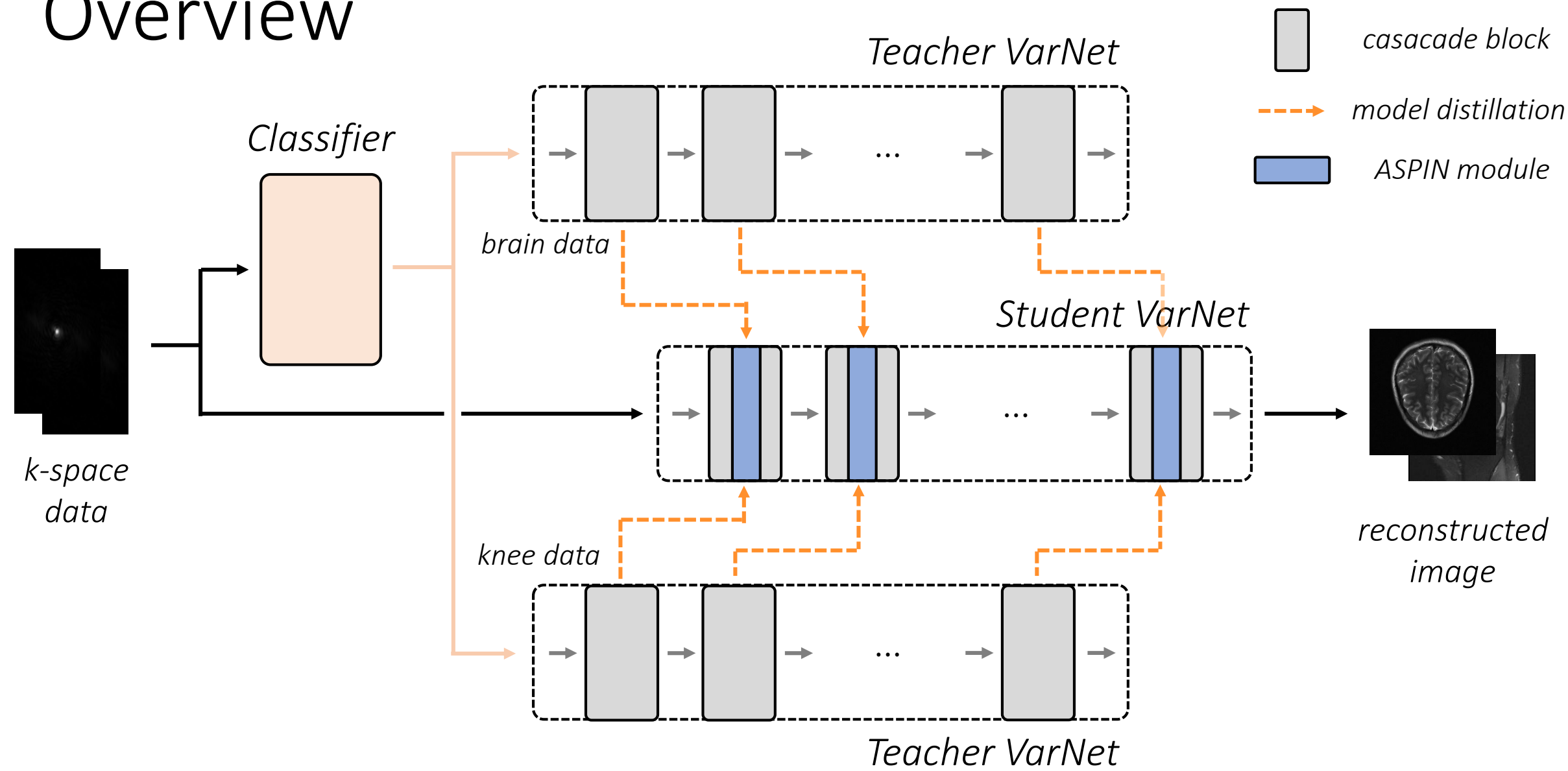


Universal VarNet:

