Welcome

AMLD 2021 - Sketchy

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The team

Senior Machine Learning Engineer

Gaetan

Senior Machine Learning Engineer

Thibault

Junior Machine Learning Engineer

Olivier

Junior Machine Learning Engineer

Pauline

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Links for the workshop

Github Repository (with links to Collab notebooks):
https://github.com/VisiumCH/AMLD-2021-Sketchy

Interactive Web Application:
https://amld.visium.ch

Todays' program

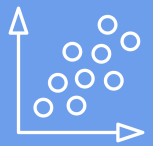
1

Retrieval Systems

2

Sketch-based Image Retrieval

3



Encoder and Embeddings

4

Attention Module

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Part 1

1

Retrieval Systems

2

Sketch-based Image Retrieval

3

Encoder and Embeddings

4

Attention Module

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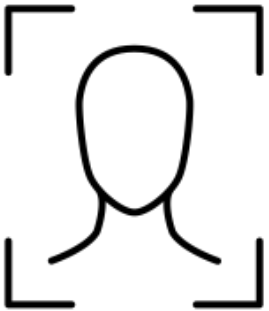
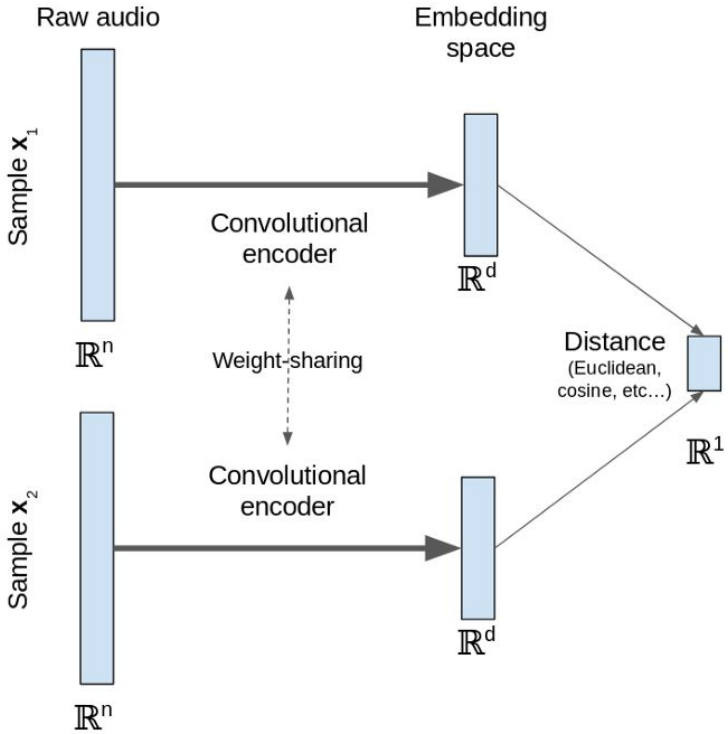
Item Retrieval Systems

