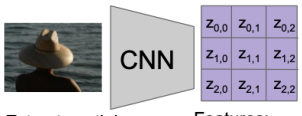
Lecture 8:
Attention and Transformers

Image Captioning using Transformers

Input: Image **I**
Output: Sequence **y** = $y_1, y_2, ..., y_T$



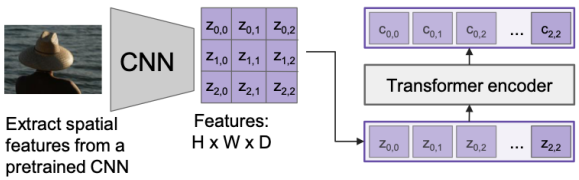
Extract spatial features from a pretrained CNN

Features: H x W x D

Image Captioning using Transformers

Input: Image **I**
Output: Sequence **y** = $y_1, y_2, ..., y_T$

Encoder: $\mathbf{c} = T_W(\mathbf{z})$
where **z** is spatial CNN features
$T_W(.)$ is the transformer encoder



Extract spatial features from a pretrained CNN

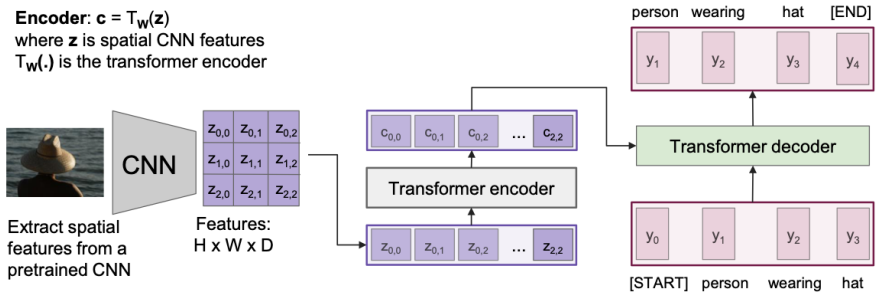
Features: H x W x D

Image Captioning using Transformers

Input: Image **I**
Output: Sequence **y** = $y_1, y_2, ..., y_T$

Decoder: $y_t = T_D(\mathbf{y}_{0:t-1}, \mathbf{c})$
where $T_D(.)$ is the transformer decoder

Encoder: $\mathbf{c} = T_W(\mathbf{z})$
where **z** is spatial CNN features
$T_W(.)$ is the transformer encoder



Extract spatial features from a pretrained CNN

Features: H x W x D

Image Captioning using transformers

- **Perhaps we don't need convolutions at all?**

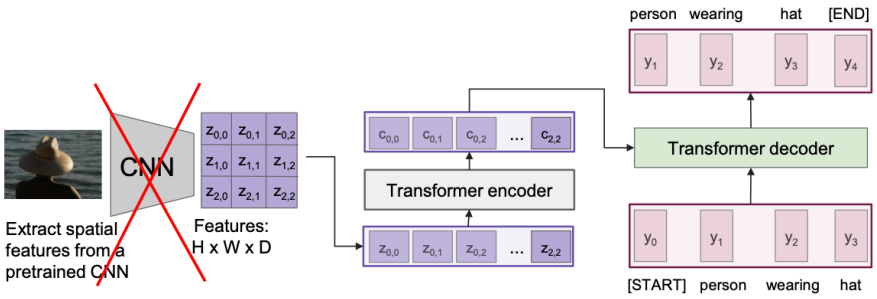
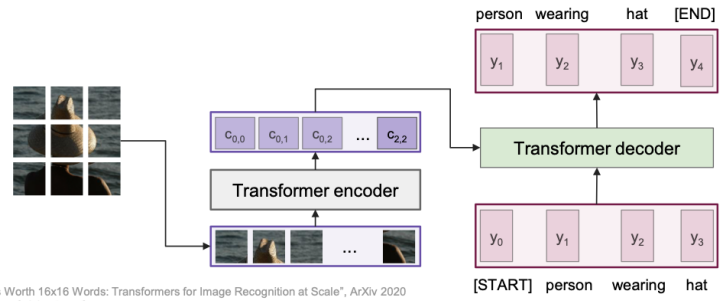