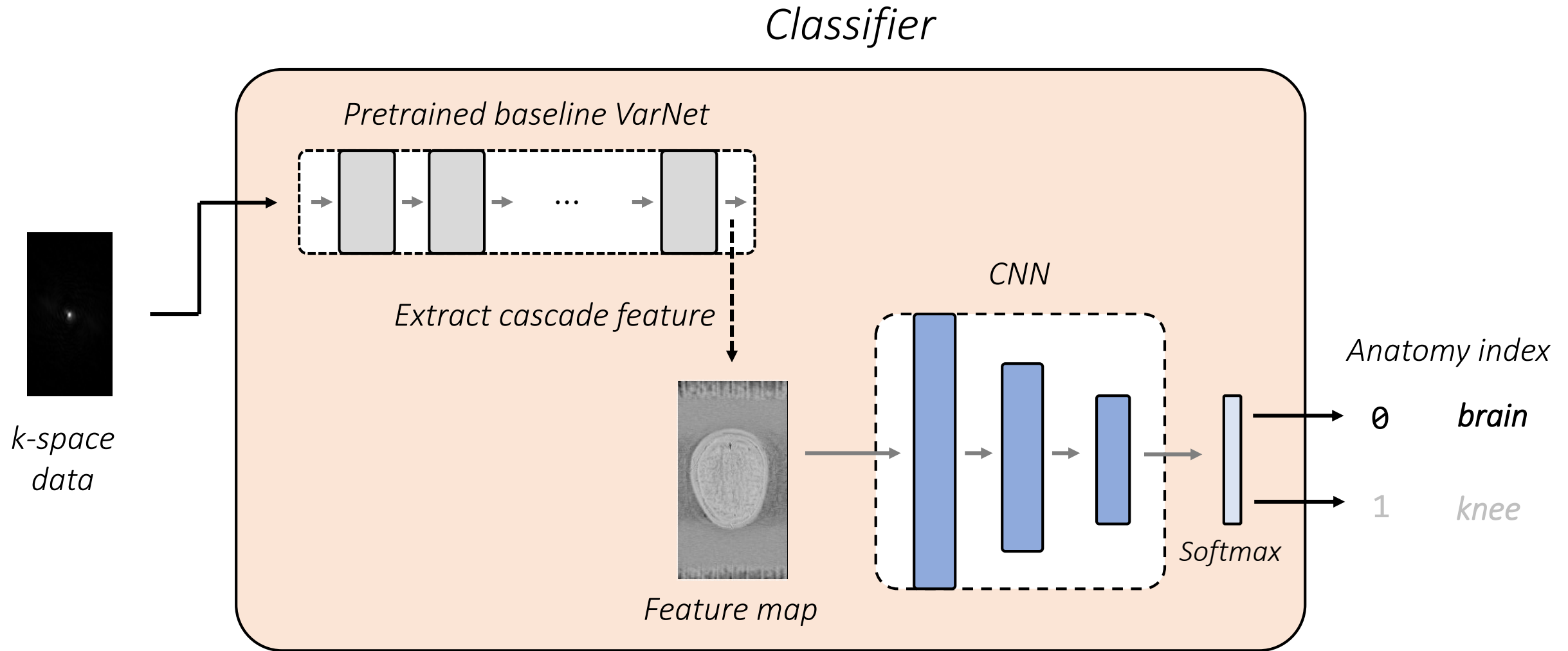
A Robust Reconstruction Framework using
Anatomy-Specific Instance Normalization and
Model Distillation

