Contrastive Learning for Enhanced Feature Extraction in Hyperspectral Imagery

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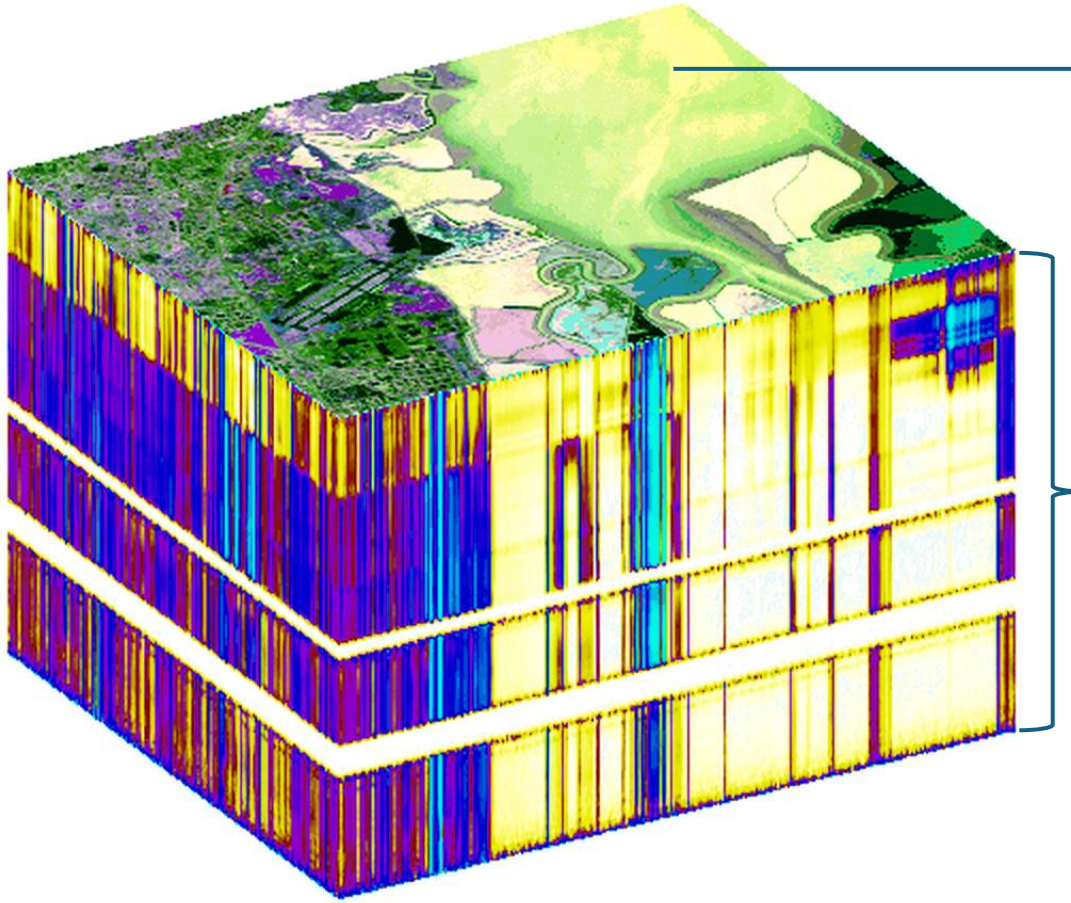
Aims of the project

- Hyperspectral image processing so far relies on older tools
- Modern methods are available in computer vision for traditional image space