Image Captioning using ONLY transformers

- **Transformers from pixels to language**



Dosovitskiy et al, "An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale", ArXiv 2020
Colab link to an implementation of vision transformers

ViTs – Vision Transformers

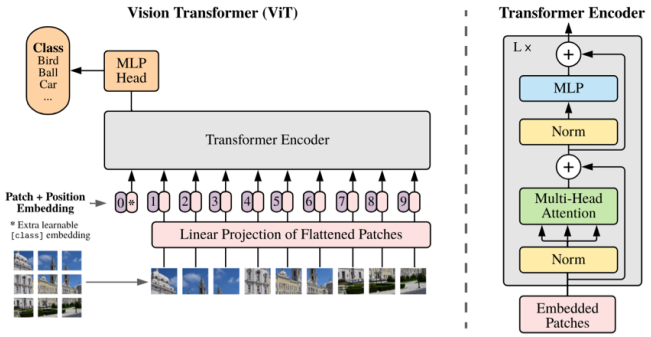


Figure from:
Dosovitskiy et al, "An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale", ArXiv 2020

Vision Transformers vs. ResNets

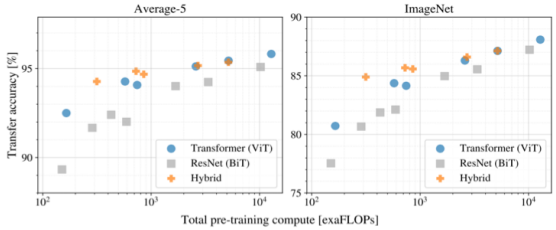
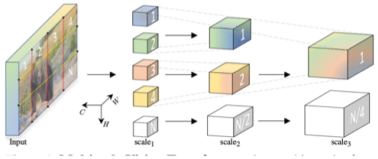


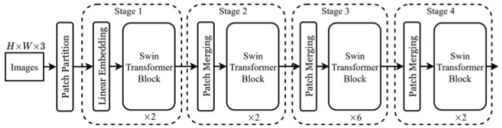
Figure 5: Performance versus cost for different architectures: Vision Transformers, ResNets, and hybrids. Vision Transformers generally outperform ResNets with the same computational budget. Hybrids improve upon pure Transformers for smaller model sizes, but the gap vanishes for larger models.

Dosovitskiy et al, "An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale", ArXiv 2020
Colab link to an implementation of vision transformers

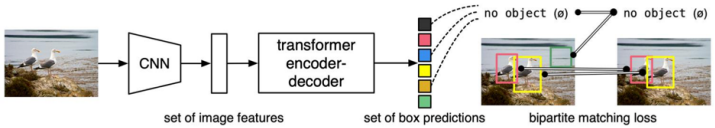
Vision Transformers



Fan et al, "Multiscale Vision Transformers", ICCV 2021

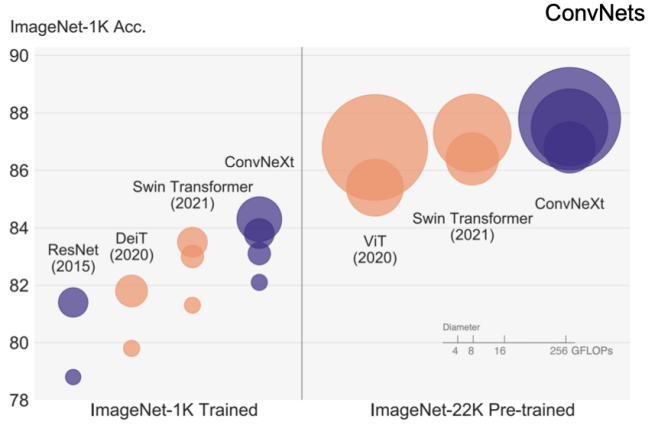


Liu et al, "Swin Transformer: Hierarchical Vision Transformer using Shifted Windows", CVPR 2021



Carion et al, "End-to-End Object Detection with Transformers", ECCV 2020

ConvNets strike back!



A ConvNet for the 2020s. Liu et al. CVPR 2022

DeiT III: Revenge of the ViT

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