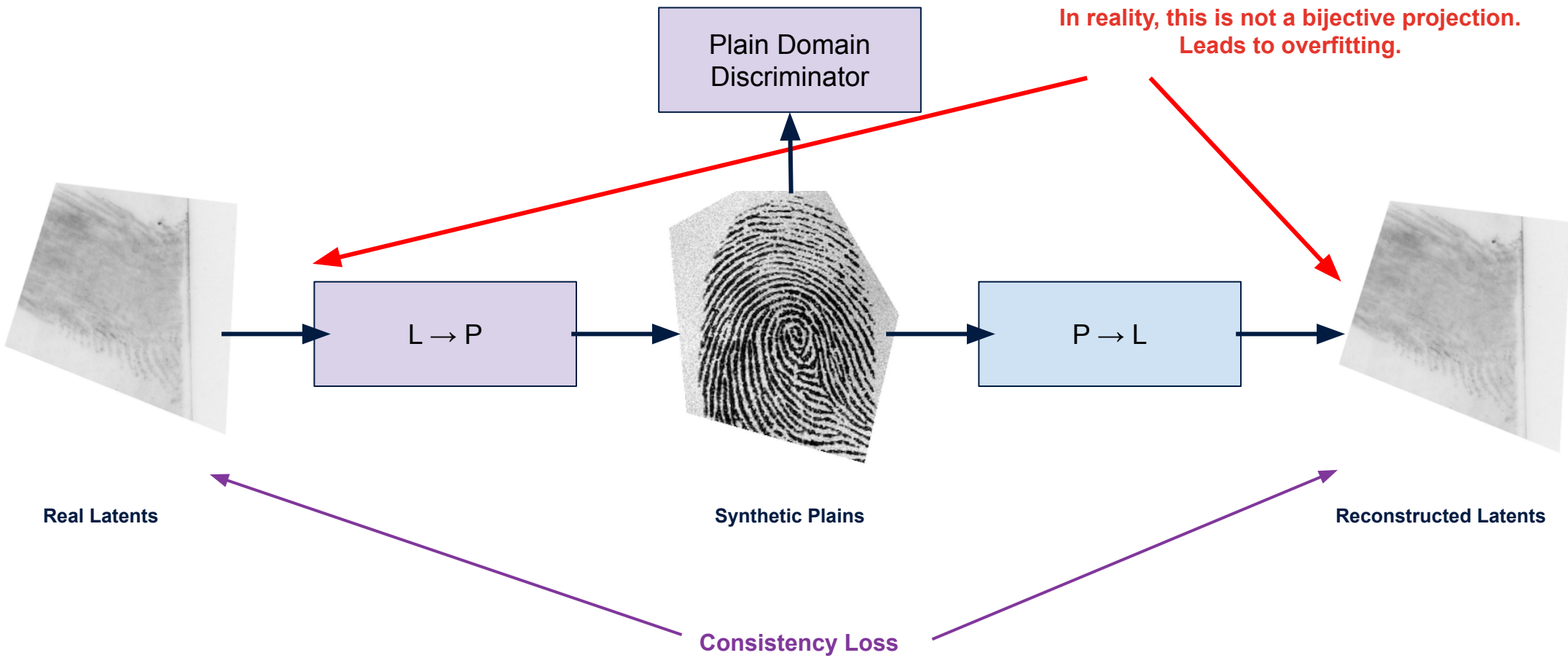
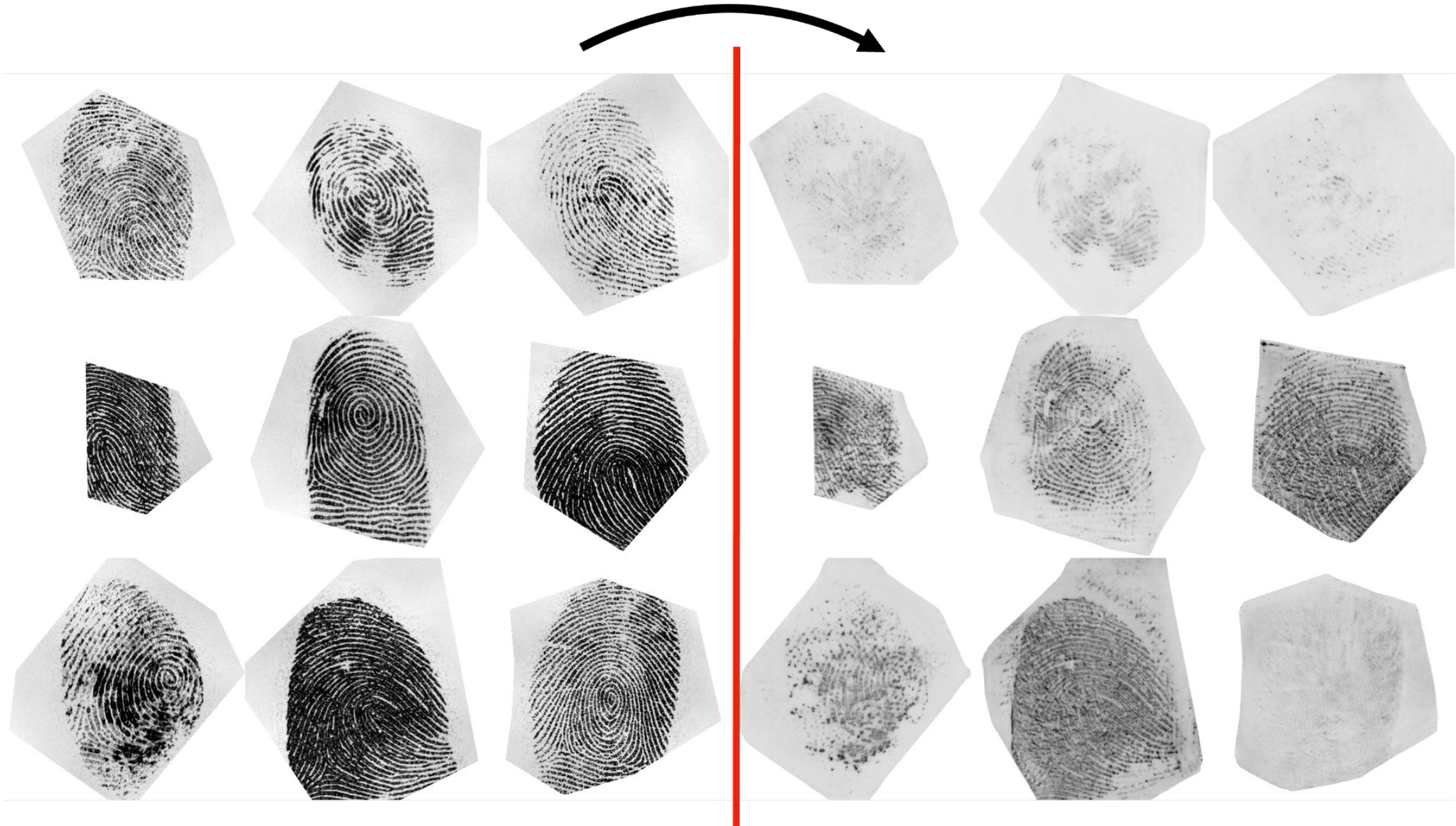