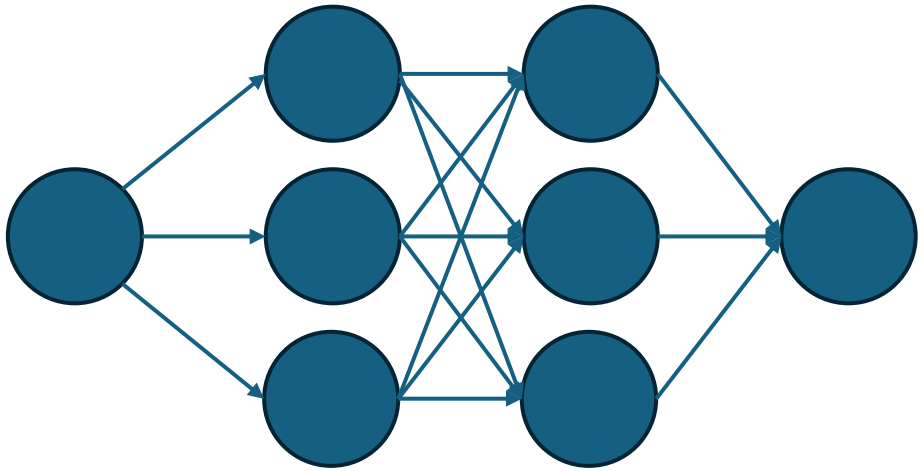
Hyperspectral image data



Unique signature

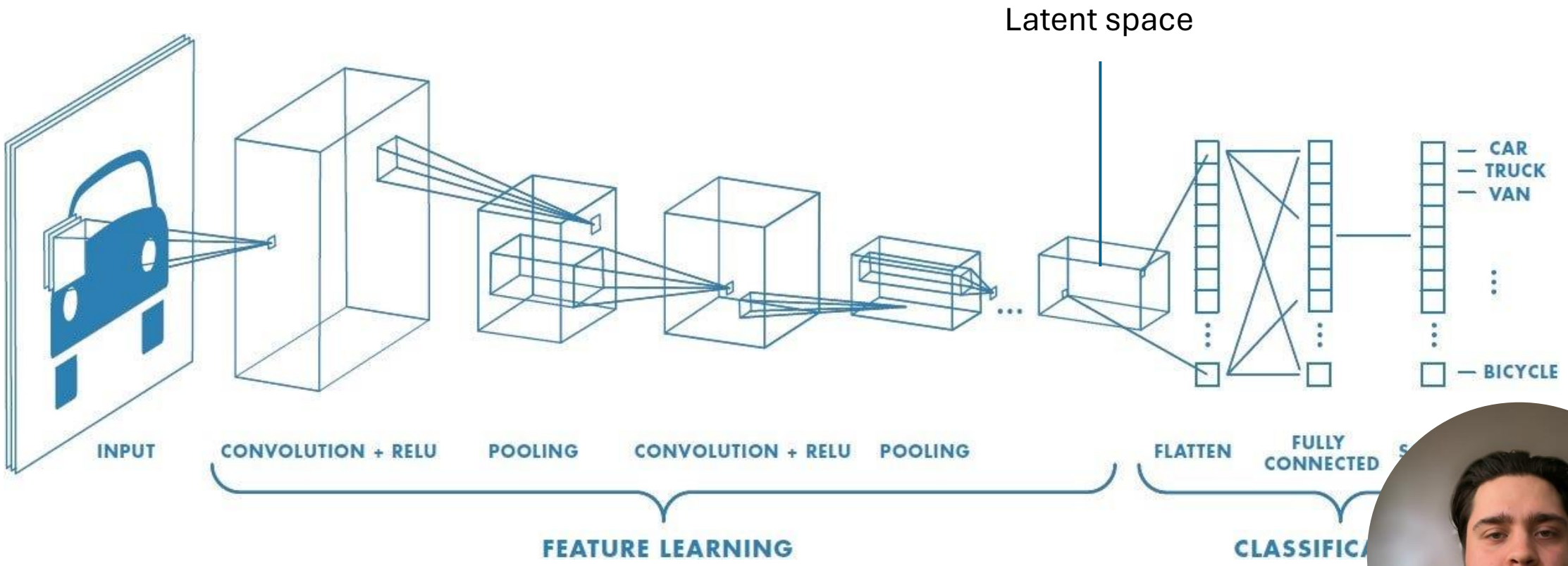
Up to hundreds of number of channels

Deep neural networks

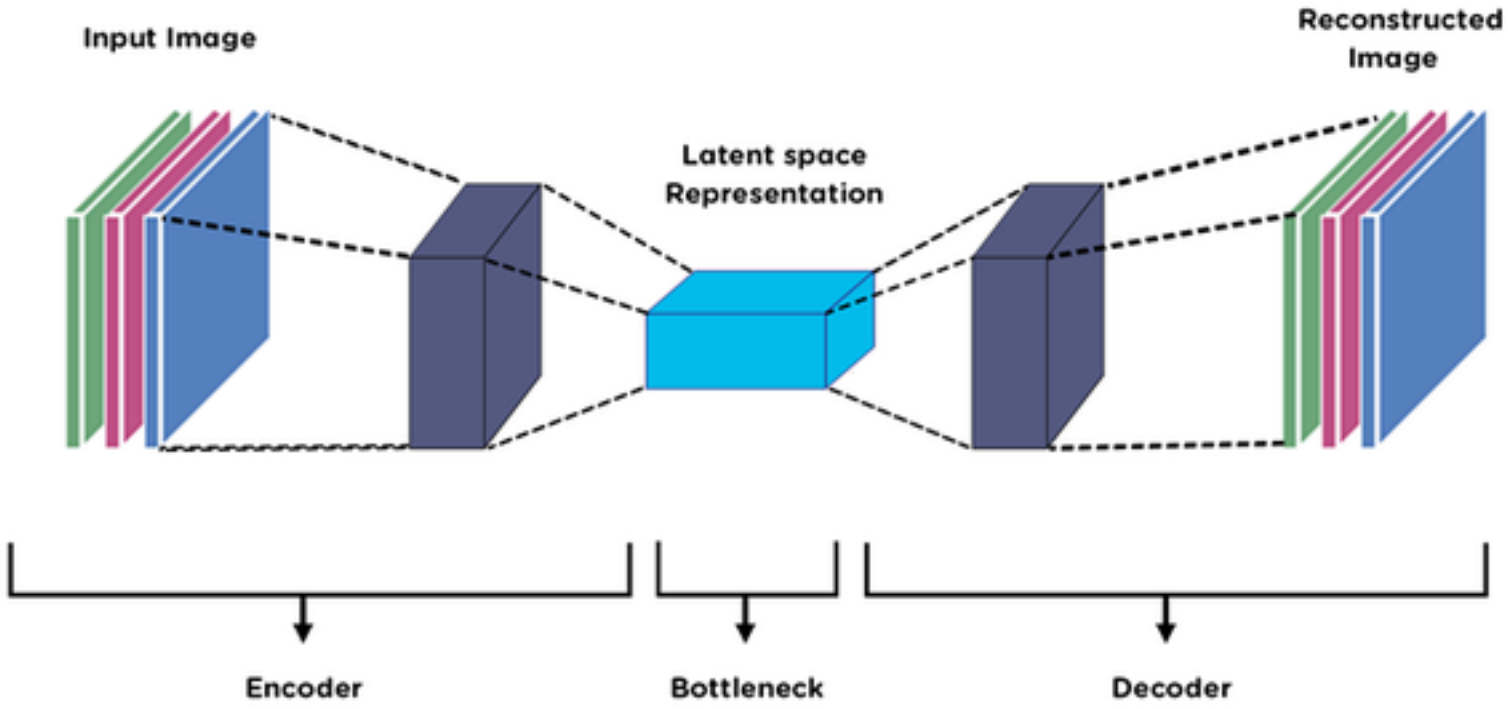


Input Hidden 1 Hidden 2 Output

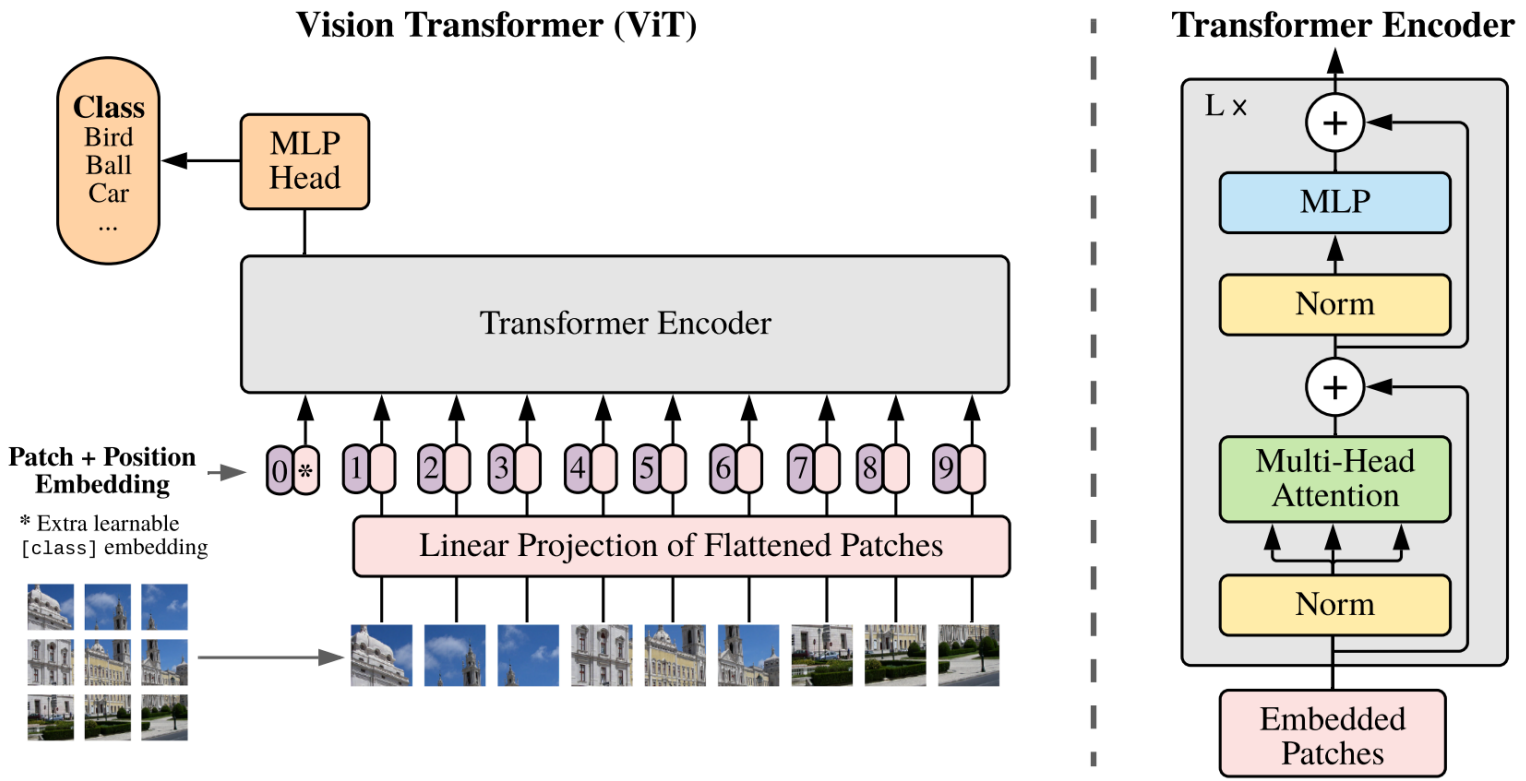
Deep neural networks



