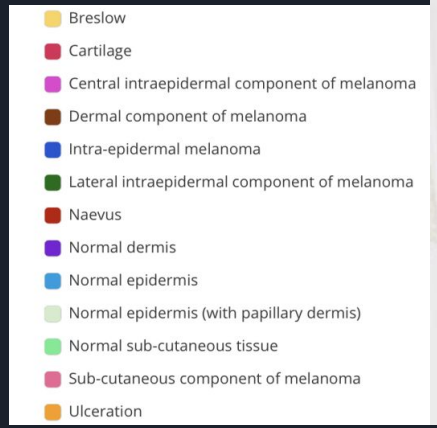
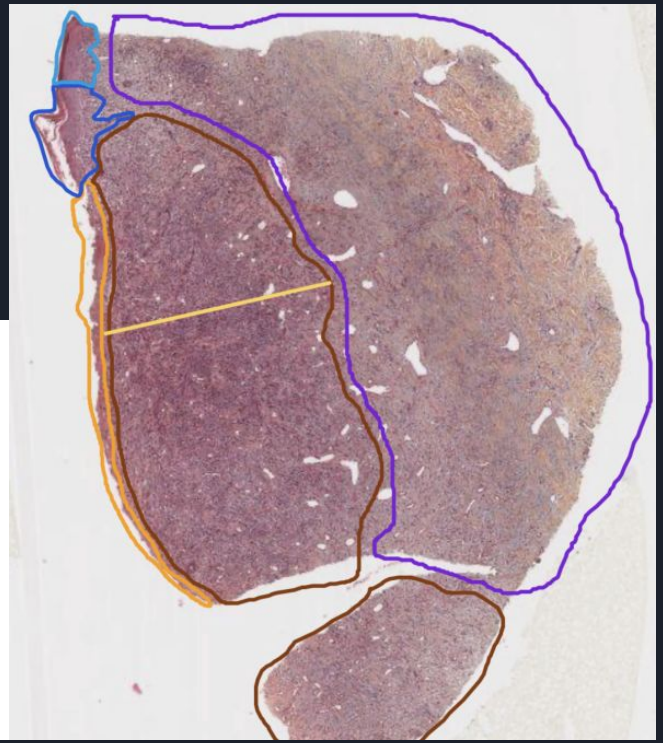
VisioMel: Melanoma Cancer

Ali Mammadov, Pietro Gori

Introduction - Cancer relapse detection

- Melanoma is a skin cancers and has a high likelihood of spreading.
- Deep learning can aid in analyzing slides for diagnosis and prognosis.
- The challenge is to predict relapse within 5 years using digitized slides.
- According to pathologists the risk of relapse based on tumor thickness and other factors:
  - Breslow is the thickness of the tumor
  - Ulceration