Speaker Identification

Face Recognition





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Part 2

1

Retrieval Systems

2

Sketch-based Image Retrieval

3

Encoder and Embeddings

4

Attention Module

Sketch-Based Image Retrieval

Image Database

Draw Sketch

Retrieve Image

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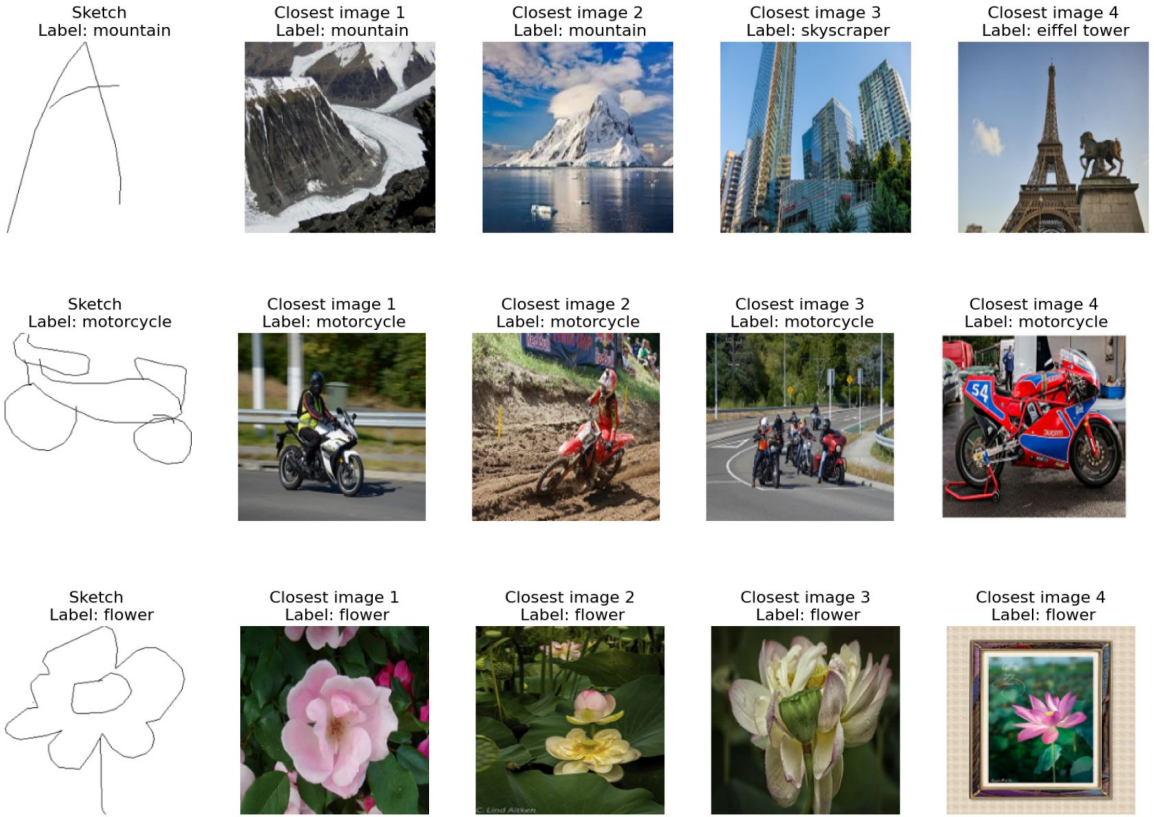
Sketch-Based Image Retrieval