Sanghwa Lee

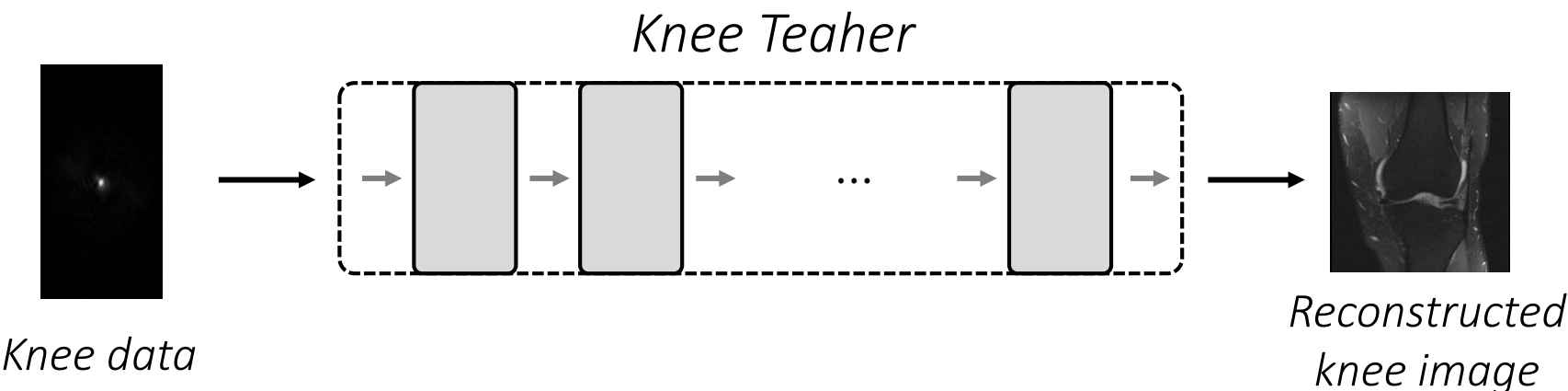
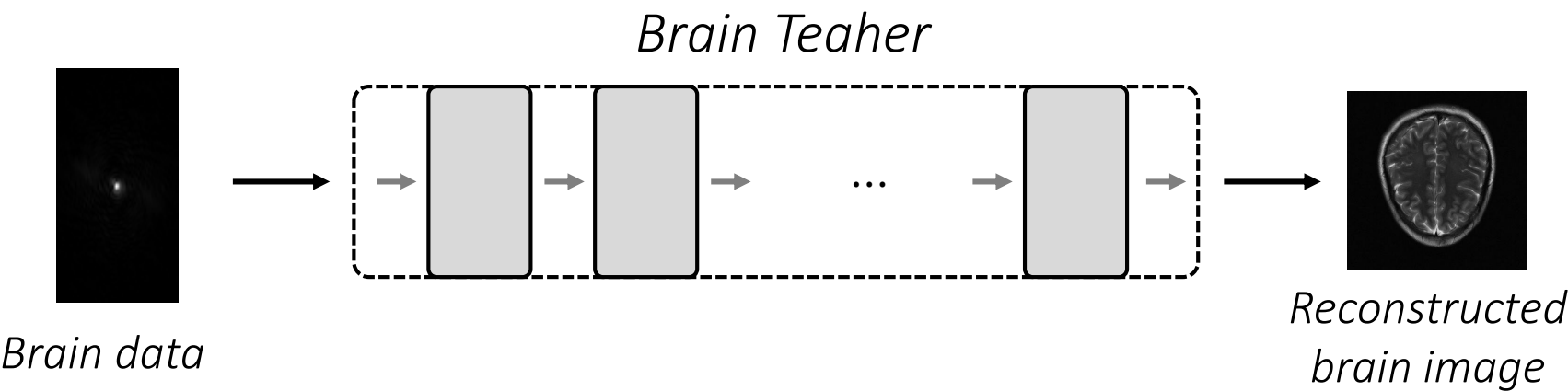
Overview



