



Brain Tumor Classifier



Agenda

1. Overview
2. The Approach
3. Findings
4. Next Steps
5. Conclusion



Overview



Brain tumors are rare, but can be fatal. Proper diagnosis as early as possible is needed to improve a patient's prognosis.



EMG Consulting has been retained to predict tumor type based on imaging taken during an MRI.





Getting a brain tumor diagnosis right is crucial.

GBM has claimed another from us. [REDACTED] is 19 and fought with grace, and faced it all with positivity and determination. He went into hospice on Wendy and passed on Friday. My heart hurts.

He was misdiagnosed twice, once at the [REDACTED] where they told him that it was a dead spot on his brain that had probably always been there and a nonissue.



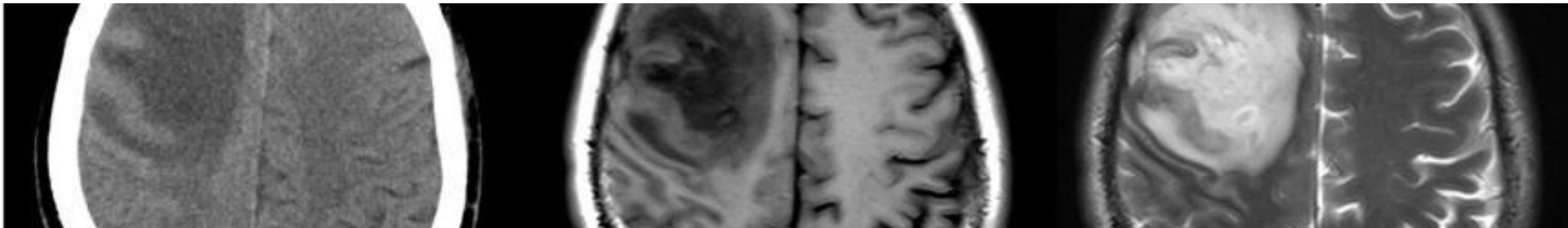
Nearly 5 to 10 %

of people with a
brain tumor receive an
inaccurate diagnosis.

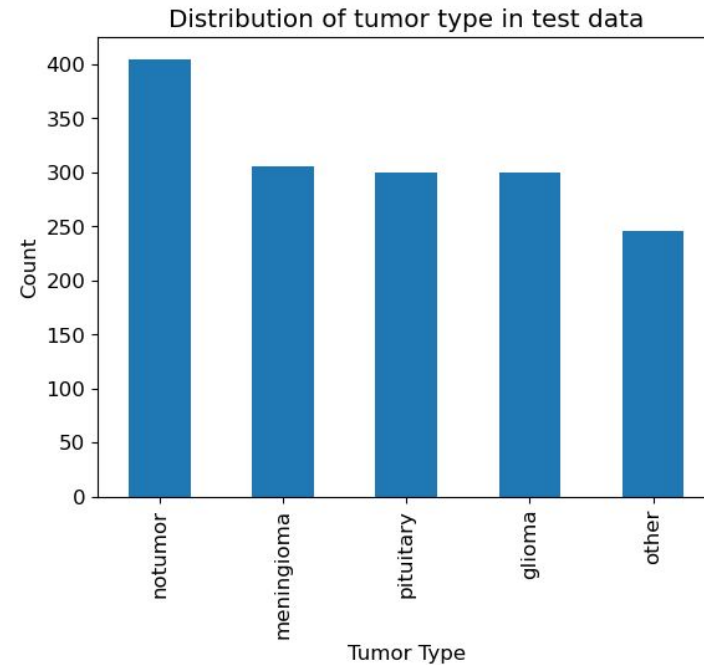
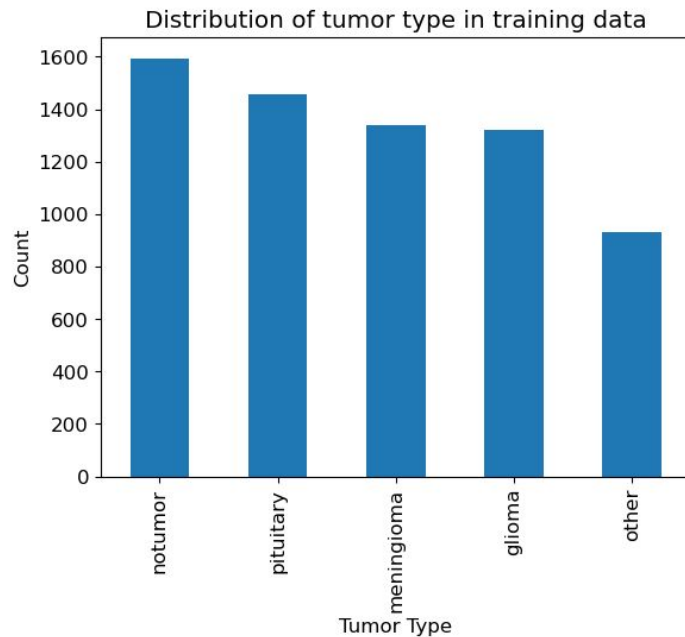
cancer.gov/nci-connect