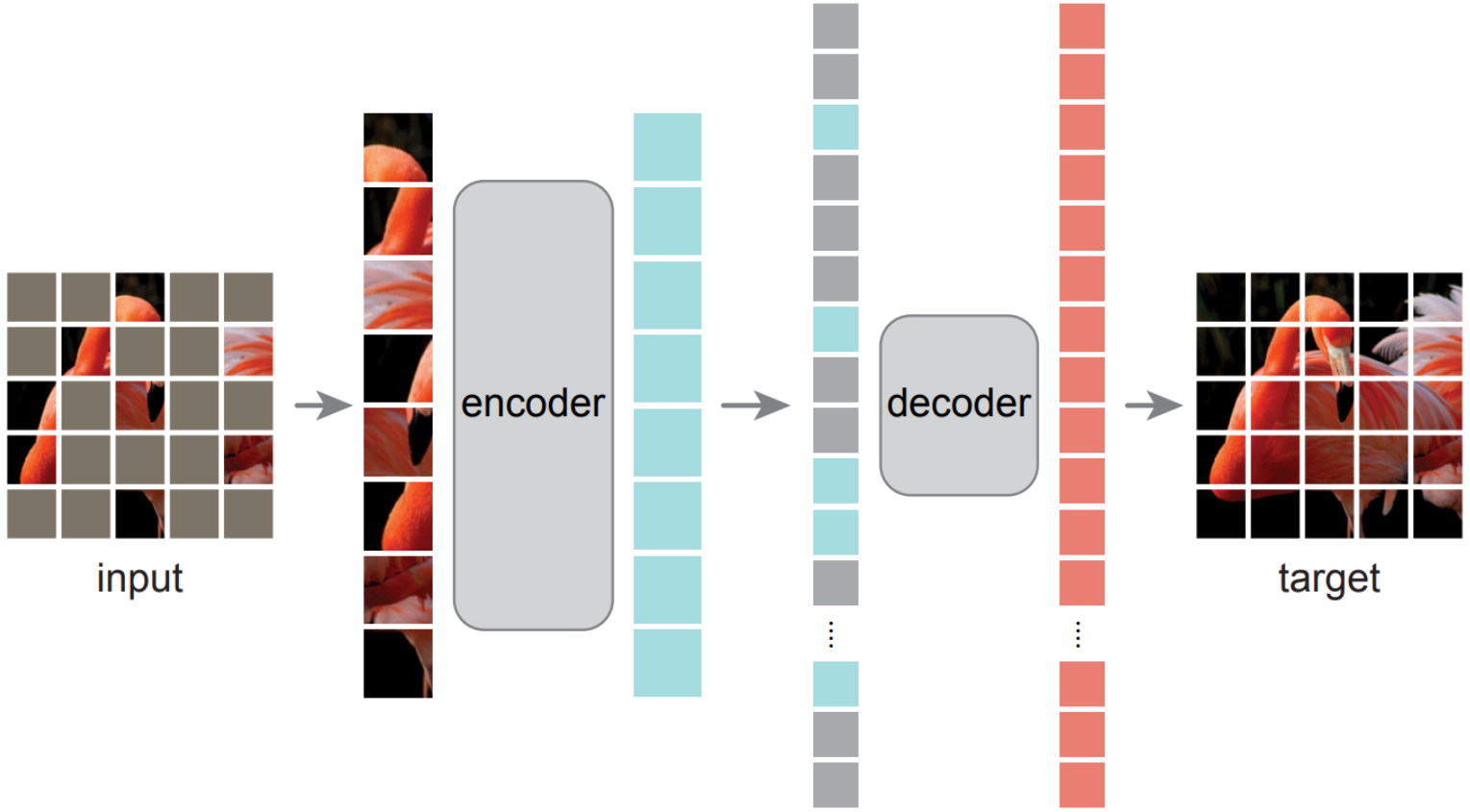
Deep neural networks



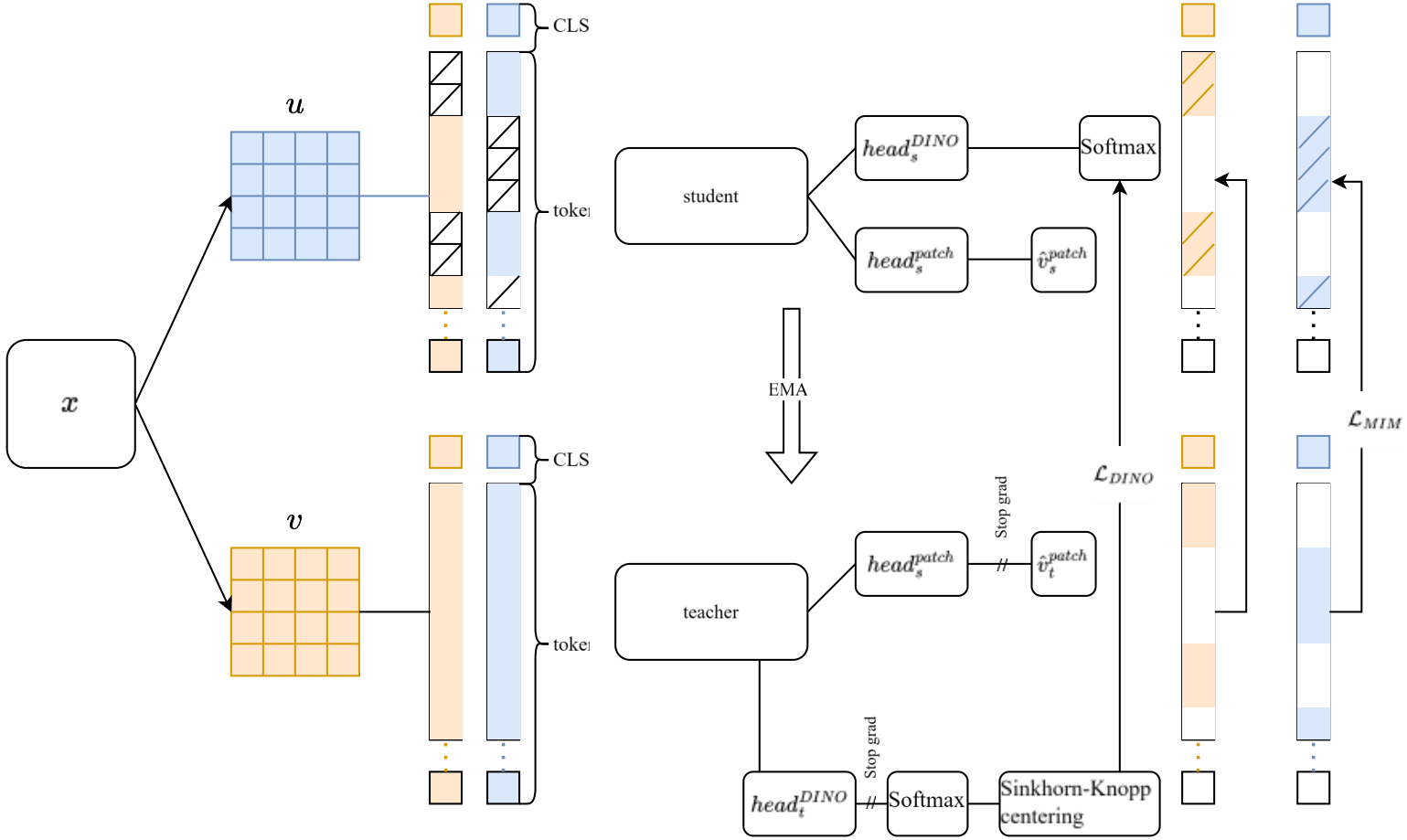
Vision Transformers



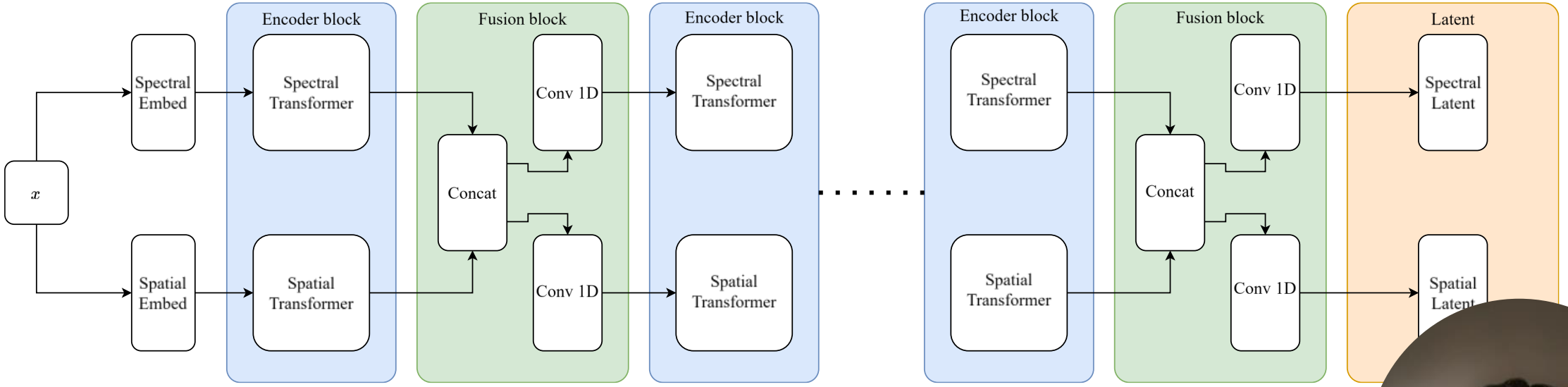
Methodology – Masked Auto-Encoder

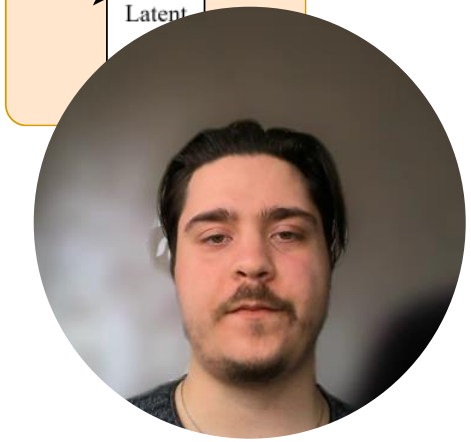


Methodology – DINOv2

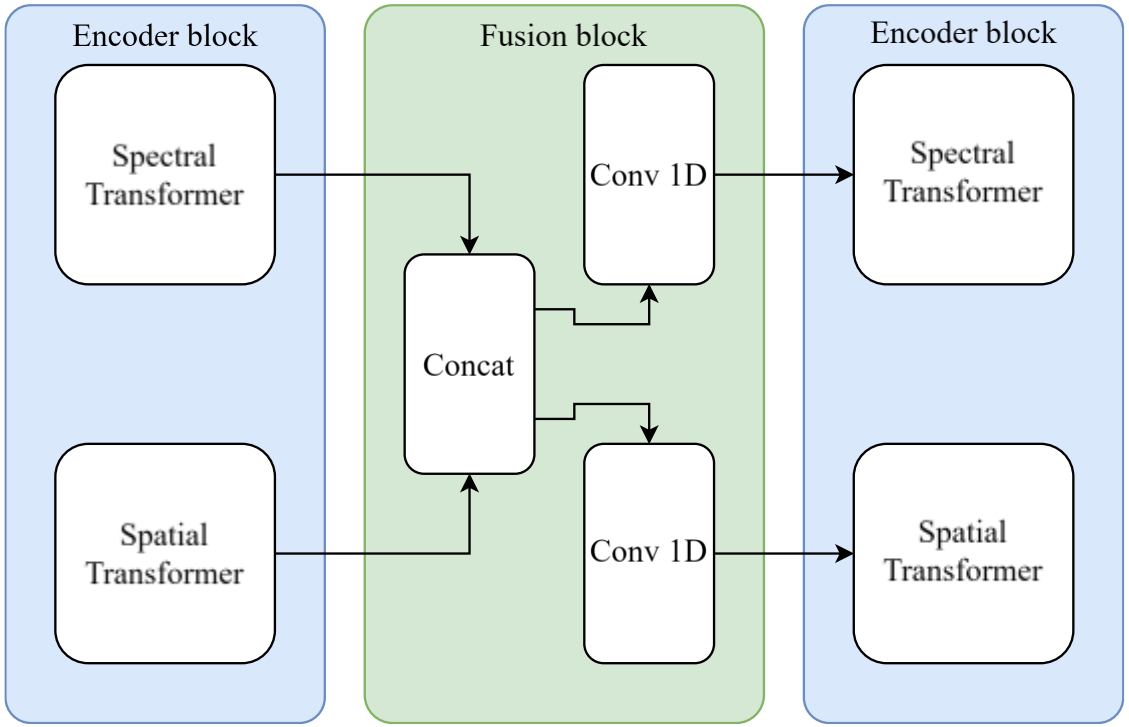