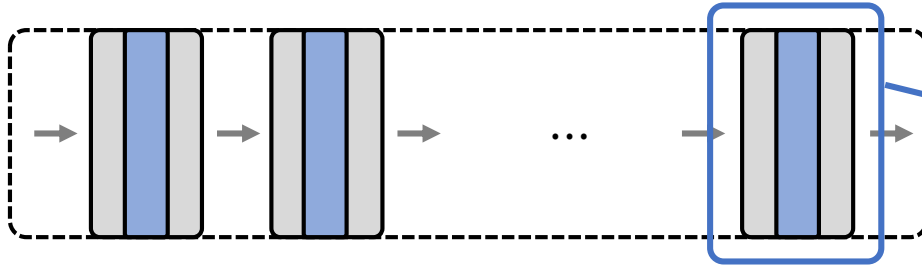
Anatomy Classifier



Teacher VarNet



Student VarNet - ASPIN



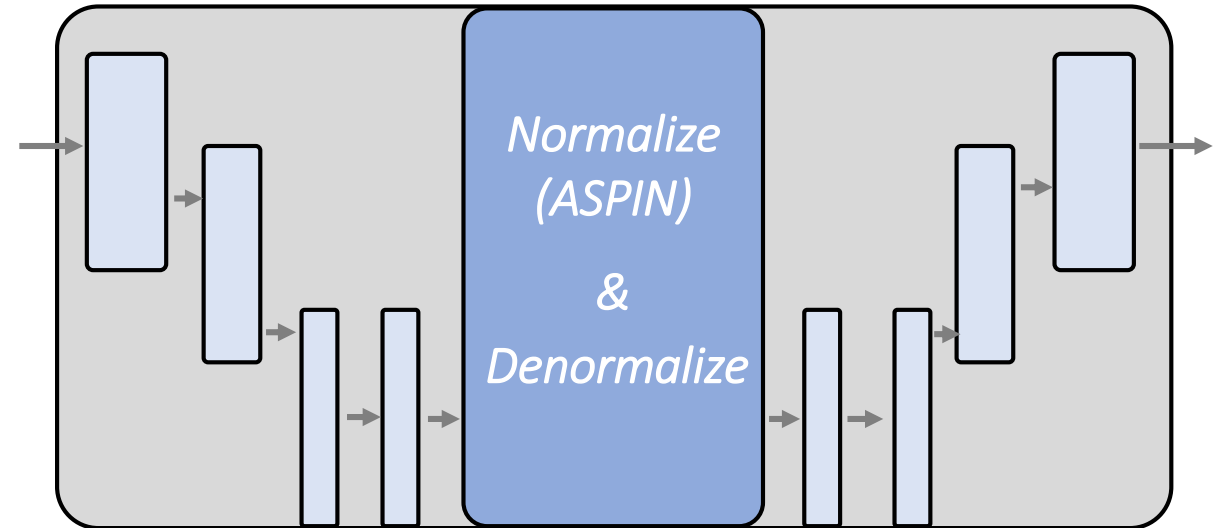
*Anatomy-Specialized Instance
Normalization (ASPIN)*