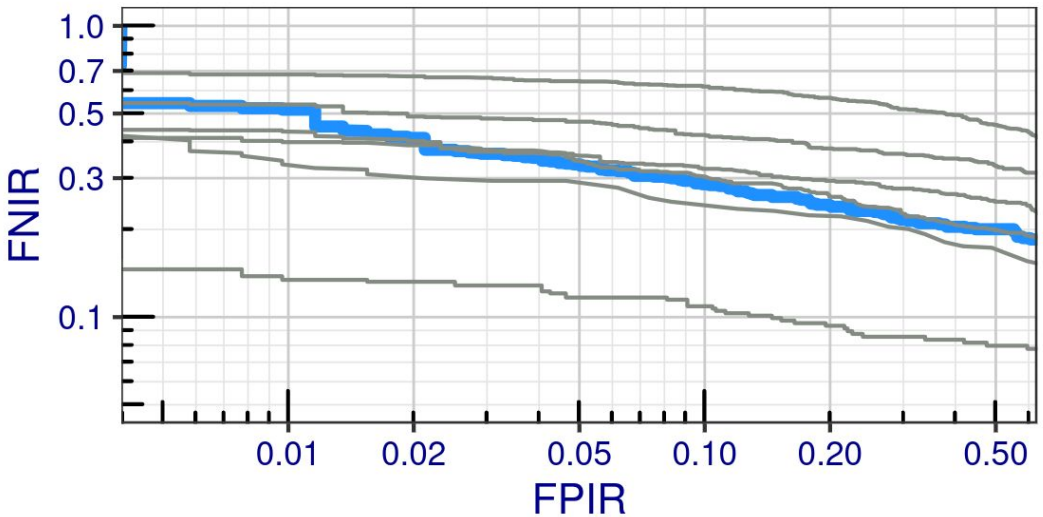