Methodology – Spatial-Spectral ViT



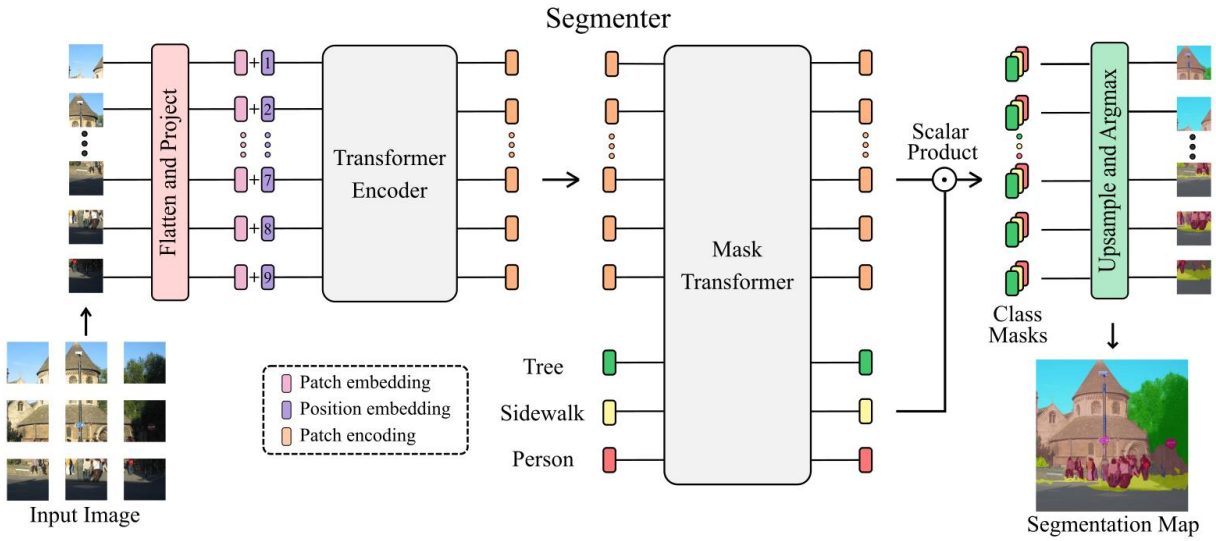


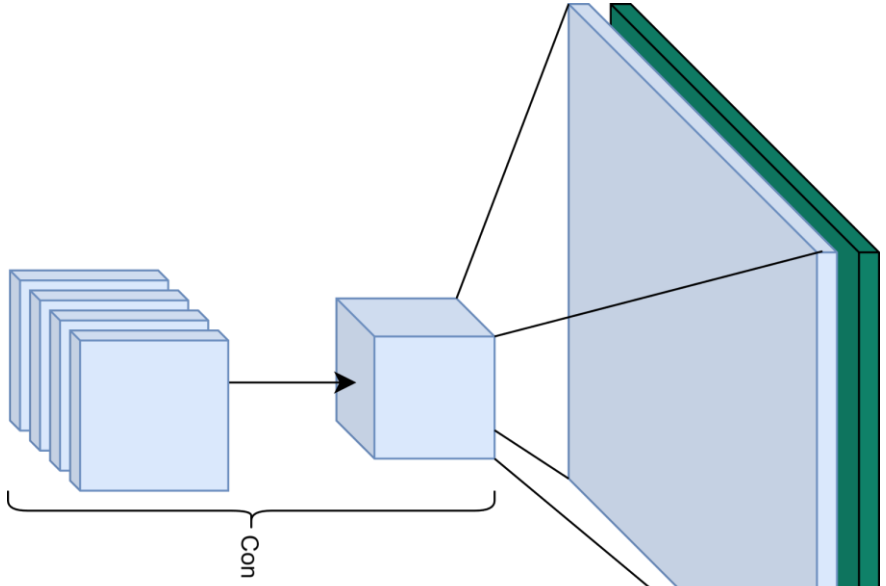
Methodology – Feature Fusion



Methodology - decoders

- Linear
- Convolutional
- Transformer - segmenter

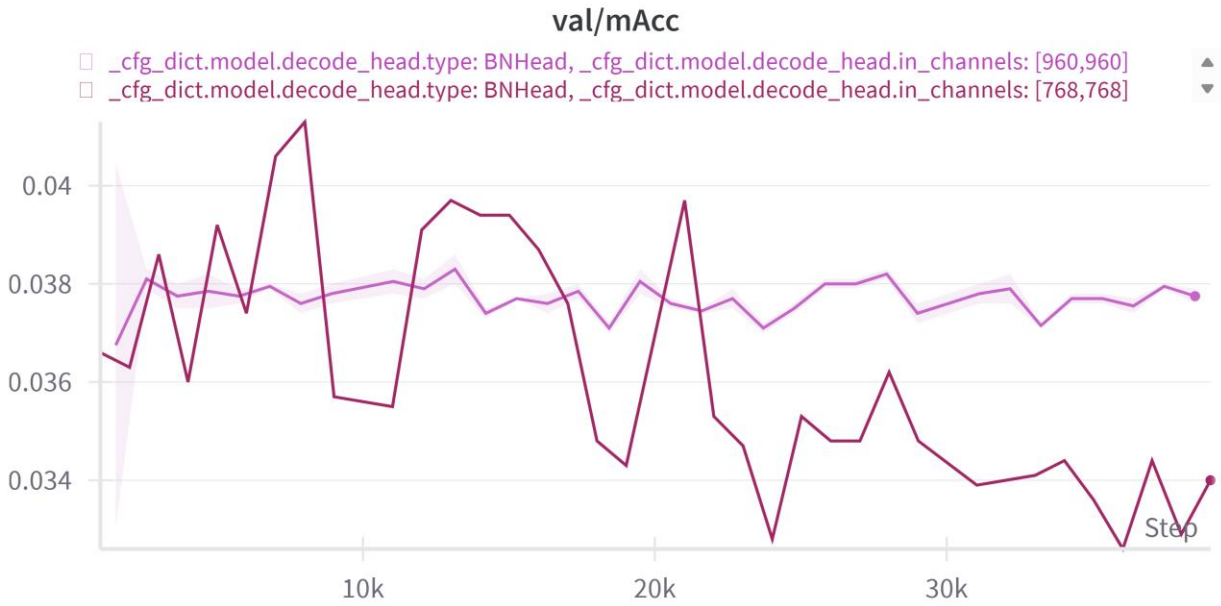


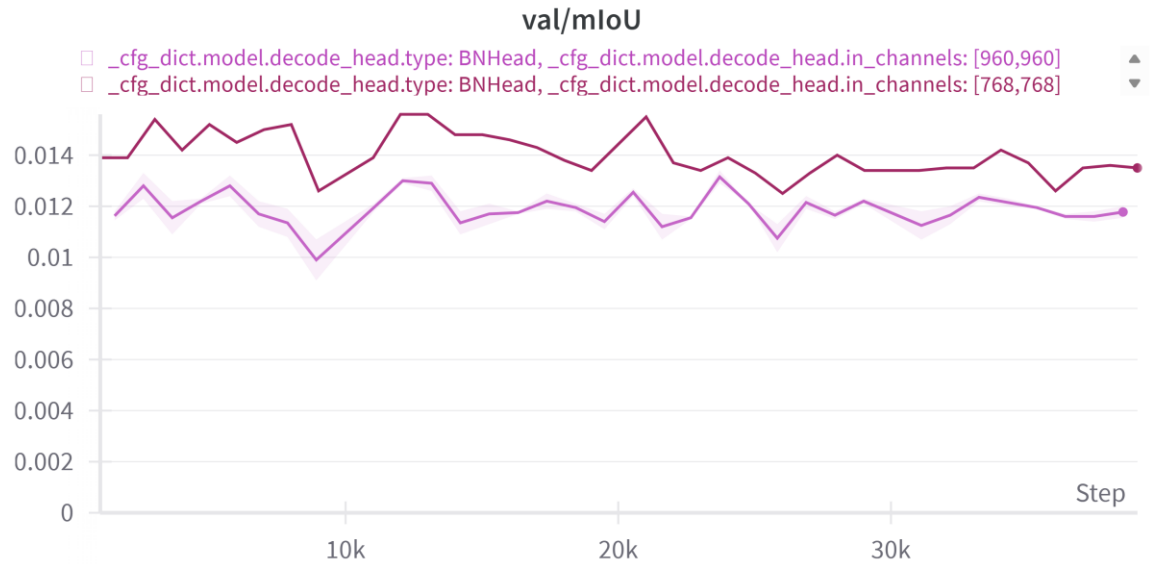