For anatomy a ,

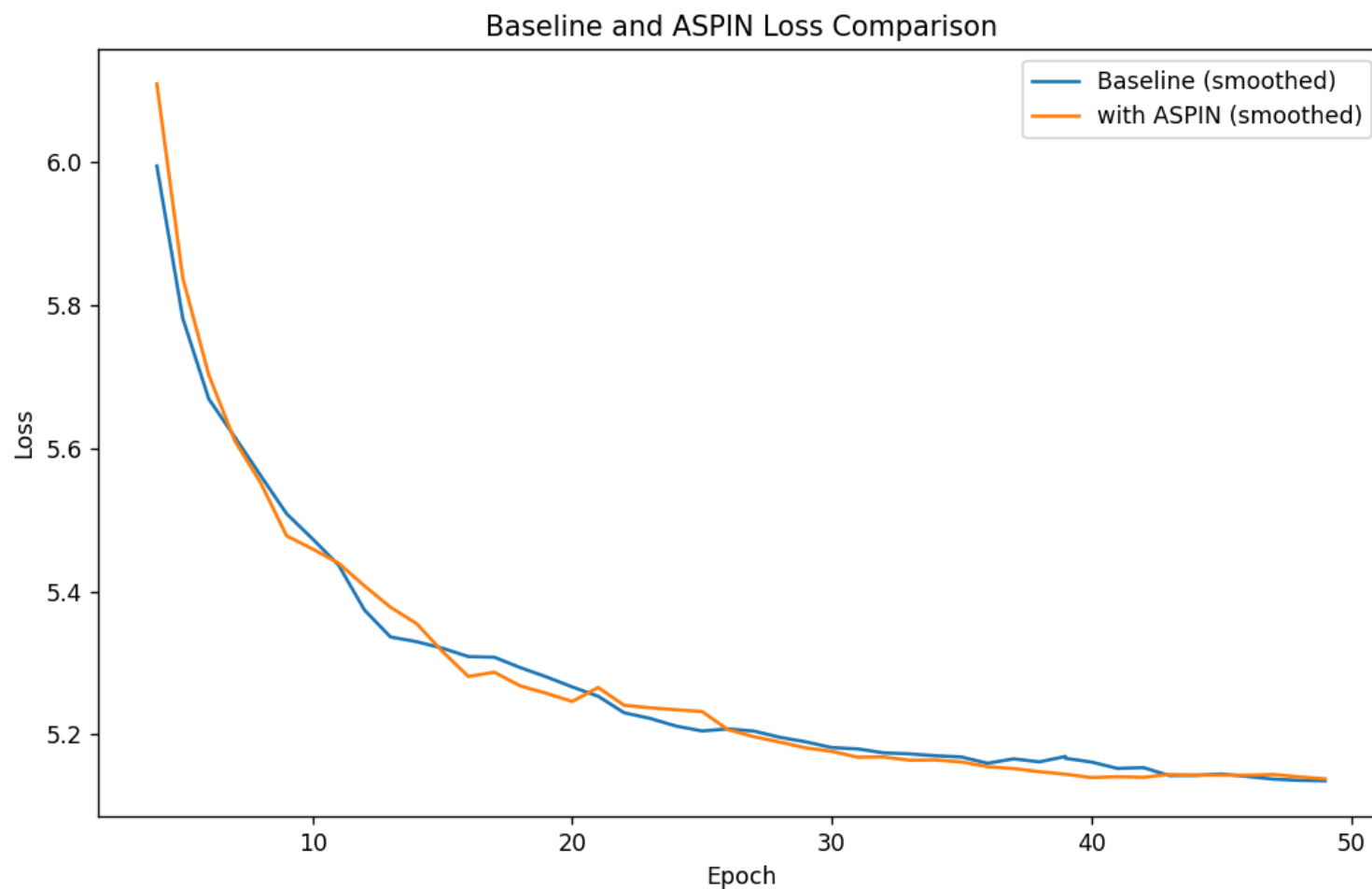
$$\text{ASPIN}_a(h) = \gamma_a \left(\frac{h - \mu(h)}{\sigma(h)} \right) + \beta_a$$

(Xinwen Liu et al., 2021)

VarNet cascade block (U-net)