The Approach

- Model trained on over 6,600 images across five classes (glioma, meningioma, pituitary, other, and no tumor) and tested on over 1,500 more - no significant class imbalance
- Make predictions using convolutional neural networks with varying degrees of depth and see which produces the best results
- Emphasis on creating a model that is accurate overall, with a secondary goal of maximizing recall for the “no tumor” class - want to avoid false negatives



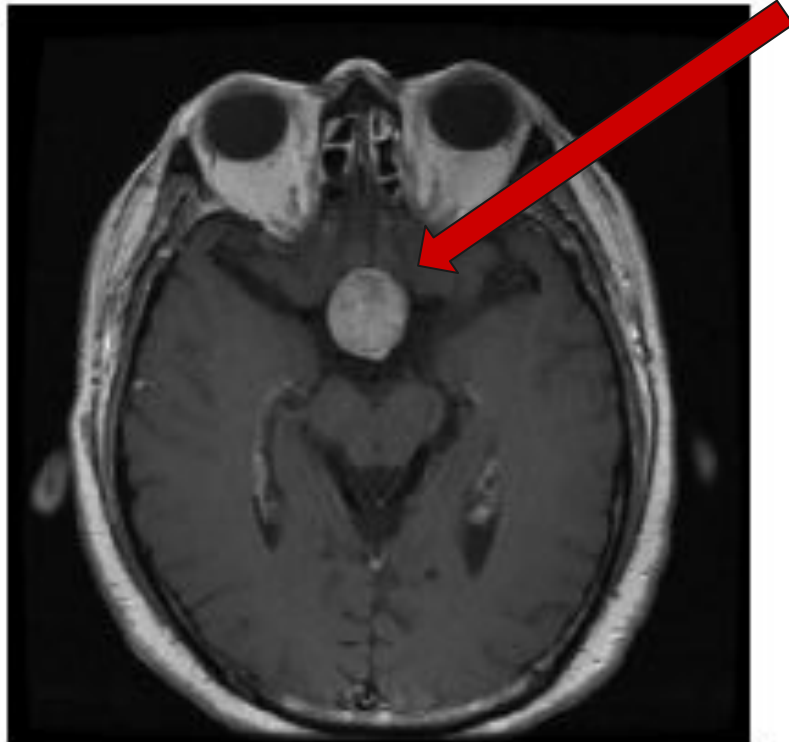
Distribution of Tumors in Data



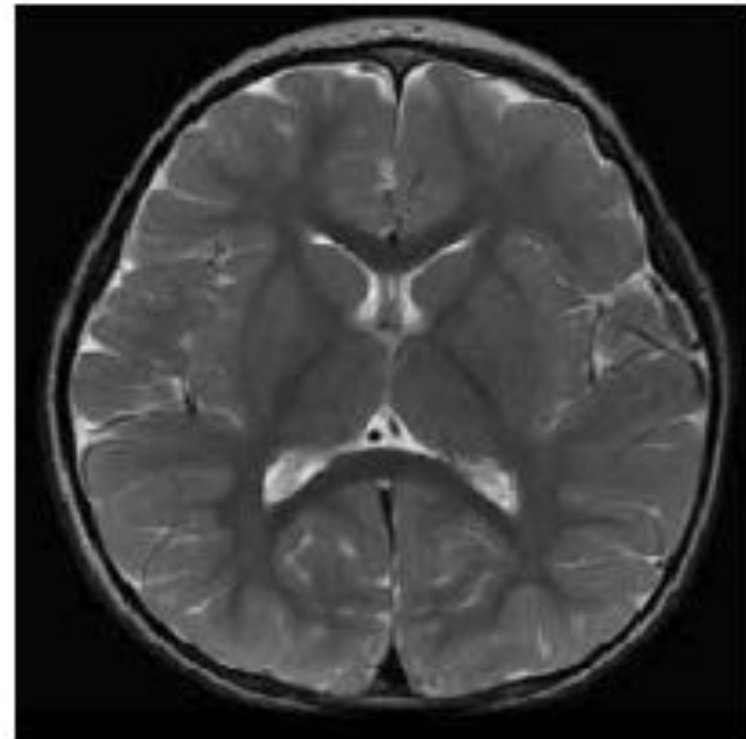


Some tumor types are harder to identify using an MRI than others.