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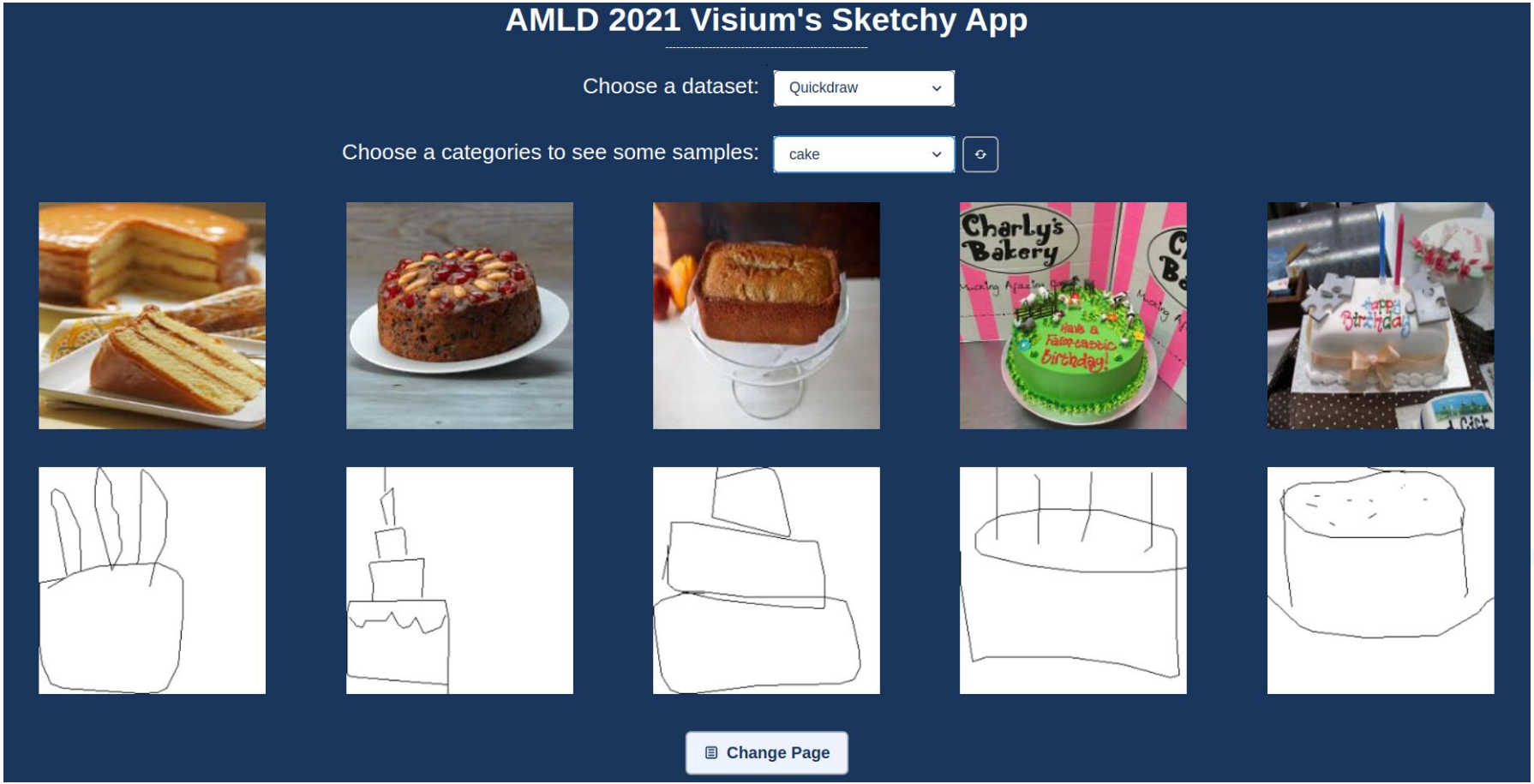
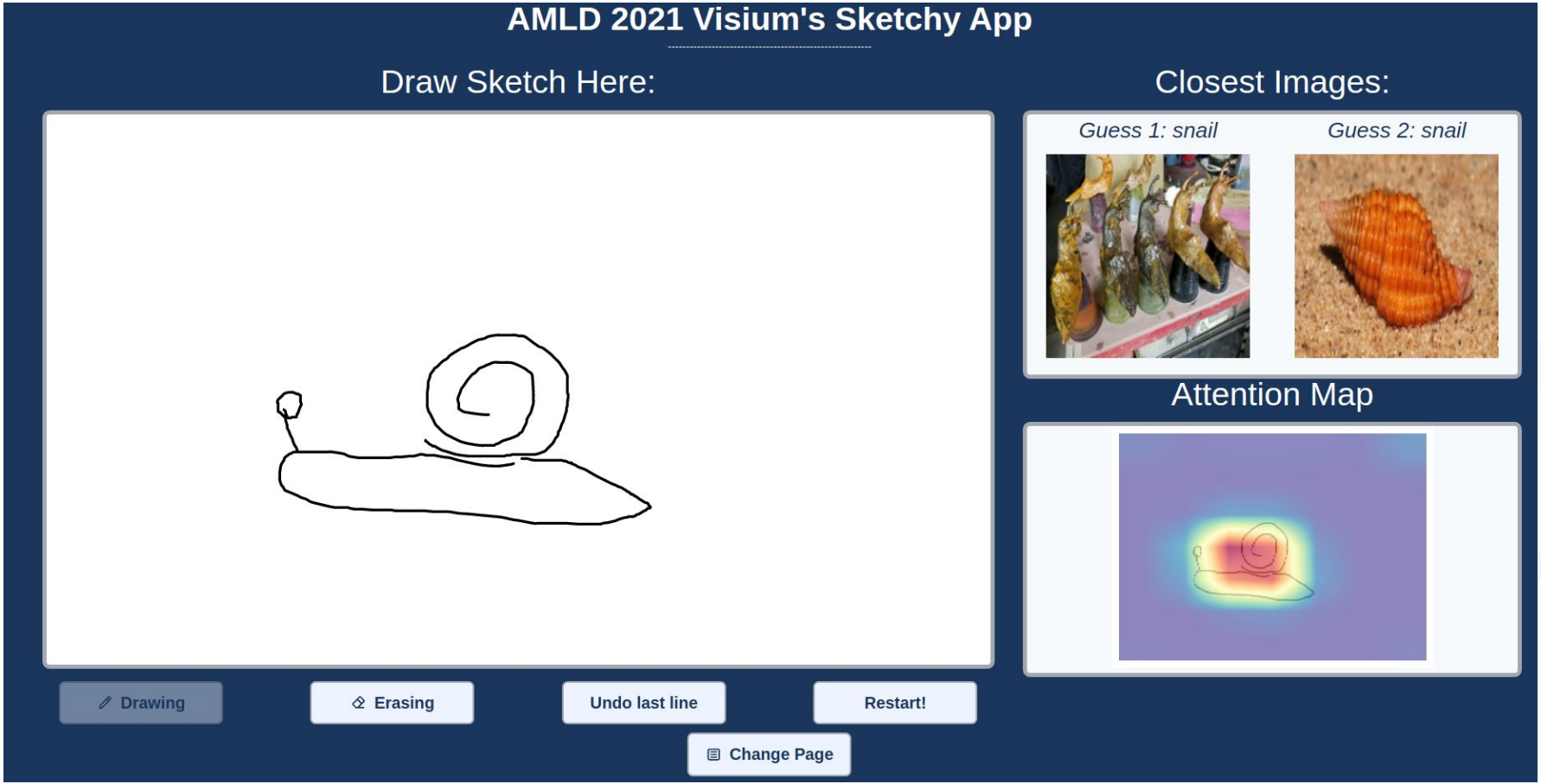
Sketch-Based Image Retrieval (amld.visium.ch)