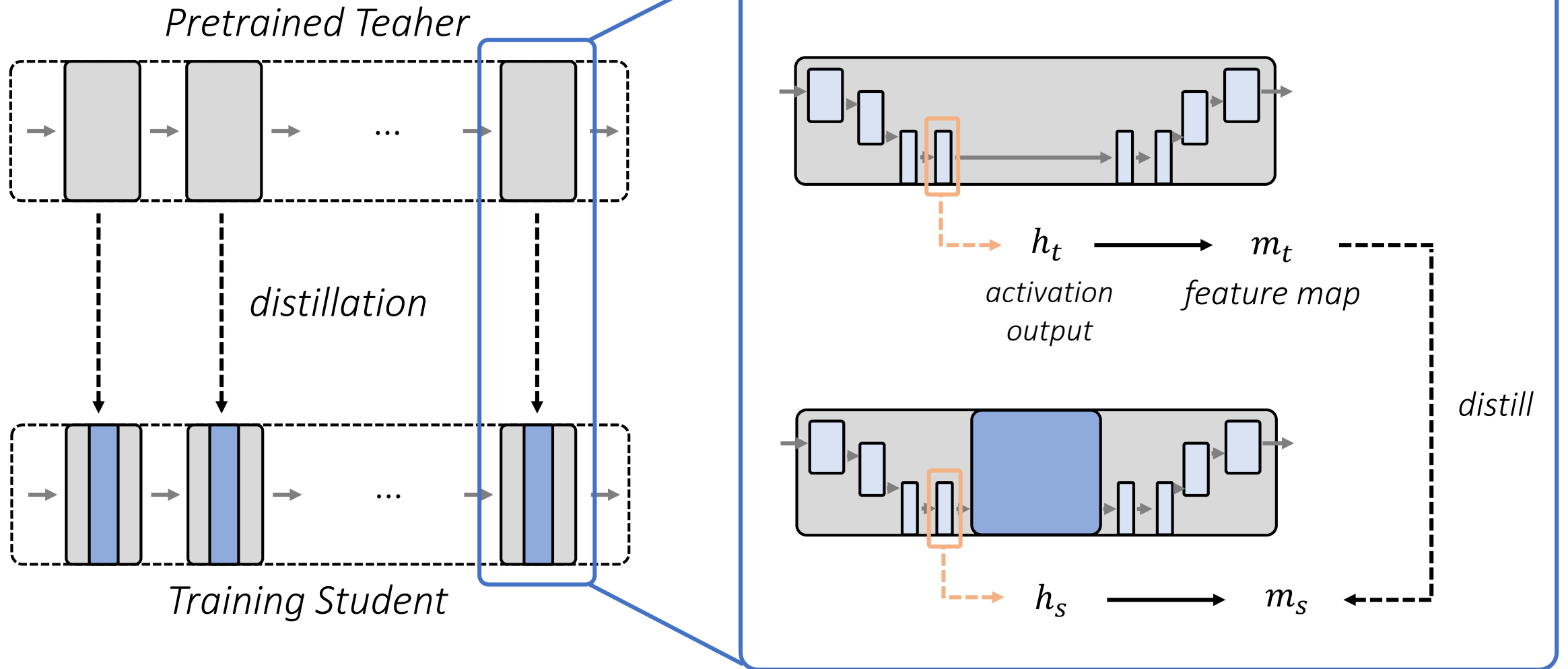


Student VarNet - ASPIN



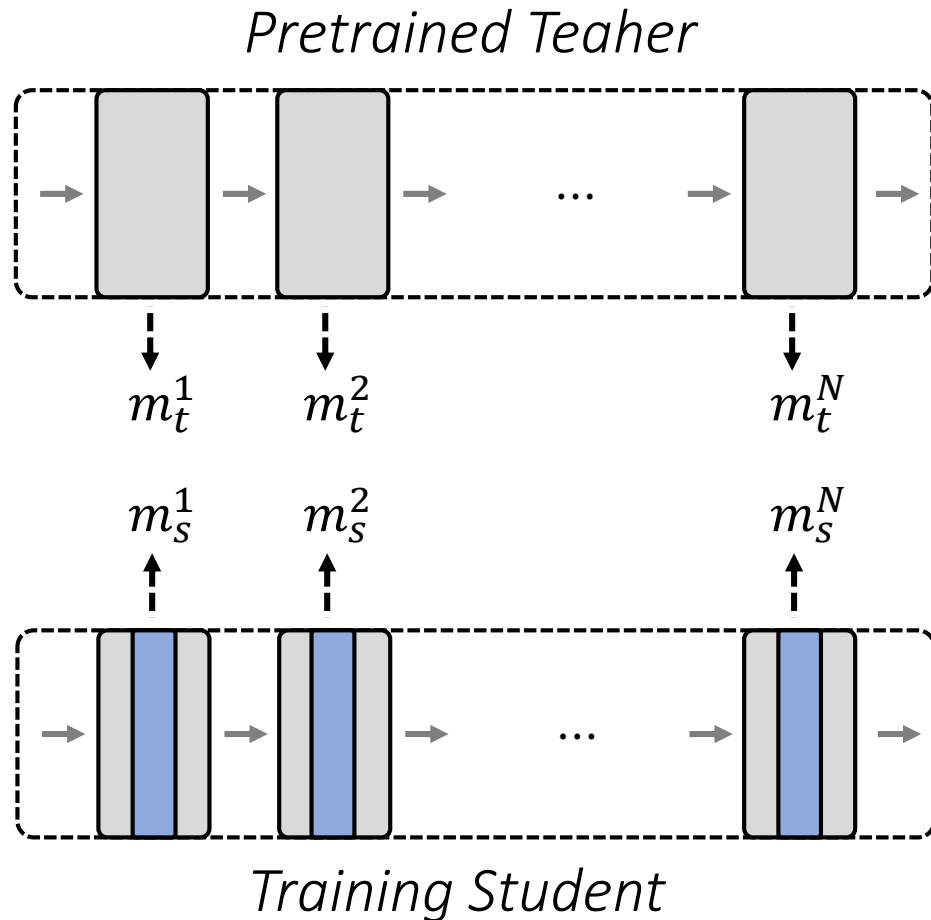
*Validation loss tends to be lower
with ASPIN module implemented*

