

Ensembled Transfer Learning for MRI-based Knee Injury Diagnosis

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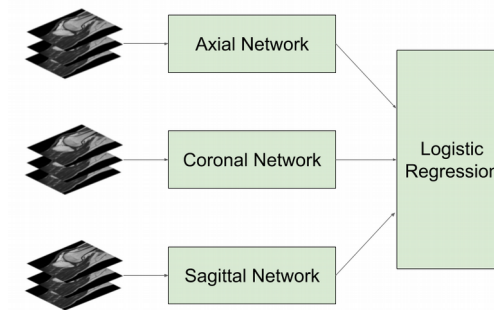
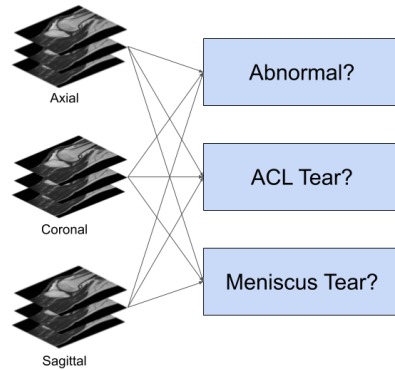
Problem formulation

Three MRI sequences per instance:

Axial (from above), Coronal (from front), Sagittal (from side)

Three independent binary labels per instance:

Is abnormal? Has ACL tear? Has meniscal tear?



Model	Average	Abnormal	ACL	Meniscus
MRNet (reported)	0.916	0.937	0.965	0.847
MRNet	0.913	0.940	0.960	0.839
MRNet-Squeeze	0.910	0.925	0.974	0.829
MRNet-Attend	0.891	0.925	0.910	0.838
<u>MRNet-SqueezeAttend</u>	<u>0.915</u>	<u>0.936</u>	<u>0.925</u>	0.885
Ensemble	0.931	0.939	0.976	0.876

AUC on validation set

Models

3 sequence-specific networks (independently trained)

Sequence-specific predictions are features for logistic regression

Model	Feature Extraction Layer	Sequence Reduction Layer
MRNet [1]	AlexNet	Max pooling
MRNet-Squeeze	SqueezeNet	Max pooling
MRNet-Attend	AlexNet	Attention
MRNet-SqueezeAttend	SqueezeNet	Attention

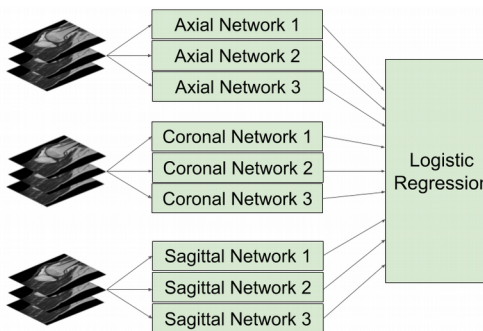
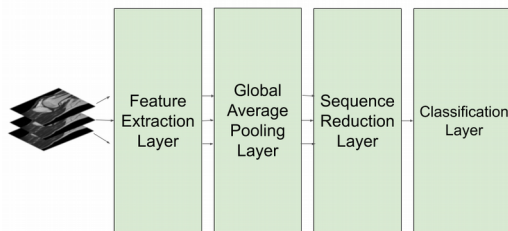
Data Set

MRNet Challenge:

<https://stanfordmlgroup.github.io/competitions/mrnet/>

1,250 instances:

training (1,010), tuning (120), and validation (120)

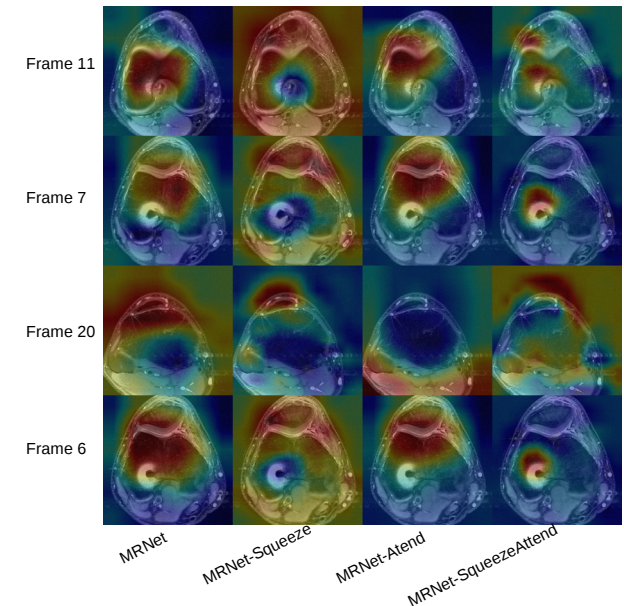


Ensemble

12 sequence-specific CNNs (4 model types x 3 sequences)

Sequence-specific predictions are features for logistic regression

Case 1218 – Axial, ACL



Sequence-specific networks

- Pretrained CNN feature extractor
- Global average pooling to reduce image dimensions
- Sequence reduction layer to reduce sequence of images
- Classification layer to predict binary label

[1] Bien, Nicholas, et al. "Deep-learning-assisted diagnosis for knee magnetic resonance imaging: Development and retrospective validation of MRNet." *PLoS medicine* 15.11 (2018): e1002699.