1. **Glioma Imaging Analysis pipeline based on Histological objects generation, resulting to histogram of Glioma images classification**
2. **A Genomic linkage of DSA-UI may validate this classification of gbm/lgg imaging use case, using mRNA gene expression.**

Pythonic Neuro Image Analysis pipeline to generate object detection

1. Generate random Tiles from selected GBM-SVS slide (grabTiles_forTraining_gbm.py), by doing
   a). Simple Masking on lowResPILimage
   b). Getting intended tiles using Girder calls on candygram server
2. Standard Colour deconvolution using HistomicsTK to generate Hematoxylin-stain, Eosin-stain images from the given tile
3. Generate histologic components or histologic objects by quantizing pixels in the above H-Stain and E-Stain channel into following groups (approximation)
   hp - pixel value in h-channel
   ep - pixel value in e-channel
   havg - Average pixel values in h-channel
   eavg - Average pixel values in e-channel
   Label pixel p as purple if hp ≤ havg
   pink (if hp > havg and ep ≤ eavg)
   white if hp > havg and ep > eavg
   a. Purple Pixels - Cell Nuclei material
   b. Pink pixels - Stroma, Stomal cells' cytoplasams, mucin-poor epithelial cells's cytoplasms
   c. White pixels - Lumina, mucin-rich epithelial cells's cytoplasms
4. Using circle fitting algorithm generate all the possible local histological objects.
   https://scipy-cookbook.readthedocs.io/items/Least_Squares_Circle.html
   a. Initially linear algebraic method will be used in implementing circle fitting algorithm
   https://dtcenter.org/met/users/docs/write_ups/circle_fit.pdf
   Based on algorithm complexity analysis, Jacobian method can be tried later
5. Using Bag of Words, get the frequency of these objects with the help of k-means and classify tissue images
   (cancerorus vs non-cancerous, gbm vs lgg) using SVM

Referenced publication (Local Object Patterns) has an accuracy 93.03% of representation and classification of pathology images of Colon tissue stained with H&E.

Reference

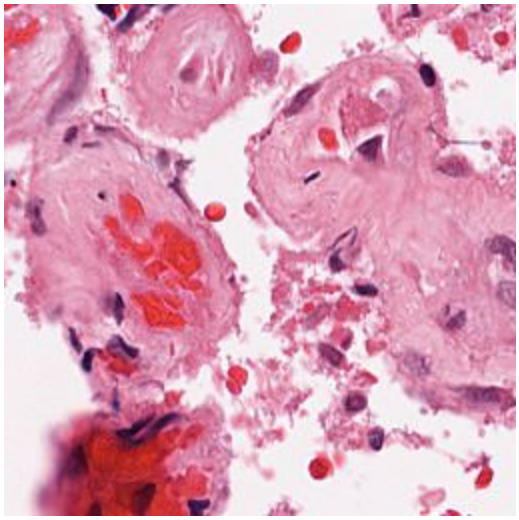
Image Analysis Pipeline :

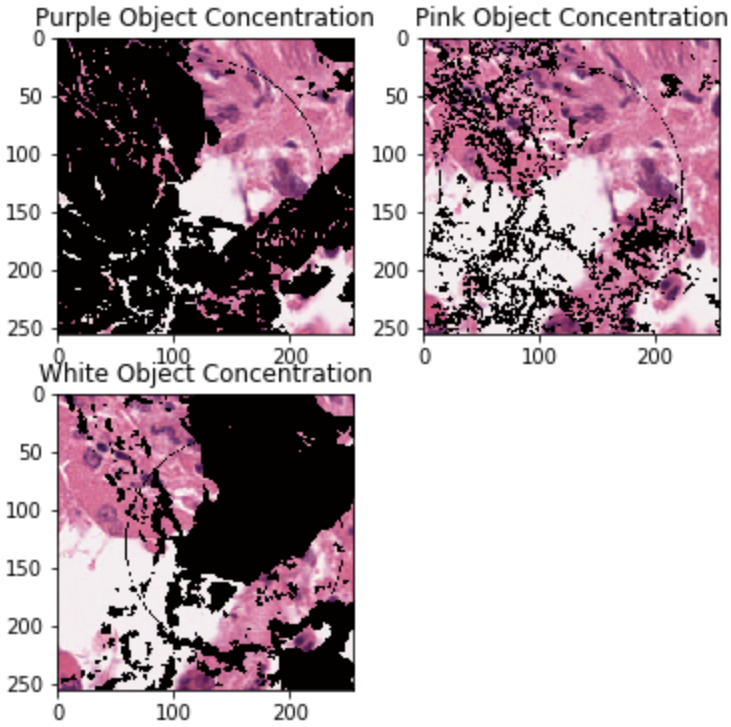
1. Local Object Patterns for the Representation and Classification of Colon Tissue Images, Gulden Olgun, Cenk Sokmensuer, and Cigdem Gunduz-Demir, IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 18, NO. 4, JULY 2014

Glioblastoma pathogenesis:

1. Discovery and validation of a glioblastoma co-expressed gene module, Leland J. Dunwoodie1, William L. Poehlman1, Stephen P. Ficklin2 and Frank Alexander Feltus1

Sample Tile:
/media/raj/Raj1_5/10ktiles/train/gbm/TCGA-02-0001-01Z-00-DX2_20x_7744_32416_256x256.png





All the Purple, Pink and White Objects are marked in Black in the above images.

Largest Object concentration, by applying k-means clustering and circle-fit algorithm