ENSEMBLED TRANSFER LEARNING FOR MRI-BASED KNEE INJURY DIAGNOSIS

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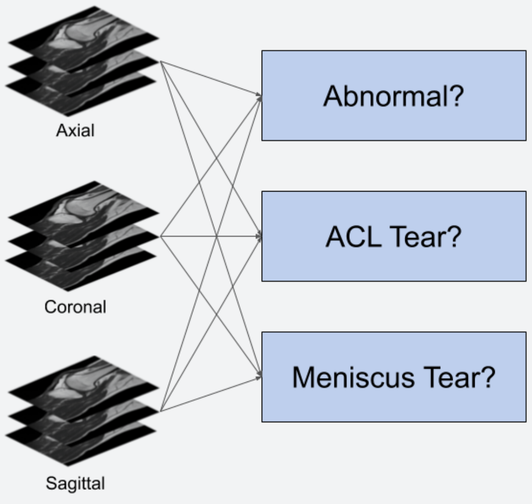
PROBLEM FORMULATION

- Three MRI sequences per instance:
  1. Axial (from above)
  2. Coronal (from front)
  3. Sagittal (from side)
- Three independent binary labels per instance:
  1. Is abnormal?
  2. Has ACL tear?
  3. Has meniscal tear?



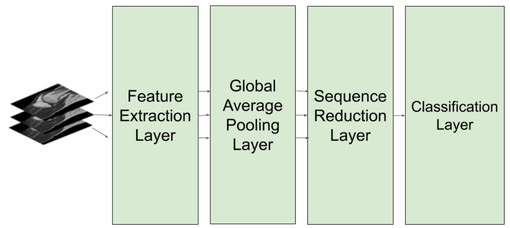
DATA SET

MRNet Challenge
https://stanfordmlgroup.github.io/competitions/mrnet/

1,250 instances
training (1,010), tuning (120), and validation (120)

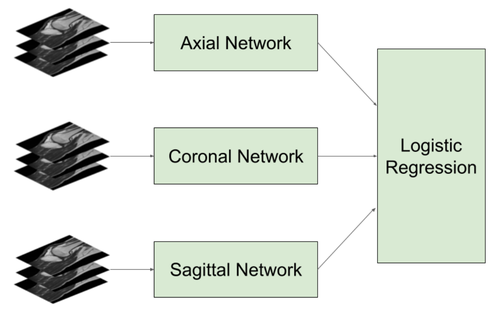
SEQUENCE-SPECIFIC NETWORKS

- 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



MODELS

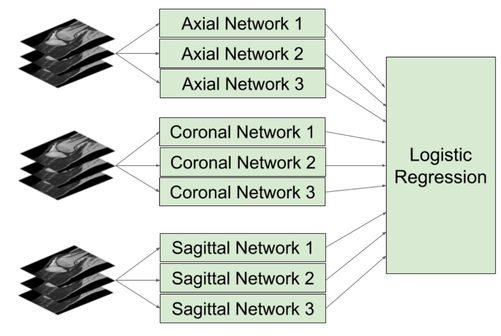
- 3 sequence-specific networks (independently trained)
- Sequence-specific predictions are features for logistic regression



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

ENSEMBLE

- 12 sequence-specific CNNs (4 model types x 3 sequences)
- Sequence-specific predictions are features for logistic regression

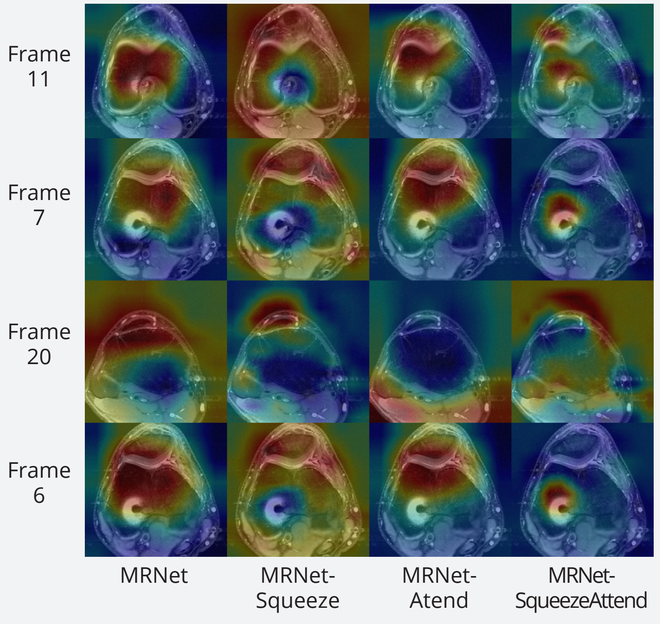


RESULTS

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
MRNet-SqueezeAttend	0.915	0.936	0.925	0.885
Ensemble	0.931	0.939	0.976	0.876

AUC on validation set

CASE 1218 – AXIAL, ACL



[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.