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Supporting Skin Lesion Diagnosis with Content-Based Image Retrieval

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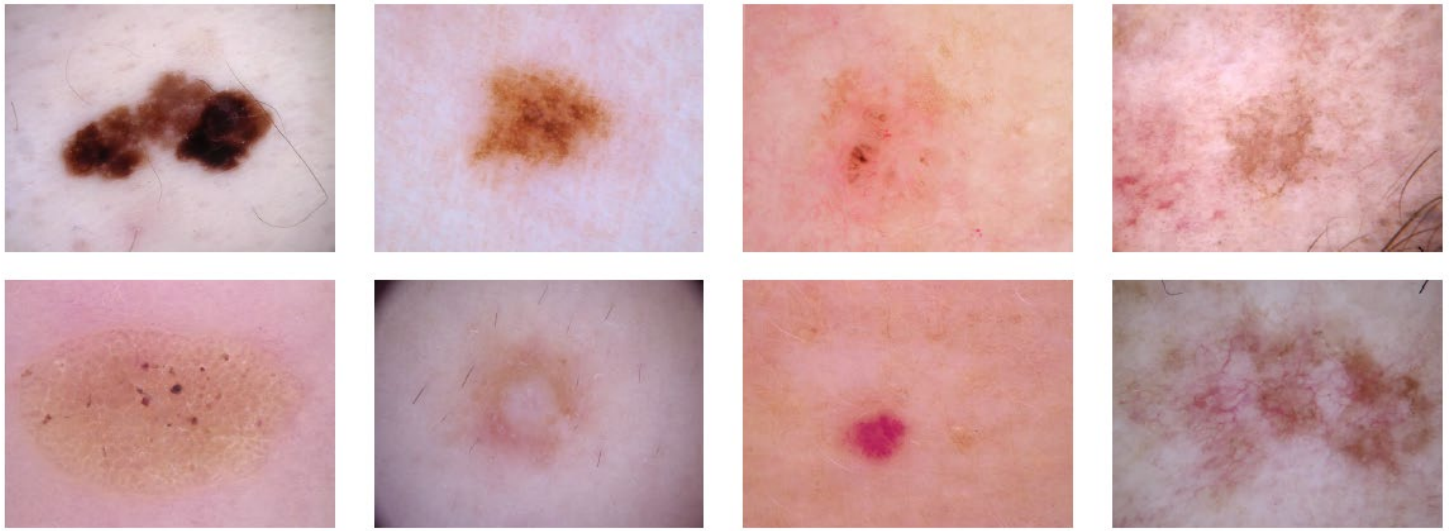
Skin Cancer

- Skin cancer is one of the most common forms of human cancer worldwide
- If caught early, it is usually curable
- Distinguishing skin cancer from other kinds of skin lesion is a difficult task



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Computer Aided Diagnosis with CNN

- Convolutional Neural Networks have been widely employed for **skin lesion classification**
- Classification CNNs have pros and cons:

Good classification accuracy, comparable to expert dermatologists

Low interpretability: Scarce diagnostic aid for physicians

- How can interpretability be improved?

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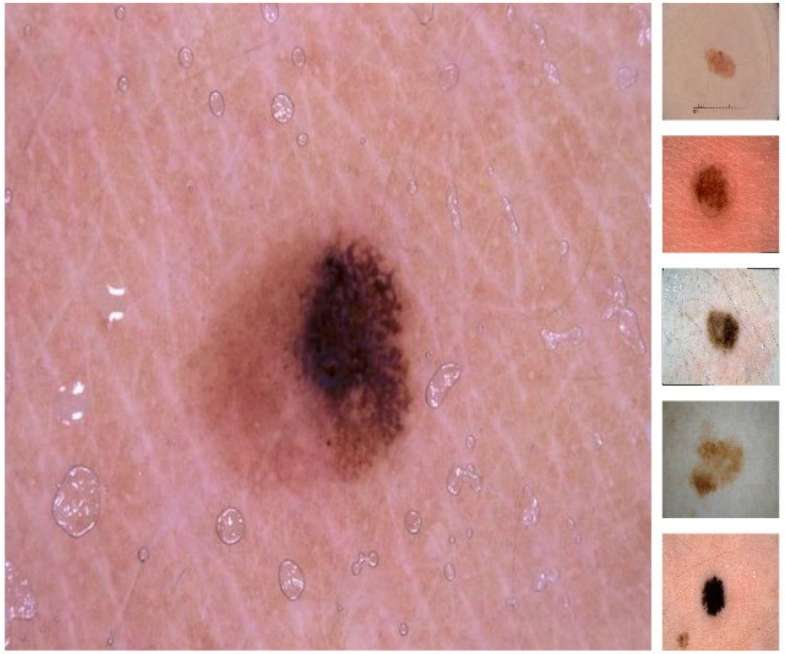
Content-Based Image Retrieval (CBIR)