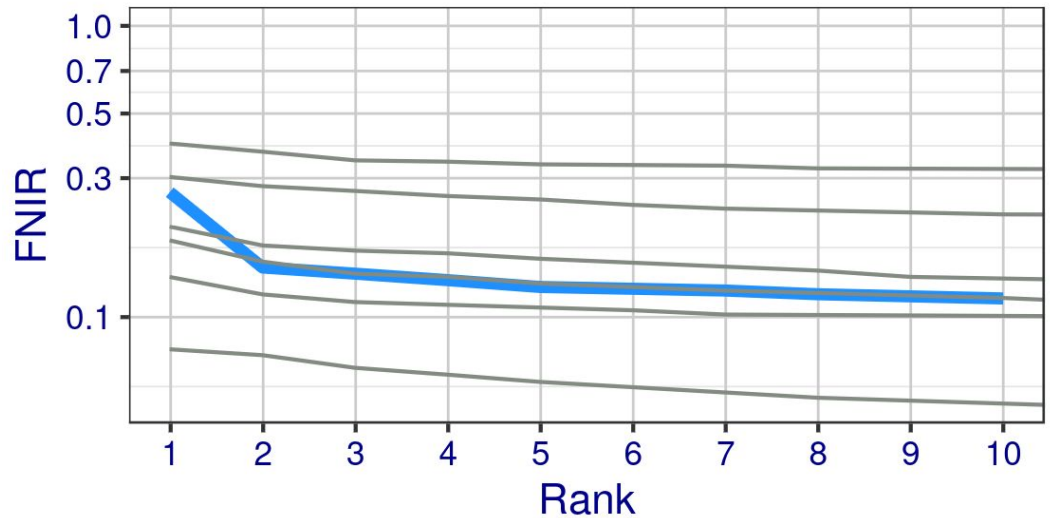


Our Submission 1

- innovatrics-0005
- Not great, not terrible results

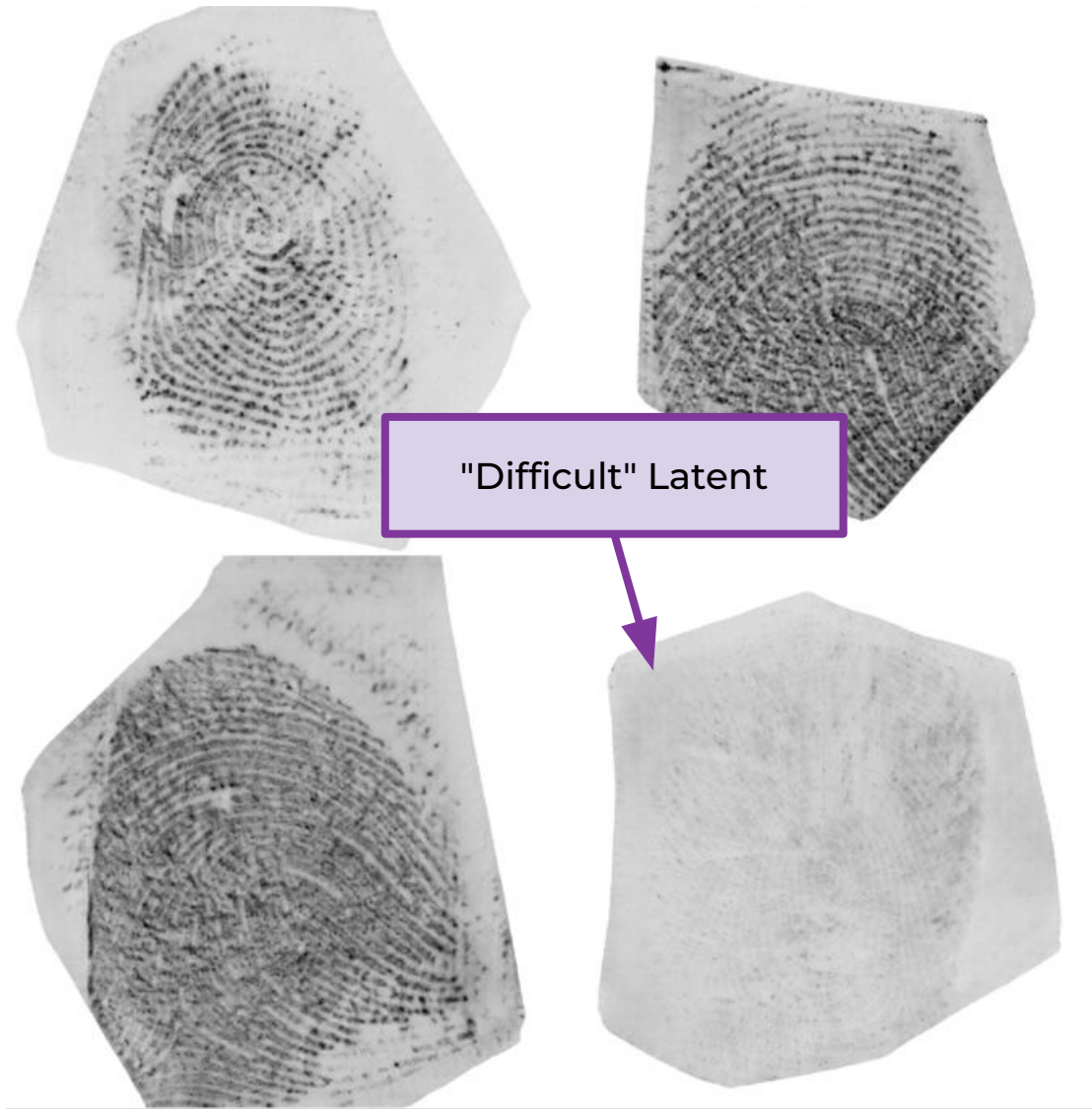


Nutrition Report, Detection Error Tradeoff (DET)



