7.7

Leveraging Pre-trained Models with Transfer Learning

Part 3: Self-Supervised Learning with SimCLR

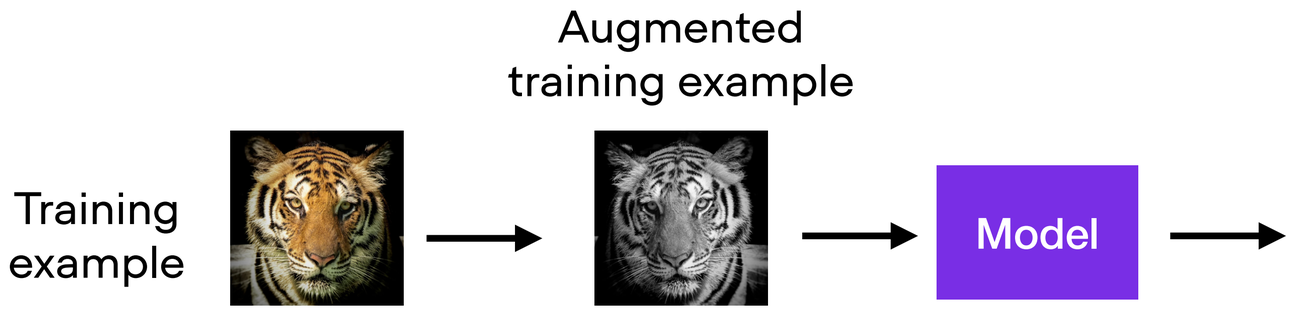
Sebastian Raschka and the Lightning AI Team

SimCLR

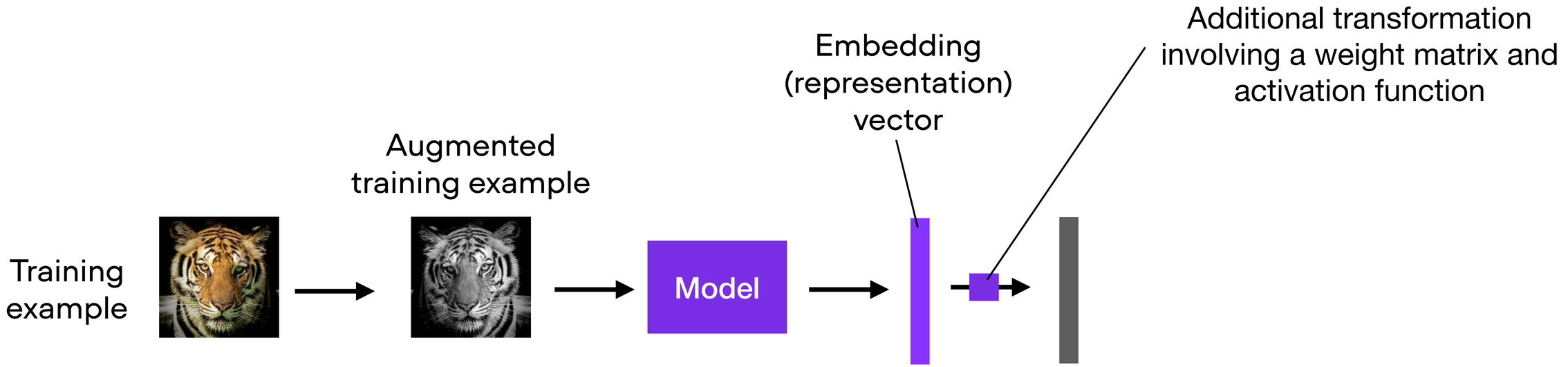
A Simple Framework for Contrastive Learning of Visual Representations

A Simple Framework for Contrastive Learning of Visual Representations,
Ting Chen, Simon Kornblith, Mohammad Norouzi, Geoffrey Hinton,
https://arxiv.org/abs/2002.05709