Experiments

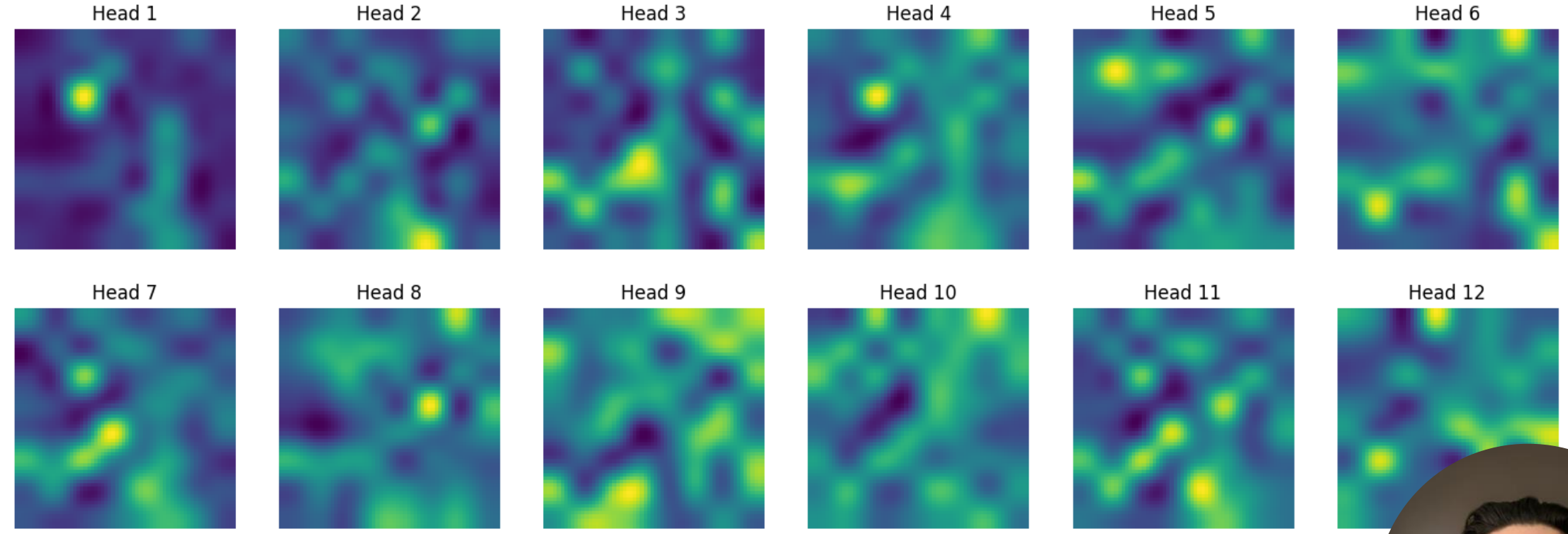
- Masked Auto-Encoder – ViT-B:
  - Linear
  - Convolutional
  - Transformer
- DINOv2 – ViT-B:
  - Linear
  - Convolutional
  - Transformer
- DINOv2 – Spatial-Spectral ViT-B:
  - Linear
  - Convolutional
  - Transformer
- DeepLabv3+
- Proof of concept

