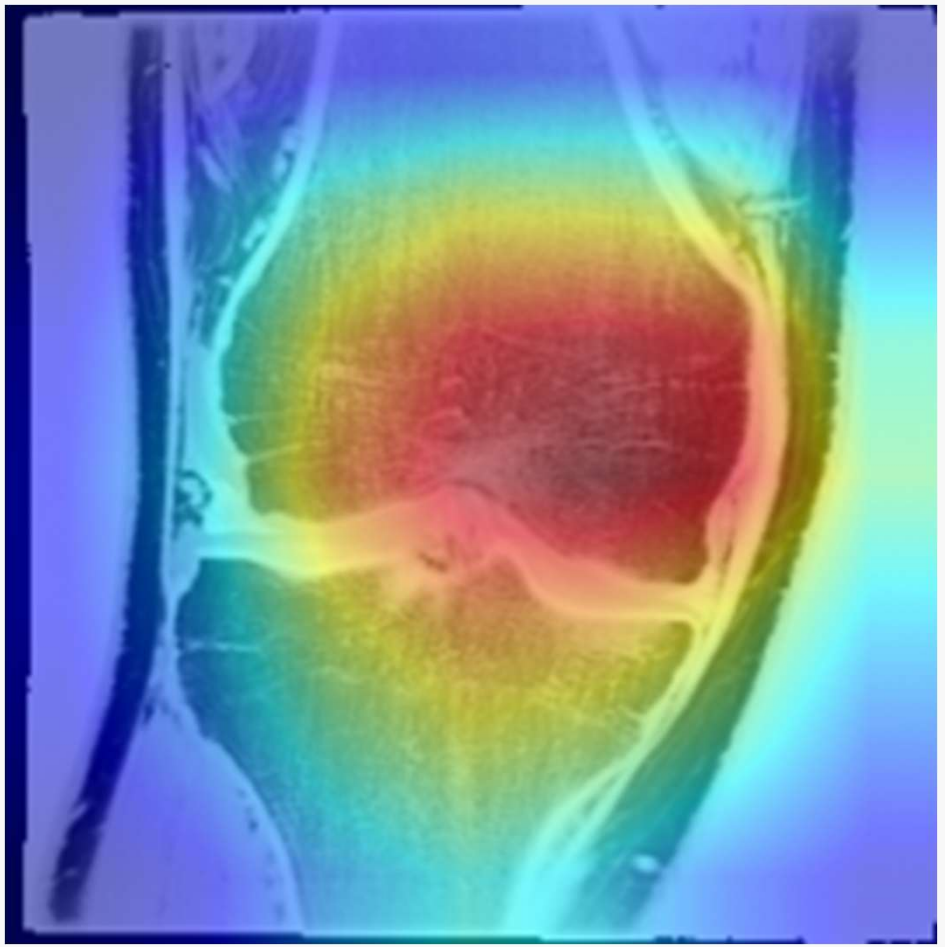
Knee MRI Interpretation



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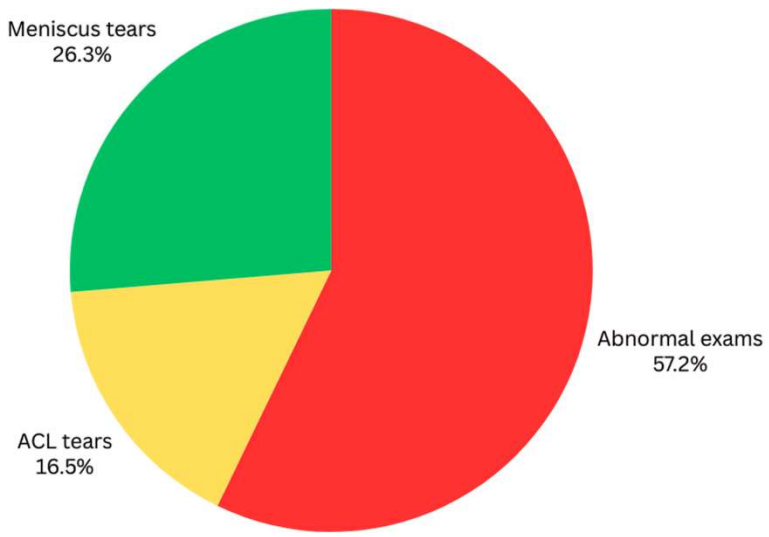
Why Automate Interpretation?

CHALLENGES IN MANUAL READINGS

Manual interpretation of knee MRI is often slow, leading to long wait times for patients. Radiologists may have differing opinions, increasing variability in diagnoses. With rising demands for MRI scans, departments face excessive strain, especially when analyzing the complex structures within the knee.

Dataset Overview

The dataset consists of 1,370 total MRI exams, with a significant number of abnormal cases. Preprocessing included multi-view extraction and image resizing.



