

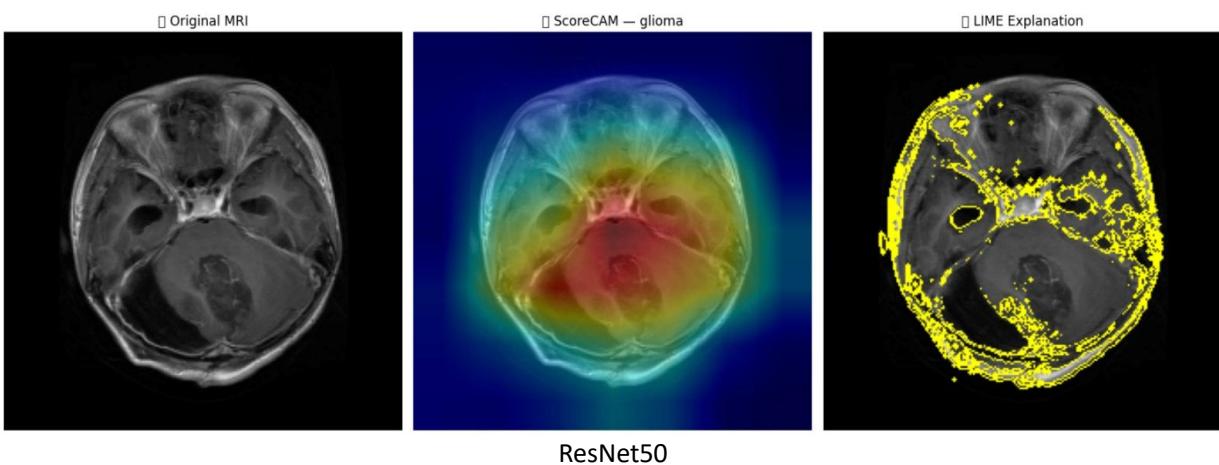
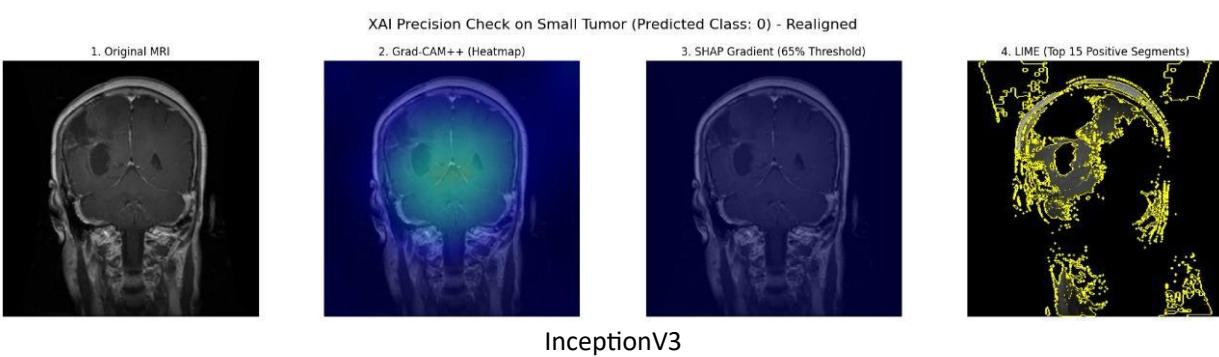
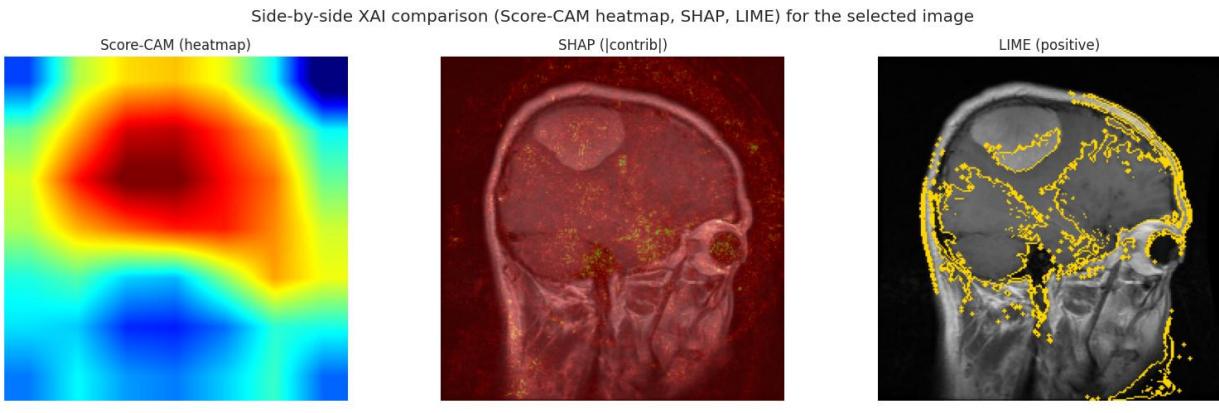
# Comparative Report: EfficientNetB4 vs InceptionV3 vs ResNet50

## Brain Tumor Classification with Explainable AI

### 1. Overview

Three CNN architectures — **EfficientNetB4**, **InceptionV3**, and **ResNet50** — were trained on the *Brain Tumor MRI Dataset (Kaggle – masoudnickparvar)* for 4-class classification (glioma, meningioma, pituitary, no tumor).

Explainable AI techniques used: **Score-CAM**, **Grad-CAM**, **SHAP**, and **LIME**.



### 2. Model & Training Summary

Model	Input	Optimizer	LR	Epochs	Fine-tuning
EfficientNetB4	224x224	Adamax	0.001→1e-5	20	Top 30 layers
InceptionV3	299x299	Adam	0.001→1e-5	50	All layers
ResNet50	224x224	Adam	0.001	20	Top layers

### 3. Performance Comparison

Metric	EfficientNetB4	InceptionV3	ResNet50
Train Accuracy	91.3%	97.5%	95.4%
Val Accuracy	88.9%	97.2%	93.8%
Test Accuracy	85.3%	<b>97.0%</b>	90.6%
F1-Score	0.85	<b>0.97</b>	0.90
AUC	0.977	<b>0.982</b>	0.962

● **InceptionV3** performed best overall, followed by **EfficientNetB4** (strong calibration), and **ResNet50** (reliable baseline).

### 4. XAI Metrics (EfficientNetB4)

Method	Deletion ↓	Insertion ↑	Faithfulness ↑
Score-CAM	0.404	<b>0.742</b>	-0.006
SHAP	0.342	0.568	<b>0.066</b>
LIME	<b>0.282</b>	0.650	0.003

✓ **Score-CAM** → Best visual localization

✓ **SHAP** → Most faithful attribution

✓ **LIME** → Most intuitive segmentation

### 5. Summary

Model	Strength	Weakness	Verdict
InceptionV3	Highest accuracy & F1	Higher compute	Best overall
EfficientNetB4	Strong AUC, best explainability	Slightly lower accuracy	Best interpretable
ResNet50	Stable, lightweight	Lower metrics	Good baseline

### 6. Conclusion

- **InceptionV3** → Best performing and clinically reliable.
- **EfficientNetB4** → Best balance of performance + transparency.
- **ResNet50** → Efficient baseline with interpretable visual results.