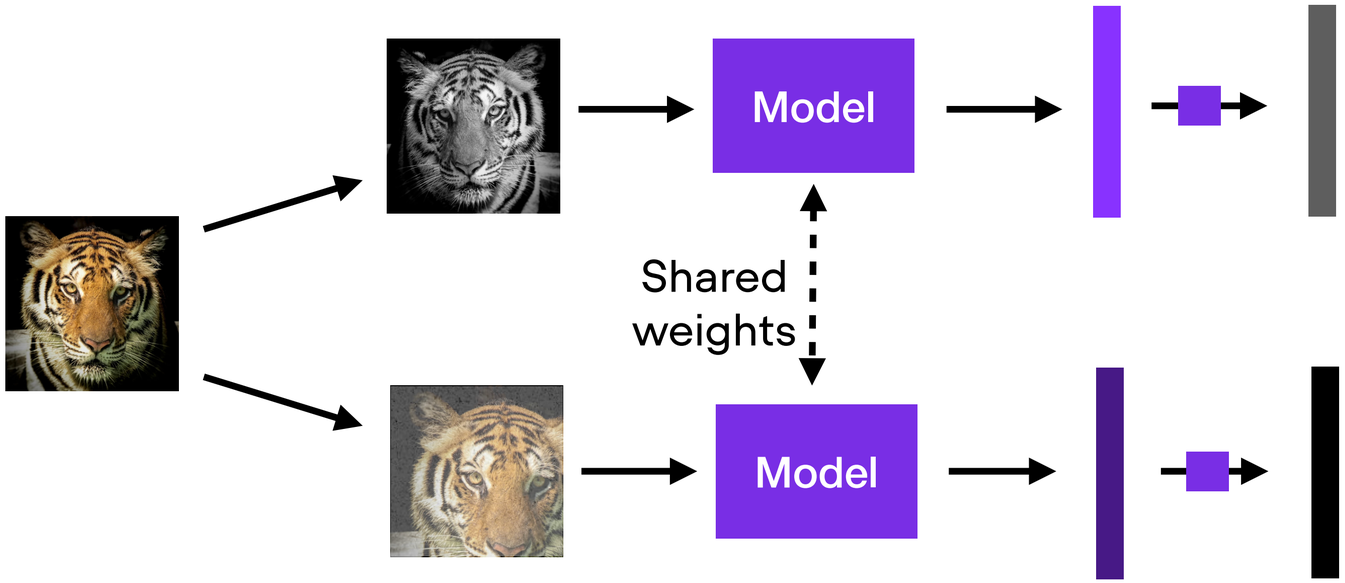
SimCLR Overview



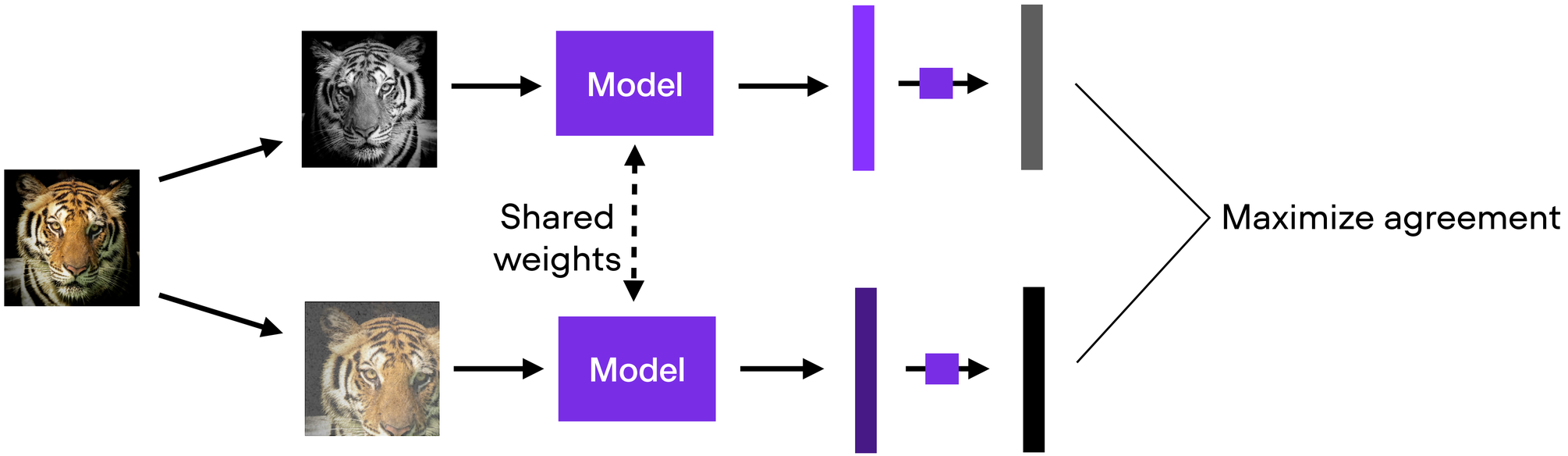
SimCLR Overview