DATASET SIZE	ABNORMAL CASES	ACL TEARS	MENISCUS TEARS
1370	1104	319	508

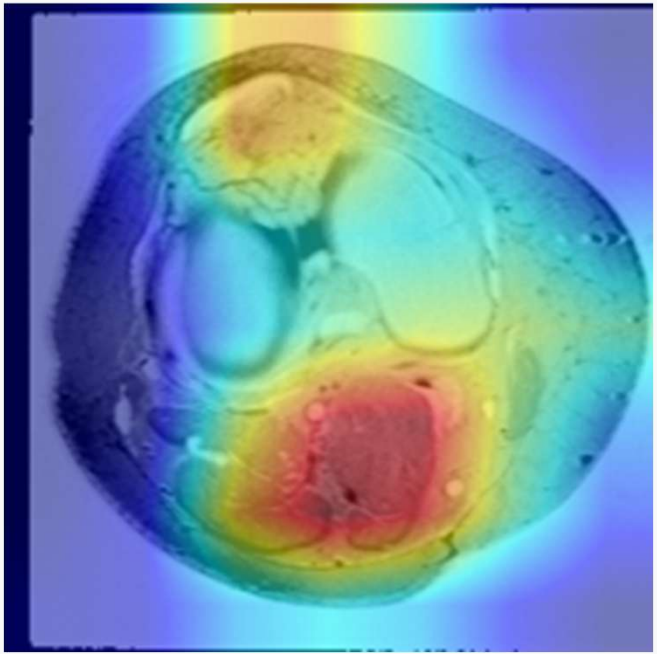
Model Architectures

BASELINE CNN MODEL

The simplest architecture, a 3-layer CNN, achieved moderate performance with 70% accuracy and a ROC AUC of 75%. Though basic, it highlights the potential for improvement.

ADVANCED ARCHITECTURES

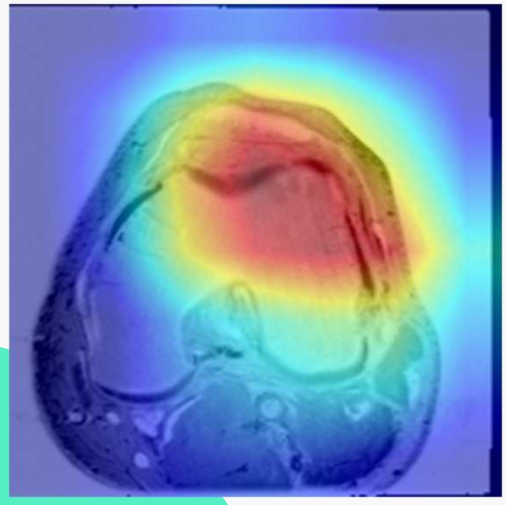
More sophisticated models like ResNet18 and Vision Transformers show superior results. ResNet18 uses residual connections, achieving 75% accuracy, while Vision Transformers excel in recognizing complex patterns.



How the Model Learns Key Anatomical Features

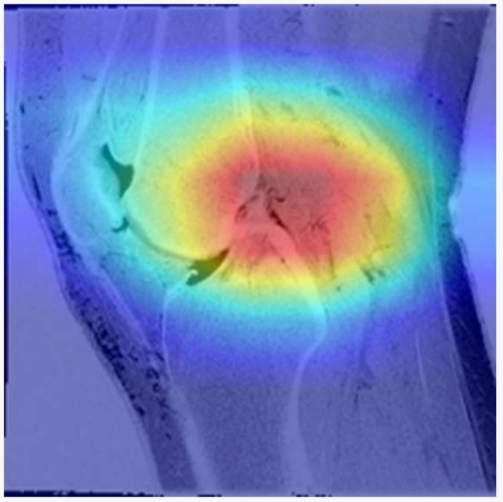
Red zones indicate areas of focus where the model learns to distinguish anatomical features during training.

This attention helps the model identify abnormalities such as ACL tears or meniscus damage.



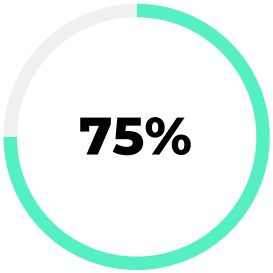
AXIAL

CORONAL



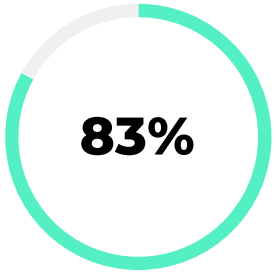
SAGITTAL

Performance Metrics



TOP ACCURACY IN MODELS

ResNet18 exhibited the highest accuracy among models.

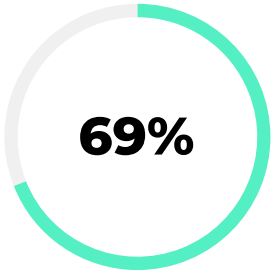


GREAT AUC FOR PRECISE DETECTION

Vision Transformers provided the best ROC AUC, showcasing their efficacy.