Nutrition Report, Cumulative Match Characteristic (CMC)


"Easy" Plain

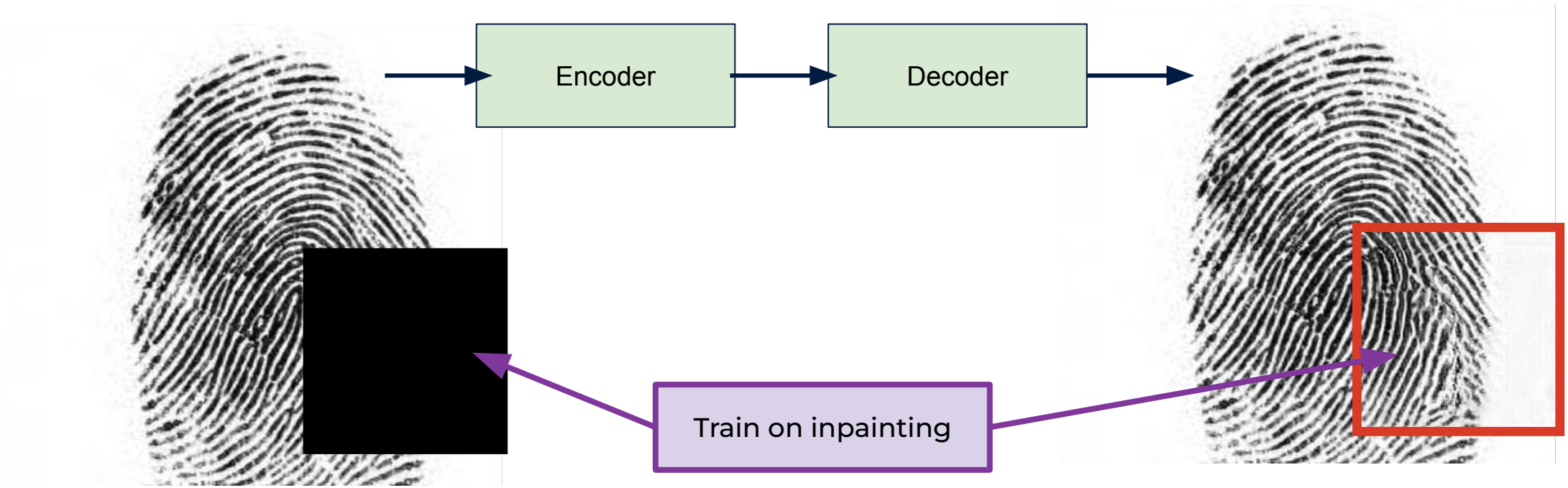

"Difficult" Latent

Submission 2

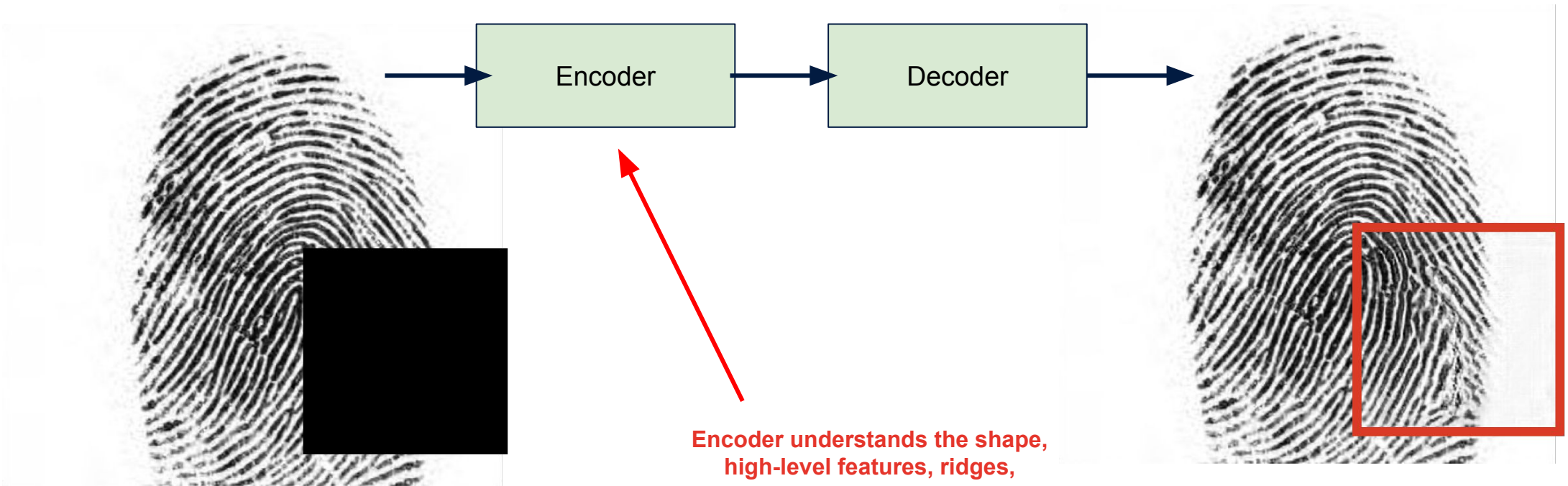
Our Submission 2

- Preserve discriminative information
- Be creative where little information is stored
- Avoid hard-coded clipping mask

