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MRNet Implementation with AlexNet

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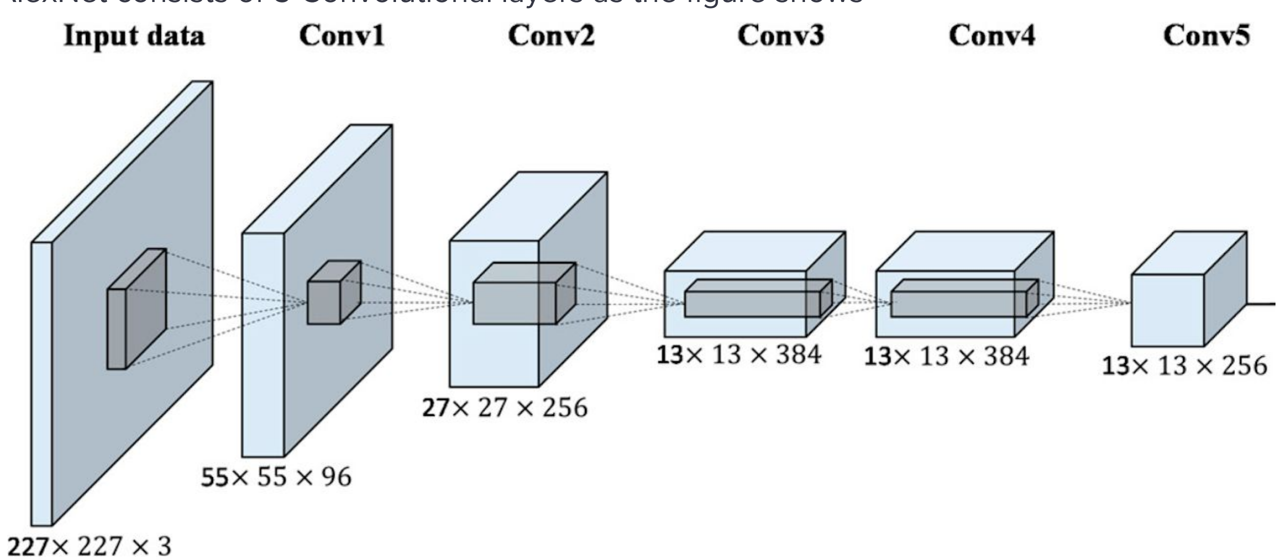
OVERVIEW

I have implemented the MRNet Algorithm that predicts abnormalities in knee MRI exams. After creating the AlexNet model as the paper mentioned, I've created 9 models corresponding for each combination of MRI angle view and test type (abnormal, ACL, meniscus). Here are my trails and my results.

AlexNet

AlexNet consists of 5 Convolutional layers as the figure shows



The input to MRNet has dimensions s × 3 × 256 × 256, where s is the number of images in the MRI series (3 is the number of color channels). First, each 2-dimensional MRI image slice is passed through a feature extractor to obtain a s × 256 × 7 × 7 tensor containing features for each slice. A global average pooling layer is then applied to reduce these features to s × 256. We then applied max-pooling across slices to obtain a 256-dimensional vector, which is passed to a fully connected layer to obtain a prediction probability.

The paper trained a logistic regression to weight the predictions from the 3 series and generate a single output for each exam. But I focused on achieving high accuracy and AUC score at the validation and testing first then I could train the logistic regression.

Trails

At first, All the initial trails were on the axial angle and abnormal class. Here are the highlights of them:

- I tried different Keras optimizers as SGD, Adadelta, and Adam. But Adam was better and faster as it achieved an accuracy of 80%
- I tried different learning rates from 0.1 to 0.000001 but found out that 0.00001 gave the best results

- I tried with aug=1 and with aug=0 and no augmentation gave better results so I used that.

At last, I decided to go with Adam optimizer using 0.00001 as a learning rate and 0 augmentation as it gave out better results. (accuracy with augmentation: 80%, 85% without it).

I trained all 9 models at the same time for 12 epochs. Then trained them another 50 epochs with loading first training weights. I got high training results. Then I validated and tested using the 12th epoch weights and got these results:

		Training		**Validation**		**Testing**	
		Accuracy	AUC	Accuracy	AUC	Accuracy	AUC
Abnormal	Axial	95.81%	97.12%	83.34%	74.99%	77.29%	73.87%
	Coronal	96.31%	98.44%	85.00%	79.90%	85.70%	76.39%
	Sagittal	96.23%	98.28%	85.00%	86.42%	83.28%	76.42%
ACL	Axial	98.35%	98.82%	80.83%	88.52%	87.54%	80.32%
	Coronal	96.89%	97.80%	66.67%	67.85%	89.42%	77.50%
	Sagittal	97.53%	98.45%	63.34%	79.94%	92.22%	89.23%
Meniscus	Axial	94.51%	97.68%	61.67%	68.01%	78.28%	48.67%
	Coronal	93.28%	96.88%	65.35%	73.38%	55.66%	76.05%
	Sagittal	95.45%	97.60%	69.54%	75.06%	77.70%	73.66%

I tried to validate and test with the 50th weights but I got way lower results than the table above. I’m assuming I’ve achieved overfitting by doing this. So I went back to the first training weights.