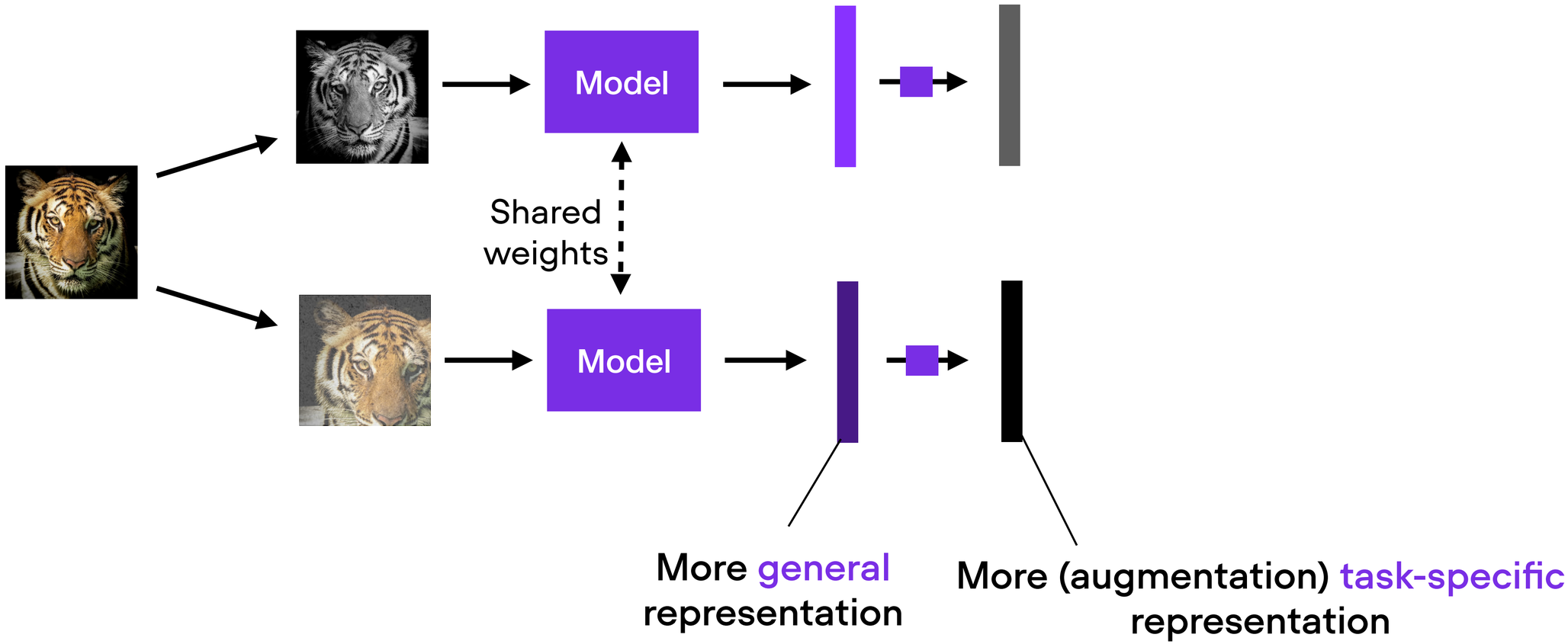
SimCLR Overview



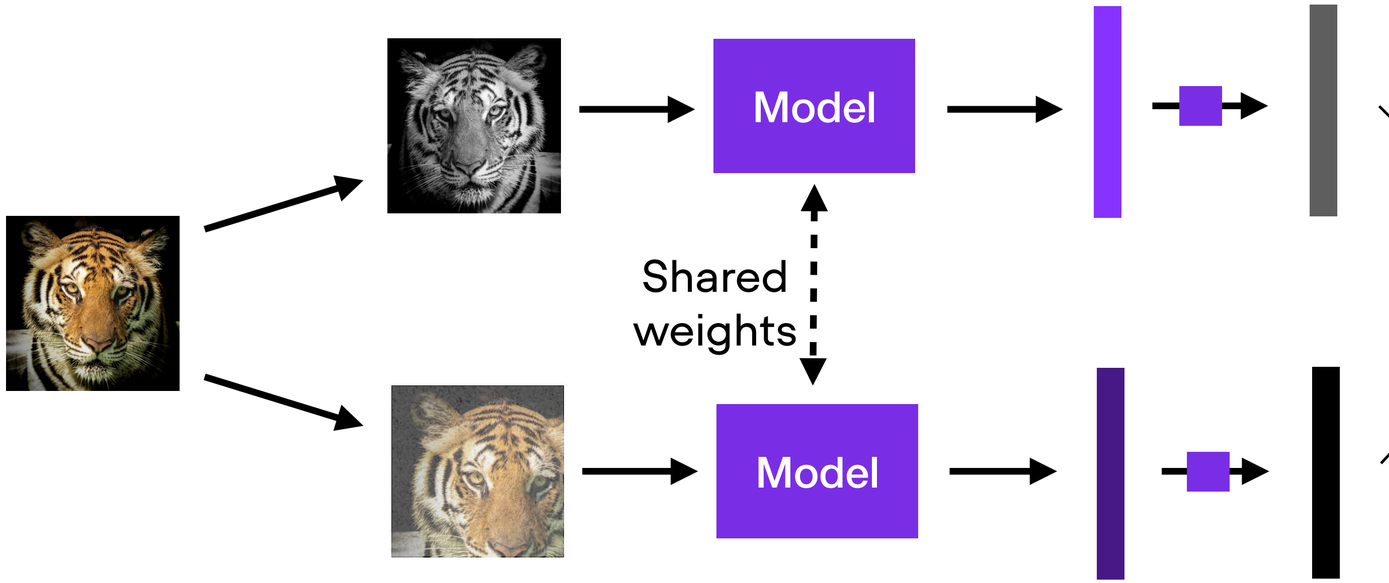
SimCLR Overview



Why the additional transformation?