Sketch-Based Image Retrieval



Part 3

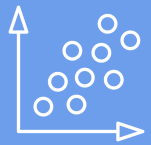
1

Retrieval Systems

2

Sketch-based Image Retrieval

3



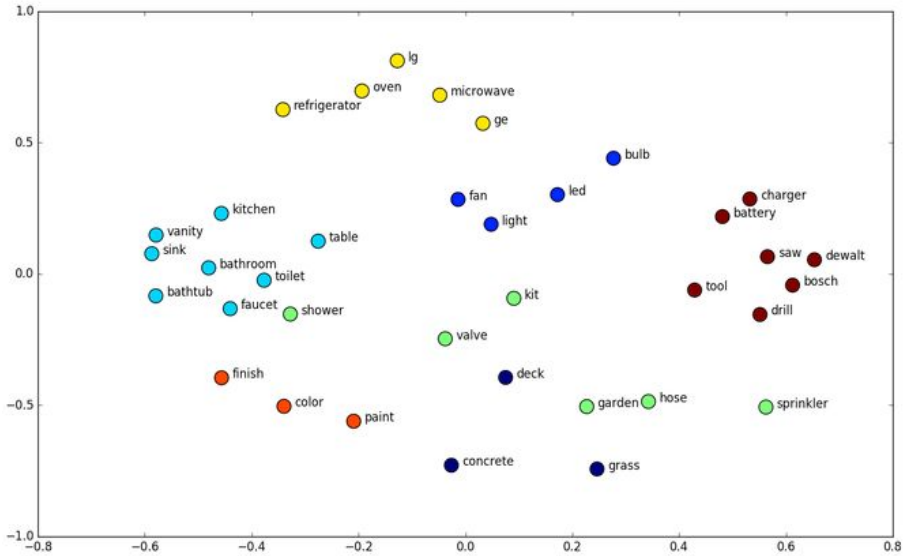
Encoder and Embeddings

4

Attention Module

Embeddings

- Embeddings are a low dimensional representation of the semantic of higher dimensional data