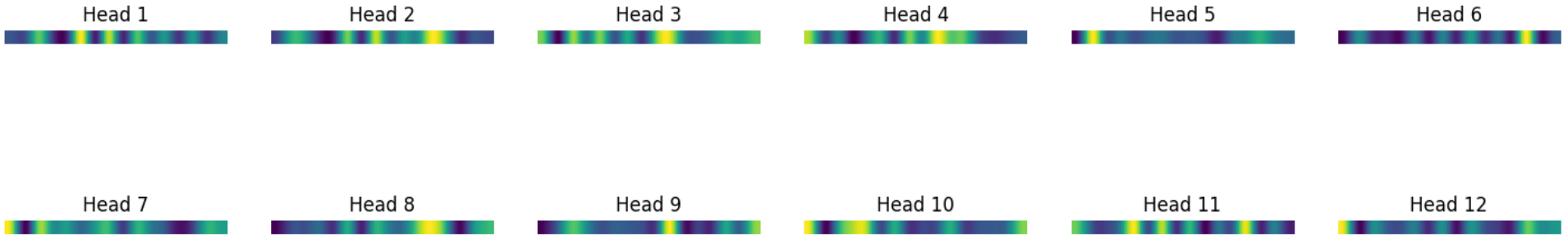
Results


val/mAcc
_cfg_dict.model.decode_head.type: BNHead, _cfg_dict.model.decode_head.in_channels: [960,960]
_cfg_dict.model.decode_head.type: BNHead, _cfg_dict.model.decode_head.in_channels: [768,768]
0.04
0.038
0.036
0.034
Step
10k
20k
30k


val/mIoU
_cfg_dict.model.decode_head.type: BNHead, _cfg_dict.model.decode_head.in_channels: [960,960]
_cfg_dict.model.decode_head.type: BNHead, _cfg_dict.model.decode_head.in_channels: [768,768]
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Step
10k
20k
30k

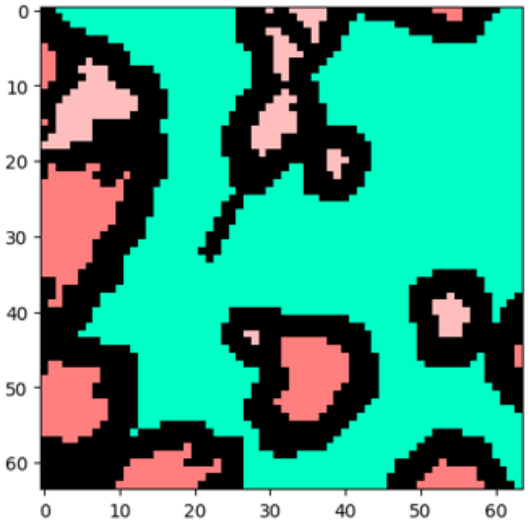
Results – Spatial-Spectral attention maps