- Given a new lesion, retrieve **similar cases** from a labeled database
- How to define image similarity?
- Past works:
  - Euclidean or Bhattacharyya distance between handcrafted features
  - Hamming distance between hash codes, computed with a modified classification CNN (AlexNet)



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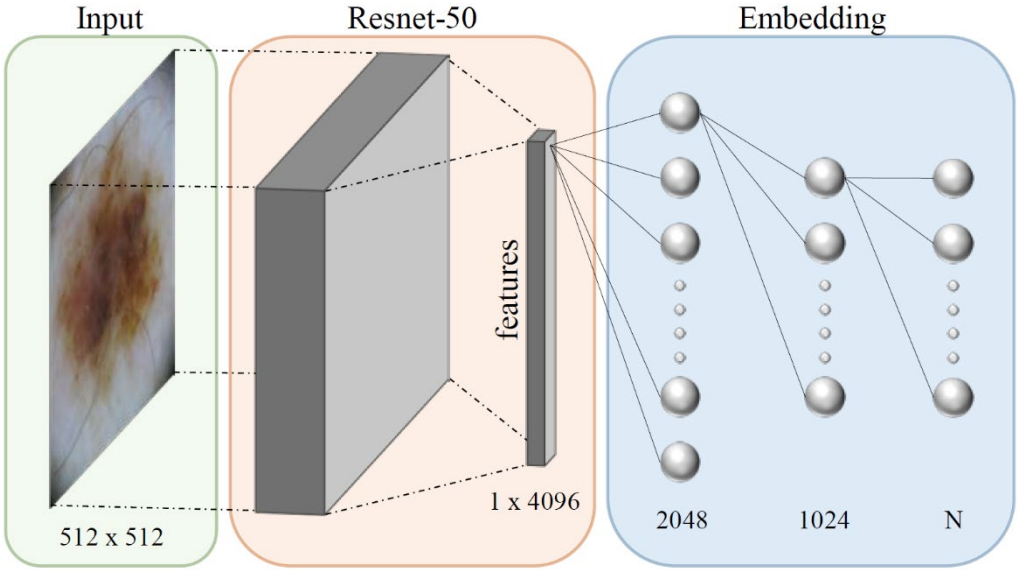
Proposed CBIR system

- ResNet Feature Extractor:
  ResNet, except for the last FC layer
- Embedding Network:
  2 FC layers, built on ResNet-extracted features



- **Cosine similarity** between image embeddings
- Embedding training with **triplet loss** function
- **ISIC dataset -** 20K images, 8 classes

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Quantitative Results

4 variations of the proposed model:

- ResNet FE trained for **classification**
- ResNet FE + EmbNet, **end-to-end** trained with **triplet loss**
- ResNet FE pretrained + EmbNet, **only EmbNet** trained with **triplet loss**
- ResNet FE pretrained + EmbNet, **end-to-end** trained with **triplet loss**

Model	Cut-Off k	AP@k
Hash-AP [45]	-	0.3404
Hash-AP ResNet*	-	0.7580
Classification*	1	0.8224
	5	0.7859
	10	0.7746
Embedding End-to-End*	1	0.7784
	5	0.7786
	10	0.7804
Class & Embedding*	1	0.8157
	5	0.8168
	10	0.8190
Class & Embedding End-to-End*	1	0.7867
	5	0.7881
	10	0.7920

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Qualitative Results

- Dermatologists classified 100 lesions two times
  - **Task 1 –** without aid
  - **Task 2** – with the 5 most similar labeled images

	Task 1	Task 2
Dermatologist #1	75%	79%
Dermatologist #2	64%	80%
Dermatologist #3	69%	71%
Dermatologist #4	68%	82%
Dermatologist #5	61%	71%

- Average accuracy improvement of 9%

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