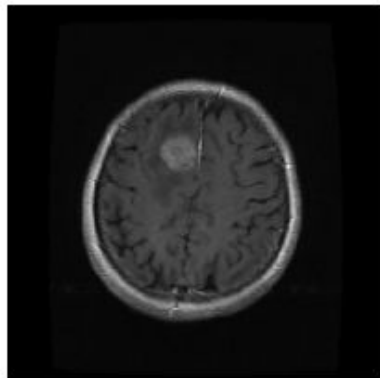
pituitary



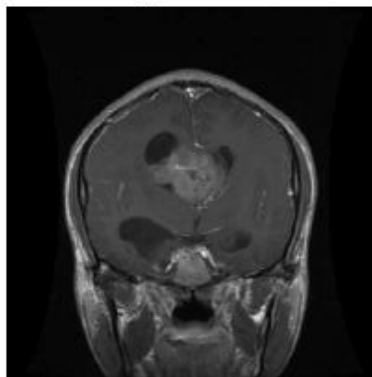
notumor



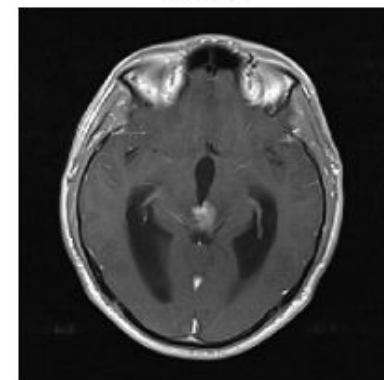
meningioma



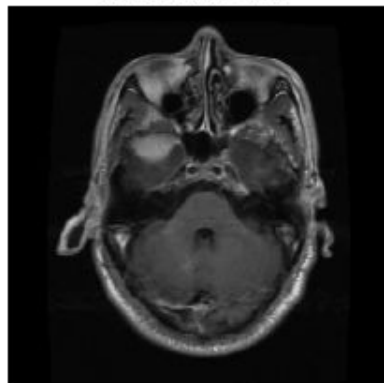
glioma



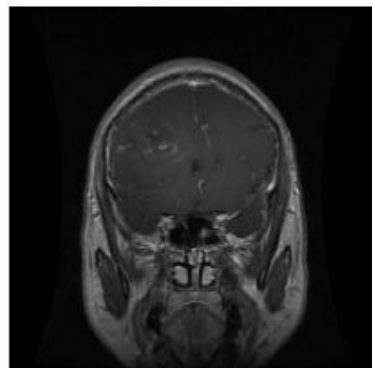
other



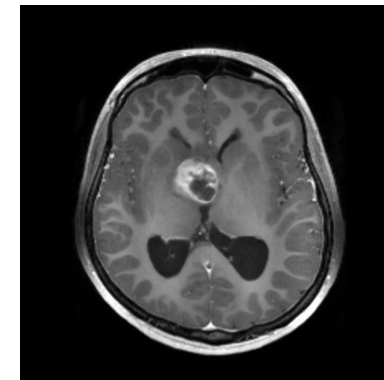
meningioma



glioma



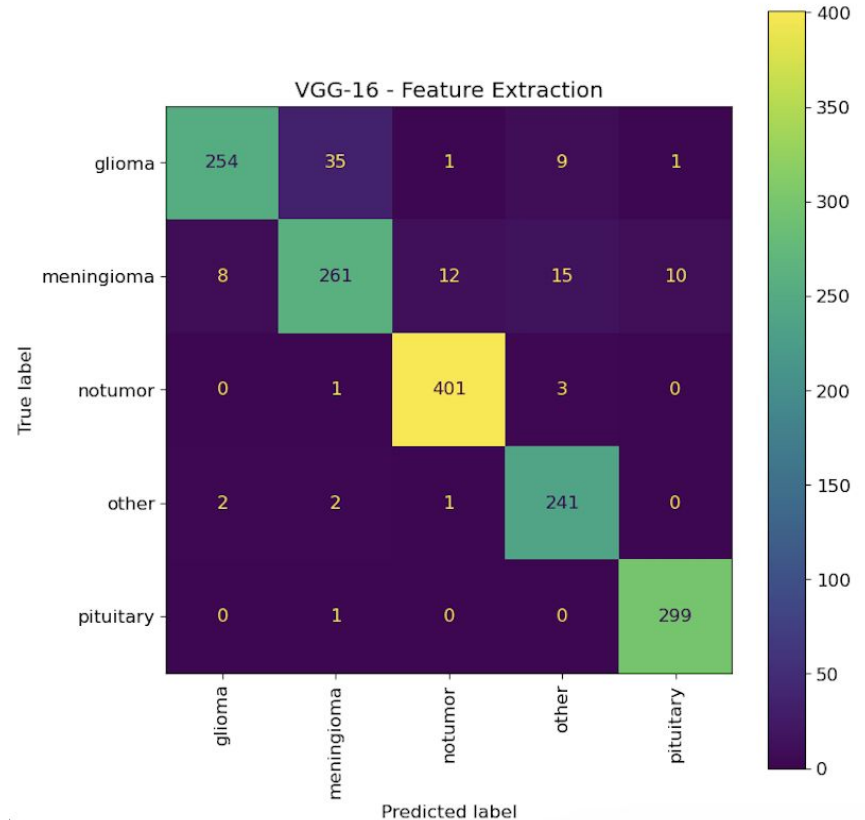
other



Overall, the model performed very well.