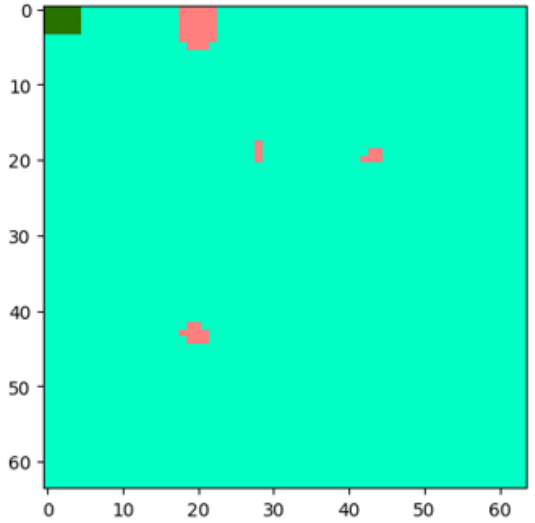




Results – Linear Outputs

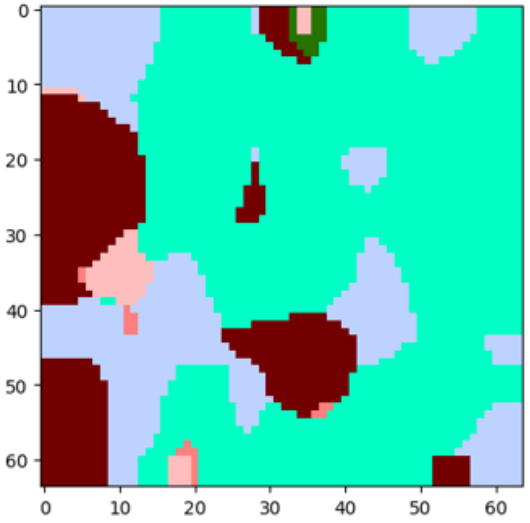
Ground truth

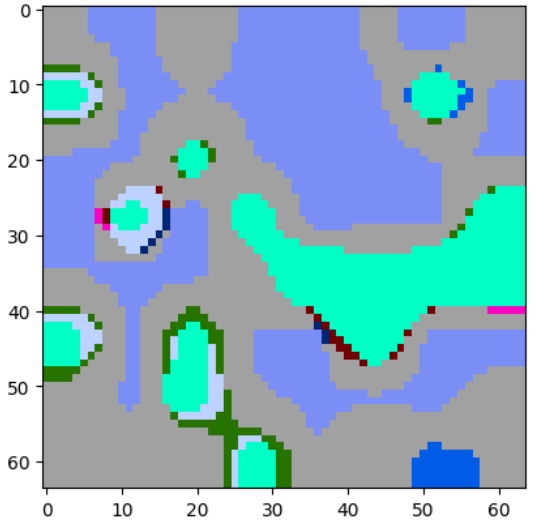




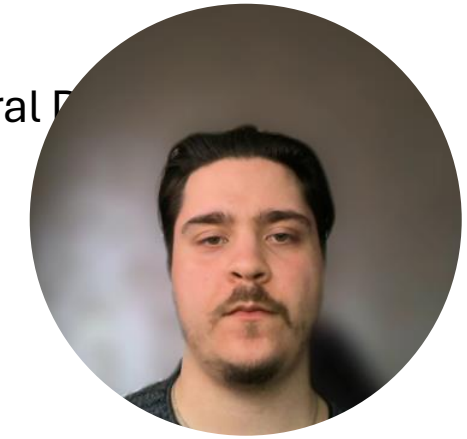
MAE

DINOv2



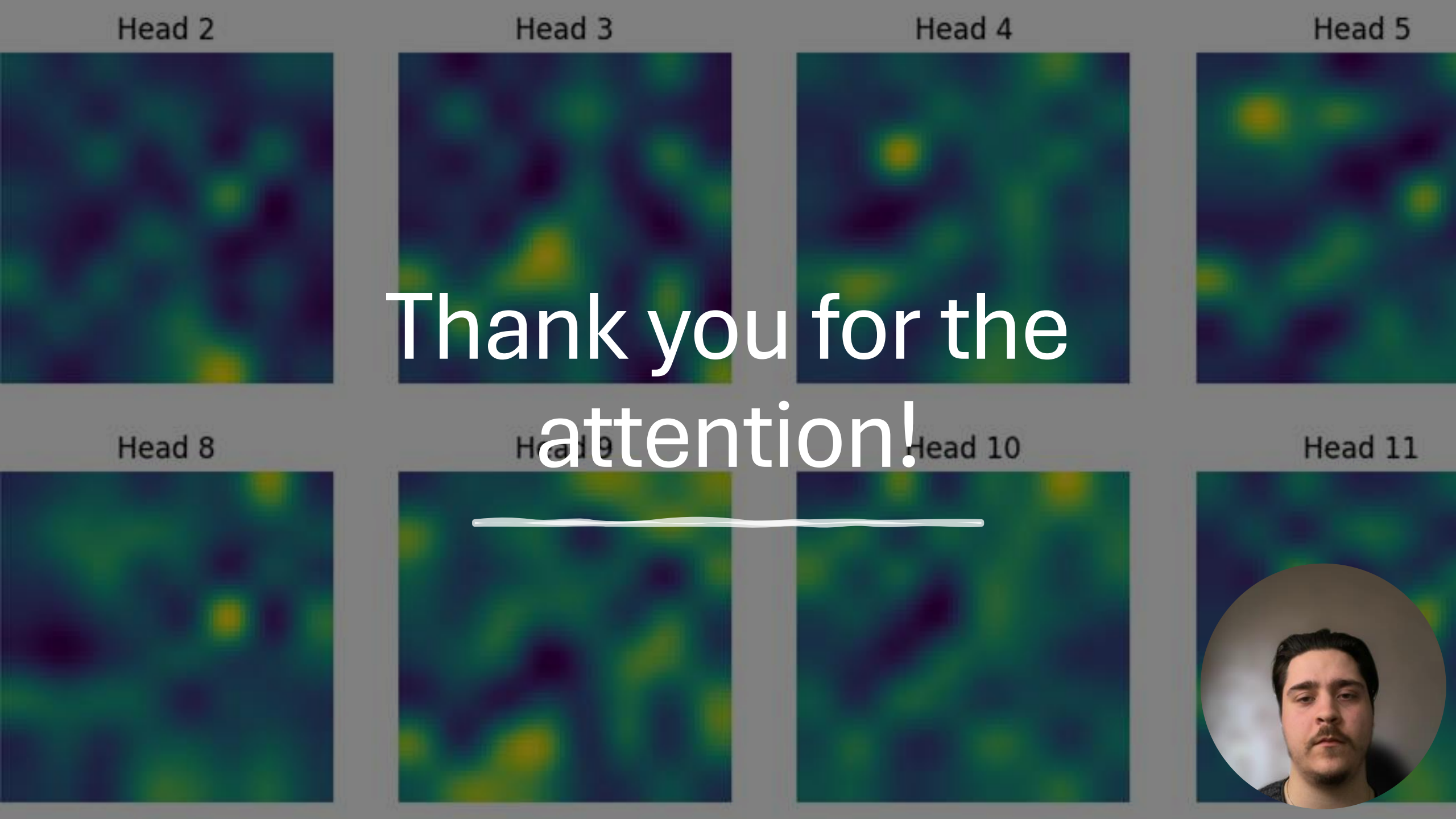


Spatial-Spectral



Conclusion

- Model performed under expectations
- We still see some benefits emerging from using contrastive learning



Thank you for the attention!