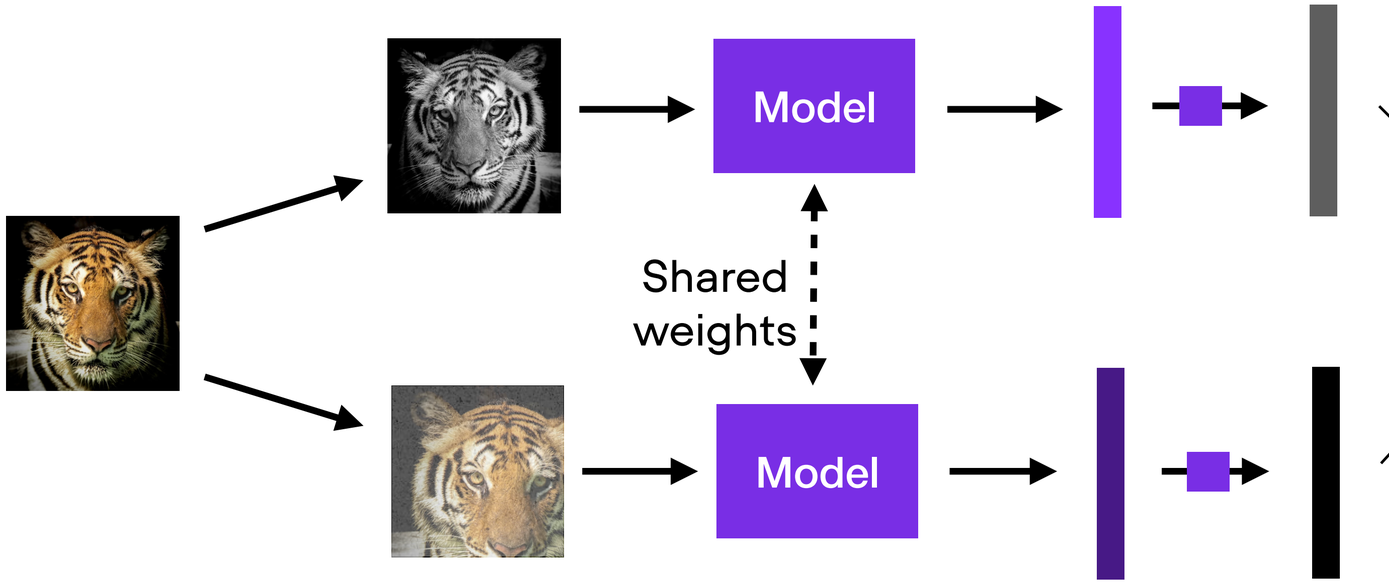
Computing the similarity



$$s_{i,j} = \frac{z_i^\top z_j}{\left(\tau \parallel z_i \parallel \cdot \parallel z_j \parallel\right)}$$