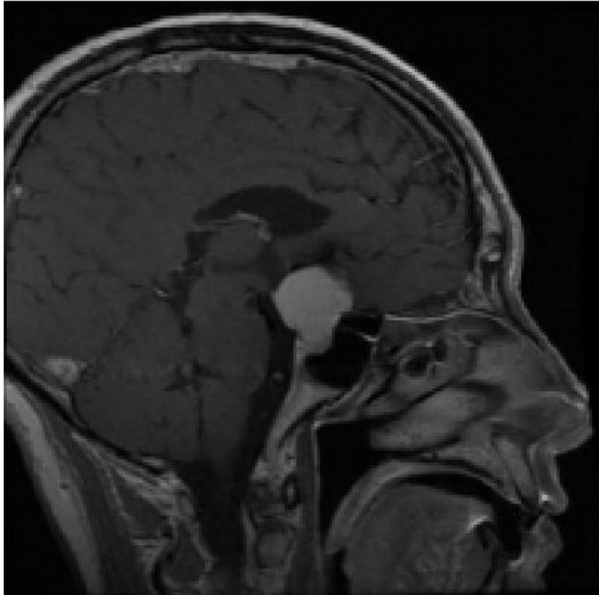
But it had some difficulties with gliomas and meningiomas.

- Used VGG-16 architecture with pre-trained weights.
- Augmented training data using Keras' ImageDataGenerator to expand dataset.
- Preprocessed images using built-in VGG-16 preprocessing.
- Roughly 94% accuracy on test data.
- Recall of 99% and a precision of 97% for the "no tumor" class.