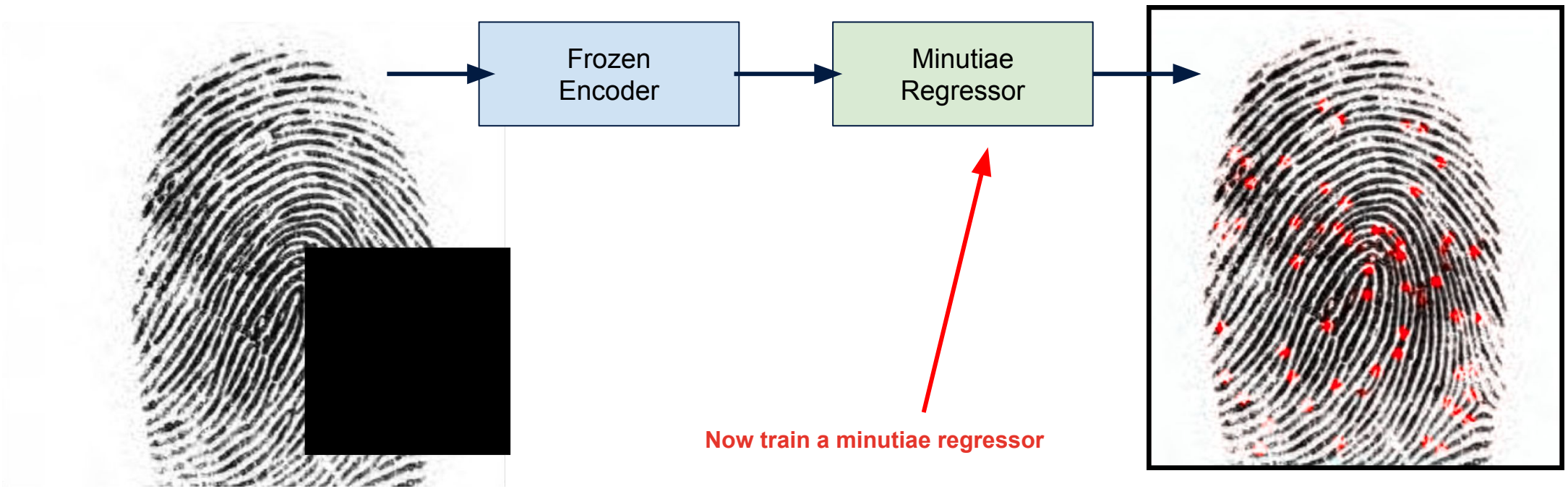
Our Submission 2

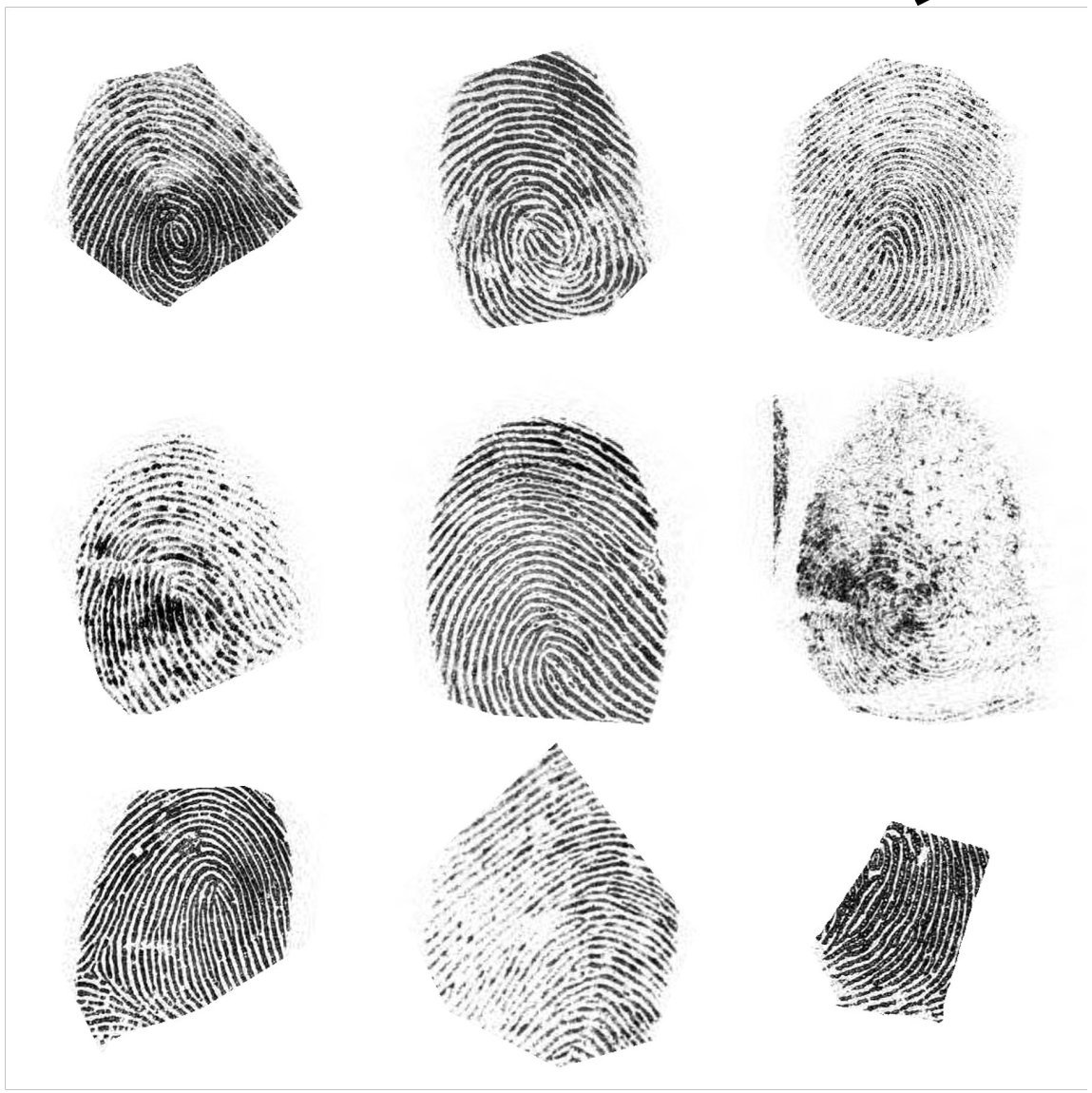


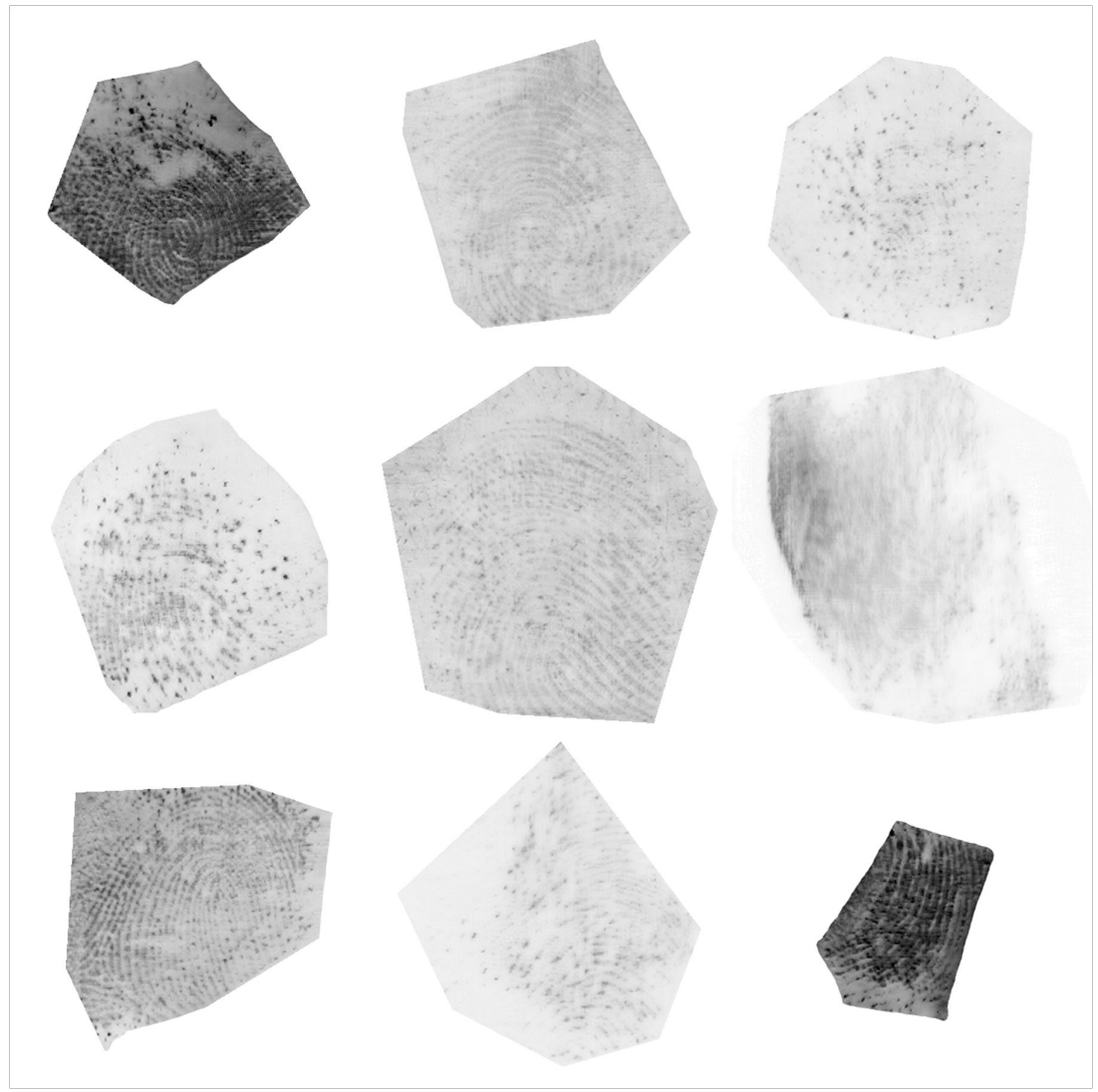
Our Submission 2



Our Submission 2