Similarity

Computing the similarity

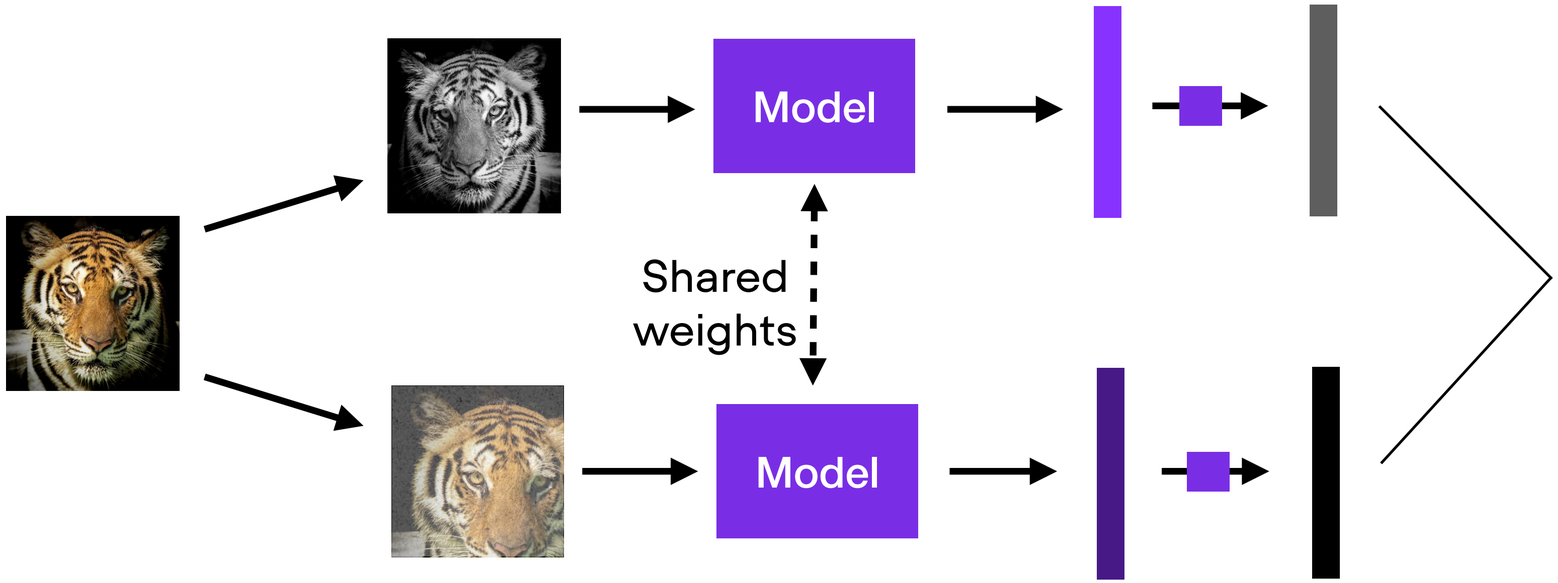


Dot product

$$s_{i,j} = \frac{z_i^\top z_j}{\left(\tau \parallel z_i \parallel \cdot \parallel z_j \parallel\right)}$$

Similarity

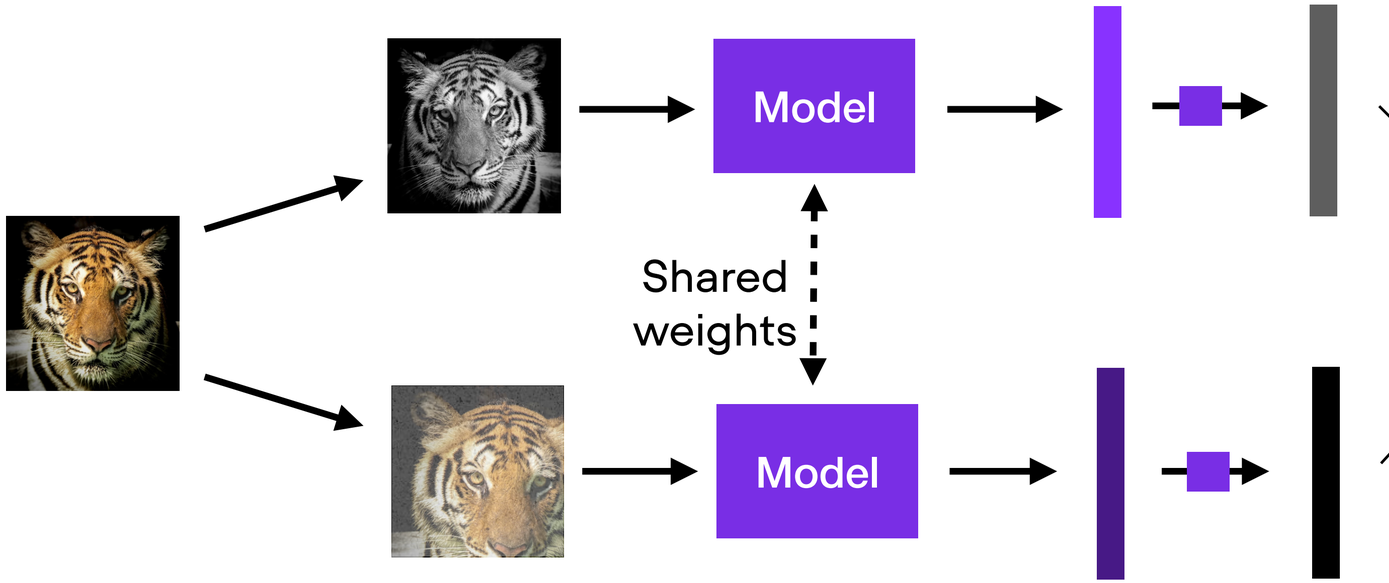
Computing the similarity



$$s_{i,j} = \frac{z_i^\top z_j}{\left(\tau \parallel z_i \parallel \cdot \parallel z_j \parallel\right)}$$