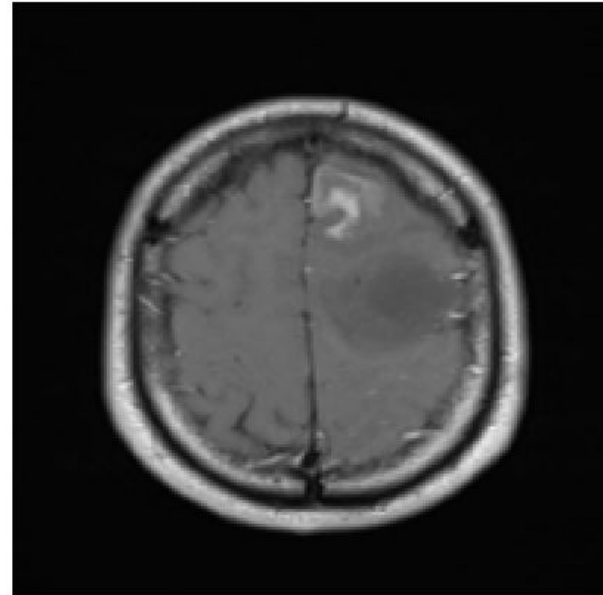


Some incorrect predictions made sense...

True: meningioma
Predicted: pituitary

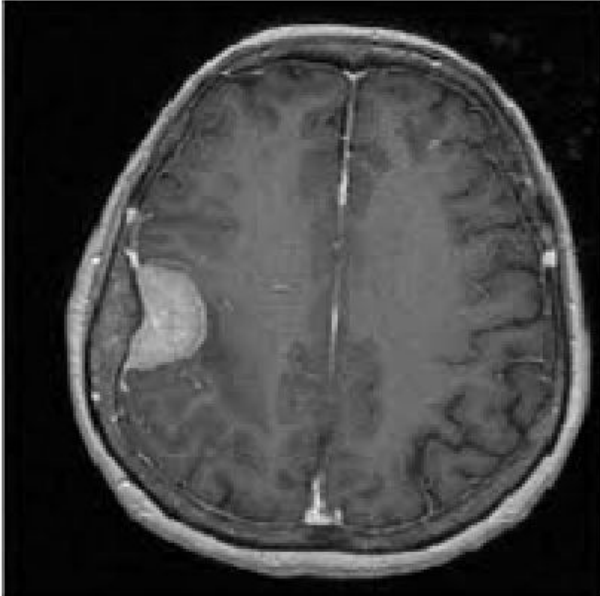


True: other
Predicted: glioma

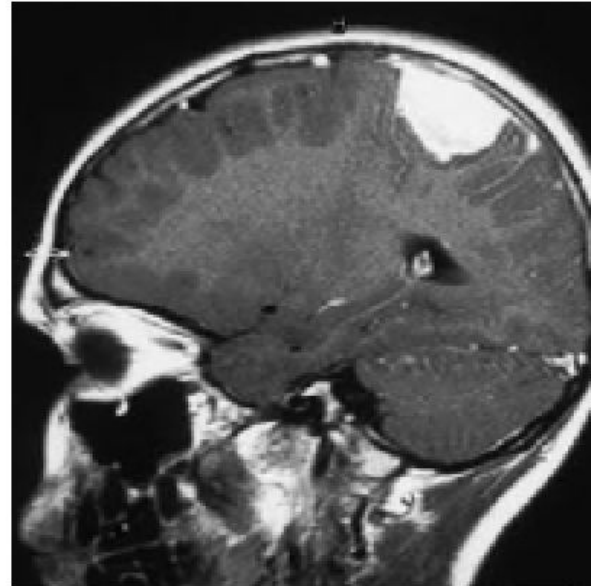


Others show why we the model needs more work.

True: meningioma
Predicted: notumor



True: meningioma
Predicted: notumor





Recommendations



Use deep learning models to assist clinicians in diagnosing patients, particularly those with rarer tumor types.



Adjust clinical practice to standardize sequence of imaging to make it easier to feed data into neural network.



Collaborate across accredited ACR institutions to increase number of images and quality of labels in training dataset as much as possible.



Next Steps



Preprocess the images further by thresholding and cropping the skull/brain, to reduce the amount of black space and other potential noise present in each image before modeling.



Expand the number of classes further to make more granular classification predictions possible.



Test additional transfer learning approaches, such as AlexNet and GoogLeNet.



Thank you.

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[GitHub Repository Link](#)