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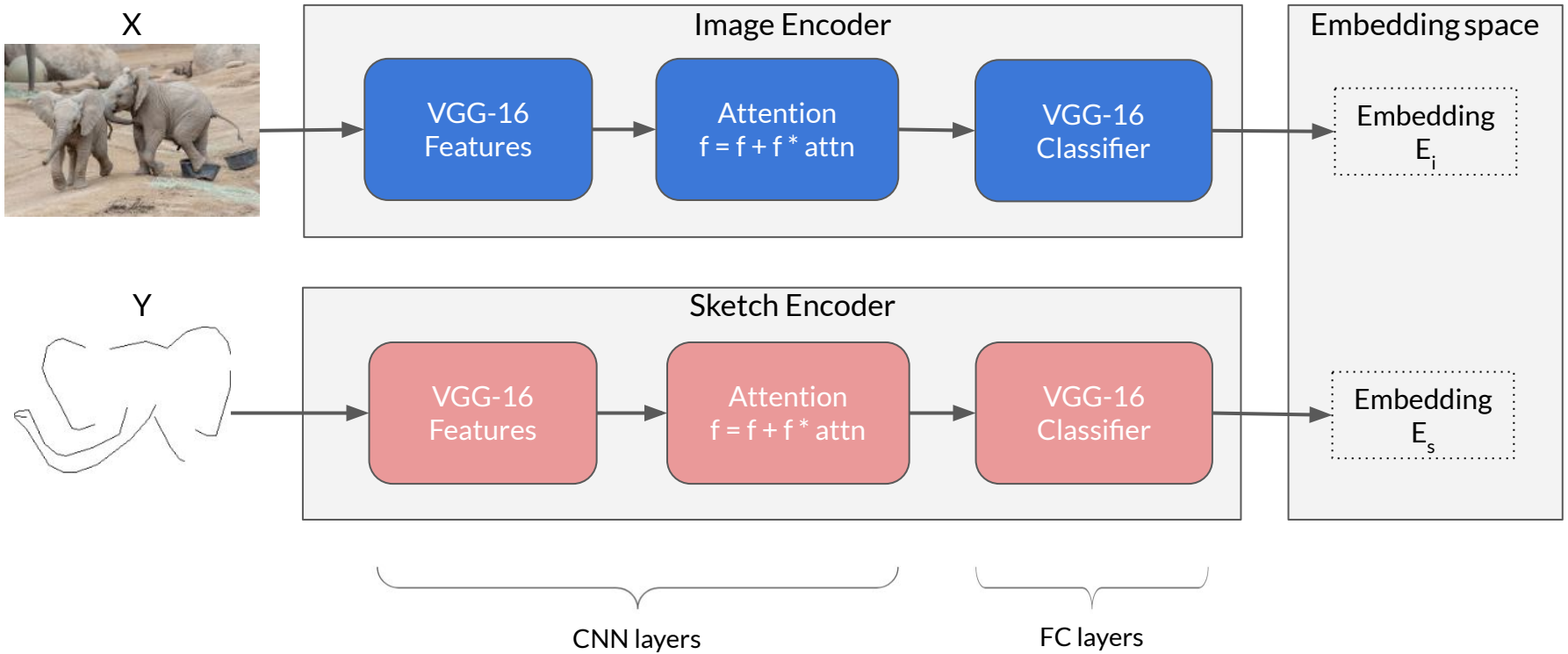
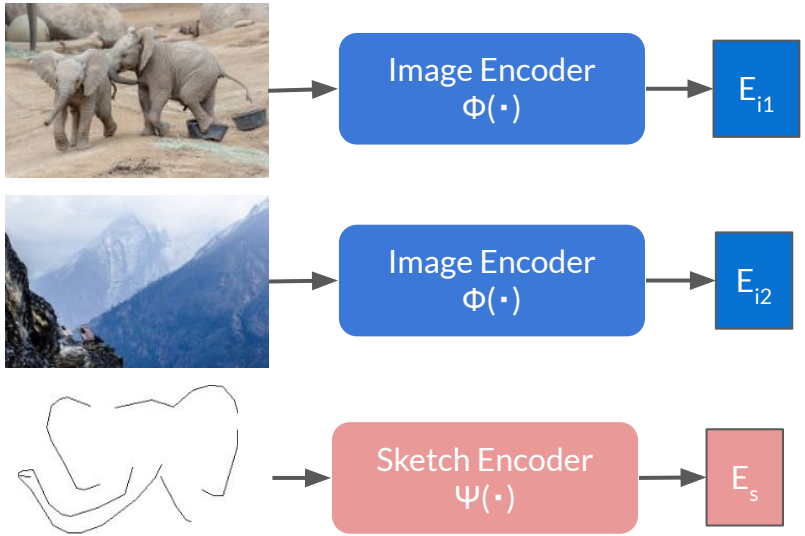
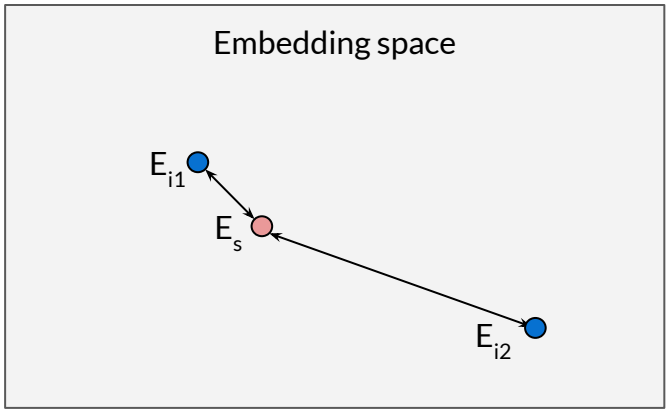
Encoder