Normalization (scaling)

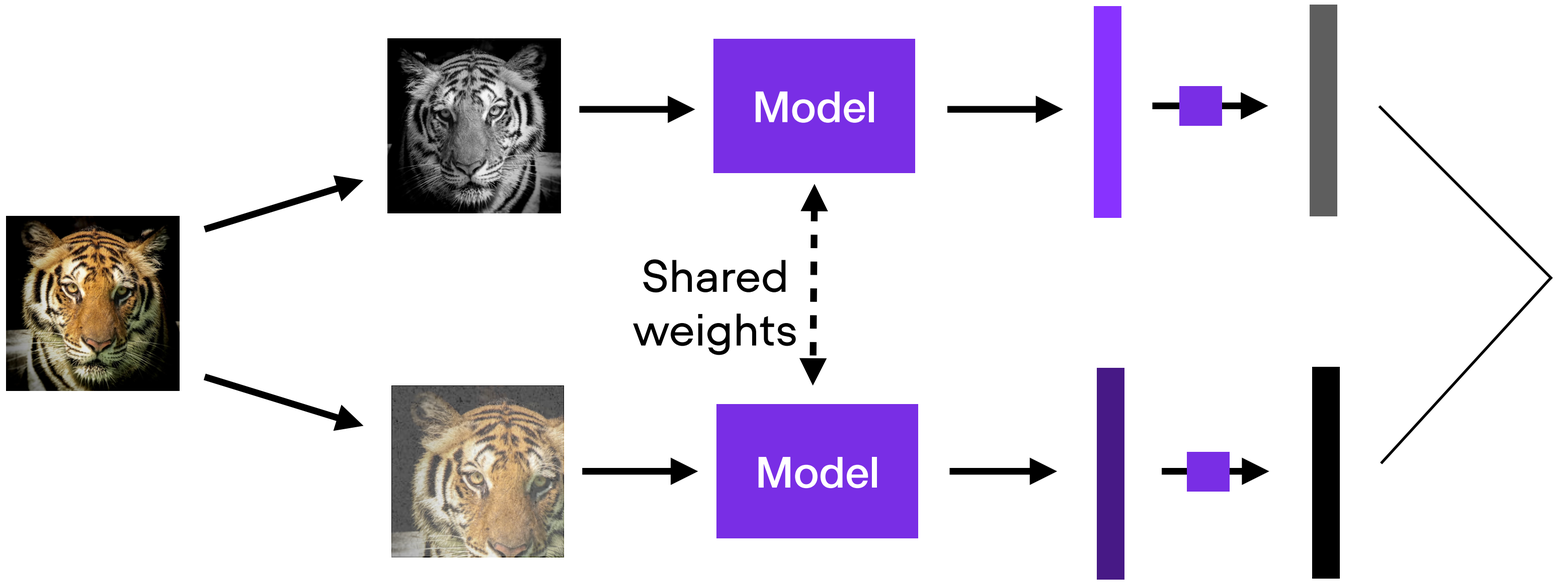
Computing the similarity



$$s_{i,j} = \frac{z_i^\top z_j}{\left(\tau \parallel z_i \parallel \cdot \parallel z_j \parallel\right)}$$