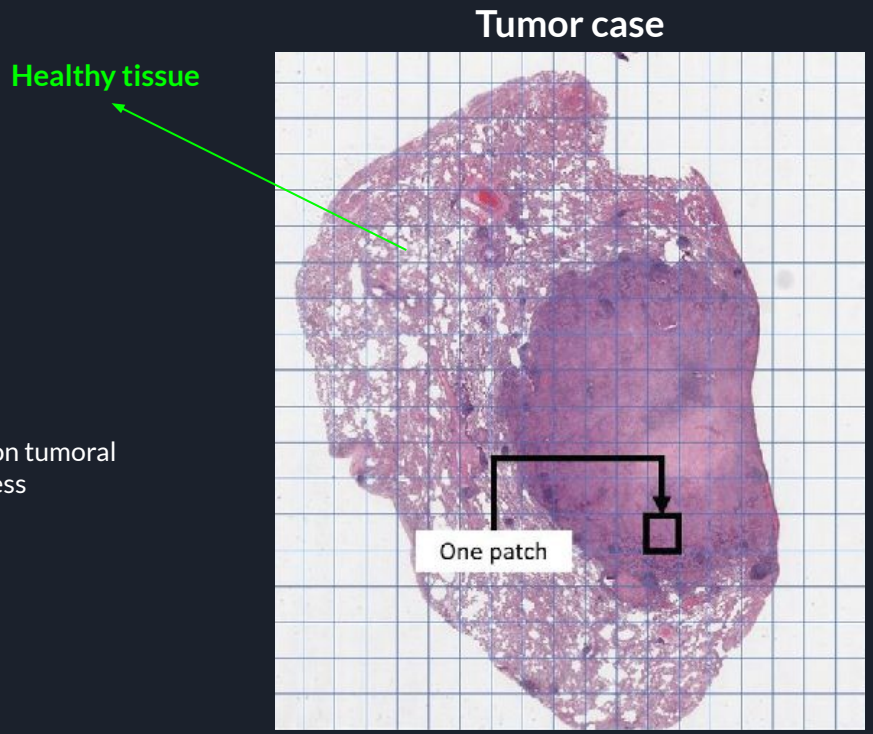




Introduction

Analysis of Pathology Images with AI

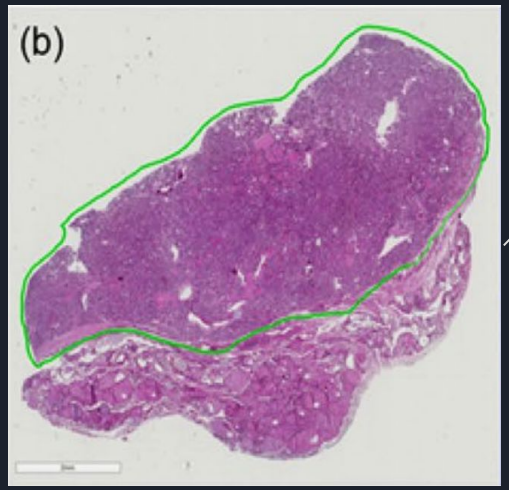
- The direct use is impossible
  - Very large sizes, does not fits to hardware
  - Differing sizes, not supported by DL methods
  - Subsampling, single patch-based, bag level methods
- Most approaches require cell level annotations
  - Only slide level labels are available
  - The label can not be associated to each region of image
    - In Tumor case, some parts of image could be non tumoral
  - Time consuming and expert requiring annotation process
  - Not possible when it is not defined what to annotate
    - Trying to detect new biomarker
  - Not interpretable (problematic in Medical field)
- State-of-the-art
  - Weakly-Supervised Learning
  - Self-Supervised Contrastive Learning
  - No need for annotations, explainable,



Subsampling Method

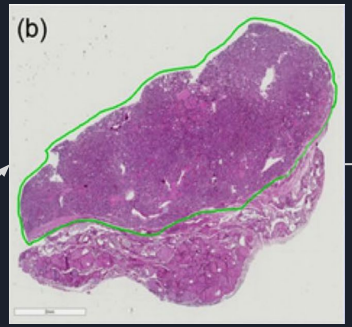
In simple words, GradCam shows the influence of each pixel to final prediction based on coefficients of its gradients

20000x20000



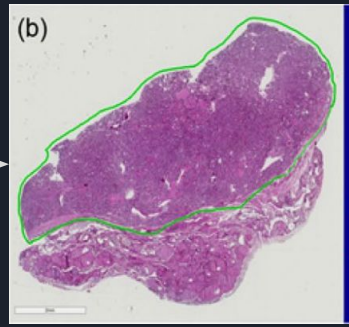
Subsample

1024x1024

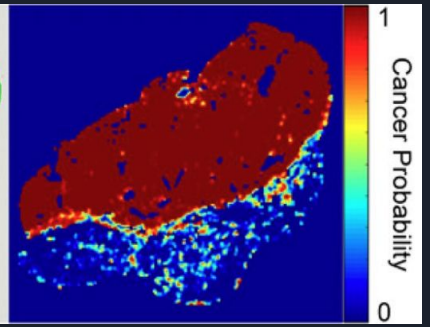


Training

Predicted as Cancer



GradCam



Advantages

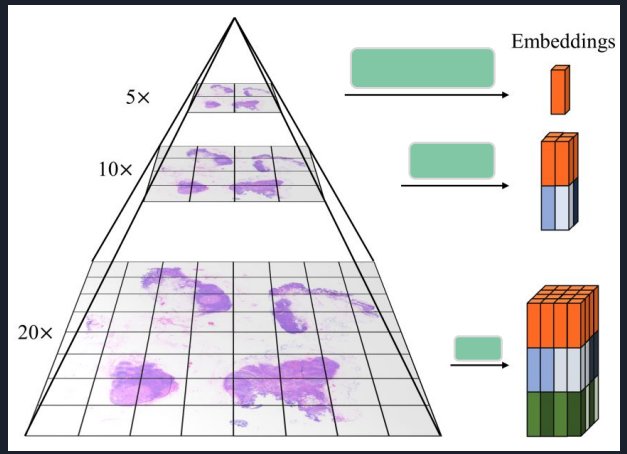
- Not difficult to interpret
- No need for low-level annotations