LOWER F1-SCORE

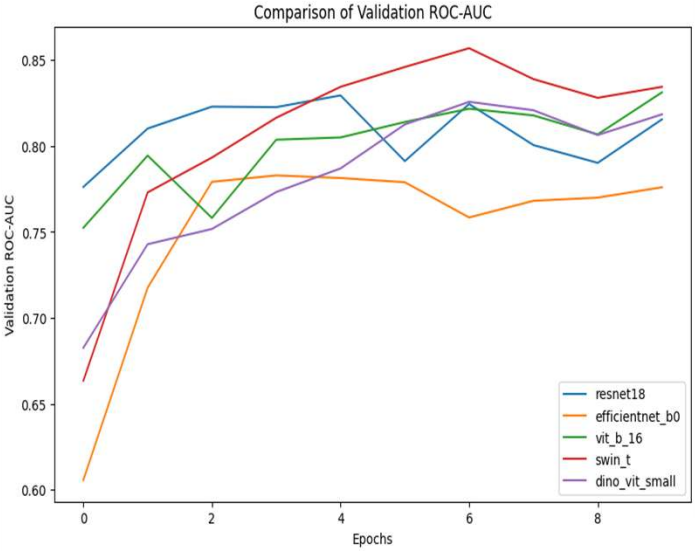
EfficientNet-B0 underperformed in the F1-Score metric.



SOLID F1-SCORE

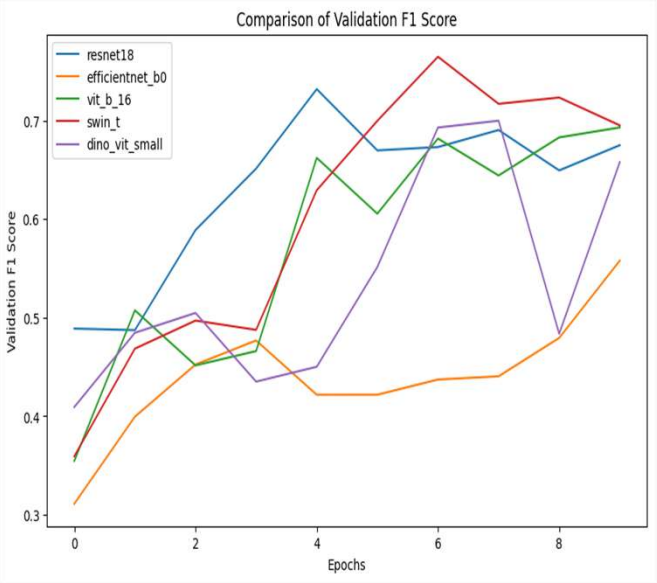
Vision Transformers also performed well in terms of F1-Score.

Model Performance Comparison



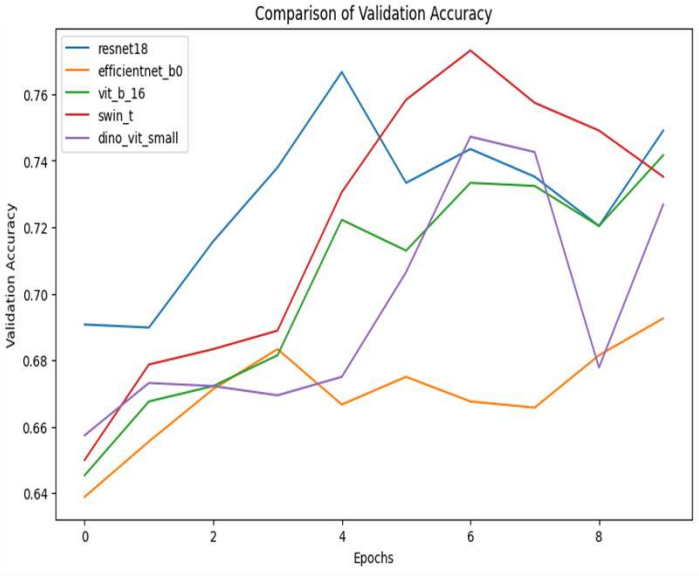
These graphs illustrate the performance metrics of different models across validation epochs.

We chose ResNet18 based on its strong performance and time efficiency during training and evaluation.



Key Observations:

- ResNet18 consistently performs well across all metrics, achieving a balance of accuracy, F1 score, and ROC-AUC.
- Vision Transformers (Swin-T and ViT-B16) show slightly higher AUC, but with increased computational requirements.
- EfficientNet-B0 underperformed in F1 score and accuracy, making it less ideal for this task.



Key Conclusions

SUMMARY OF FINDINGS

Automated models in knee MRI interpretation offer significant improvements in diagnostic efficiency and consistency. ResNet18 strikes a favorable balance between performance and computational requirements. Meanwhile, Vision Transformers excel in detecting subtle abnormalities, marking an advancement in interpretative accuracy.

Future Directions

AVENUES FOR FUTURE RESEARCH

Upcoming research should focus on expanding datasets to include varied demographics and pathologies. Moreover, volumetric MRI data analysis is essential for improving depth perceptions and accuracy.

TECHNOLOGICAL ENHANCEMENTS

Integrating hybrid models, such as CNN-transformer combinations, could capitalize on the strengths of both architectures. Additionally, enhancing model interpretability is vital for clinical application.