

Is Texture Predictive for Age and Sex in Brain MRI?

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MOTIVATION

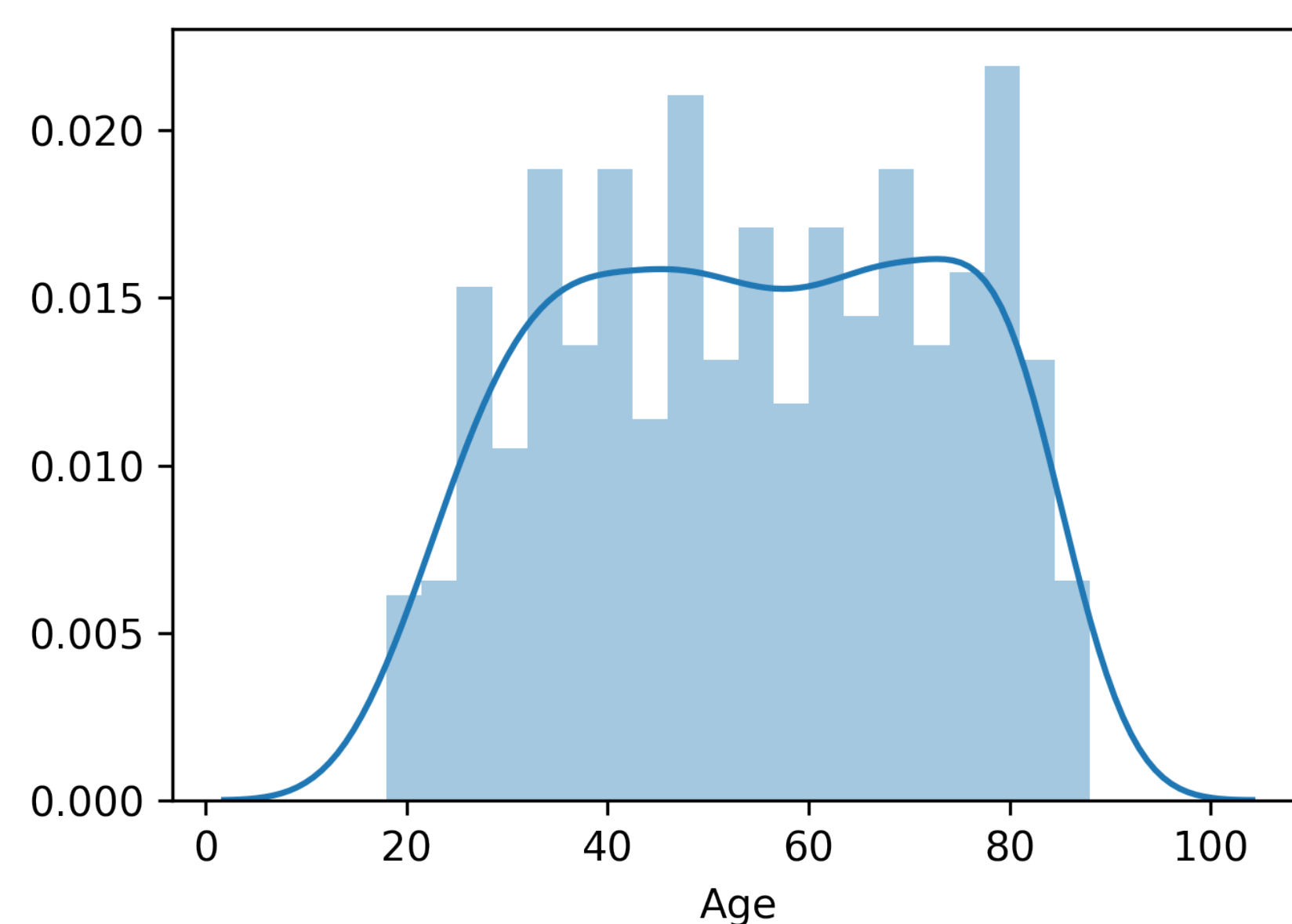
Deep learning builds the foundation for many medical image analysis tasks where neural networks are often designed to have a large receptive field to incorporate long spatial dependencies. Recent work [1] has shown that large receptive fields are not always necessary for computer vision tasks on natural images. We explore whether this translates to certain medical imaging tasks such as age and sex prediction from a T1-weighted brain MRI scans.