X
Image Encoder
VGG-16
Features
Attention
f = f + f * attn
VGG-16
Classifier
Embedding space
Embedding
E_i
Y
Sketch Encoder
VGG-16
Features
Attention
f = f + f * attn
VGG-16
Classifier
Embedding
E_s
CNN layers
FC layers

Encoder and Embeddings

- Networks map images and sketches to ***Embeddings.***
- The closest image in the lower dimensional space is retrieved.





E_{i1} is retrieved

Embeddings

AMLD 2021 Visium's Sketchy App

Embeddings: Images and Sketches in 3D after TSNE projection

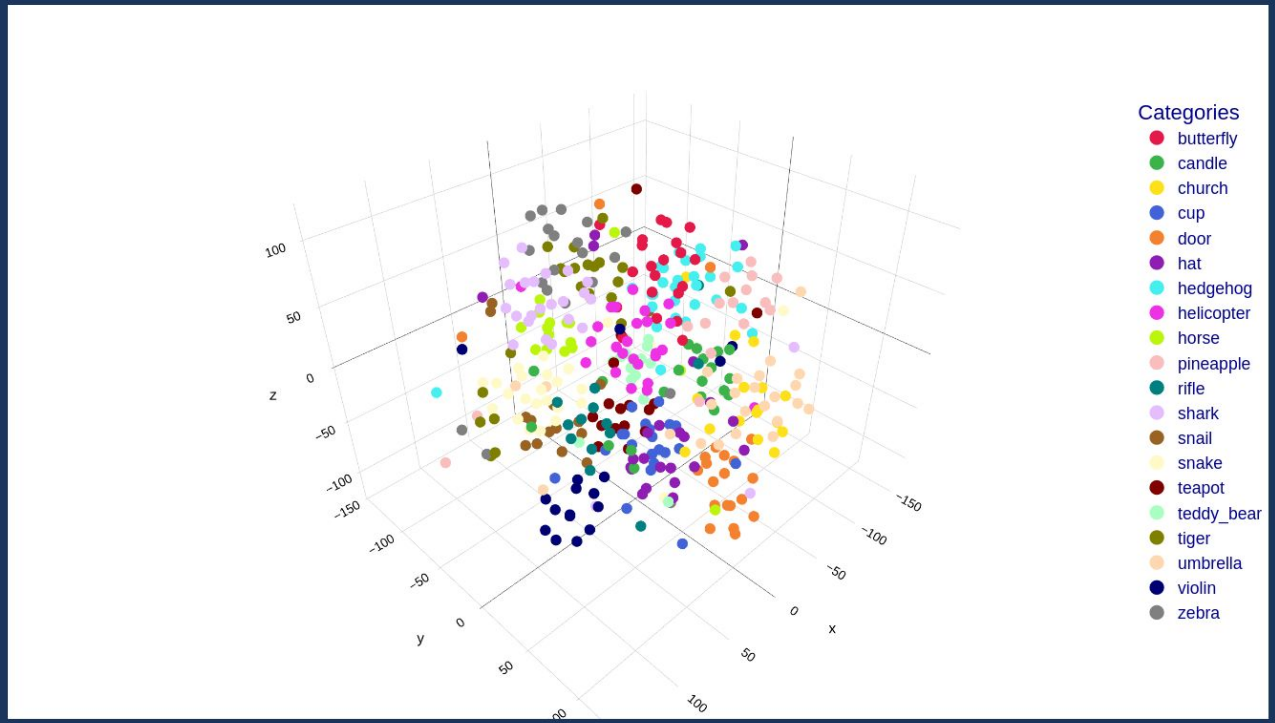
Options

2D 3D

PCA TSNE UMAP

My Sketch

Clicked image



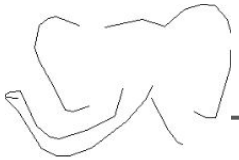
Change Page

Encoder and Embeddings Training

Image Encoder
Φ(·)