τ (tau) temperature factor

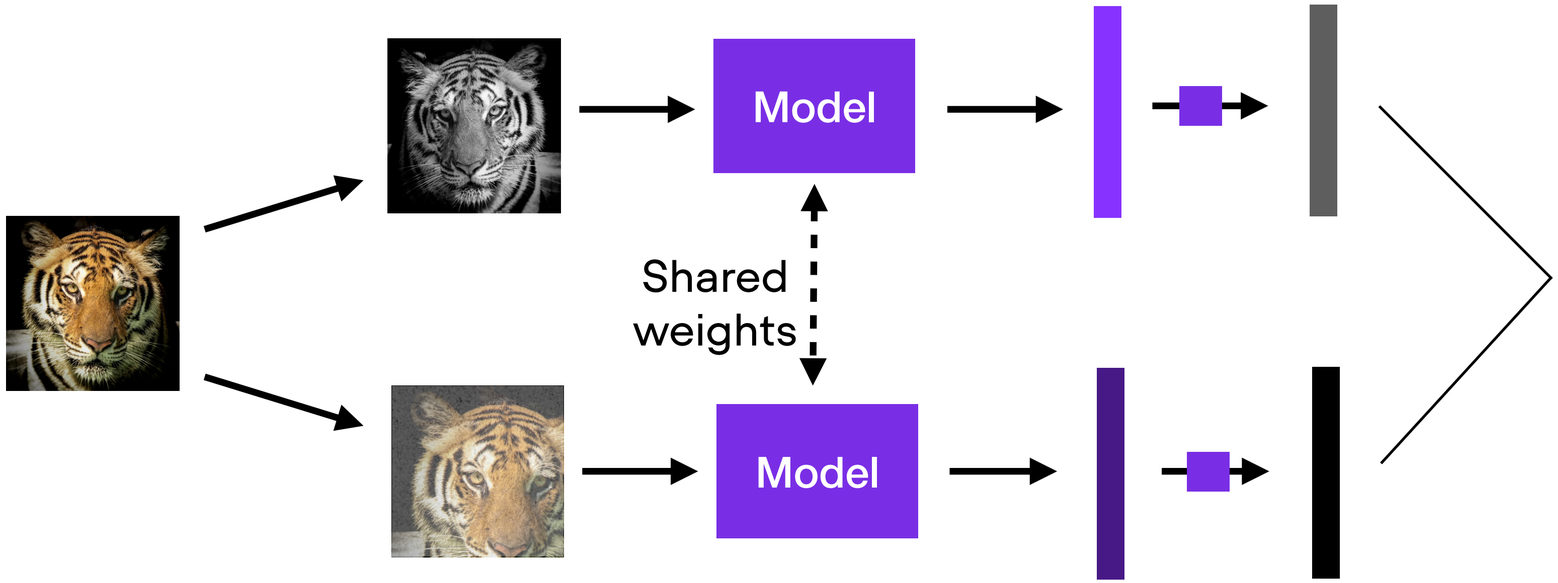
Computing the similarity



$$s_{i,j} = \frac{z_i^\top z_j}{\left(\tau \, \| z_i \| \cdot \| z_j \| \right)}$$

vector length

Computing the similarity



$$s_{i,j} = \frac{z_i^\top z_j}{\left(\tau \left\| z_i \right\| \cdot \left\| z_j \right\|\right)}$$

Cosine similarity

ranges between -1 and 1, where 1 is maximally similar

SimCLR Data Augmentation

(a) Original (b) Crop and resize (c) Crop, resize (and flip) (d) Color distort. (drop) (e) Color distort. (jitter)

(f) Rotate $\{90°, 180°, 270°\}$ (g) Cutout (h) Gaussian noise (i) Gaussian blur (j) Sobel filtering

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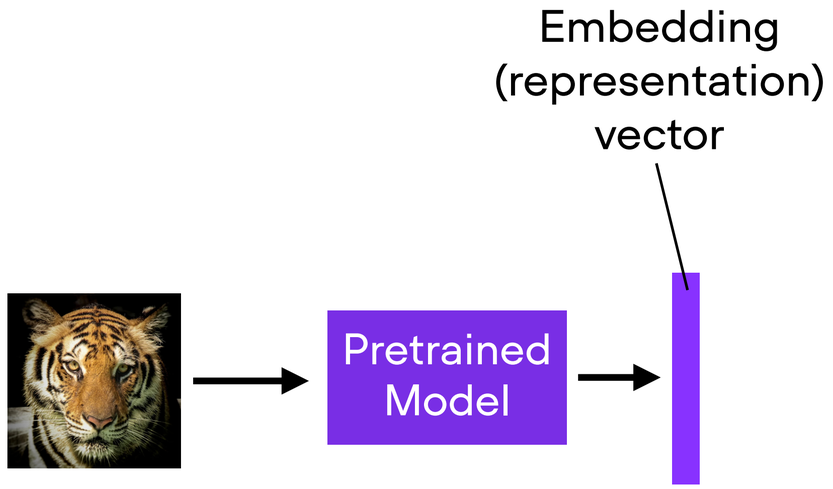
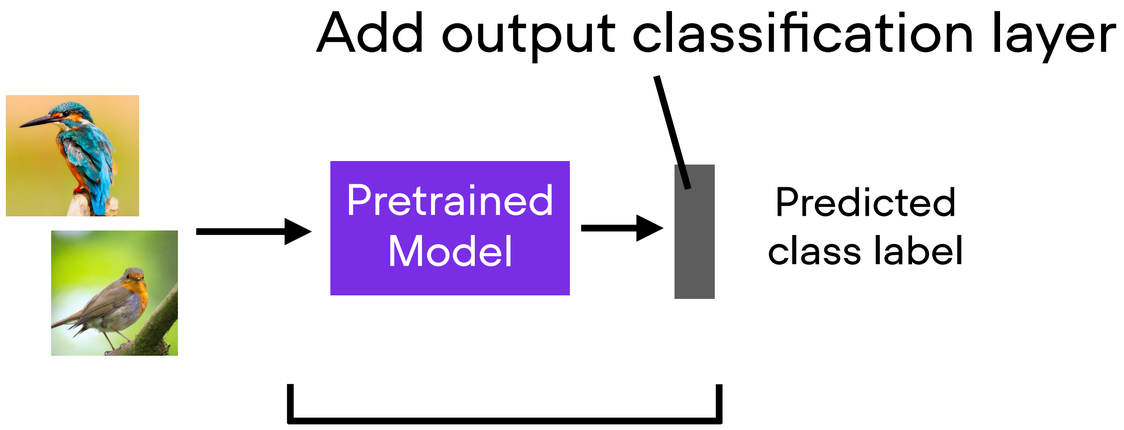
After self-supervised learning