DATA

CamCAN [2] dataset:

- T1- and T2-weighted Brain MRI
- 652 healthy subjects
- 18 - 87 years

The dataset is approximately gender-balanced and has an almost uniform age distribution:



We only use the T1-weighted scans and preprocess them:

- 1mm isotropic resolution
- skull-stripped and bias-field corrected
- random crops of shape $[128 \times 160 \times 160]$
- whitening within brain mask

RESULTS

We find that texture of brain MRI is predictive of age and sex. We report mean absolute error (age) and accuracy (sex):

Receptive Field	Age	Sex
$(9mm)^3$	5.53	83.2%
$(17mm)^3$	5.32	84.0%
$(33mm)^3$	4.98	84.0%
$(177mm)^3$	3.86	80.9%

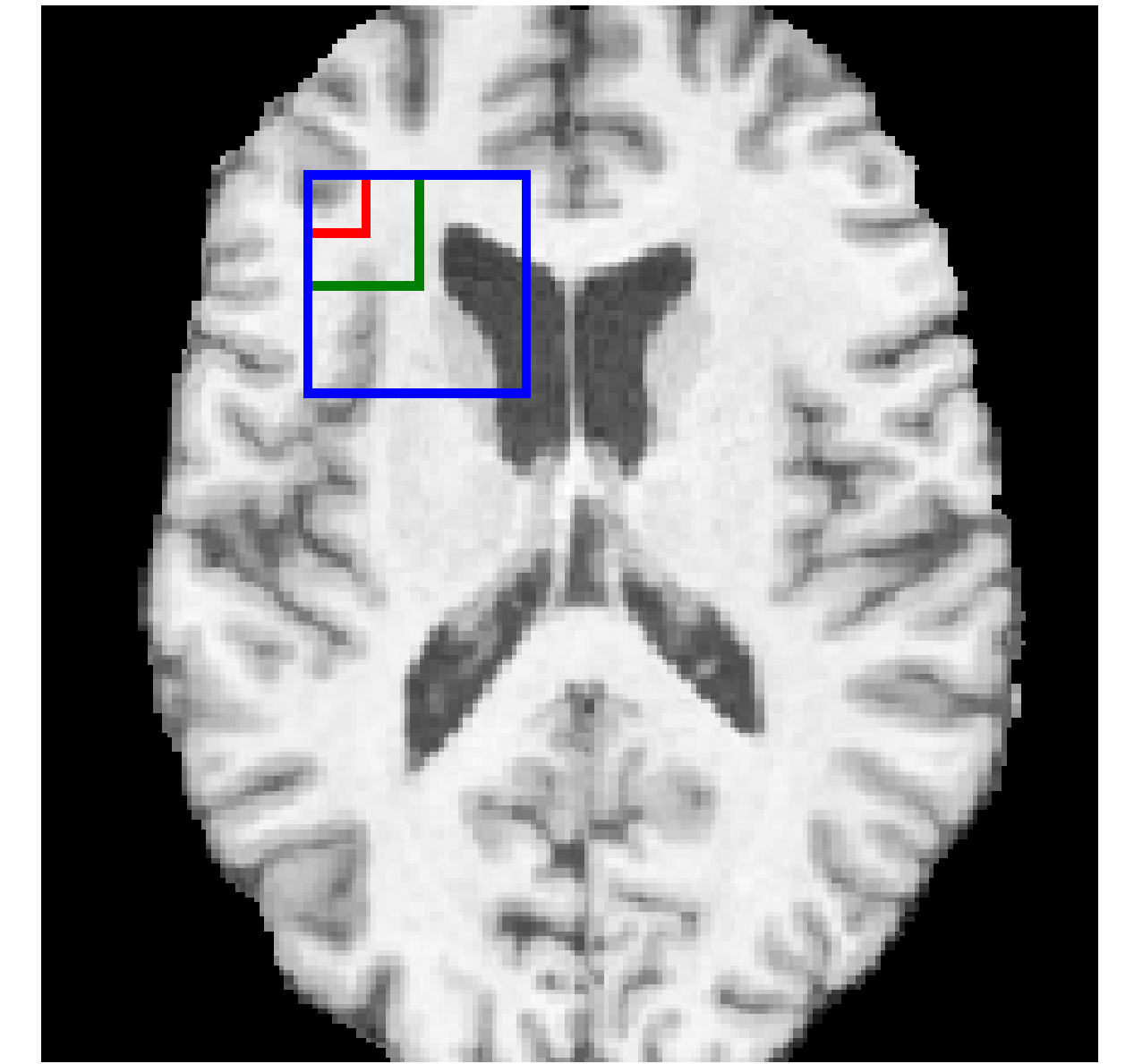
REFERENCES

- [1] W. Brendel *et al.*, “Approximating cnns with bag-of-local-features models works surprisingly well on imagenet,” *arXiv preprint arXiv:1904.00760*, 2019.
- [2] J. R. Taylor *et al.*, “The cambridge centre for ageing and neuroscience (cam-can) data repository: Structural and functional mri, meg, and cognitive data from a cross-sectional adult lifespan sample,” *Neuroimage*, 2017.
- [3] D. Ulyanov *et al.*, “Instance normalization: The missing ingredient for fast stylization,” *arXiv preprint arXiv:1607.08022*, 2016.