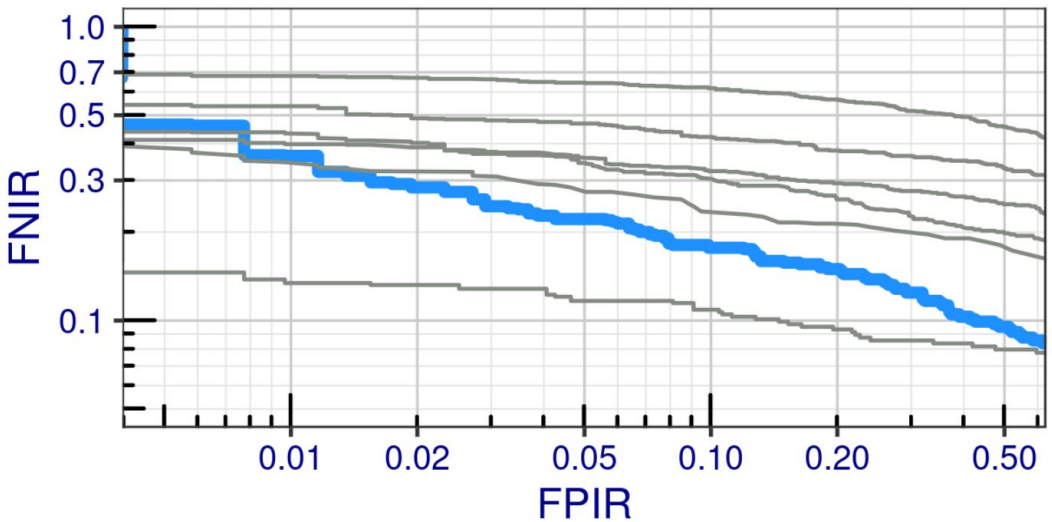





Nothing important is here
Minutiae are preserved

Our Submission 2

- innovatrics-0009
- Kind-of promising



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