Disadvantages

- Information loss during subsampling
  - Mainly the cell level ones
- Uses only single magnifications
  - Pathologists analyzing in multiple
- Subsampling from different size to one
  - Changes the structures of elements (cells)
- Poor performance for most of tasks
- Makes this approach not reliable

State-of-the-Art

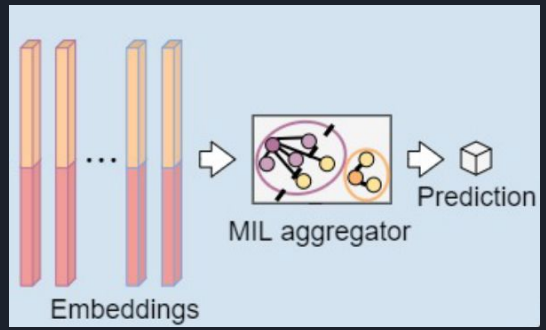
A.) **Self-Supervised Contrastive Learning based Feature Extraction**



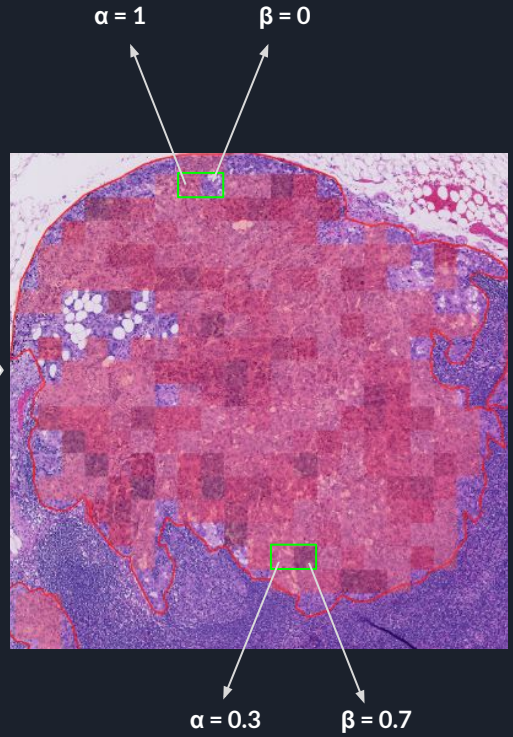
Li, B., Li, Y., & Eliceiri, K. W. (2021).

B.) **Weakly-Supervised learning based on Multiple-Instance Learning(MIL)**
Aggregations usually done by:

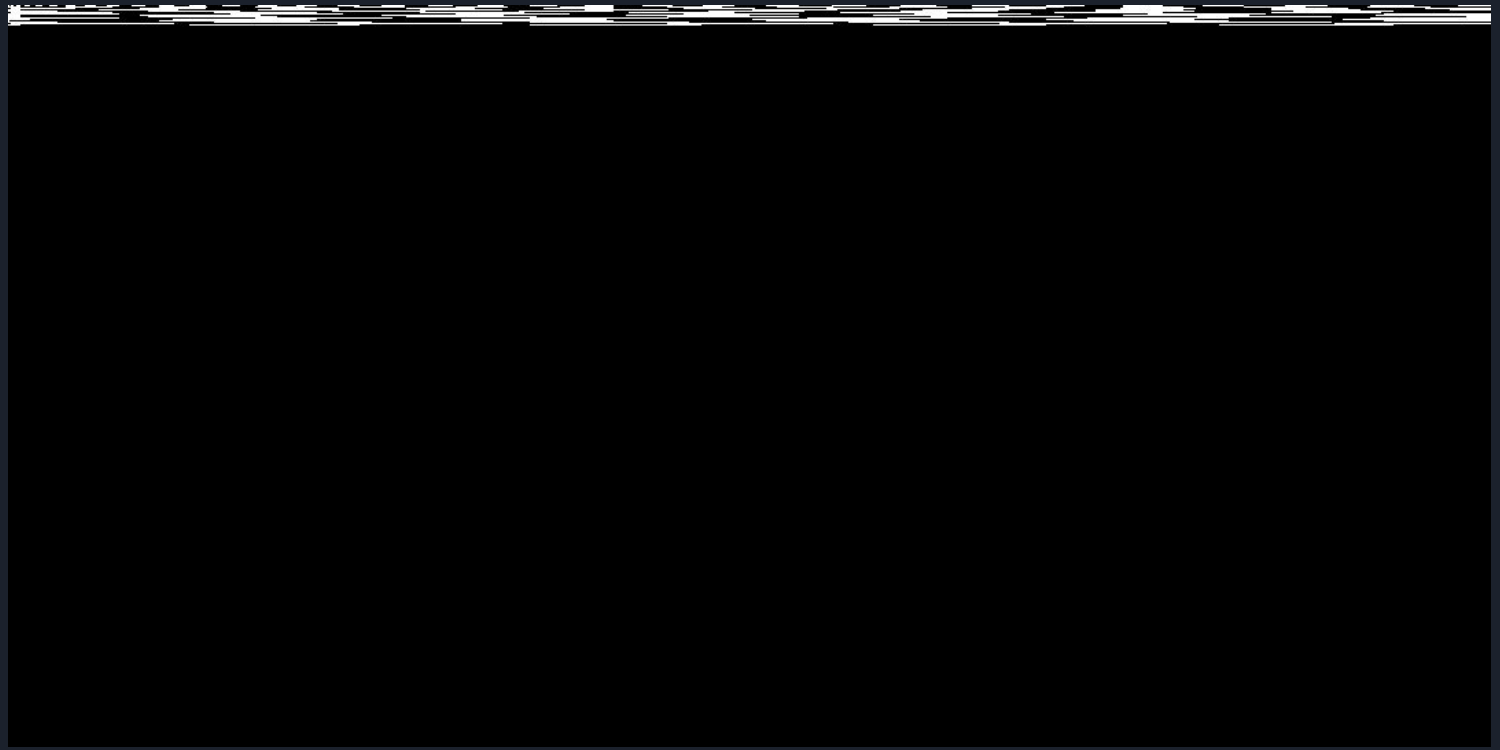
- *Graph Neural Networks*
- *Attention Layers*
- *Various Poolings*
- *Transformers*