Student VarNet - Distillation



Student VarNet - Distillation

(Xinwen Liu et al., 2021)



For each cascade n ,

$$O_t^n = \sum_{c=1}^c |m_t^n| \quad : \text{Spatial attention map}$$

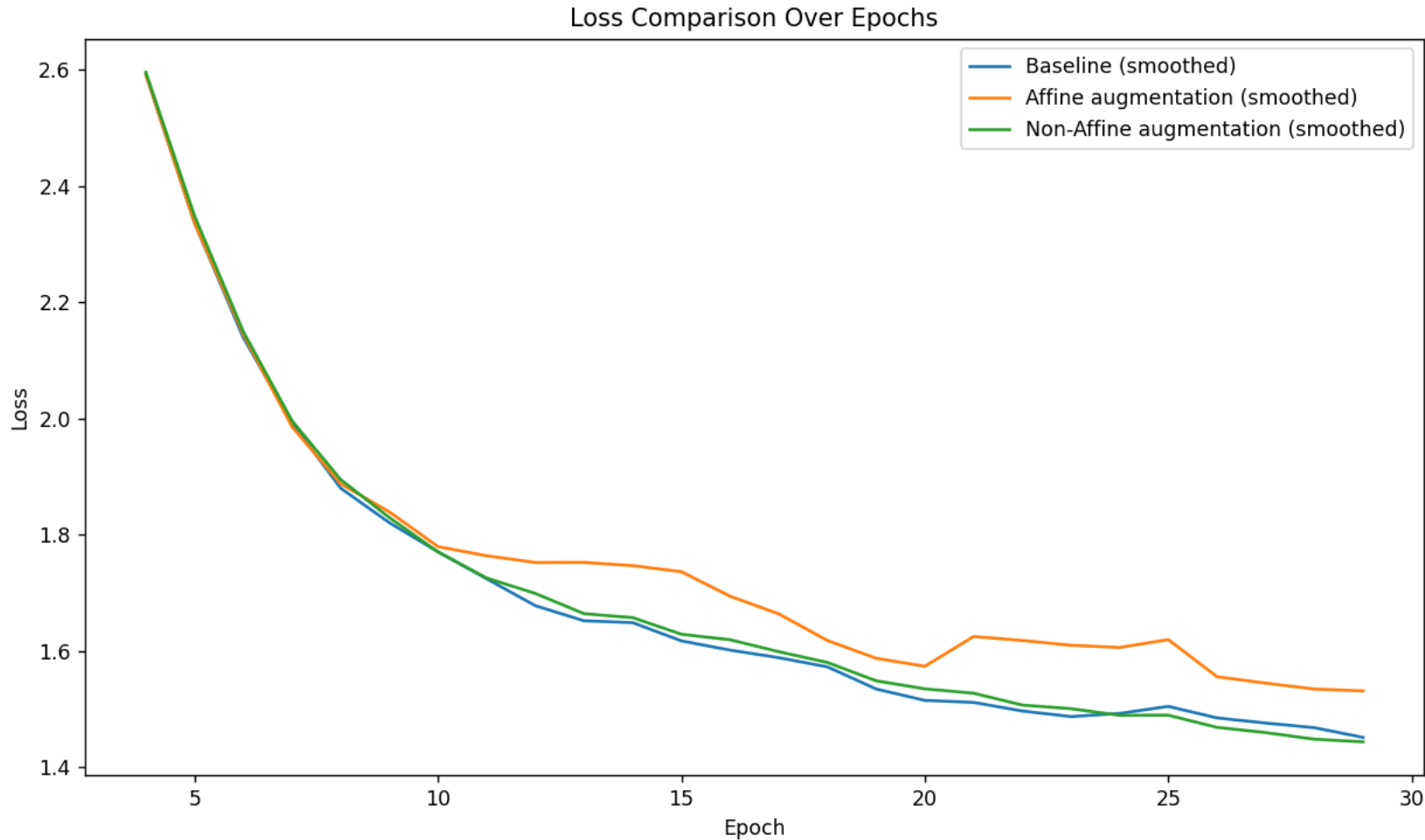
$$l_{distill}^n = \left\| \frac{O_t^n}{\|O_t^n\|_2} - \frac{O_s^n}{\|O_s^n\|_2} \right\|_1$$