E_{i1}

positive



Sketch Encoder
Ψ(·)

E_s

anchor

Triplet Margin Loss

Image Encoder
Φ(·)

E_{i2}

negative

Make **positive and anchor close** to each other and **far from negative**.

$$\delta_- = ||\Psi(a) - \Phi(n)||_2$$

$$\delta_+ = ||\Psi(a) - \Phi(p)||_2$$

$$\lambda(\delta_+, \delta_-) = max\{0, \mu + \delta_+ - \delta_-\}$$

$$L_t = \frac{1}{N} \sum_{i=1}^{N} \lambda(\delta_+^i, \delta_-^i)$$

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Encoder and Embeddings Training

Force **sketch and image embeddings to same area in embedding space**.
Reverse gradient of classifier.

$$l_t(e) = tlog(f(R_{\lambda_d}(e))) + (1-t)log(1-f(R_{\lambda_d}(e)))$$

$$L_d = \frac{1}{3N}\sum_{i=1}^{N}(l_0(\Psi(a_i)) + l_1(\Phi(p_i)) + l_1(\Phi(n_i)))$$

Encoder and Embeddings Training

Image Encoder
Φ(·)

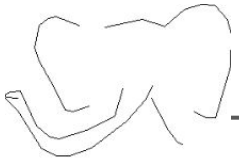
E_{i1}

GRL λ_d

Domain
Classifier f(·)

Domain
Loss

positive



Sketch Encoder
Ψ(·)

E_s

anchor

Triplet
Margin Loss

negative

Image Encoder
Φ(·)

E_{i2}

Train with both losses.

$$L_{tot} = w_d * L_d + w_t * L_t$$

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Part 4

1

Retrieval Systems

2

Sketch-based Image Retrieval

3

Encoder and Embeddings

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Attention Module

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(Soft)-Attention

- Powerful concept in deep learning
- Help localise and highlight important features
- Assign weight depending on region of feature map
  - $x = x + x * attn(x)$