Example of simple approach with 2 patches:
- α*embed_1 + β*embed_2 = Embedding
- α, β are trainable parameters



Contrastive Learning



Chopra et al in 2004

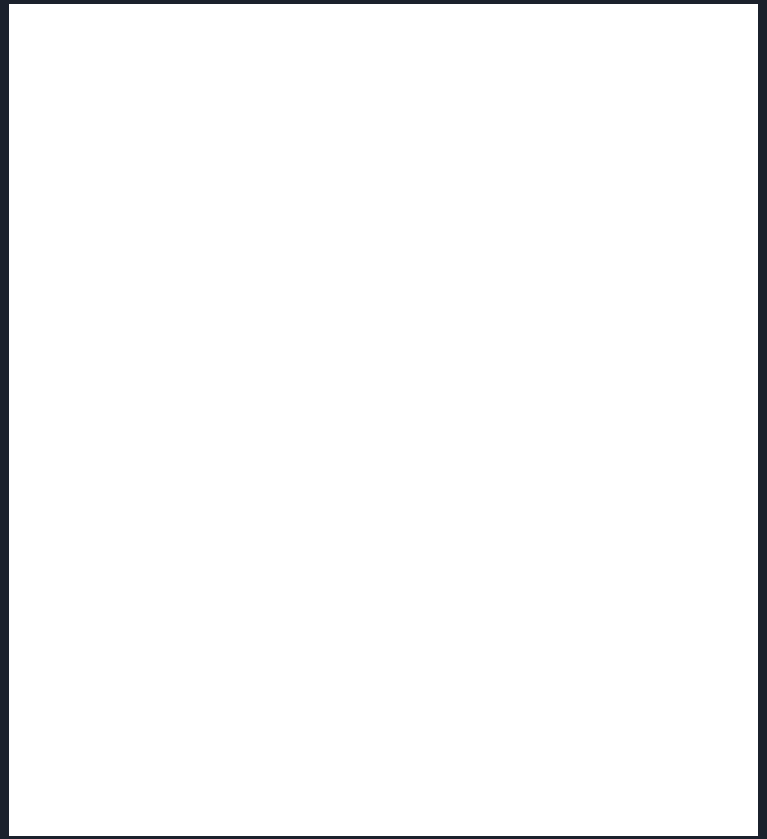
SimCLR / MoCo

Transformations:

- Crop
- Shift
- Flip
- Blur, Noise
- Brightness

Sjogren Dataset:

- What are the transformations that will not destroy semantic information of images?



SimCLR: Chen, Ting, et al. 2020

DINO / BYOL

DINO :

- Uses Multi-Scale Vision Transformers
- That makes possible to extract features from different magnifications of pathology slides
- And do not uses negative samples

Caron, Mathilde, et al. 2021

Multiple Instance Learning