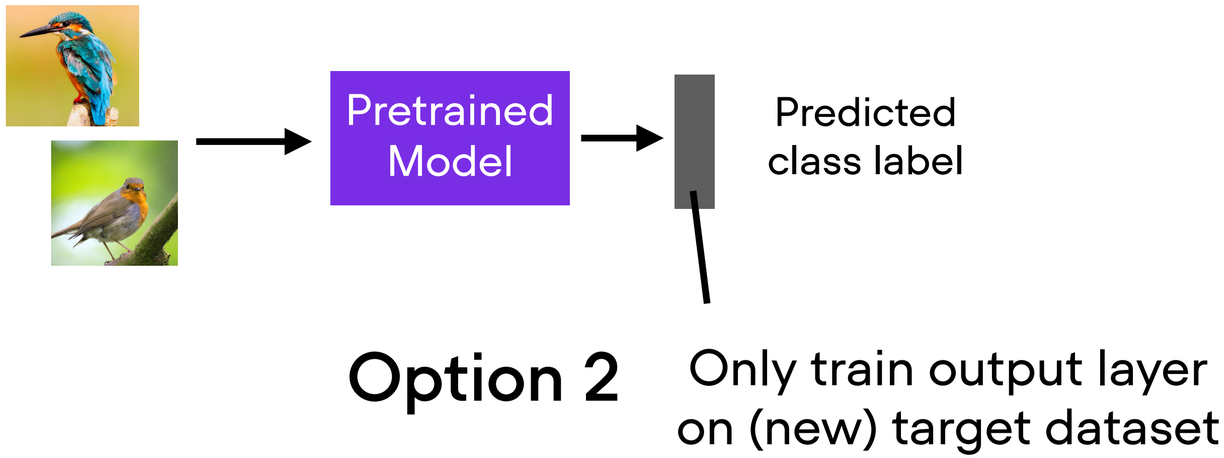


After self-supervised learning

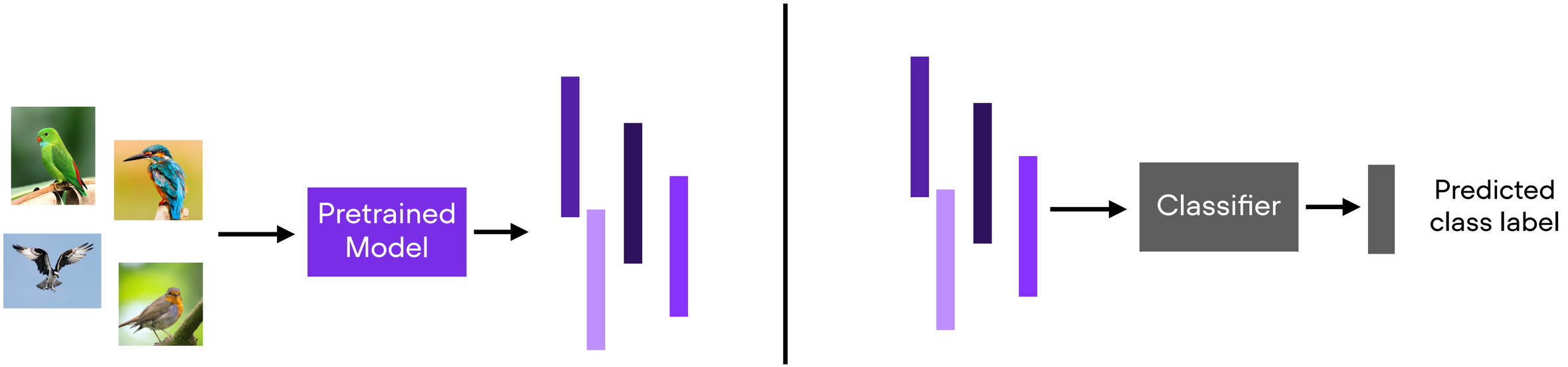


Option 1 Train all layers on (new) target dataset

After self-supervised learning



After self-supervised learning



Option 3 Let model generate embeddings, then train new classifier on embedding vectors

Next: Implementing SimCLR