OVERVIEW

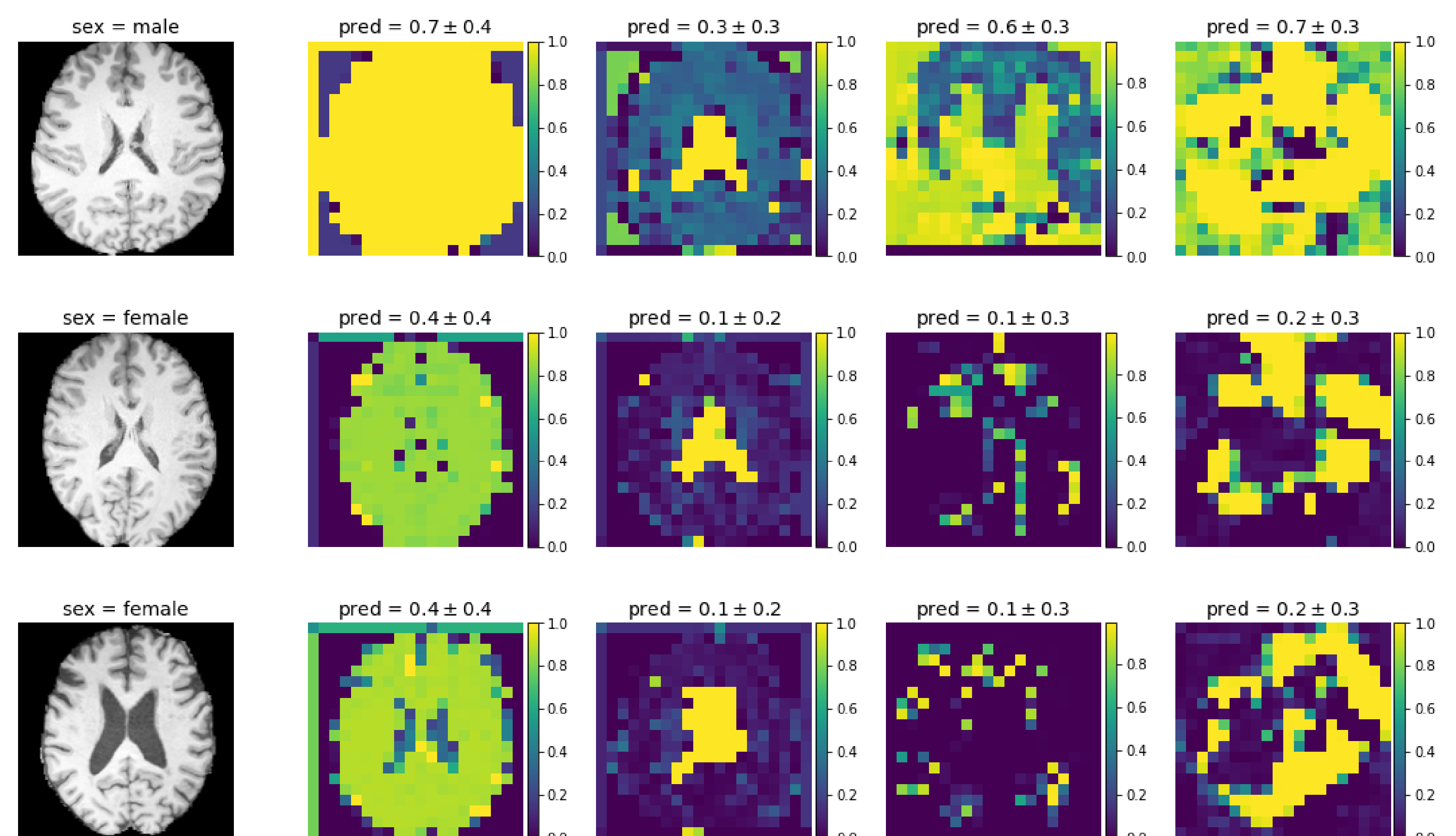
We use BagNets [1] to examine whether texture information from brain MRI is predictive.