Optimize the total loss L_{total}

$$L_{distill} = \sum_{n=1}^N l_{distill}^n$$

$$L_{total} = \omega L_{recon} + (1 - \omega) L_{distill}$$

Minor improvements



Non-affine (filp, translation) augmentations tend to show lower validation loss compared to the baseline and affine (rotation, scaling) augmentations

Minor improvements

```
--cascade 8  
--chans 9  
--sens_chans 4
```

Training

```
--aug_delay 10  
--aug_strength 0.6  
--aug_weight_fliph 0.5  
--aug_weight_translation 0.5  
--aug_max_translation_x 0.02  
--aug_max_translation_y 0.02
```

*Non-affine
augmentation*

Loss

$$L_{total} = \omega L_{recon} + (1 - \omega) L_{distill}$$

$$L_{recon} = L_{SSIM} + \alpha L_1$$

Optimizer & Scheduler

AdamW (weight decay 1e-4)

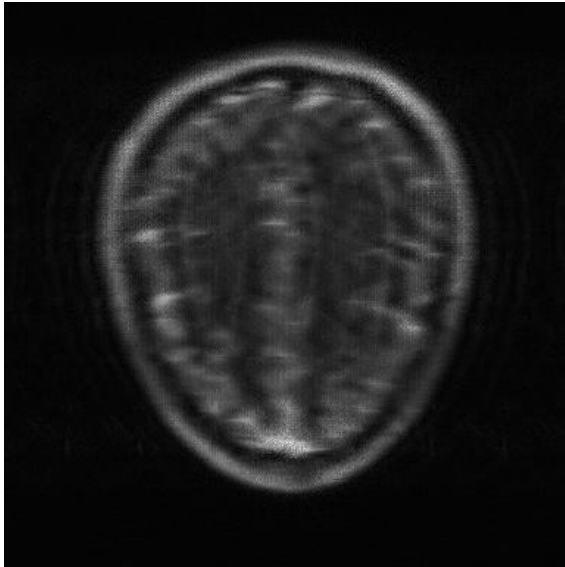
Cosine annealing decay

Warmup 10

Initial rate 1e-3

Conclusion

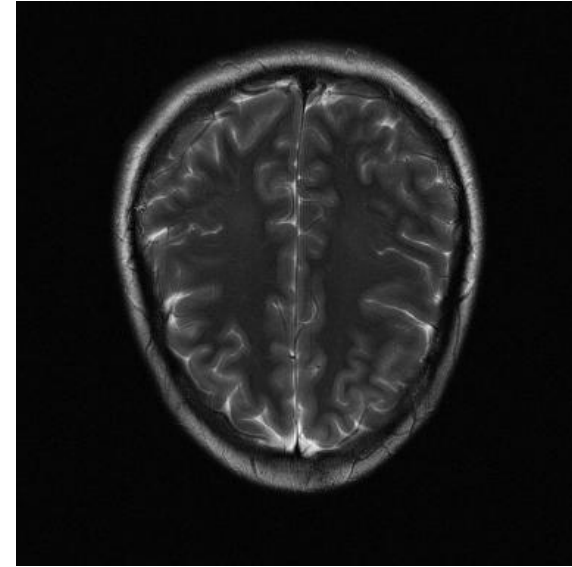
Undersampled image



Universal VarNet



Reconstructed image



SSIM 0.9697