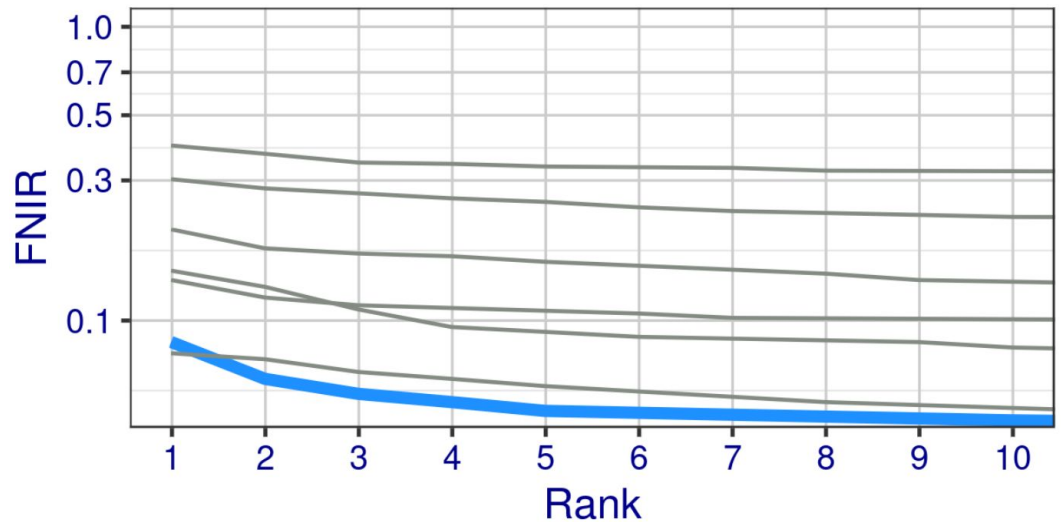
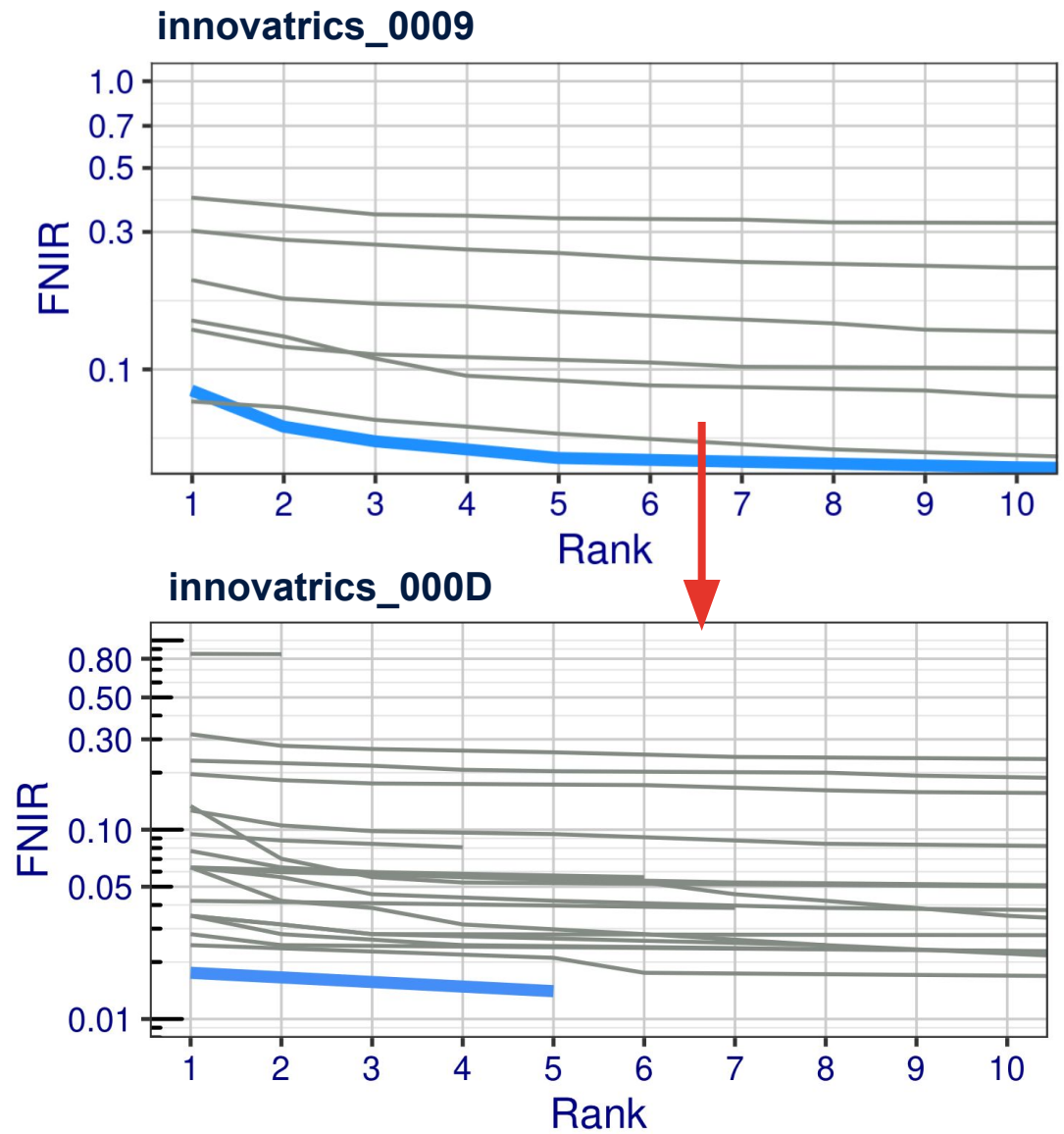


Nutrition Report, Cumulative Match Characteristic (CMC)

Current State

Current State

- Improved techniques of data synthesis
- **Still trained on purely synthetic data**



Nutrition Report, Cumulative Match Characteristic (CMC)

Thank you

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