- We extend BagNets [1] to 3D data
- Use InstanceNorm [3] and ‘same’ padding
- Encode image into bags with ResNet-50-like architecture
- Test receptive fields of $(9mm)^3$ (red), $(17mm)^3$ (green), $(33mm)^3$ (blue)
- Predict local age and sex



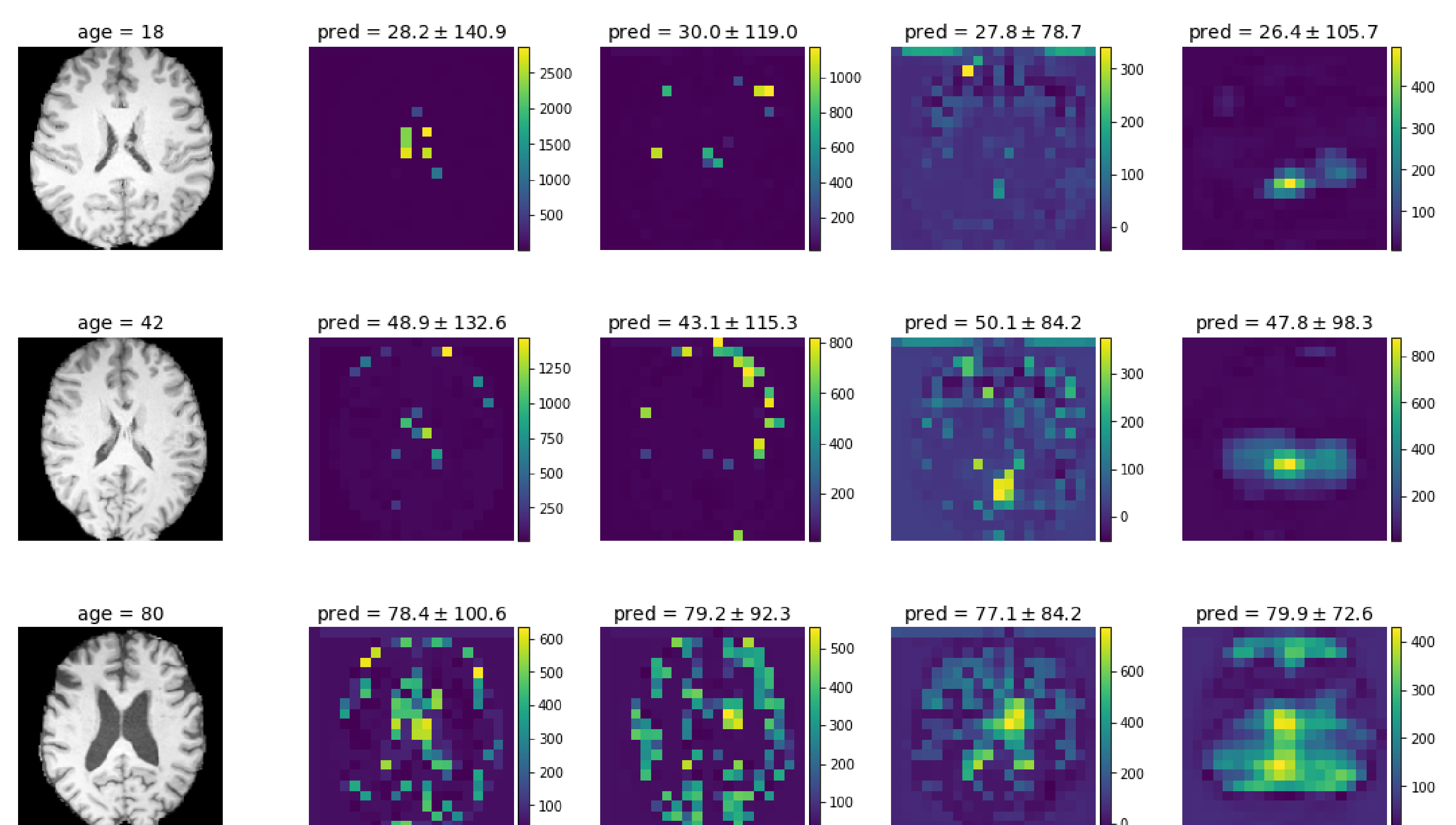
SEX PREDICTION

We test the spatial attribution by localised sex predictions using the BagNet architecture:



AGE PREDICTION

We test the spatial attribution by localised age predictions using the BagNet architecture:



CODE



ACKNOWLEDGEMENTS

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