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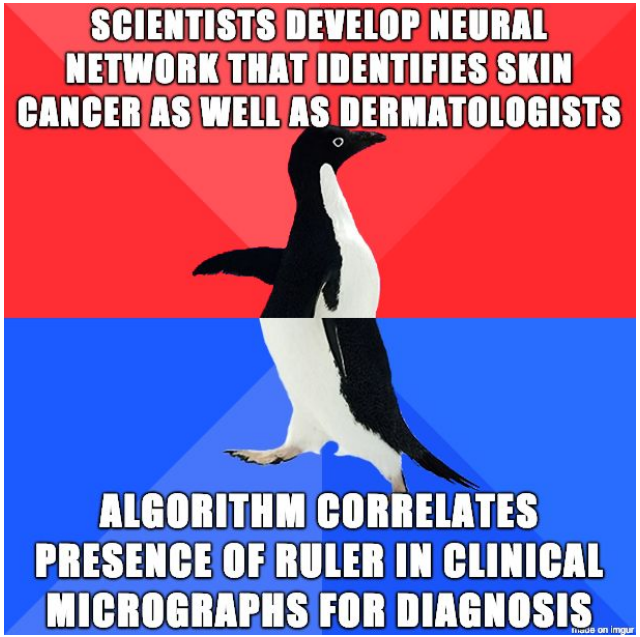
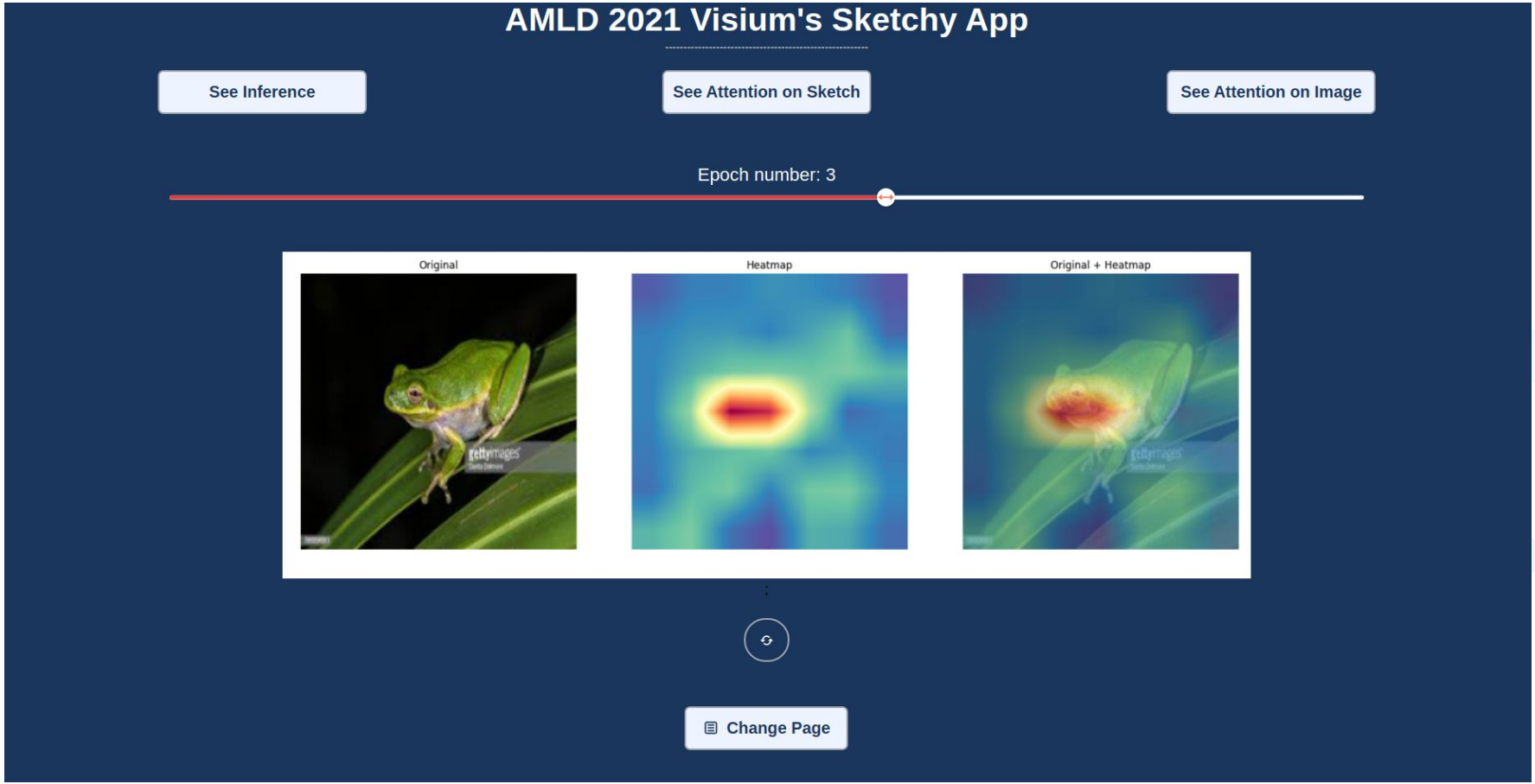
Attention

Visualise attention for sanity check



Attention in Web App



Jupyter Notebooks

Github Repository (with links to Collab notebooks):
https://github.com/VisiumCH/AMLD-2021-Sketchy

1. Training:
    a. Implement the network structure
    b. Understand and implement the different losses

2. Performance:
    a. Compute the performance metrics
    b. Implement the inference pipeline and visualize results

Takeaways

- Item retrieval systems fundamentals
- Always break down complex problems into digestible parts

To go further:

- You can also include other losses to change the behaviour of the model. For example, **[1]** include a semantic loss based on word embedding similarities

[1]: Doodle To Search: Practical Zero-Shot Sketch-based Image Retrieval, Dey, Sounak and Riba, Pau and Dutta, Anjan and Lladós, Josep and Song, Yi-Zhe

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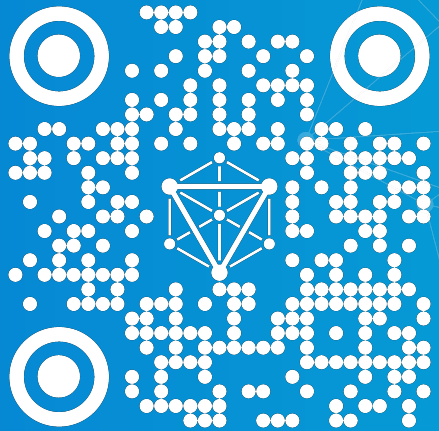

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